"NATURE", October 26, 1940

SUPPLEMENT: FORTHCOMING and NEW BOOKS



# NATURE

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

Vol. 146, No. 3704 SATURDAY, OCTOBER 26, 1940 ONE SHILLING

# NATURE

Vol. 146 SATURDAY, OCTOBER 26, 1940 No. 3704

## CONTENTS



Editorial and Publishing Offices:
MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London
The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4 Telephone Number: City 4211
Registered as a Newspaper at the General Post Office

Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 146 SATURDAY, OCTOBER 26, 1940 No. 3704

# FOOD SUPPLIES AND NUTRITION IN EUROPE

WITH the approach of winter, the problem of food supplies and nutrition in Europe is receiving much attention. Already it is clear that difficulties will have to be faced, and that they will present a major problem on the conclusion of hostilities. But the problem is, in fact, only a part of the much wider question of the planning of relations between food-importing and food-growing countries so as to clear the channels of trade, to regulate its even flow and to remove the arbitrary interference of national or individual self-interest. In his preliminary report to the Economic Committee on Standards of Living, Prof. N. F. Hall suggested that the principal need was a large variety of improvements and reforms, many of them small in themselves, but with cumulative effect through more or less simultaneous action by many Governments of very greatly increasing world economic activity. The intensification of Government efforts to increase efficiency and the reduction of costs in both production and distribution is an important means of progressively raising standards of living; and, particularly in regard to food production and distribution, measures forced upon us as part of our food policy in war-time may offer the prospect of considerable immediate advance after the War. The recent scheme for free or cheap milk in Britain represents the latest development of a policy begun tentatively before the War to increase the consumption of the protective foods, dairy products and fruit, of which the poor consume so much less than the richer classes.

It should be recognized, moreover, that the power which our blockade of Germany puts in our hands entails a special obligation of the British people to Europe. The power of the British blockade must be used not only to defeat the enemy of freedom in Europe but also to help Europe to restore and reorganize her strength and to create a unity of life and purpose. The fatal mistake of suspending at the end of the War of 1914–18 such organizations as the Allied Maritime Transport Council and the Supply Council must not be repeated. Mr. Bryant's haunting picture of famine over Europe in his recent book "Unfinished Victory" should ever be in our minds when we are tempted to face the peace unprepared.

So far as Germany itself is concerned, the effects on public health of the Nazi regime are described by Dr. Martin Gumpert in his recent book "Heil Hunger"*. The record affords a striking parallel to the picture of labour under Nazi rule which Dr. W. A. Robson drew in a recent Oxford Pamphlet. While the deterioration of intellectual activity in Germany in the last seven years as an outcome of the proscription of freedom of thought, teaching and speech is widely known, the price which has been paid in physical health for the Nazi achievements is far from being appreciated. Dr. Gumpert, like Dr. Robson, shows that even the "Strength through Joy" movement has an uglier side, and his book should supply a corrective, if any were still needed in Great Britain, to the perspective in which the methods by which even undoubted progress has been secured are viewed.

Dr. Gumpert's figures have been severely criticized by Dr. W. A. Brend in an article in the *Nineteenth Century*, and it is true that Dr. Gumpert has failed to present his statistics in comparison with those of other European countries. His assertion that six years of Nazi rule have led to an

* Heil Hunger! Health under Hitler. By Dr. Martin Gumpert. Translated from the German by Maurice Samuel. Pp. 128. (London: George Allen and Unwin, Ltd., 1940.) 5s. net.

increased death-rate and a falling birth-rate is flatly contradicted by Dr. Brend, who maintains that in some respects health conditions in Germany are ahead and in others only a little behind other leading European nations. Dr. Gumpert's statistics, however, are the least impressive feature of his book. Much more significant and impressive are the quotations from official German publications indicating concern with the results of policy or a deliberate disregard of considerations of health and welfare.

In spite of efforts to improve the health and working capacity of German students, the numbers of those physically inadequate steadily increases. Under-nourishment is officially admitted, simultaneously with the recommendation that those who are physically fit for sport should be excluded from courses of study. The systematic demand for over-exertion, the abrogation or evasion in various ways of the restrictions on child labour which had existed in Germany for decades, and the deterioration of standards of education, have already had dire consequences on the youth of the nation.

Equally sombre is the picture of the ruin of science drawn by Dr. Gumpert. With the outlines of this scientific workers are already familiar, but his chapter under this heading is more concerned with the way in which the standards of medical training, research and practice have been relaxed, opening the door to quackery and threatening a shortage of trained personnel. The impressive decline in the numbers of university students has been accompanied by a neglect and decay of vital physical and intellectual values in Germany which have already affected the military power of the country and its capacity for war.

It would be unwise to exaggerate the significance of this effect, but Dr. Gumpert clearly indicates that during six years of Nazi rule, Germany has been under the stress and strain which are associated with war rather than peace, with the usual effects on health. The really significant part of the book lies in those chapters in which, dealing with food consumption and diet, agricultural policy and the like, Dr. Gumpert indicates that Germany is to-day in the condition of a nation which has been carrying on an exhausting war for six years. The under-nourishment which exists in Germany is not comparable with the deprivation which reigned there in the latter part of the War of 1914–18 and afterwards. Its inroads on health are more insidious but may be equally far-reaching, and Dr. Gumpert refers to a memorandum in 1938 in which leading scientific men such as Abderhalden, Kuhn and others directed the attention of the Reich Government to the shortage of vitamin B in the food of the German people and to the need for a larger supply of fresh fruit and vegetables to safeguard the public health.

To what extent the position has been relieved by German expansion and the ruthless exploitation of the occupied territories during the past year is problematic. Even after the absorption of Austria and the Sudetenland, official spokesmen asserted that a 25 per cent increase in agricultural production was necessary for complete independence in food supply. The dependence of Denmark and Holland on imported feeding stuffs should prevent Germany from reaping more than temporary advantage from her despoilation of those countries.

The position appears to resemble that which developed towards the end of the 1914–18 period sufficiently closely to warrant the conclusion that Germany herself will be in no less need of relief than the occupied territories when Nazi domination is overthrown. It will be remembered that in undertaking to encourage the building up all over the world of food reserves destined for the relief of countries held by Germany, Mr. Churchill was careful to include the people of Germany itself and of Austria. The planning of post-War relief in this way might well be used by the Ministry of Information to develop more effective relations with the submerged democratic movements abroad, to strengthen them in their resistance to Nazi tyranny and to prepare the way for corporate planning after the War.

Such a task will involve the handling of the world's accumulated surpluses of primary products, which already represent a standing problem of modern world economy, exaggerated by the abnormal conditions of the War. The exportable surpluses of wheat in overseas countries may well exceed a thousand million bushels. Management of this problem is part of the larger problem of the re-organization of the world's agriculture and the direct treatment of poverty and malnutrition. To prepare now for this task, and to extend the survey to other aspects of European reconstruction —to problems of transport, of housing and public works, and of industrial reconstruction—would be a prudent anticipation of needs which must be met whatever political shape a liberated Europe may assume. It may indeed well prove that concentration on such aims—an improved level

of nutrition, higher standards of living, a more prosperous world agriculture, freer international trade and an increased volume of trade—interlocked as they are, may make a practical contribution to the future world order by affording opportunity between armistice and final settlement for passions and prejudices to die down, issues to be clarified and international understanding and co-operation to be fostered.

This approach to the economic needs of Europe cannot be made in isolation from the needs of Great Britain. The main responsibility for the defence of civilized Europe rests on Britain. The power that is ours carries also the responsibility for the initiative for the building up of a new Europe. As we recognize and discharge these twin responsibilities, we shall find that many of the solutions to our present problems of defence hold the key to the solution of post-War problems of reconstruction and readjustment, and that the policies best calculated to meet our own post-War needs are essentially part of wider policies designed, in co-operation with the Dominions and with the United States of America, to restore order to Europe, to relieve her necessities and to stimulate a new and progressive era of welfare and freedom.

---

# NATURE AND PSYCHE

## The Idea of the Soul in Western Philosophy and Science

By Dr. William Ellis. Pp. 314. (London : George Allen and Unwin, Ltd., 1940.) 12*s.* 6*d.* net.

THIS is a book of unusual interest. Many writers have discussed the influence which the investigations and theories of natural science have had on our notions of 'mind', 'soul' or 'spirit', but Dr. Ellis has had the brilliant idea of treating the question the other way round ; of tracing historically the influence that the notion of the soul has had on the development of science. He has no difficulty in showing that the influence has been decisive at certain critical stages and has left indelible marks on the thought and language of western Europe.

The first point he makes (following A. E. Crawley in his "Idea of the Soul") is that this European notion of the soul is not primitive. For primitive man the 'soul' of anything—man, beast, or stone—is simply the mental image of it. When the nineteenth-century anthropologists attributed 'animism' to primitive man, they were simply reading in their own ideas and attributing to him distinctions which he is incapable of thinking and which his language cannot express. ". . . Animism, in the sense of a belief in the spiritual nature of the universe, is not a naïve, but on the contrary, a highly sophisticated view ; indeed the mere conception of *spirit*, as we understand it and as the anthropologists of the last century understood it, was unknown before the Platonic, or Christian, idea of the soul. Animism in the sense we have defined could not in fact have existed before Socrates' discovery of the immaterial concept" (p. 92).

The Socratic or Platonic view is that there is on one hand a changing world of sensuous appearance, to which belong the human body and its passions, on the other the eternal world of forms, to which belong the human reason as displayed in theoretical knowledge and moral intuitions and also the mind of God. The first of these worlds, because it is changing, is only half real. In a famous passage in the "Phædo", Socrates contrasts the account that could be given of his sitting in prison waiting for death in terms of the position and motions of his 'bones and sinews', that is to say in terms of a behaviourist theory of physical causes, with what he considers the true account in teleological terms. "It was because he conceived himself as two beings, a corpse or puppet on the one hand, actuated by a detachable ghost on the other, that Socrates found behaviourism unthinkable" (p. 295). As Dr. Ellis points out, Socrates very unfairly fathers the behaviourist theory on Anaxagoras, because prior to Socrates himself the distinction between a material world of mechanical causation and an immaterial world of ends had not been drawn. Of late, behaviourism seems to have had its revenge on Socrates ; but the manner in which that has come about is the result of the peculiar twist which the seventeenth century gave to the prevailing Socratic-Platonic tradition, largely owing to the influence of Descartes.

The material world for Descartes was entirely real but also entirely dead and possessed none but mathematical properties, but for that reason was amenable throughout to scientific investigation. The Cartesian view, in fact, provided a stimulus to science which was lacking in the Platonic. The sensible qualities of things, like colours and sounds, belonged to the material world for Plato, but for Descartes were mental and therefore immaterial and in themselves inaccessible to science. The experimental method of science consists in

determining general (preferably mathematical) relations between certain abstractions from perceptual experience ; but it is only the abstractions and their mathematical relations that enter into the scientific account. Again the Cartesian view offers no difficulties initially. Almost at the birth of science Pythagoras found that musical intervals corresponded to certain numerical ratios, by plucking a stretched string stopped off at different lengths. In principle the experimental method can do nothing more than Pythagoras did : it remained only to exploit the method to the full in all possible regions of experience. This has now been done to a very large extent, but under the influence of Cartesian rather than Socratic ideas. However, the behaviourist method, which Socrates rejected, has successfully invaded what was considered the stronghold of the soul, conscious and intelligent behaviour. Naturally the exploration of living and conscious organisms by physical methods reveals nothing that is not physical. If vitalists, such as Driesch, deny this, the denial is self-contradictory.

From the point of view of scientific method there is everything to be said for behaviourism and nothing against it, but when it becomes philosophy on Cartesian lines there are certain difficulties. ". . . The function of 'scientific' theories is to explain the perceptively known in terms of the perceptively known. As soon as the philosophical behaviourist calls the perceptively known world (or rather abstractions from it) the 'physico-chemical' world, and then tells us he can explain experience in terms of the physico-chemical he has embarked on a task which metaphysics may or may not be able to achieve, but which science, from the nature of the case, cannot even attempt. For the fact of perceptual knowledge cannot be grounded in the perceptively known. Any attempt to find the ontological ground of perception in the perceptively known is a project, like that of lifting oneself by one's own boot-straps, doomed to self-refutation" (p. 266). The source of the trouble is that the mind which perceives and thinks has been treated as an epiphenomenon by the Cartesian tradition. We are asked to believe ". . . that thinking is in some sense unreal and that only matter is real, because thinking tells us that matter causes thinking" (p. 269). The trouble remains whether it is said, with the naive realist, that colours and smells somehow belong to the surfaces of material objects whether or not any one is looking or smelling, or whether it is said that matter itself has no perceptible qualities, in which case it is entirely unknown and unknowable. No compromise between these two views is possible ; either matter is exactly as it appears or it does not appear at all. Positivism again, which is only "a misplaced application of scientific method" (p. 286), is no solution of a problem that cannot be dealt with by that method.

Dr. Ellis states his problem with admirable clarity. The methods of experimental science must be pursued rigorously to the very end. No metaphysical fiat of "thus far and no farther" can stop them. On the other hand, scientific method solves no metaphysical problems, and the problems of how we apprehend the world revealed by science and what that world is still remain. Platonic or Cartesian dualism makes a solution impossible. But, whatever our decision as to the nature of the material world may be, it depends on our decision as to the nature of the mind or soul and also as to the nature of the organism that links it to the material world. Dr. Ellis only sketches in rough outline his suggestion for a solution, and his account is not easily summarized without unfairness. It must suffice to say that, as a biologist by training, he is first of all concerned to contradict Descartes, for whom matter was necessarily dead, and to establish a position much more akin to Leibniz—and also to such present-day views as Prof. Whitehead's "philosophy of organism" or Prof. Stout's "animism". The life of any organism consists of interchange and reciprocal relations with the environment. If there is any truth in saying an organism is alive, then it cannot be true that the environment is quite dead. The other main point Dr. Ellis makes is that there must be a hierarchy of forms or systems in Nature such that the higher, though not entirely disparate from the lower, display characters not apparent in the lower. The view is not unlike the doctrine of "emergents" elaborated by Alexander. It also leads him to the Leibnizian conclusion that matter is momentary mind, that is to say, what mind would be reduced to if it lacked all memory and foresight.

The one serious defect of the book is the unfair and indeed scurvy treatment of Aristotle. Admittedly his views did not greatly influence the main European tradition and admittedly they are confused by cross currents of Platonism, but he did attempt something better than the notion of a "corpse or puppet actuated by a detachable ghost". It would not be altogether unjust to call Dr. Ellis's own conclusion Aristotelian. There are a number of minor defects in the book. They include some irritating misprints, a certain slackness in giving references to the less-known authors mentioned and a few loose and excessively sweeping statements. A useful addition would have been some treatment of the post-Socratic attempts to give a purely materialist account of the soul. However, these are small blemishes in a most valuable work.

A. D. RITCHIE.

# INTROVERTED SCIENCE

## The Integration of the Personality

By Dr. Carl G. Jung. Translated by Stanley M. Dell. Pp. iv+313. (London: Kegan Paul & Co., Ltd., 1940.) 15*s*. net.

IT will be interesting to see how this book with its steady introverted illumination of the psychic interior succeeds in overcoming the mental black-out of the War. Its main contents first saw the light in an ideal setting on the lovely edge of Lake Maggiore a mile or two from Ascona. The place, the speakers, the enthusiastic and hospitable convenor and the company of people all contributed to the making of a unique spiritual atmosphere in which inner realities could be discussed in their own right. These papers need to be read with this setting in mind. Prof. Jung is telling all those who are interested what the process of individuation actually consists of and what it involves as a real-life adventure. But he is also, and first of all, a great empirical man of science, and is therefore concerned to display this rather special field with scientific objectivity and detachment.

The first lecture is concerned with the meaning of individuation as a general psychological process; the process which aims at making a human being "a unique indivisible unit or 'whole man'". This comprehensive introduction to the subject is followed by a short study of a patient who began spontaneously to paint her symbolical way towards the centre. The author then gives an excellent description of the principal figures or archetypes of the collective unconscious through which the psychic realm of the non-ego is experienced. These introductory chapters are clearly not intended to give an exhaustive description of the phenomenology of individuation. Rather one gets the impression that the author is outlining the ground-plan of the science of being, leaving the elaboration of the main edifice for a fuller work.

In effect, individuation is a solitary experience: it is therefore not everybody's medicine. It must be admitted that in so far as the experience remains irrelevant, this book will seem unintelligible. There are many for whom the idea of psychic value, the treasure difficult of attainment, the "purple hall of the city of jade", the "golden flower", bear no meaning and invite no response. We may even find eminent psychologists among these excluded sons; in which case their comments upon the book are more than likely to be superfluous. The goal of extroverted science has so far lain in the world of external and therefore verifiable phenomena. The goal of the introverted science of being is naturally incommensurable with that of its worldly and more successful twin. Yet science must embrace both. As Jung shows in the chapter on dream symbols of the process of individuation, the tendency towards psychical integration arises quite spontaneously at a certain phase of life and frequently becomes the major motive. In the next chapter he demonstrates the continuity of tradition through the history of alchemy, proving that the same symbolic material, which now appears within the individuation process, manifested itself in alchemy in the form of quasi-material projections. Since, therefore, individuation is a process of Nature which develops its own peculiar transformations within the individual psyche with a certain regularity, it follows that its study must eventually be incorporated within the body of science.

The chief obstacles in submitting the evidence to a general verdict are twofold. The first, exemplified to some extent in the present work, comes from the prolific nature of subjective material. The second, more serious still, comes from the fact that people who are outside the experience obstinately persist in regarding psychical material as unreal and imaginary. Thus a quandary is created; since those within the experience find the required elaboration of evidence superfluous, while those without will never even consider it. Actually, in the author's selection of relevant material in the very interesting dream-sequence of Chapter iv, insufficient evidence is provided to support some of the author's conclusions. Here and there one feels the need for more material and for a fuller knowledge of the subject's personal psychology in order to bridge the unavoidable gaps in the selected material; whereas in "The Idea of Redemption in Alchemy" the author gives a completely satisfying psychological explanation of that bewildering stream of tradition which carried the developing germ of individuation from antiquity to the Reformation.

In these two chapters Jung has begun to make the bridge between the individual process of healing within the modern soul and the central ideas of the alchemical quest. The present work is in the nature of a pontoon. It demonstrates that psychic continuity with the past can surely be established. But the great work which represents the actual construction of the bridge has yet to be done.

The translation from the German has been done with exceptional skill.

# FUNDAMENTALS OF ELECTROCHEMISTRY

(1) The Principles of Electrochemistry
By Duncan A. MacInnes. Pp. 478. (New York : Reinhold Publishing Corporation ; London : Chapman and Hall, Ltd., 1939.) 30*s*. net.

(2) Theoretical Electrochemistry
By N. A. McKenna. Pp. xiii + 470. (London : Macmillan and Co., Ltd., 1939.) 15*s*.

THE introduction of the activity concept by Lewis and his collaborators, and the development of the interionic attraction theory by Debye, Hückel, Onsager, and others, have stimulated interest in certain aspects of electrochemistry, particularly those dealing with conductance, transference numbers and electrode potentials. The researches in this field of physical chemistry have fallen mainly into two categories ; these are, first, improvements in experimental technique for the purpose of providing more accurate data for testing the theories that have been proposed, and secondly, extensions of the theoretical treatment so as to include the behaviour of relatively concentrated solutions. The advances made in recent years have opened up new vistas in the study of strong electrolytes, and hence it is not surprising that, almost simultaneously, two books were published, one in England and the other in the United States, dealing with the fundamental principles of electrochemistry.

(1) In the preface of his book, Dr. MacInnes, who has made a number of significant contributions to our knowledge of transference numbers, conductance, cells with liquid junctions, etc., states that his object is "to furnish an account of theoretical electrochemistry as it is to-day". The first chapter is introductory and historical ; then follow sections on Faraday's laws, electrolytic conductance and transference ; the latter, as is to be expected, is particularly good. In the two succeeding chapters the essential thermodynamic principles are given clearly and concisely ; it may be mentioned, however, that the symbols used by the author are not those in common use either in Great Britain or in the United States. The table on p. 104, in which the thermodynamic symbols employed in a number of familiar texts are compared, emphasizes the necessity for some form of standardization in this respect.

The next eleven divisions deal with various aspects of electrode potentials and their applications, the concept of activity and the Debye-Hückel theory and its extensions. The subject of electrolytic conductance is taken up again in the three following chapters, which deal with the Onsager theory and the use of conductance measurements in various fields of physicochemical investigation. In the last three chapters of the book the problems of dielectric constants and dipole moments, electrokinetic phenomena, and irreversible electrode behaviour are discussed briefly.

Although this book by Dr. MacInnes deals with the theoretical principles of electrochemistry, the outlook may be described as essentially practical. The experimental methods are explained fully, and the best available data are quoted to illustrate the principles and to test the various theories that have been proposed. The derivation of the important equations is given in detail ; nevertheless, the reader does not get the impression that electrochemistry is almost entirely a theoretical subject. The author points out that electrochemistry is now so extensive that he has been compelled to make an arbitrary selection of topics, and he has very wisely chosen to treat in most detail those matters with which he has been actively concerned in his own researches. The space—13 pages—devoted to irreversible electrode phenomena, including passivity, is, however, liable to give a false impression to readers not familiar with this branch of electrochemistry ; in some respects, therefore, it might have been better to omit this section entirely. The treatment of transference, conductance and E.M.F.'s is exceptionally good, and so far as these subjects are concerned the book constitutes a major contribution to the literature of physical chemistry. The text is remarkably free from misprints, and the whole work shows signs of exceptional care on the part of author, printer and publisher.

(2) The second book under review covers very much the same ground as that already considered ; the author's guiding principle has been the Debye-Hückel theory, and once more the subject of irreversible electrode processes, the Cinderella of electrochemistry, is dismissed in a mere 17 pages. The outlook in the two books is, however, fundamentally different, for the one by Mr. McKenna gives the impression of being essentially theoretical in character. The main emphasis appears to be on the derivation of equations, and not so much on their experimental verification. It is true that there are descriptions of experimental methods, and that the book contains 109 figures, many of which constitute graphical representations of experimental results, but there are very few tabulations of data. The reviewer has sought in vain for tables of transference numbers, of ionic

and equivalent conductances, of activity coefficients, or of standard electrode potentials; these, at least, might be expected in a book on electrochemistry. Further, the erroneous use of "ln", where logarithms to the base 10 are intended, diminished the value of certain of the figures.

The derivations of the Debye-Hückel, Onsager, and other important equations, as well as the modified treatments of Gronwall and LaMer, of Bjerrum, and of Fuoss and Kraus, are given in more detail than is generally found in text-books, and many readers will be glad to have this material in an accessible form.

It is unfortunate, however, that what might have been a useful book is marred by a number of errors and inconsistencies. The following, among others, have been noted: p. 87, nitrobenzene is described as a proton donor; p. 88, the mobilities of the ions $H_3O^+$ and $OH^-$ are said to be smaller than the mobilities of the corresponding ions in alcohols; p. 231, equation (347) is incorrect; p. 240, the interpretation of equation (363) is erroneous; p. 271, the antimony electrode is not "widely used as a substandard" in place of the standard calomel electrode; p. 309, the curves for different oxidation-reduction systems are not always parallel; p. 400, an aliphatic amino-acid is said to show "complete acid and base dissociation at the iso-electric point"; p. 417, the value recorded for the ionic product of water is far from being "one of the most accurate" available. There is much confusion of signs in the chapter on reversible cells, and the equations are not consistent with those derived in the section on thermodynamics.

A reader of sufficient experience not liable to be misled or confused will, however, find in this book much useful and interesting material concerning the theory of electrolytic solutions.

S. Glasstone.

# KINETIC THEORY OF GASES

## An Introduction to the Kinetic Theory of Gases

By Sir James Jeans. Pp. vi + 311. (Cambridge: At the University Press, 1940.) 15*s*. net.

In 1904 there appeared a slender volume entitled "The Dynamical Theory of Gases", in which the author, now Sir James Jeans, endeavoured to develop the theory "upon as exact a mathematical basis as possible". It was an original and somewhat severe book, the reader being at once confronted with the difficulties of the law of distribution of molecular velocities and with statistical mechanics and the controversies and unresolved problems on the equipartition of energy. At that time the English student whose reading was confined to his own language had to choose between the somewhat arid treatises by Burbury and by Watson, or the translation of Meyer's attractive, almost chatty, but unmathematical book. Jeans' book, which was much more akin to Boltzmann's elegant "Vorlesungen über Gastheorie", found acceptance, despite its severity, and many of to-day's physicists, as well as mathematicians, were 'brought up on it' so far as gas-theory was concerned, and looked to it as to an oracle, sometimes difficult to fathom as is the way with oracles.

In 1916, 1921 and 1925 new editions were issued. The difficulties concerning equipartition—Lord Kelvin's "Nineteenth Century Clouds over the Dynamical Theory of Heat"—had by then "to a great extent been dissipated by the development of the Quantum Theory, a theory explained in its proper place . . ." in the second and later editions. The account of the quantum theory, thus given, was among the first published in English, at a time when the theory was being developed almost wholly in other countries.

The subsequent enormous growth of the quantum theory led to the publication of many treatises upon it. These, together with the appearance of such works as R. H. Fowler's "Statistical Mechanics", decided Sir James Jeans to transform his "Dynamical Theory of Gases", on the exhaustion of the last edition, with the result now under review.

Among the first things the usually impecunious student may note about it is that the new "Introduction to the Kinetic Theory of Gases", though about three quarters the size of its predecessor, is only half the price—a welcome and almost miraculous reversal of the general trend in book prices, made possible, doubtless, by the wide circulation likely to be gained by any book by Sir James Jeans. The format is also smaller, less imposing and less forbidding, as befits a book intended less for the mathematician than for "the serious student of physics and physical chemistry".

The principal negative change in the book is the omission of all save a bare reference here and there to the quantum theory and wave mechanics, which do not appear even in the index; another omission is that of the brief chapter on aerostatics

and planetary atmospheres, a subject the growth of which now demands a book (still wanting) to itself. Apart from these omissions, the major part of the "Dynamical Theory of Gases" is preserved in this book, often in the same words; but the order is changed, and several interesting interpolations are made, dealing with such subjects as Perrin's experiments on the Brownian motion, and the experimental verification of Maxwell's law of distribution of velocities by Dunoyer, Stern and Gerlach and others. Features in which the book is deficient, by comparison with other recent treatises (such as those by Loeb or Kennard), are the phenomena of gases at low densities, fluctuations, and the electric and magnetic properties of gases (the word mobility, for example, is not even in the index). It is for the author, however, to determine his own scope, and for the purchaser to decide whether or not he is suited by the result; there can be little doubt that, judged by the text, the book will deservedly succeed, and maintain for many years to come the already long association of the author's name with his present subject.

S. CHAPMAN.

# ELECTRICAL EFFECTS AT CHEMICAL BOUNDARIES

## Electrocapillarity

The Chemistry and Physics of Electrodes and other Charged Surfaces. By Dr. J. A. V. Butler. Pp. x + 208. (London: Methuen and Co., Ltd., 1940). 12*s*. 6*d*. net.

MATTER being fundamentally electrical in nature, it is impossible to have two materials of different chemical composition which are not also different in electrical constitution. When different materials come in contact in such a way that electrical forces can produce observable effects, such effects are invariably present. They may arise through the materials being conductors, so that electric current may flow across the boundary, or through the boundary being deformable, so that electrokinetic effects, in the widest sense, may arise. Dr. Butler has neither written a long treatise on the whole vast subject, nor a brief general introduction to it, nor again has he chosen but one particular aspect. The selection of subjects has been made, as he explains in his preface, by avoiding those which he feels to have been adequately treated in other works, and by concentrating chiefly on those in which he has become, through his own researches, most interested. To the general reader, the book will therefore appear to lack balance though not interest. To a student interested in some particular point, it may prove to be informative, stimulating or wholly silent. The reviewer feels, therefore, that his chief task should be to summarize the subjects dealt with.

Although modern work on the response of nerve and muscle tissue to electrical stimuli has been left out of the scope of the book, it is Galvani's early observations on this subject which introduce us to the voltaic pile in the first chapter. This carries us quickly through ideas on the origin of electromotive force to the thermionic work function and quantum mechanics. A condensed chapter on thermodynamics follows, and then a fuller discussion of the mechanism of reversible potentials.

In the fourth chapter, a general discussion of electrical double layers, the distribution of ions in them, their capacity and experimental methods of studying them, is preceded and followed by a more specialized discussion of electro-capillary curves. The author accepts the letter of Guggenheim's contention that the single potential difference between two phases has no physical meaning, but appears to reject the spirit of it. Classical electrical theory can define potential differences exactly in terms of the work of transfer of abstract electric charges. The abstraction is justified only so long as a process begins and ends in matter of the same kind. In dealing with phase boundaries, we must be concerned frequently with inseparable electrical and chemical transfers: our exploring unit charge must be carried by an atom which is usually more affected by its chemical than by its electrical environment—or perhaps one should say by its micro- than by its macro-electrical environment. The reviewer feels this problem to be so fundamental to the whole subject that he could have wished it to be more explicitly dealt with. The diffuse part of the double layer, where this problem is of less importance, is dealt with again in the next chapter, which is concerned with electrokinetic phenomena in general. The author points out that the Faraday Society's discussion on this subject appeared too late for inclusion of reference to it in these chapters.

The remainder of the book deals with electrode reactions of various kinds. The lion's share of attention is claimed by the confusing subject of over-voltage, which the author has made remarkably intelligible. Deposition of metals and the formation of oxide films are discussed more briefly, and the book concludes with a short account of electrolytic oxidation and reduction.

G. S. HARTLEY.

# ARCHÆOLOGICAL JOURNEYS IN WESTERN PERSIA

## Old Routes of Western Īrān

Narrative of an Archæological Journey carried out and recorded by Sir Aurel Stein. Antiquities examined, described and illustrated with the assistance of Fred H. Andrews. Pp. xxviii+432+97 plates. (London : Macmillan and Co., Ltd., 1940.) 42*s*. net.

UNTIL less than twenty years ago, excavation in Persia for archæological research was restricted by treaty for the French Government, and it is accordingly to the French Mission that we are chiefly indebted for our knowledge. The activities of that Mission have been confined to western Persia ; even when restrictions were removed and American expeditions undertook work, it was on sites in western or central Persia that interest centred. The consequence has been that, especially during the last ten years, a formidable *corpus* of material has accumulated and a large literature has served to place research at the service of field workers. In archæology, as in other scientific work, aims and methods are likely to vary in accordance with the stage of knowledge reached. In western Persia there is now no need for pioneer work, and no excuse for pioneer methods in digging or publication.

More than ten years ago, Sir Aurel Stein began travelling in eastern Persia, and since then he has covered the eastern and southern border-lands. There he was doing pioneer work. The archæological material he found, necessarily confusing owing to the circumstances of discovery, had considerable value because it showed the nature of the archæological material to be expected in hitherto untapped sources ; it created problems, and showed where and how they might be solved. His last journey, however, was devoted to the west, ground by no means unexplored, but containing many unexplored sites. It is extremely doubtful whether any good purpose is served by soundings at these sites unless an expedition is fully equipped ; the report on soundings undertaken can only increase doubts on this matter.

The account of the actual journey is pleasantly written and strongly reminiscent of early nineteenth century travellers. But the book seems to be intended as a final record of "new finds of great antiquarian interest", in the manner of Sir Aurel's publications of his eastern journeys. Attention was given to four classes of antiquity, architectural remains, rock reliefs, a queer collection of statuary from one site, and pottery and small antiquities of early periods from many sites.

The architectural remains, mainly bridges, do not add to our knowledge more than the fact of their existence. The rock reliefs—why does Sir Aurel entertain such an affection in 1940 for *relievos* ?—are inadequately described, and the pictures are too small to be of use. This is most unfortunate. Good drawings, a minute description, full discussion of one set would have been infinitely preferable to the inadequate report on several here given. Tang-i-Sarawak especially deserves, and some day must receive, fitting publication which alone was now necessary as a record. There seem to be hints in the text that this monument may be Parthian, though there is no explicit statement ; this seems very unlikely, but is a matter of interest and importance. The traveller hurries on.

At the village of Shami the local people had just found some statuary in bronze, which will for many years constitute an archæological puzzle. Sir Aurel Stein, like M. Godard and M. Seyrig, who have both published scientific discussions, is convinced that a large statue of a man wearing typical trousers and a long moustache is Parthian. Of this there is not the slightest tangible proof. The dress is only similar ; it is not the same. The head does not point to such a date, even if it belongs to the statue (the set of the neck on the shoulders is very odd) ; it cannot be earlier than the establishment of Roman portrait types in the East, and is probably later than Palmyra and Gandhara. Fortunately, Sir Aurel was able to plan the remains of a building in which this statue and some other fragments were found. He calls it a shrine, chiefly because he identifies certain small structures as altars ; he then decides that a Hellenistic mask done in the style of the Alexander heads, a type constantly copied in the debased Hellenistic work of the East, "represented a royal personage, whether Alexander the Great whose worship prevailed for a considerable period throughout the Hellenized East, or also a Seleucid monarch. Its presence in the ruined shrine throws a significant light on the cult to which it was devoted". In fact, it is historically impossible to suppose that there was a cult of any Macedonian king at Shami when the large statue was made, and the mask may be earlier than the building, but cannot be much earlier. A careful examination at Shami should lead to a different conclusion.

But the greatest lack in the book is an adequate report on the soundings made and on the pottery found. Most, if not all, of the pottery belongs to perfectly well-known classes ; what is wanted is

more information about the circumstances in which it was found. At Hasanlu, for example, there was a wonderful opportunity to investigate strata in which a highly distinctive form of pottery belonging to the early centuries of the first millennium occurs. The chance has been missed, and the publication of the pottery itself can only be called inadequate. Sir Aurel should have allotted more space to Mr. Andrews for technical descriptions, in the manner which can alone satisfy scientific requirements.

On the whole, then, this book from a veteran's hand will prove a disappointment to students; lovers of travellers' books will find it admirable. The publishers have made it a pleasant book to handle and read. SIDNEY SMITH.

---

# CELL "RADIATIONS"

## The Secret of Life

Cosmic Rays and Radiations of Living Beings. By Georges Lakhovsky. Translated from the French by Mark Clement. Pp. viii + 201. (London: William Heinemann (Medical Books), Ltd., 1939.) 10*s*. 6*d*. net.

GEORGES LAKHOVSKY is an engineer who, struck by the idea that radiation might be concerned in the peculiar phenomena of life, formulated a hypothesis and has collected evidence in support of his views. Reduced to its simplest terms his theory is that the cell, as the unit of life, is an electromagnetic resonator, capable of emitting and absorbing radiations of very high frequency, that life is the harmony of multiple radiations of all the cells in a body reacting upon one another, and that disease is a disequilibrium introduced from outside into the cell-harmony.

There is evidence that certain creatures are susceptible to vibrations beyond human sensitivity, and even that some may emit such vibrations; but the author's knowledge of animal life is so limited that improbable examples are mixed indiscriminately with probable. For example, he suggests that lemmings occasionally require fishes for food, and on that assumption he explains the migrations of lemmings, which may reach the sea, as being the response to radiations from shoals of marine fishes (p. 36). Response is due to auto-electrification produced by an animal when it waves its tail in the air; the lemmings would have difficulty in performing that feat. The zoological standard is suggested by "amongst nocturnal birds let us take the bat as an example" (p. 35), or by the inaccurate statement that terns (called sterns) perform a series of circular movements in the air before alighting to fish in the waves (p. 46), though the translator is responsible for the "alighting", which is not expressed in the original text.

The theory, however, is based upon the structure of the cell and by that must be tested. The nucleus is said to be the seat of radiation. This is due to the chromosomes or nuclear filament, described as tubular, composed of a core of organic materials or mineral conductors surrounded by an insulating membrane of cholesterol, plastin and other dielectric substances; so that the twisted coil constitutes an electric circuit endowed by construction with self-inductance and capacity, which may be compared to an oscillating circuit. The description is so far removed from known facts, and the illustrations of chromosomes which accompany it are so crude, that even in this matter, all-important from the point of view of the hypothesis, the knowledge of the author becomes suspect; and the suspicion is confirmed almost on the next page where a description and a figure said to be of *Corynactis viridis*, a "marine organism measuring but 0·1 mm.", is no more than part of a stinging cell of that sea-anemone, and the "oscillating circuits" are the thread of the cnidocyst, the primary purpose of which has certainly nothing to do with emitting radiations.

It may be that cells emit and receive radiations, but the hypothesis is not substantiated by these tenuous speculations. Since the basis of the theory fails, it seems unnecessary to examine the other claims of its author. His multiple wave oscillator, to which a special appendix is given, may work and apparently has worked marvellous cures in cases of cancer, goitre and enlarged prostate, but that does not prove that its electric radiations acted upon hypothetical cell-oscillations; nor is his statement that fever causes the death of cells by "melting" the insulating membrane of nuclear filaments likely to be taken seriously.

We have discussed the weaknesses of this revelation of the secret of life at more length than may seem necessary, because the author and his translator consider that biologists and particularly British biologists have neglected the theory. The translator suggests that the backing of Prof. d'Arsonval indicates exceptional merits in the work; but it is only fair to say that d'Arsonval's preface is frankly non-committal.

JAMES RITCHIE.

# VIRUS AND VITAL ORGANIZATION

By Dr. John Grainger,
Tolson Memorial Museum, Huddersfield

RESEARCH workers who deal with virus diseases have many brilliant pieces of investigation to their credit. The study of little more than a decade has elucidated the size of different virus particles, the nature of virus protein, and its reactions as an immunological agent; the patient inquiry into virus pathology has now made possible a general review of the problem. A recent book[1] by Dr. Kenneth M. Smith, one of the foremost authorities on the subject, still says, however, that it cannot yet be said whether the virus is living or not, and many modern reviews of the problem[2,3,4] testify to the intense, though still unsatisfied, interest in this particular question. It is, indeed, of fundamental importance to determine whether virus is the smallest living entity or the most complex of non-living phenomena; it is already conceded by most research workers that it occupies a position intermediate between these states, having affinities with both.

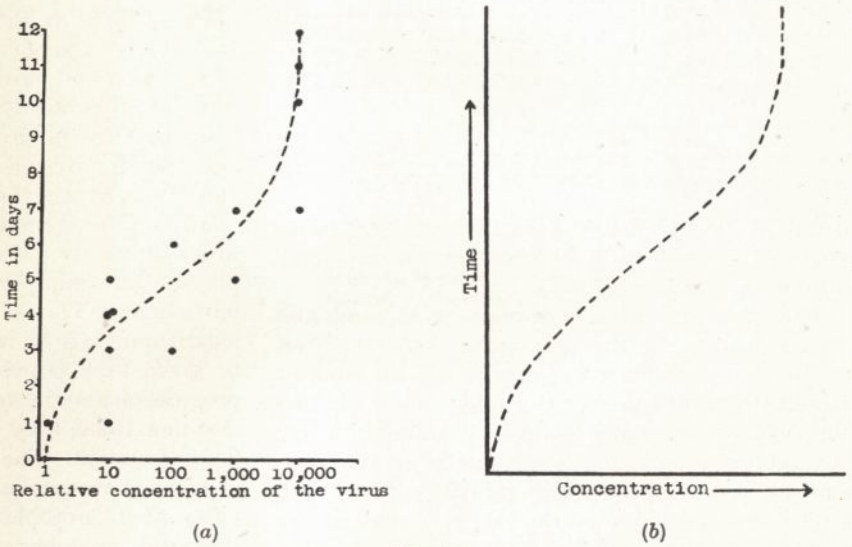



Fig. 1.

(*a*) Rate of increase of Nicotiana virus 1 in tissue of *Nicotiana tabacum*. (*b*) Rate of increase of the autocatalyst in an autocatalytic reaction. The *S*-curve is also characteristic of the rate of increase of bacteria, and of other growth-rates.

The chief difficulty is to define the qualities which separate living from non-living matter. The older biological dicta that reproduction, irritability and movement are the main criteria are no longer tenable without qualification. Reproduction, as exhibited in bacteria, the lowest form of life accepted at present, has a direct parallel with the rate of increase of one product in a non-living, autocatalytic reaction (Fig. 1). One has, indeed, merely to transpose chemical and bacteriological nomenclature to see the complete similarity. The bacteriologist says a bacterium acts upon a culture medium to produce more bacteria; the chemist states that an autocatalyst acts upon another substance to produce more of the autocatalyst. Reproduction in its simplest form, therefore, is not a reliable character for the separation of living from non-living. Irritability, if conceived as a reaction to external stimulus, is of even less value, since inanimate objects respond implicitly to outside forces such as temperature, magnetism, contact, light, and other factors of the environment.

Movement may also be a response to external stimulus such as gravity, but autonomous movement, or motion controlled by the organism itself, gives the first real clue to the quality of life. Living things are not completely at the mercy of their environment, whereas non-living matter has a totalitarian subjection to external surroundings. Thus a non-living mass of protein always rolls down a slope with unquestioning obedience to the law of gravity; living protein in certain forms *can* move up the slope, following its internal direction. It does not always do so; gravity is often the dictator, but the living organism is not completely subject to the laws of gravity. Motile bacteria can move against a slight stream of liquid; inanimate particles are always carried with the flow, or left stationary. The organization of evolution can, I think, be conceived as having three departments: the non-living, which is completely dependent upon its surroundings, the living, where independence of the environment exists in varying

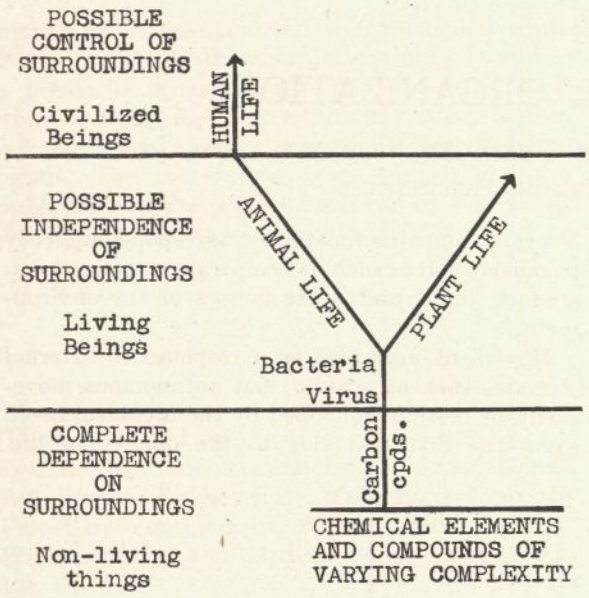



Fig. 2.

DIAGRAM TO SHOW THE RELATIONS OF CIVILIZED AND LIVING BEINGS WITH NON-LIVING THINGS.

degree, and civilized humanity, where some measure of control of external events and conditions is possible (Fig. 2).

The virus multiplies within its host, and also moves therein. Is this motion subject to the host, or does it exhibit any degree of autonomy? Results from such an inquiry ought to show whether the virus possesses any claim to vital organization. A plant host is particularly suitable for such studies, since it eliminates the gross circulation of a blood-stream and provides gentle barriers, more amenable to investigation.

It is a well-known fact that a tobacco plant can be infected by inoculating Nicotiana virus I into the epidermal cells of the stem. The virus can later be recovered from all parts of the plant, thus involving a transfer across the relatively inert cells of the cortex, where protoplasmic streaming could not provide an aid to progress, and where the static conditions of osmosis or of salt concentration within the cells are probably the dominant forces. The rate of travel is too great for an explanation in terms of diffusion[5,6]. Here, then, is *prima facie* evidence that virus movement is not necessarily dependent upon the streams of nutrient, water or protoplasm which are known to be present in the green host plant.

It has also been shown[5] that virus can multiply within a tobacco leaf severed from the plant and kept in a humid atmosphere. Here the various streams of transpiration and translocation within the plant are eliminated, yet the virus advances in a wave down the leaf, following inoculation at the tip. It may even move faster than in a similar leaf attached to the plant, and can be detected in the lamina of the leaf before it occurs in the midrib, thus demonstrating the elimination of mechanical transport along the conducting tissues. It is noteworthy that tobacco leaves scratched with a sterile needle at the tips, as for inoculation, and then dipped in red ink solution, did not permit any transfer of the inanimate dye. Similar results can be obtained with detached stems; the virus spreads upwards and downwards at about the same rate (Fig. 3), and appears to be independent of any help from the host. It does not seem to make any difference if a bias is given to the transpiration stream by leaving one or two leaves upon the detached stem[5]. In so far as the passage of a dye can be regarded as an indication of the transpiration stream, it very often follows a course different from the virus. Red ink taken up from the cut end of a shoot penetrates the vascular ring of the stem and enters the lower leaves first; the virus often proceeds first to the youngest leaves. Transport to the growing point by the stream of elaborated nutrients in this case appears to be ruled out by the fact that virus spreads downwards in the stem at about the same rate as it moves upwards[5]. Carriage of the virus by protoplasmic streaming would require a linear rate of movement; Fig. 3 shows that the virus has a logarithmic rate of travel, which could, moreover, be given by a population increasing in geometric progression and free to orientate themselves into the first new tissue they reach within the parallel confines of a stem. The similar rates of upward and downward movement again eliminate the possibility that protoplasmic streaming might carry the virus predominantly in one direction.

In the matter of temperature also, virus is not completely dependent upon its host. It does not

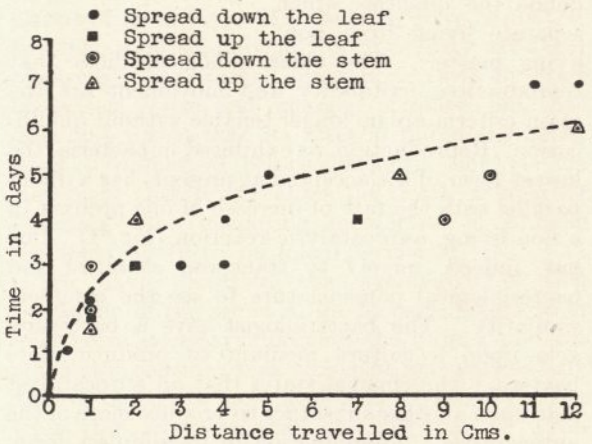



Fig. 3.

THE RATE AND MANNER OF SPREAD OF NICOTIANA VIRUS I IN LEAF AND STEM TISSUE OF *Nicotiana tabacum*, FOLLOWING A LIMITED INOCULATION.

produce symptoms at all temperatures at which the host will grow, though virus is present in the tissues[7,8,9]. The virus, moreover, has a temperature of optimum activity different from that of its host[7,8], thereby exhibiting a degree of independence of the plant which it attacks.

It now seems possible to suggest that the virus is actually a living organism, since it exhibits a type of independent movement through its host which can only be interpreted as autonomous, and shows further independence in the calibre of its temperature relations. It is not yet possible to envisage the actual mechanism of the movement. Sheffield[10] has produced categorical evidence that protoplasmic connexions between cells are necessary. The experimental evidence, however, seems to indicate the broad fact of virus autonomy.

The results of many workers, notably Stanley and Bawden and Pirie, show that the virus is a crystalline protein, different from the usual biological conception of such substances. This has been interpreted as an argument against the living nature of the virus, but cannot, I think, be an overwhelming criterion. Difference in structure between the protein of fungi and bacteria must have seemed great at the time of its discovery—as large as the known differences between bacterial and virus protein. Moreover, virus is not always crystalline ; it may occur as amorphous inclusion bodies, which look much more like the traditional proteins of biology. The lack of demonstration of virus respiration is not a significant difficulty, for it is impossible to separate bacterial respiration from changes of the substrate brought about by the organism ; both bacteria and virus disturb the composition of the substrate. Virus is active within the limits of temperature already known for other organisms, and its inactivation by chemicals presents no feature not already familiar to the biologist.

One corollary from the living nature of the virus is somewhat difficult of elucidation ; if virus was the first form of life, it ought to be possible to find prototrophic viruses which feed on inorganic materials. Those known at present are entirely parasitic, but the detection of prototrophic viruses presents so many difficulties that they are not likely to be discovered until research comes to be organized with an intensity comparable to the present war effort.


[1] Smith, K. M., "The Virus ; Life's Enemy" (Cambridge : Univ. Press, 1940.)
[2] Davis, L. J., *Proc. Rhodesia Sci. Assoc.*, **37** (1939).
[3] Levaditi, C., *Bull. Soc. d'Encour. pour l'Indus. nationale*, 137e annee, 27–42 (1938).
[4] Rivers, T. M., Lecture to N.Y. Acad. of Med., March 29, 1940. See also NATURE, **145**, 853 (1940).
[5] Grainger, J., *Ann. Appl. Biol.*, **20**, 2, 236–257 (1933).
[6] Henderson Smith, J., *Biol Rev.*, **5**, 2, 159–170 (1930).
[7] Grainger, J., NATURE, **137**, 31 (1936).
[8] Grainger, J., *Phytopath.*, **29**, 5, 441–448 (1939).
[9] Johnson, J., *Phytopath.*, **11**, 446 (1921).
[10] Sheffield, F. M. L., *Ann. Appl. Biol.*, **23**, 3, 506–508 (1936).


# THE AIR-DRIVEN ULTRACENTRIFUGE


By Dr. F. R. Eirich and Prof. E. K. Rideal, M.B.E., F.R.S.,
Laboratory of Colloid Science, Cambridge


SEDIMENTATION and diffusion constants of macromolecules are conveniently determined with the oil-driven ultracentrifuge of the Svedberg type. Such machines are not generally available for normal routine laboratory work, and in a search for an apparatus which was at the same time simple to run, economic to install but also precise in operation, our attention naturally turned to the air-driven top of Henriot and Huguenard, which has been developed so well in the United States by Beams, McBain and especially by the Sharples Centrifuge Company of Philadelphia.

Whilst machines of this type have frequently been used for purposes of separation and determination of approximate mass weights, it seemed worth while to examine how far it could be made an instrument of precision.

After a visit to Philadelphia, an experimental model was kindly constructed for us by the Sharples Co. The driving mechanism is of the turret-type[1], and spins a round rotor (8·85 cm. diameter) in an atmosphere of hydrogen. The air pressure necessary to lift the rotor is 5¼ lb./sq. in., and 20 lb./sq. in. air pressure on the driving jets produces a speed of about 75,000 r.p.m. at 15 mm. hydrogen pressure. The bursting risk limits the speed to 105,000 r.p.m. (fields of 372,000 *g* in the cell), but in the interests of safety speeds exceeding 85,000 r.p.m. (245,000 *g*) are rarely used, allowing molecular weights of about 15,000 (cytochrome *C*) to be determined.

The solutions to be examined are contained in transparent cells differing but little from those used by Svedberg[2]. The cells are sectorial in shape, 10 mm. high, 2 mm. deep with a radial angle of 5° ; the depth, which influences the working concentrations, has since been increased to 5 mm., and recently a modification of the original design has

enabled cells 10 mm. deep to be used. The weights of these cells are adjusted to 0·001 gm. and the position of the centre of gravity (height above bottom plate) to 0·1 cm., thus reducing the stresses in the rotor.

The speed of the rotor is measured by amplifying an alternating current to drive a synchronous motor. The current is generated by a small brass disk, containing an iron segment, which is fixed to the top of the rotor shaft and rotates in a magnetic field. The general scheme is as illustrated (Fig. 1).

It has been stated that this or a similar method of speed measurement has been applied in the Laboratory of Physical Chemistry, Uppsala, and was criticized[3] for not functioning reliably at speeds above 90,000 r.p.m. Our own experience is that it is entirely satisfactory and preferable to all stroboscopic methods. The highest operating speed used on this ultracentrifuge has been 91,700 r.p.m., and the speed indicated was checked by plotting the driving air pressure at lower speeds and extrapolating to 91,700; no large error was observed. The inaccuracy can be made of the order 0·1 per cent with practice as it only entails stop-watching a mark past an index. The reduction gear is such that each revolution of the mark per minute corresponds to 10,000 r.p.m. of the rotor. A rough evaluation of the speed is obtained from the current output of the generator.

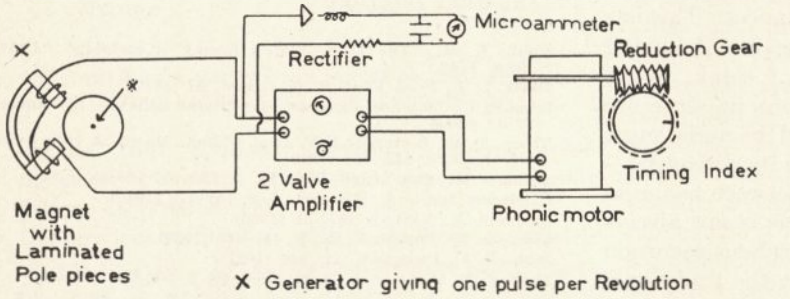



Fig. 1.

REVOLUTION COUNTER: SCHEMATIC DIAGRAM

After preliminary examination of several methods of optical examination, including that of Lamm, we finally decided to make observation of the sedimenting boundary by the Philpot *Schlieren* method[4]. The optical bench, some 2·8 m. long, was erected on concrete pillars and isolated from the rest of the basement floor. The centrifuge, likewise mounted on a concrete table, ran perfectly smoothly without any vibration, even when the air compressor (Ingersoll-Rand) was in operation. The diagrams first obtained (2 per cent solutions in the cell) were good, but when the resolving power was increased by magnification (0·1 per cent solutions in the cell), the diagrams were crossed by innumerable dark lines which hazed the outline of the sedimenting 'peak'. These lines were eventually traced to refractive index gradients in the material of the lenses and plates. The two fused quartz plates which admit the light beam into the centrifuge housing were found to be particularly bad, so these were removed and replaced by the two *Schlieren* lenses. Many of the dark lines were due to dust particles on the lenses and edges, so these are now kept clean. The lamp used is a Philips tungsten ribbon lamp (100 w. 6 v.) and the intensity is such that exposures are only one tenth as long as those required with the mercury lamp previously used.

At the present time there is some uncertainty as to the temperature of the rotor; the rotor spins in hydrogen at *ca.* 10 mm. pressure in a chamber through the walls of which is circulated thermostated water. It was assumed in the preliminary runs that the rotor is at the temperature of the walls; this, however, is probably not the case and a method for determining the exact temperature is being evolved.

Up to the present time, only sedimentation velocity measurements have been made, but it is hoped before long to include sedimentation equilibrium determinations. In addition to the sedimentation constant the diffusion constant of the solute must be known. A value for the diffusion constant can be obtained[5] from the sedimentation by applying Weiner's[6] development of Fick's law.

The experimental results described below were carried out more with the idea of developing technique than measuring molecular weights, but the results are sufficiently interesting to warrant description. When considering these results, it should be remembered that the sedimentation constant $S_{20}$ is calculated assuming that the temperature in the cell is the same as the walls of the chamber. The materials centrifuged were several proteins.

*Ovalbumin.* A sample of ovalbumin was subjected to analysis to determine whether the instrument was functioning satisfactorily; the results are given in Table 1, together with data[7] obtained

TABLE 1. OVALBUMIN.

Solution, 0·75 per cent ovalbumin in 0·2 *M* sodium chloride. $T = 25°$ C. *p*H 8·0.

| | Air driven | Oil driven (Uppsala) |
|---|---|---|
| Sedimentation constant, $S_{20}$ | $3{\cdot}75 \times 10^{-13}$ cm./sec. | $3{\cdot}55 \times 10^{-13}$ cm./sec. |
| Diffusion constant, $D_{20}$ | $7{\cdot}6 \times 10^{-7}$ cm./sec. | $7{\cdot}76 \times 10^{-7}$ cm./sec. |
| Molecular weight | 49,000 | 43,800 |

(*Continued on page 551.*)

# NATURE

## SUPPLEMENT

Vol. 146 SATURDAY, OCTOBER 26, 1940 No. 3704


## SHORT REVIEWS

### Vital Religion

A Brotherhood of Faith. By Sir Francis Younghusband. Pp. ix+101. (London: John Murray, 1940.) 3*s*. 6*d*. net.

SIR FRANCIS YOUNGHUSBAND relates that, at the end of his successful mission to Tibet thirty-four years ago, to negotiate a treaty of commerce and intercourse, he went alone to the mountainside with the feeling of peace on earth and goodwill among men filling his mind and heart. It was there and then that he became exalted with emotion like that experienced in evangelical conversions, and to which modern psychology is inclined to refer all religious convictions. From that time he has in several books, and in the organization of World Congresses of Faiths, been delivering the message of fellowship among men of all high religious beliefs.

In this small book Sir Francis brings together eight addresses given by him on this theme. The spiritual and ethical elements in the great religions of the world should unite people of many countries in the common cause of truth and righteousness. A World Commonwealth may be a dream, but the federation of faiths is one way of approaching it, and the movement of which Sir Francis is an inspired apostle is towards that high destiny of mankind.

### The Soul of the Universe

By Gustaf Strömberg. Pp. xviii+244. (Philadelphia: David McKay Company, 1940.) 2 dollars.

THIS book contains a clear and well-written statement of some recent developments in physical and biological theory. Combined with this is a speculative cosmology based on the hypothesis of a world-soul. This is worked out in some detail with considerable ingenuity, specially in its biological and psychological implications. Unfortunately the working out requires subsidiary *ad hoc* hypotheses of the kind that enable any theory to be fitted to any facts. It must be said in favour of the author that his account is plain and straightforward and free of the mystifications and paradoxes used by certain contemporary popularizers. The book may appeal to the general public on its merits. It is scarcely likely to interest the man of science, and the philosopher who is concerned with the notion of the world-soul will probably prefer Plato's "Timæus", even though the physical theory is out of date.

### Chemicals of Commerce

By Dr. Foster Dee Snell and Dr. Cornelia T. Snell. Pp. viii+542. (London: Chapman and Hall, Ltd., 1940.) 28*s*. net.

AS chemicals enter more and more into commerce there arises the need among those who have to deal with them for a minimum of information giving at least the salient facts. Chemical dictionaries tend to become too long and are expected to be more or less complete to be of service. The authors have made a selection of substances of trade importance and give more or less information about them in paragraphs grouped into chapters under appropriate headings. The chemical composition, but not the structural formulæ, of the substances is indicated. For each product there is in general given a short description, method of manufacture, common impurities, commercial grades and uses.

The book is primarily intended for American consumption, where they are more chemically minded than in Great Britain, by people without formal chemical training. The wide experience of the authors as consultants makes it probable that the selection is sound and the information reliable; the venture deserves success as a means of spreading accurate chemical knowledge.

### Electrochemistry and Electrochemical Analysis

A Theoretical and Practical Treatise for Students and Analysts. By Dr. Henry J. S. Sand. Vol. 2: Gravimetric Electrolytic Analysis and Electrolytic Marsh Tests. Pp. iv+149. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5*s*. net.

THIS second volume of the treatise on electrochemistry and electrochemical analysis deals with gravimetric electrolytic analysis, including internal electrolytic analysis (in which the electro-

lysing current is generated in the deposition cell itself by anodes of baser metal separated from the test solution by a diaphragm), electrolytic micro-analytical methods and the electrolytic Marsh test as applied to arsenic, antimony and germanium. Particular attention is given to methods of separation by control of the cathodic potential with the aid of an auxiliary electrode. The treatment is essentially practical, the first chapter dealing fully with apparatus, the second with technique and the remaining six chapters with special determinations and separations. Industrial applications, such as alloy analysis, are adequately covered.

Since many of the methods have been developed or perfected by the author, the treatment is based on sound practical experience, and the many small details which are essential for success are satisfactorily presented. The compositions of the solutions, for example, are given, together with the electrolysing currents and voltages and the method of treatment of the deposit for weighing if this is necessary.

The book is a valuable contribution to the literature of analytical chemistry and should find a place in every laboratory. A third volume dealing with volumetric methods, capacitance measurements and *p*H determination is planned.

### Elementary Crystallography

By Dr. John W. Evans and George M. Davies. Second edition. Pp. vii+149. (London: Thomas Murby and Co., 1940.) 6*s*. 6*d*. net.

THIS well-established text-book has served some generations of students faithfully and continuously. It now re-appears in its traditional form, but with the addition of a particularly clear account of X-ray crystallography, accompanied by illustrations from the work of Mrs. G. M. Davies.

This new section follows the usual lines: the important point is that readers of this second edition will have before them an adequate introduction to modern methods, alongside the classical treatment.

### Aids to Physical Chemistry

By R. G. Austin. Pp. x+361. (London: Baillière, Tindall and Cox, 1940.) 5*s*.

THIS little manual is a valuable member of the "Students' Aid Series". All the usual branches of physical chemistry are represented, and the information is at once concise and adequate. Perhaps it is well to stress that the booklet is not intended to be a substitute for text-books; to use it for such a purpose would be a great mistake. Its purpose is to facilitate reference by those already conversant with the subject. There are many numerical examples, worked out in full.

### Hydrocarbon Chemistry

A General Discussion held by the Faraday Society, April 1939. Pp. ii+805–1092. (London and Edinburgh: Gurney and Jackson, 1939.) 12*s*. 6*d*. net.

THIS volume comprises the papers presented at one of the Faraday Society's well-known discussions, that on hydrocarbons held in London a few months before the outbreak of war. It fully maintains the standard expected of those deliberations. Part 1 deals with homogeneous thermal reactions, Part 2 with catalysis, Part 3 with synthesis and transformations, and Part 4 with olefine polymerization. The introduction is contributed by Prof. E. K. Rideal.

The subject is of great importance to-day, in view of increased piston speeds in many engineering problems, and the insatiable demand for higher pressures in bearings. Again, new chemical industries are likely to look upon hydrocarbons more and more as a source of raw materials.

Some theoretical work of great interest upon structural and energy problems is presented by Lennard-Jones and Coulson, and a critical review of the pair theory of mesomerism by Lloyd and Penney. Hydrogenation of coal and lignite is discussed as a large-scale example in Part 3. As usual, much detail is brought out by individual speakers on their special aspects of the general theme.

### Colloid Chemistry (A Textbook)

By Prof. Harold Boyer Weiser. Pp. viii+428. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 24*s*. net.

THIS text-book, by the author of the well-known "Inorganic Colloid Chemistry" in three volumes, is intended for students who have an elementary knowledge of physical chemistry, and is planned to acquaint the student with the foundations of colloid chemistry, to formulate systematically and to correlate critically the theories underlying colloid chemical behaviour, and to illustrate the wide applications of the subject in the fields of the industrial arts, agriculture and biology. After a brief introduction on general principles, there are seven chapters on adsorption at various types of surfaces, ten chapters on the preparation and properties of lyophobic and lyophilic sols, two shorter sections on gels, emulsions and foams and aerosols and solid sols, respectively, and finally two chapters on the applications of colloid chemistry to contact catalysis, dyeing and clay. Numerous useful references are given, many of them to technical as well as scientific journals.

The treatment is on the whole descriptive and experimental rather than theoretical and mathematical, although many important equations are deduced and the section on Brownian movement gives a simplified derivation of the Einstein equation. There are many tables of numerical data, and the quantitative side of the subject is well cared for. Historical developments add interest to many sections, and the older classical work of Graham, Linder and Picton, Freundlich, Ostwald, and others receives proper recognition alongside the newer developments of the subject. In this way a well-balanced treatment is achieved, and the misleading idea that the subject is of very recent growth is corrected. A critical treatment of the results and theories (for example, of the so-called activated adsorption) is a valuable feature. Modern work is well represented, and a concise yet clear style has made it possible to give a

very large amount of interesting information in a small compass.

The reader never feels that the treatment is sketchy, and the student who assimilates the contents of the book will have laid a solid foundation for further study of special fields of colloid chemistry. There are more than a hundred good illustrations.

### Chemical Calculations

By J. S. Long and H. V. Anderson. (International Chemical Series.) Fourth edition. Pp. xii+266. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 11*s*. 6*d*.

THE fact that this book has reached a fourth edition in six years indicates that it has achieved popularity, and the contents show that it provides a very sound and interesting course of exercises. Each section has an introductory outline and a brief statement of the underlying theory, and much of the material here presented is supplementary to that found in text-books. The examples for exercise are numerous, well-chosen and in very many cases provided with answers. Although it is stated that answers are "purposely omitted" in come collections of problems, it is not clear that this has any advantage, and these might well be provided in future editions.

The usual topics in an elementary course are well covered and special mention must be made of the chapters on gas analysis, oxidation and reduction, and those parts of physical chemistry which are of importance in chemical analysis (mass action and solubility product). In the sections on ionic equilibrium the limitations to weak electrolytes are not emphasized, and in calculations involving strong electrolytes the fact that complete ionization is assumed and that the simple law of mass action should not be applied to them is not clearly stated. There is no reason why this should not be done even in an elementary course, and these chapters might well be supplemented and revised in future editions.

The intention of the authors to fit the student to encounter the actualities of chemistry is wholly praiseworthy, and it has been very ably implemented in the book. As they say: "chemical calculations serve to develop in the student aptitude in the application of various principles of chemistry under actual working conditions", and since the book can be covered in fifteen weekly periods in the first year, this valuable training should not encroach unduly on other parts of the course.

### Gmelins Handbuch der anorganischen Chemie

Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 27: Magnesium. Teil B, Lief 4: Schluss der Verbingungen, Technische Darstellung der Magnesiumverbindungen. Pp. 423–550+xx+xviii. (Berlin: Verlag Chemie, G.m.b.H., 1939.) 18.75 gold marks.

THE present part of "Gmelins Handbuch" covers compounds of magnesium with the alkali metals and ammonium and beryllium, and describes technical methods of manufacturing the oxide, hydroxide, carbonate, chloride and sulphate of the metal. Magnesium oxide and hydroxide are manufactured chiefly from magnesite, although numerous processes have been adopted for utilizing dolomite. The temperature at which the oxide sinters is very high, but can be lowered appreciably by the addition of ferric oxide. The hot material is sprinkled with water to hydrate any calcined limestone, dolomite or caustic magnesia, which react much more easily than sintered magnesia to form a dust which is easily separated.

Much work has been done on the preparation of anhydrous magnesium chloride for the electrolytic extraction of the metal. As is well known, dehydration of the hexahydrate is accompanied by hydrolysis, so that the salt has to be heated in the presence of hydrogen chloride, which causes rapid corrosion of the vessels from 325° C. upwards, but it has been found possible to raise the temperature to 450° C. and thereby greatly accelerate dehydration by rigorously excluding air. Other methods used for dehydration of the chloride involve either electrolytic decomposition of the water alone, or the formation at low temperatures of a hexamine which can be dried at 300° C., or the conversion of the oxide direct to chloride.

### Introduction to Carbohydrate Biochemistry

By Dr. D. J. Bell. Pp. viii+112. (London: University Tutorial Press, Ltd., 1940.) 3*s*. 6*d*.

NO class of organic compounds surpasses the carbohydrates in interest. Sir Frederick Hopkins speaks of the intellectual thrills induced by the progress of the work of Emil Fischer in particular: since then the development has been to some extent in Great Britain. Almost every worker in biochemistry, using the term in its widest significance, has to know something about the sugars and to master their structural formulæ. It is for these that the present book is provided, and its ordered assembly of formulæ drawn and printed with praiseworthy clarity will go far to make what is in reality difficult appear easy.

The subject-matter is highly concentrated, but the author has the knack of putting the essentials into the fewest words. After describing the sugars themselves he discusses the liberation of energy during fermentation, metabolism in muscle, uronic acids, glycosides, nucleotides in particular. Sufficient references are given to the literature.

The book forms a notable contribution to any library which no biochemist can be without.

### Principles of Animal Biology

By Prof. Lancelot Hogben. Second edition, revised. Pp. 415. (London: George Allen and Unwin, Ltd., 1940.) 7*s*. 6*d*. net.

PROF. HOGBEN'S text-book on animal biology was first published in 1930 and later went out of print. The present edition planned on the same lines as the original, although the pattern has been improved by the adequate revision of the whole book

and the complete rewriting of certain chapters. This applies particularly to the chapter on fossil veterbrate skeletons, which has been extended and remoulded in order to include references to the many new discoveries of the past ten years. An advantageous innovation in this edition is that the combination of author Hogben with artist Horrabin, which was so successful in the preparation of "Science for the Citizen" and "Mathematics for the Million", has again been used. Mr. Horrabin has redrawn each illustration and has added many new ones, in which diagrammatic clarity is constantly emphasized, although never at the expense of artistic refinement.

Prof. Hogben remarks in the preface that this work is not intended to supplant dissecting manuals or formal text-books ; it has been prepared solely as a supplementary reader to the more rigid lecture courses in animal biology taken by candidates of Higher Schools and first-year university standard, emphasis throughout being placed on function rather than on structure. *Homo sapiens* receives attention strictly on his merits as a vertebrate animal, although one might have hoped that the author had dipped his pen in a less restraining fluid. A general criticism of the book is that Prof. Hogben frequently overestimates the sum total of factual information possessed by university students after a one-year course in zoology. This is particularly evident in the chapter dealing with the principle of succession with special reference to the vertebrate skeleton. The new edition is a useful addition to the current stock of literature, however, and should establish itself as quickly and successfully as its predecessor. As one would expect in a second edition, the book is free from even minor inaccuracies.

### Silviculture of the Trees of Trinidad and Tobago, British West Indies

By R. C. Marshall. Pp. xlvii+248+16 plates. (London : Oxford University Press, 1939.) 21*s*. net.

IN this book the author summarizes, from a sylvicultural point of view, the results of eleven years work, during which he was in charge of the Forest Department of Trinidad and Tobago. The first part of the book consists of an account of the physiography and vegetation of the two islands, condensed from the author's previous publication (*Oxford Forestry Memoirs*, No. 17 ; 1934).

In a brief discussion of the sylviculture of the tropical high forest which follows, the author urges the advisability of so conducting regeneration operations as to produce a forest resembling the natural type, especially in structure, though with a higher proportion of valuable species. In these forests the number of such valuable species is small ; they are found usually in the dominant class and there is a tendency to confine attention to them. The importance of the sub-dominant and understory constituents for the maintenance of the health and well-being of the forest must be recognized though it is not fully understood. "The question at issue is to what extent the very complex natural vegetation can be simplified without impairing the properties that enable it to persist healthily as a vegetative type, self-supporting and permanent."

The bulk of the book consists of descriptions of the trees of the islands, arranged in families as in a Flora, under some or all of the following heads : name, botanical and vernacular, general description of the tree, distribution and habitat, botanical, germination, seedling, sylvicultural characteristics, regeneration, utilization. The botanical descriptions are nearly all from field examinations of fresh material. Twenty-eight excellent line drawings by Mrs. Marshall supplement the botanical descriptions of the more important species.

### Laboratory Studies in Zoology

By Dr. H. D. Reed and Prof. B. P. Young. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xii+207. (New York and London : McGraw-Hill Book Co., Inc., 1939.) 9*s*.

THIS is the second edition of the manual used by beginners in zoology at Cornell University. The frog is dissected in some detail to illustrate bodily structure in a vertebrate, followed by a study of the usual invertebrate types, Amphioxus and a freshwater fish. The only mammalian material is the eye, though it is suggested that at the end of the course an opportunity should be given for an investigation of the fœtal pig. The simple tissues are dealt with very briefly. Practical studies in mitosis, gametogenesis and heredity are a welcome addition to the first-year course, and are rarely attempted in Great Britain. In embryology the student sees the early developmental stages of the starfish and all the stages in the life-history of the frog. A study of mixed protozoan cultures provides training also in the use of a key for the identification of common species.

Directions and descriptions are clearly expressed, and questions at the end of each chapter suggest problems for the student to elucidate for himself. The production of the book is excellent.

### Anatomy of the Sheep's Brain

A Laboratory Atlas for Students of Zoology. By Prof. E. A. Briggs. Pp. xiii+50+8 plates. (Sydney : Angus and Robertson, Ltd., 1939.) 6*s*.

THIS small book contains a useful elementary account of the structure of the sheep's brain intended, as its sub-title suggests, for first-year students of zoology. The brain of the sheep from its size and the ease with which it can be obtained and handled affords a much better object for study than the brains of the smaller mammals generally employed for dissection in this course. The detail given is well suited for first-year zoology, but the medical student would also find it helpful to work through it as a revision exercise before passing on to the detailed study of the more complex human brain. The text is written in a clear and straightforward manner, and the well-produced illustrations add considerably to its usefulness.

### Notter and Firth's Hygiene

Revised by L. C. Adam and E. J. Boome. Tenth edition. Pp. x+518+16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 12*s*. 6*d*. net.

SINCE the last edition of this well-known work which appeared in 1921, so much advance has been made in the domain of hygiene that the present editors, who are assistant medical officers in the Public Health Department of the London County Council, have found it necessary to make numerous additions and deletions to bring the book up to date. The principal additions which have been made in the present volume are the descriptions of the Public Health Act of 1936, the Housing Act of 1936, the Factories Act of 1937 and the Food and Drugs Act of 1938. The sections on diet, school hygiene, maternity and child welfare, speech defects, infectious diseases and mental deficiency have also undergone revision. The work, like previous editions, will form a valuable guide to those seeking information on the various departments of public health.

### Mental Disorders in Modern Life

An Outline of Hopeful Treatment. By Dr. Isabel Emslie Hutton. Pp. xiii+204. (London: William Heinemann (Medical Books), Ltd., 1940.) 3*s*. 6*d*. net.

THIS little work, which is based on many years experience of mental diseases not only in Great Britain but also on the Continent and in America, is primarily intended for non-medical readers, especially magistrates, coroners and social workers, but it will also prove a useful introduction to the study of psychiatry, particularly in its practical aspects, by the medical student and graduate. In spite of its subtitle the book is not confined to treatment but also contains a concise and lucid account of the history, causes, symptoms and legal aspects of the various forms of mental disease. Special chapters are devoted to the discussion of mental deficiency, sterilization and research. In the last chapter Dr. Hutton maintains that the most important development of the future lies in the out-patient clinic, where all who feel mentally ill can openly come for treatment.

---

# FORTHCOMING BOOKS OF SCIENCE

## Mathematics: Mechanics: Physics

D. Appleton-Century Co., Ltd. Mathematics in General Education—V. T. Thayer.

Blackie & Son, Ltd. The Student's Physics, Vol. 2: Acoustics—Alexander Wood (Royal Institution Christmas Lectures). University Physics, Vol. 2: Heat—F. C. Champion.

Cambridge University Press. A Mathematician's Apology—G. H. Hardy. Electron Inertia Effects (Cambridge Physical Tracts)—F. B. Llewellyn. The Indian Mathematician Ramanujan—G. H. Hardy. The Theory and Applications of Harmonic Integrals—W. V. D. Hodge. Statistical Calculation for Beginners—E. G. Chambers. Vital Arithmetic and Geometry—R. S. Williamson.

Chapman & Hall, Ltd. Tables for the Identification of Molecular Spectra—R. W. B. Pearse and A. G. Gaydon. Classical and Modern Physics—Harvey E. White. General Physics for Students of Science—R. B. Lindsay. Principles and Practice of Chromatography—L. Zechmeister and L. Cholnoky, translated by A. L. Bacharach and F. A. Robinson. Statistical Mechanics—J. E. Mayer and M. G. Mayer. Motion and Time Study (second edition)—Ralph M. Barnes.

McGraw-Hill Book Co., Ltd. The Development of Mathematics—E. T. Bell. Statistical Procedures and their Mathematical Bases—Charles C. Peters and Wallis R. Van Voorhis. Theory of Plates and Shells—S. P. Timoshenko. Experimental College Physics (second edition)—M. W. White.

Methuen & Co., Ltd. The Special Theory of Relativity—Herbert Dingle. The Physical Principles of Wireless (Methuen's Monographs on Physical Subjects) (fourth edition, revised and enlarged)—J. A. Ratcliffe.

Oliver & Boyd, Ltd. Waves (University Mathematical Texts)—Charles Coulson.

Oxford University Press. The Separation of Gases (International Series of Monographs on Physics)—M. Ruhemann. Algebra: a Text-Book of Determinants, Matrices and Quadratic Forms—W. L. Ferrar.

University Tutorial Press, Ltd. Textbook of Light (seventh edition)—R. W. Stewart and John Satterly, revised by Charles T. Archer. Intermediate Electricity (new edition)—Robert W. Hutchinson.

## Engineering

D. Appleton-Century Co., Ltd. Getting Acquainted with Radio—Alfred Morgan.

Edward Arnold & Co. Analytical Processes: a Physico-Chemical Interpretation (second edition)—T. B. Smith.

Blackie & Son, Ltd. The High Speed Internal Combustion Engine (third edition)—Harry R. Ricardo. The High-Speed Compression-Ignition Engine—C. B. Dicksee. Internal-Combustion Engineering—A. T. J. Kersey. Transformers—Eric E. Wild.

Chapman & Hall, Ltd. Thermionic Tubes at Very High Frequencies—A. F. Harvey. Electric Power Stations—T. H. Carr. Circuit Analysis for Electrical Engineers—Members of the Staff of the Department of Electrical Engineering, Massachusetts Institute of Technology. Design of Electrical Apparatus (second edition)—J. J. Kuhlmann. Electrical Communication (second edition)—A. L. Albert. Aircraft Engines, Vol. 2—A. W. Judge. Elements of Acoustical Engineering—H. F. Olson. Practical Solution of Torsional Vibration Problems (second edition)—W. Ker Wilson. The Rigid Frame Bridge (second edition)—Arthur G. Hayden.

Constable & Co., Ltd. Practical Design of Simple Steel Structures, Vol. 2 (new edition)—David S. Stewart.

Charles Griffin & Co., Ltd. The Dry Battery: a Practical Manual, including Battery Manufacture—Waring S. Sholl.

Hutchinson & Co., Ltd. Works Boiler Plant—F. J. Matthews.

Crosby Lockwood & Son, Ltd. Portable Producer Gas Plants for Road Transport: a Handbook describing the Various Types of Plant, with Practical Notes on their Use and Up-keep—H. Scott Hall and M. S. Horner.

McGraw-Hill Book Co., Ltd. Handbook of Applied Hydraulics—Calvin V. Davis. Aircraft Instruments—George E. Irwin. Practical Tunnel Driving—H. W. Richardson and Robert S. Mayo. Applied Heat Transmission—H. J. Stoever. Mechanical Vibrations (second edition)—J. P. Den Hartog. Engineering Mechanics (second edition)—S. P. Timoshenko and D. H. Young.

Oxford University Press. Relaxation Methods in Engineering Science (Oxford Engineering Science Series)—R. V. Southwell.

SIR ISAAC PITMAN & SONS, LTD. Power System Interconnection (Transmission Problems)—H. Rissik. Engineering Inspection—A. C. Parkinson. Introducing Radio Receiver Servicing—E. M. Squire. Gear Design—H. E. Merritt. Experimental Radio Engineering—E. T. A. Rapson. Airscrews (Variable Pitch)—W. J. Speller. Mechanical Testing of Metallic Materials—R. A. Beaumont. Mechanical Engineering: the Profession and its Opportunities—W. H. Atherton. Rate-fixing and Estimating for Engineers—Joseph Freeman. Speech Signals in Telephony—A. Lloyd James.

UNIVERSITY TUTORIAL PRESS, LTD. Electrical Engineering, Vol. 2—W. Tolmé Maccall.

## Chemistry: Chemical Industry

CHAPMAN & HALL, LTD. Hydrogen Ions: their Determination and Importance in Pure and Industrial Chemistry (third edition)—Hubert T. S. Britton. The Systematic Identification of Organic Compounds (second edition)—Ralph L. Shriner and Reynold C. Fuson. Chemical Computations and Errors—Thomas B. Crumpler and John H. Yoe. Handbook of Chemical Microscopy, Vol. 2: Chemical Methods and Inorganic Qualitative Analysis (second edition)—E. M. Chamot and C. W. Mason. An Introduction to Organic Chemistry (fifth edition)—Alexander Lowy and Benjamin Harrow. An Introduction to Organic Chemistry (second edition)—Ira D. Garard. The Chemical Analysis of Ferrous Alloys and Foundry Materials—E. C. Pigott. Twelfth Report of the Committee on Catalysis—Members of the National Research Council. Quantitative Analysis (second edition)—W. C. Pierce and E. L. Haenisch.

CONSTABLE & CO., LTD. Chemical Thermodynamics: an Introduction to General Thermodynamics and its Applications to Chemistry (new edition)—J. R. Partington.

ENGLISH UNIVERSITIES PRESS, LTD. Modern Chemistry—B. C. Saunders and R. E. D. Clark.

CHARLES GRIFFIN & CO., LTD. The Analysis of Minerals and Ores of the Rarer Elements (second edition)—W. R. Schoeller and A. R. Powell. Spectrochemical Analysis of Metals and Alloys—F. Twyman.

HUTCHINSON & CO., LTD. Cosmetic Art and Science—Fred Winter.

MCGRAW-HILL BOOK CO., LTD. A Laboratory Course in General Chemistry—R. H. Crist. Experiments in Colloid Chemistry—Ernst A. Hauser and Lynn J. Edward. Practice of Organic Chemistry (third edition)—H. Adkins, S. W. McElvain and H. W. Klein. Physical Chemistry for Colleges (fifth edition)—E. B. Millard.

METHUEN & CO., LTD. Photosynthesis—E. C. C. Baly. Numerical and Constitutional Exercises in Organic Chemistry—J. B. L. Smith and M. Rindl.

## Technology

BASIL BLACKWELL. Modern Paper-Making (second edition)—R. H. Clapperton and William Henderson.

CAMBRIDGE UNIVERSITY PRESS. The Scientific Photographer—A. S. C. Lawrence.

CHAPMAN & HALL, LTD. Coal: its Properties, Analysis, Classification, Geology, Extraction, Uses and Distribution (second edition)—Elwood S. Moore. Canning Practice and Control (second edition)—Osman Jones and T. W. Jones. Plastics in Industry—'Plastes'. Silver in Industry—edited by Lawrence Addicks. Photographic Facts and Formulas (new edition)—E. J. Wall.

CHARLES GRIFFIN & CO., LTD. Cutting Tools for Metal Machining—Max Kurrein and F. C. Lea.

MCGRAW-HILL BOOK CO., LTD. Press Working of Metals—C. W. Hinman.

SIR ISAAC PITMAN & SONS, LTD. The Iron and Steel Industry—G. Brown and A. L. Orford.

## Astronomy

MACMILLAN & CO., LTD. The Birth and Death of the Sun—George Gamow.

## Meteorology: Geophysics

MCGRAW-HILL BOOK CO., LTD. Weather Analysis and Forecasting—Sverre Petterssen. Physics of the Air (third edition)—W. J. Humphries.

## Geology: Mineralogy

CAMBRIDGE UNIVERSITY PRESS. The West Highlands and the Hebrides: a Guide for Amateur Geologists—the late Alfred Harker, edited by J. E. Richey.

MCGRAW-HILL BOOK CO., LTD. Methods of Study in Sediments—W. H. Twenhofel.

## Geography: Travel

B. T. BATSFORD, LTD. Chiltern Country (Face of Britain Series)—H. J. Massingham. English Lakeland (Face of Britain Series)—Doreen Wallace. Cambridge—John Steegmann.

BASIL BLACKWELL. Norway: the Northern Playground—W. Cecil Slingsby.

CAMBRIDGE UNIVERSITY PRESS. Landscape: as Developed by the Processes of Normal Erosion—C. A. Cotton. Mexico: a New Spain with Old Friends—J. B. Trend.

JONATHAN CAPE, LTD. Assam Adventure—F. Kingdon Ward. Kabloona—Gontran de Poncins, in collaboration with Lewis Galantière.

CASSELL & CO., LTD. The Prodigious Caribbean: Columbus to Roosevelt—Rosita Forbes.

CHAPMAN & HALL, LTD. College Geography (second edition)—E. C. Case and D. R. Bergsmark.

J. M. DENT & SONS, LTD. Sweet Thames run Softly—Robert Gibbings. Ten Great Mountains—R. L. G. Irving.

ROBERT HALE, LTD. Cape Horn—Capt. Felix Riesenberg. Cherry Kearton's Travels—Cherry Kearton. Polynesian Paradise—Donald Sloan. Our Arabian Nights—Ruth and Helen Hoffman. Alaska Challenge—Ruth and Bill Albee. One Man against the North—David Irwin.

GEORGE G. HARRAP & CO., LTD. The Story of the Pacific—Hendrik Willem Van Loon.

HODDER & STOUGHTON, LTD. Sons of Sindbad: 10,000 Miles Sailing with the Arabs in their Dhows—Alan Viliers. I went to Tristan—Allan Crawford.

JARROLDS PUBLISHERS (LONDON), LTD. Jungle in the Clouds—Victor W. v. Hagen.

HERBERT JENKINS, LTD. Easy Going—Rex Tremlett. Savoy! Corsica! Tunis!—Bernard Newman. Distant Horizons—Carl Shreve. A Greenhorn in Africa—Roger Courtney. Wanderings through Many Counties with Field-Glass, Note-Book and an Observing Eye—James J. Cash.

LONGMANS, GREEN & CO., LTD. Deltaic Formation with Special Reference to the Bengal Delta—C. Strickland.

METHUEN & CO., LTD. The Silent Traveller in the Yorkshire Dales—Chiang Yee. England without End—John R. Allan. Africa (new and revised edition)—Walter FitzGerald.

UNIVERSITY OF LONDON PRESS, LTD. The British Isles—David L. Linton.

## General Biology: Natural History
## Botany: Zoology

GEORGE ALLEN & UNWIN, LTD. Evolution: the Modern Synthesis—Julian Huxley.

CAMBRIDGE UNIVERSITY PRESS. International Wildfowl Inquiry, Vol. 1.

JONATHAN CAPE, LTD. The Advance of the Fungi—E. C. Large.

CHAPMAN & HALL, LTD. Insect Pests in Stored Products—H. Hayhurst. Elements of Botany (third edition)—Richard M. Holman and Wilfred W. Robbins.

J. & A. CHURCHILL, LTD. Plant Physiology (second edition)—Meirion Thomas.

LINDSAY DRUMMOND, LTD. Trees: a Book of the Seasons—Richard St. Barbe Baker. Lundy, Isle of Puffins—Richard Perry.

ROBERT HALE, LTD. Jungle Friends—Osa Johnson. Animals are like That!—Frank Buck.

HUTCHINSON & Co., LTD. Biological Botany—R. Ruggles-Gates.

MCGRAW-HILL BOOK CO., LTD. This Living World—C. C. Clark and R. H. Hall. Entomophagous Insects—Curtis P. Clausen. Embryology of the Insects and Myriapods—O. A. Johannsen and F. H. Butt. Elements of Botanical Microtechnique—J. E. Sass.

OXFORD UNIVERSITY PRESS. Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies. Supplement 1921–35 to Pritzel's Alphabetical Register of Representations of Flowering Plants and Ferns—W. C. Worsdell.

FREDERICK WARNE & Co., LTD. Wayside and Woodland Trees—Edward Step (new edition by A. Keith Jackson and A. B. Jackson).

## Agriculture: Horticulture: Forestry

BAILLIÈRE, TINDALL & COX. The Diseases of the Coconut Palm—the late H. R. Briton Jones, edited by E. E. Cheesman.

B. T. BATSFORD, LTD. Corn Country—C. Henry Warren.

CAMBRIDGE UNIVERSITY PRESS. The Seasons and the Gardener—H. E. Bates.

CHAPMAN & HALL, LTD. Practical Poultry Management (fourth edition)—James E. Rice and Harold E. Botsford. Judging Dairy Cattle—Edwin S. Harrison.

MCGRAW-HILL BOOK CO., LTD. Soils and Soil Management—A. F. Gustafson. Commercial Timbers of the United States (second edition)—H. P. Brown and A. J. Panshin. Textbook of Dendrology (second edition)—W. M. Harlow and E. S. Harrar.

OXFORD UNIVERSITY PRESS. Colonial Forest Administration—the late R. S. Troup. Elementary Manual of Indian Forest Utilization—H. Trotter.

## Anatomy: Physiology

D. APPLETON-CENTURY CO., LTD. A Text-book of Histology—H. E. Jordan.

## Anthropology: Archæology

D. APPLETON-CENTURY CO., LTD. Acculturation in Seven American Indian Tribes—Ralph Linton.

B. T. BATSFORD, LTD. Prehistoric England (British Heritage Series)—Grahame Clark.

W. & R. CHAMBERS, LTD. Prehistoric Communities of the British Isles—V. Gordon Childe.

CRESSET PRESS, LTD. The Tower of Five Glories: a Study of the Min Chia of Ta Li, Yunnan—C. P. FitzGerald.

GEORGE G. HARRAP & Co., LTD. Witchcraft—William Seabrook.

LAWRENCE & WISHART, LTD. Aeschylus and Athens—George Thomson.

LONGMANS, GREEN & Co., LTD. Hindu Social Institutions: with Reference to their Psychological Implications—Pandharinath H. Valavalkar.

MCGRAW-HILL BOOK CO., LTD. The Great Cultural Tradition—Ralph E. Turner.

OXFORD UNIVERSITY PRESS. The Social and Economic History of the Hellenistic World—M. Rostovtzeff. Cisalpine Gaul: Social and Economic History from 49 B.C. to the Death of Trajan—G. E. F. Chilver. Lachish II: the Fosse Temple—Edited by Olga Tufnell, C. H. Inge and Lankaster Harding. A History of the Giza Necropolis—George A. Reisner. Modern India and the West—Edited by L. S. S. O'Malley. The Transformation of Islamic Society: a Study of the Impact of Western Civilization on Moslem Culture in the Near East. Vol. 1: Islamic Society in the Eighteenth Century—H. A. R. Gibb and Harold Bowen.

## Philosophy: Psychology

GEORGE ALLEN & UNWIN, LTD. An Inquiry into Meaning and Truth—Bertrand Russell. The Analysis of Knowledge—Ledger Wood. The Problems of Logic—Andrew Paul Ushenko. Heaven Wasn't his Destination: the Philosophy of Ludwig Feuerbach—William B. Chamberlain. I Believe: a Book of Living Philosophies.

D. APPLETON-CENTURY CO., LTD. Emotion and Conduct in Adolescence—Caroline B. Zachry, in collaboration with Margaret Lighty.

CAMBRIDGE UNIVERSITY PRESS. Man on his Nature—Sir Charles Sherrington (The Gifford Lectures). Political Propaganda—F. C. Bartlett.

J. & A. CHURCHILL, LTD. The Human Mind: the Organ of Thought in Function and Dysfunction—Murdo Mackenzie.

ENGLISH UNIVERSITIES PRESS, LTD. Straight Thinking in War-Time—Robert H. Thouless. Teach Yourself Psychology (Teach Yourself Series)—Arnold Bellwood.

HAMISH HAMILTON. LTD. Stammering and Speech Therapy—W. Kingdon Ward.

LONGMANS, GREEN & Co., LTD. Psychoanalytic Method—Roland Dalbiez.

MCGRAW-HILL BOOK CO., LTD. Education for the Good Life—Franklin Bobbitt. Psychodynamics of Abnormal Behavior—J. F. Brown. Audio-Visual Aids to Instruction—Harry C. McKown and Alvin B. Roberts.

METHUEN & Co., LTD. An Essay on the Metaphysics of Descartes—M. Versfeld. Science versus Materialism—R. O. Kapp. Psychology: a Study of Mental Life—Robert S. Woodworth.

OXFORD UNIVERSITY PRESS. Hume's Theory of the External World—H. H. Price. Morality and Freedom in the Philosophy of Immanuel Kant (Oxford Classical and Philosophical Monographs)—W. T. Jones.

SIR ISAAC PITMAN & SONS, LTD. The Stammerer Unmasked—R. Macdonald Ladell.

GEORGE ROUTLEDGE & SONS, LTD. Personality and Mental Illness—John Bowlby. The Philosophy of Peirce (International Library of Psychology, Philosophy and Scientific Method)—Justus Buchler.

UNIVERSITY OF LONDON PRESS, LTD. The Factors of the Mind—Cyril Burt.

## Bacteriology: Hygiene

EDWARD ARNOLD & Co. Modern Drugs in General Practice—Ethel Browning.

CHAPMAN & HALL, LTD. Public Water Supplies (fourth edition)—F. E. Turneaure, H. L. Russell and M. S. Nichols. Sewage Treatment—Karl Imhoff and Gordon M. Fair.

## Miscellany

D. APPLETON-CENTURY CO., LTD. Science on Parade—A. Frederick Collins. The Pan-American Highway: from the Rio Grande to the Canal Zone—Harry A. Franck and Herbert C. Lanks.

CHAPMAN & HALL, LTD. A Handbook of English in Engineering Usage (second edition)—A. C. Howell.

CHATTO & WINDUS. The Uniqueness of Man—Julian Huxley.

ROBERT HALE, LTD. The Art of Camouflage—Lieut.-Col. C. H. R. Chesney.

LAWRENCE & WISHART, LTD. Science in Peace and War—J. B. S. Haldane.

MCGRAW-HILL BOOK CO., LTD. Technical Exposition—Leslie M. Oliver.

MACMILLAN & Co., LTD. The Social Relations of Science—J. G. Crowther.

METHUEN & Co., LTD. The Cambridge Evacuation Survey—Susan Isaacs, R. H. Thouless, S. Clement Brown and others. Speech and Voice: their Pathology and Therapy in the Light of Evolution—Leopold Smith. General Science, Part 2—J. C. Platt, Freda Jones and J. H. Hopkinson.

SIR ISAAC PITMAN & SONS, LTD. Science for Girls, Book 3—W. B. Little.

# RECENT SCIENTIFIC AND TECHNICAL BOOKS

*Volumes marked with an asterisk (*) have been received at "NATURE" Office*

## Mathematics : Mechanics : Physics

**Allen, R. M.** The Microscope. Med. 8vo. Pp. viii + 286. (London : Chapman and Hall, Ltd., 1940.) 15*s.* net.*

**Bhagavantam, S.** Scattering of Light and the Raman Effect. Imp. 8vo. Pp. x +333 +2 plates. (Waltair : Andhra University, 1940.) 15 rupees ; 22*s.* net.*

**Richardson, E. G.** Physical Science in Art and Industry. Demy 8vo. Pp. xi +293 +6 plates. (London : English Universities Press, Ltd., 1940.) 15*s.* net.*

**Stead, G.** Elementary Physics : for Medical, First Year University Science Students and General Use in Schools. Sixth edition. Demy 8vo. Pp. xiv +562. (London : J. and A. Churchill, Ltd., 1940.) 12*s.* 6*d.**

**Wilson, O.** Spaced Test Papers in Physics. Roy. 8vo. (London, Bombay and Sydney : George G. Harrap and Co., Ltd., 1940.) 2*s.* 3*d.*

## Engineering

**Baker, T.** Land and Engineering Surveying. Twenty-fifth edition, revised by G. L. Leston. Cr. 8vo. Pp. 64. (London : The Technical Press, Ltd., 1940.) 15*s.* net.

**Hartshorn, L.** Radio-Frequency Measurements by Bridge and Resonance Methods. (Monographs on Electrical Engineering, Vol. 10.) Demy 8vo. Pp. xv +265. (London : Chapman and Hall, Ltd., 1940.) 21*s.* net.*

**Hill, F. T.** The Materials of Aircraft Construction. Fourth edition. Demy 8vo. Pp. ix + 449. (London : Sir Isaac Pitman and Sons, Ltd., 1940.) 20*s.* net.

**Rubey, Harry ; Lommel, George Edward, and Todd, Marion Wesley.** Engineering Surveys. (Engineering Science Series.) Revised edition. Cr. 8vo. Pp. xv +322 + 142. (New York : The Macmillan Company, 1940.) 15*s.* net.*

## Chemistry : Chemical Industry

**Gyngell, Eric S.** Applied Chemistry for Engineers. Demy 8vo. Pp. viii +328. (London : Edward Arnold and Co., 1940.) 15*s.* net.*

**Lowy, Alexander, and Harrow, Benjamin.** An Introduction to Organic Chemistry. Fifth edition. Med. 8vo. Pp. 400. (London : Chapman and Hall, Ltd., 1940.) 18*s.* net.

**Moelwyn-Hughes, E. A.** Physical Chemistry : an Introduction. Imp. 8vo. Pp. viii +660. (Cambridge : At the University Press, 1940.) 45*s.* net.*

**Morgan, Alfred.** Things a Boy can Do with Chemistry. Demy 8vo. Pp. 305. (New York and London : D. Appleton-Century Co., Inc., 1940.) 10*s.* 6*d.* net.

**Pierce, Willis Conway, and Haenisch, Edward Louth.** Quantitative Analysis. Second edition. Med. 8vo. Pp. 462. (London : Chapman and Hall, Ltd., 1940.) 18*s.* net.

## Technology

**Benfield, Eric.** Purbeck Shop : a Stoneworker's Story of Stone. Demy 8vo. Pp. xvi +172 +9 plates. (Cambridge : At the University Press, 1940.) 12*s.* 6*d.* net.

**French, Thomas E., and Svenson, C. L.** Mechanical Drawing. Fourth edition. Med. 8vo. Pp. 300. (New York and London : McGraw-Hill Book Co., Inc., 1940.) 11*s.* 6*d.*

**Garrard, F. J.** Watch Repairing, Cleaning and Adjusting. New edition. Cr. 8vo. (London : The Technical Press, Ltd., 1940.) 6*s.* net.

## General Biology : Natural History Botany : Zoology

**Dawson, A. J.** Everybody's Dog Book. New edition. Demy 8vo. Pp. viii + 231. (London : Philip Allan and Co., Ltd., 1940.) 5*s.* net.

**Ellerman, J. R.** The Families and Genera of Living Rodents. Vol. 1. Roy. 8vo. Pp. 689. (London : Oxford University Press, 1940.) 35*s.* net.

**Goldschmidt, Richard.** The Material Basis of Evolution. (Yale University : Mrs. Hepsa Ely Silliman Memorial Lectures.) Med. 8vo. Pp. xi +436. (New Haven, Conn. : Yale University Press ; London : Oxford University Press, 1940.) 30*s.* net.*

**Hubbard, C. E., and Vaughan, R. E.** The Grasses of Mauritius and Rodriguez. Roy. 8vo. Pp. 128. (Mauritius : Director of Agriculture ; London : The Crown Agents for the Colonies, 1940.) 4*s.* 6*d.* ; 3 rupees.*

**Romany of the B.B.C.,** Edited by. The "Out with Romany" Calendar, 1941. Sup. Roy. 8vo. Pp. 56. (London : University of London Press, Ltd., 1940.) 3*s.* 6*d.* net.*

**Verrill, A. Hyatt.** Wonder Creatures of the Sea. Demy 8vo. Pp. 288. (New York and London : D. Appleton-Century Co., Inc., 1940.) 15*s.* net.

## Agriculture : Horticulture : Forestry

**Anthony, David J.** Diseases of the Pig and its Husbandry. Demy 8vo. Pp. ix + 272. (London : Baillière, Tindall and Cox, 1940.) 10*s.* 6*d.* net.

**Grainger, John.** Garden Science. Cheap edition. Imp. 16mo. Pp. 265. (London : University of London Press, Ltd., 1940.) 2*s.* 6*d.* net.*

**Gray, Ernest.** Diseases of Poultry : their Aetiology, Diagnosis, Treatment and Control ; with a Section on the Normal Anatomy and Physiology of the Fowl. (Lockwood's Agricultural and Horticultural Handbooks.) Demy 8vo. Pp. x +198 +16 plates. (London : Crosby Lockwood and Son, Ltd., 1940.) 9*s.* 6*d.* net.*

## Anatomy : Physiology

**Cameron, A. T.** Recent Advances in Endocrinology. Fourth edition. Demy 8vo. Pp. vii + 432. (London : J. and A. Churchill, Ltd., 1940.) 18*s.* net.

**Grant, J. C. Boileau.** A Method of Anatomy. Second edition. 8vo. Pp. 794. (London : Baillière, Tindall and Cox, 1940.) 33*s.* net.

## Philosophy : Psychology

**Ayer, Alfred J.** The Foundations of Empirical Knowledge. Demy 8vo. Pp. x +276. (London : Macmillan and Co., Ltd., 1940.) 10*s.* 6*d.* net.*

**Price, Harry.** "The Most Haunted House in England" : Ten Years' Investigation of Borley Rectory. Demy 8vo. Pp. x +255 +8 plates. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1940.) 10*s.* 6*d.* net.*

**Thorndike, E. L.** Human Nature and the Social Order. Demy 8vo. Pp. xx +1020. (New York : The Macmillan Company, 1940.) 18*s.* net.*

**Watson, E. L. Grant.** Man and his Universe. Demy 8vo. Pp. 192. (London : Hutchinson and Co. (Publishers), Ltd., 1940.) 10*s.* 6*d.* net.

**Weymouth, Anthony.** A Psychologist's War-Time Diary. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1940.) 12*s.* 6*d.* net.

## Miscellany

**Clynes, J. R.** When I Remember . . . (Macmillan War Pamphlets, No. 6.) Cr. 8vo. Pp. 32. (London : Macmillan and Co., Ltd., 1940.) 3*d.* net.*

**Forster, E. M.** Nordic Twilight. (Macmillan War Pamphlets, No. 3.) Cr. 8vo. Pp. 32. (London : Macmillan and Co., Ltd., 1940.) 3*d.* net.*

**Halifax, Viscount.** Speeches on Foreign Policy. Edited by H. H. E. Craster. (Issued under the auspices of the Royal Institute of International Affairs.) Demy 8vo. Pp. x +368. (London, New York and Toronto : Oxford University Press, 1940.) 10*s.* 6*d.* net.*

**Woolf, Leonard.** The War for Peace. Ex. Cr. 8vo. Pp. x +244. (London : George Routledge and Sons, Ltd., 1940.) 7*s.* 6*d.* net.*

For your *Information*

The address of the Editorial and Publishing Offices of "NATURE" is

MACMILLAN & CO., LTD.,
St. Martin's Street, London, W.C.2.

Telephone Number : Whitehall 8831
Telegrams : Phusis, Lesquare, London.

The annual subscription rate, Inland or Abroad, is £3 0 0, payable in advance. Volumes begin in January and July of each year, but subscriptions may commence with any issue. Payment from abroad should be made by International Money Order or by Cheque payable at a London Bank, and Cheques, Money Orders and Postal Orders should be made payable to Macmillan & Co., Ltd.

All editorial communications, books for review, etc., should be sent to the above address.

Advertisements only should be addressed to T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number : City 4211.

---

Free Copies of "NATURE".

Each of the signatories of a letter published in the Correspondence columns will be sent, free of charge, on publication, 1 copy of the issue of "NATURE" containing the letter.

If more than 1 copy is desired, written application must be made to the Manager of "NATURE", stating the number of copies that is required. Not more than 6 free copies in all can be presented in connexion with any letter published.

This offer of free copies does not refer to articles and similar contributions to "NATURE".

---

If any contribution includes illustrations, the blocks used for their reproduction may be obtained by the author, after publication, at half the cost price. Application for the blocks should be made to the Manager of "NATURE".

---

Proofs will not usually be sent to authors living outside Great Britain. Orders for reprints should, therefore, accompany MSS. All communications regarding reprints should be sent direct to the printers :

FISHER, KNIGHT & CO., LTD.,
Gainsborough Press, St. Albans, Herts.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

(*Continued from page 542.*)

by the Uppsala school. The agreement between the two series is fair, especially as the temperature is doubtful.

*Cytochrome C.* This protein was centrifuged in order to determine the lower limit of molecular weights resolvable. The sedimentation constant $S_{20}$ 2·1 × $10^{-13}$ cm./sec. for a 0·7 per cent solution in phosphate buffer at *p*H 7·3 agrees well with that obtained by Anderson and Pederson[8] ($S_{20}$, 1·9 × $10^{-13}$).

*A globulin arachin from the ground nut* (*Arachis hypogaea*). Preliminary runs on this protein indicate the existence of five different groups of molecular weights dependent on the nature of the salt used to effect solution.

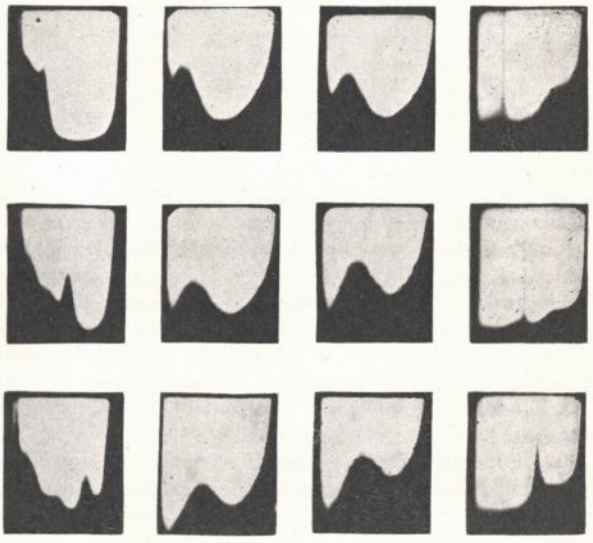
The sedimentation constant, diffusion constant and molecular weight are tabulated below (Table 2) together with the shape factor, which indicates an increasing globular shape with decrease in molecular weight.

TABLE 2. ARACHIN.

| Group | $S_{20}$ | $D_{20}$ | Mol. Wt. | Shape factor |
|---|---|---|---|---|
| I | 13·8 × $10^{-13}$ | 2·0 × $10^{-7}$ | 600,000 | 1·92 |
| II | 11·2 | 2·4 | 400,000 | 1·84 |
| III | 7·4 | 5·0 | 140,000 | 1·30 |
| IV | 3·25 | 10·0 | 30,000 | 1·05 |
| V | 1·75 | 9·3 | 20,000 | 1·21 |

These fractions of differing molecular weights were obtained by treating the protein with lyotropic salts; different salts either extracted different preformed globulins or effected different decompositions of one globulin, but no salt produced a diagram showing all five groups; dilute ammonia solutions revealed the presence of groups II, III, and V in the extract. The diagrams for ammonia are reproduced (Fig. 2 *a*). During solubility tests of the protein in lyotropic solvents, it was found that the salts fell into three groups. It is interesting to note that the presence or absence of some of the five groups places the sedimentation diagrams into the same three classes.

*Carbonic Anhydrase.* Prof. D. Keilin kindly provided us with a sample of carbonic anhydrase which had been centrifuged by Dr. Philpot at Oxford (unpublished result), but in no way did the two diagrams resemble one another. The diagram obtained by Dr. Philpot was typical of that obtained with a fibrous protein, with a sedimentation constant of about $S_{20} = 3 \times 10^{-13}$. The diagram (Fig. 2 *b*) obtained with the fresh sample was very much like a globular protein with a sedimentation constant of $S_{25}$ 3·80 × $10^{-13}$. This first sample had been prepared using neutral salts as precipitants, so a further sample prepared by acetone precipitation was obtained; here again the diagram (Fig. 2 *c*) was similar to that of a globular protein with a sedimentation constant of $S_{25} = 3{\cdot}90 \times 10^{-13}$. Finally, it was suspected that perhaps some acetone had been retained by the sample sent to Dr. Philpot; a solution of carbonic anhydrase in a 14·3 per cent acetone solution was analysed. This time the diagram (Fig. 2 *d*) is exactly similar to that obtained by Dr. Philpot, the sedimentation constant being $S_{25} = 3{\cdot}20 \times 10^{-13}$. The diagram is typical of a fibrous protein and agrees with Dr. Philpot's to the extent of having the same minor 'peak' near the bottom of the cell which does not appear to move at all during the run. Though the amount of acetone is high there seems little doubt, in view of the identity of diagrams, that this is the reason for the anomaly



(*a*) (*b*) (*c*) (*d*)

Direction of sedimentation, ⟶.

Fig. 2.

SEDIMENTATION DIAGRAMS. (*a*) GLOBULIN FRACTION IN *N*/10 AMMONIA; (*b*) CARBONIC ANHYDRASE SALT PRECIPITATION; (*c*) CARBONIC ANHYDRASE ACETONE PRECIPITATION; (*d*) CARBONIC ANHYDRASE IN 14·3 PER CENT ACETONE SOLUTION.

shown by the early centrifuge diagrams. Table 3 shows a summary of the data on carbonic anhydrase.

TABLE 3.

| Substance | Run 72<br>0·6% carbonic anhydrase | Run 73<br>0·6% carbonic anhydrase ppt. by acetone + acetone dialysed | Run 76<br>0·6% carbonic anhydrase acetone prep. |
|---|---|---|---|
| Solvent | 0·2 *M* NaCl | 0·2 *M* NaCl | 14·3% acetone 86·7% 0·2 *M* NaCl |
| Gravitational force | 222,000 | 220,000 | 240,000 |
| Sedimentation constant × $10^{-13}$ 25° C. | 3·80 | 3·90 | 3·20 × $10^{-13}$ |

It should be mentioned that the diagrams shown have not been corrected for the reference diagrams, which have been omitted.

We have to thank Mr. R. P. Sinclair for considerable assistance. Our thanks are also due to Dr. Philpot for many discussions, to the Sharples Centrifuge Co., the Royal Society and Imperial Chemical Industries, Ltd., for financial and technical assistance.

---

Owing to the present international situation, it has not proved possible to obtain the collaboration of my co-worker, Dr. F. R. Eirich, in writing this brief survey of work on the air-driven ultracentrifuge. Whilst he might not agree in detail with some of the observations made therein, he expressed an earnest desire for these results to be communicated as soon as was conveniently possible.—E. K. R.

[1] Pickels, E. G., *Rev. Sci. Inst.*, **9**, 358 (1938).
[2] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), pp. 9, 124 and 152.
[3] Bjornstahl, Y., *Rev. Sci. Inst.*, **10**, 258 (1939).
[4] Philpot, J. St. L., NATURE, **141**, 283 (1938).
[5] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), pp. 9 and 297.
[6] Weiner, O., *Ann. Phys. und Chem.*, N.F. **49**, 105 (1893).
[7] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), pp. 9 and 382.
[8] Svedberg, T., and Pederson, K. O., "The Ultracentrifuge" (Oxford, 1940), p. 390.

# OBITUARIES

## Prof. R. T. Hewlett

RICHARD TANNER HEWLETT, a well-known and highly respected figure in British bacteriology for some forty-five years, died on September 10 at the age of seventy-five. Educated at King's College School and trained for his professional career at the King's College School of Medicine, Hewlett graduated M.B. Lond. in 1890 and for three years acted as demonstrator in bacteriology, eventually in 1901 succeeding to the chair of bacteriology vacated by his chief, Prof. Edgar Crookshank. In the interval he had served (1894–1901) on the bacteriological staff of the British Institute of Preventive Medicine under its then director, Dr. Allan Macfadyen. During his career he also acted as director of pathology and later as consulting pathologist at the Seamen's Hospital, and for many years he lectured on bacteriology at the London School of Tropical Medicine.

Hewlett's interests lay almost entirely in the application of bacteriology to hygiene and public health, and numerous articles from his pen on a diversity of subjects—water pollution, shell-fish and sewage contamination, pure milk supplies, cellular contents of milk, insect carriers of disease, etc.—will be found in the appropriate journals from 1897 onwards. He was particularly interested in the disinfection process and in methods of testing disinfectants, to which subject he devoted his Milroy Lectures before the Royal College of Physicians in 1909. In these lectures he expressed the view that the similarity of certain disinfection curves to that of a monomolecular reaction was only apparent, and that the course of disinfection processes generally was most probably to be accounted for by the assumption of a variation of resistance existing among the individuals in the bacillary population exposed—a view which has since been widely ventilated and experimentally tested.

At the British Institute of Preventive Medicine, Hewlett had been greatly intrigued by the experiments of Macfadyen and Rowland on the extraction of cell juices from yeasts and bacteria by grinding at the temperature of liquid air. Later, with the help of his former colleague Mr. J. E. Barnard, an improved grinding apparatus was devised, and the results obtained by immunization of animals with such juices (endotoxins) were communicated to the Royal Society in 1909 and 1911. Assay of this work, which unfortunately was not carried far enough or conducted on a sufficiently large scale, is difficult even now; but it still has its interest for workers occupied with the more detailed analysis of bacterial antigens on modern chemical and serological lines.

Hewlett was widely read in his subject and wrote with ease. His student text-books on "General and Special Pathology" and on "Applied Bacteriology" have had a large vogue for many years. To the "System of Bacteriology" he contributed important articles, and the columns of NATURE contain many contributions from his pen. In recent years he took a great interest in the work of the Royal Microscopical Society, of which he was honorary secretary at his death. Unassuming and ever helpful and friendly in his human relations, Hewlett leaves a pleasant memory, and the undersigned records with gratitude the interest he maintained in the work and affairs of the Lister Institute, where he served an apprenticeship in the 'nineties. To his widow and family our sincere sympathy is extended.

J. C. G. LEDINGHAM.

---

## Prof. H. Stroud

HENRY STROUD was born at Bristol on August 7, 1861. He began his education at Bristol Grammar School and proceeded with an entrance scholarship in 1879 to the University College in that city, where he came under the influence of Silvanus Thompson. In 1880 he was awarded the Gilchrist Scholarship tenable at Owens College, Manchester, where he studied under Balfour Stewart and Henry Roscoe for two years, at the end of which period he apparently scooped up all the mathematical and physical scholarships in his immediate neighbourhood and went with them to St. John's College, Cambridge. In the

Mathematical Tripos list for 1885 he was eighth Wrangler. In 1886 he obtained a first class in physics in Part II of the Natural Sciences Tripos, and in the same year graduated as doctor of science in the University of London.

Stroud was appointed lecturer in physics at the College of Physical Science (which later became Armstrong College and is now King's College), Newcastle-upon-Tyne, in 1886 and was elected professor a year later. In the following years he became a strong believer in the value of popular scientific lectures, and many will remember his numerous experimentally illustrated lectures given in towns and villages throughout the northern counties of England on X-rays, radium and wireless telegraphy at a time when these subjects were in their infancy. He played an important part in the development of the institution as a self-contained university college and as a unit of the University of Durham.

For several years Stroud was associated with the late Lord Armstrong in his researches on "Electric Movements in Air and Water". Although he published little himself, he was always keenly interested in research and he endowed various college prizes with a view to its encouragement. On his retirement in 1926, after forty strenuous sessions in harness, he was elected professor emeritus by a college grateful for his valuable services. Stroud died in peaceful seclusion at Gerrard's Cross on September 3.

George W. Todd.

## Colonel H. L. Crosthwait, C.I.E.

Herbert Leland Crosthwait, who died on September 11, aged seventy-two, was the eldest son of the late Mr. Samuel Crosthwait, of The Lodge, Bagenalstown, County Carlow, Ireland, and educated at Rossall and at Trinity College, Dublin. He entered the Royal Engineers in 1890. Two years later he went to India and in 1897 he joined the Survey of India, in which he remained for the rest of his service. Here he soon became well known for his very extended knowledge of a variety of scientific subjects; in fact, if he had concentrated on any one subject he would easily have been one of the authorities on that subject. His wide knowledge and experience, however, made him a most delightful companion. He could talk well and easily and with full knowledge on many topics.

As a surveyor, Crosthwait was mostly employed on the scientific side, but quite easily switched on to the topographical branch when required, as, for example, when employed on the Chile-Argentine Boundary Commission, or during the War of 1914–18 in East Persia, and during the Waziristan Expedition and Third Afghan War of 1919–20. For these services he was awarded a C.I.E.

On his retirement Crosthwait began to specialize on the subject of air surveys and became a director of the Aircraft Operating Company, Ltd., where his knowledge of topography and his very quickly acquired knowledge of the application of air photography to map-making made him a much valued colleague. He was on the council of the Royal Geographical Society for many years, where his appreciation of the value of air photography to map-making made him a most useful member; it might, in fact, be fairly said that no one rendered better service to cartography of late years than Crosthwait did in leading air survey on the right lines; that is, to a full but not excessive appreciation of its value.

Added to his wide knowledge over an extensive range of subjects, Crosthwait had a great charm of manner, and a very human kindliness which made him a valued companion, whether in the wilds of the jungle or at a civilized meeting of the members of a scientific society. His death will leave a wide gap among his large circle of friends.

C. H. D. Ryder.

## Lieut. J. H. Martin, R.N.V.R.

Lieut. James Martin, who has been reported lost at sea, had an unusual career compared with other polar explorers of the last twenty years. His whole interest was the sea, and his contributions to Antarctic discovery depended on his intimate knowledge of seamanship and his devotion to shipwork. He broke away from office work in the City to serve before the mast in the sailing ship *Garthpool*, and some years later he signed on as a seaman in the *Discovery* on a summer voyage to the Antarctic in 1929–30 under Sir Douglas Mawson. Martin shipped on her again in the following season and was ranked as boatswain. In order to improve his knowledge of ice navigation he then went to Norway for spring sealing in the White Sea and served as a seaman in the *Quest*. Soon afterwards he was chosen as leader of the 1933 Oxford University Expedition to Spitsbergen, but was prevented in the end from actually taking part owing to having been severely frostbitten whilst sledging in Northern Canada.

Martin made plans for an Antarctic expedition, but set them aside in favour of John Rymill's British Graham Land Expedition. He accordingly volunteered as one of Rymill's crew and was appointed mate in the *Penola* commanded by Lieut. R. E. D. Ryder, R.N. Much of the ship work was done under sail, in which Martin was an expert. Great size and strength, fearlessness and gentleness went to the make up of this remarkable man. Ryder has made clear how much he depended on his mate during the three years voyage, and the success of the expedition was in part due to the way these two understood each other, and worked the ship in narrow waters. When war broke out, Martin transferred to the Navy from the Grenadier Guards, in which he had held a commission in 1918, and from then for most of the time was shipmate once again with Ryder.

J. M. Wordie.

We regret to announce the death of Mr. J. B. Beresford, C.B.E., formerly secretary of the University Grants Committee, and of the Standing Committee on Museums and Galleries, as a result of enemy action, aged sixty-two.

# NEWS AND VIEWS

## Lieut.-Colonel J. T. C. Moore-Brabazon, M.P.

THE announcement on October 3 of the appointment of Lieut.-Colonel J. T. C. Moore-Brabazon to be Minister of Transport has been received with satisfaction by men of science. He is well known as a pioneer in motoring and aviation, and holds No. 1 certificate granted by the Royal Aero Club for pilots. Throughout his career he has brought scientific principles to bear on his work and expressions of opinion, and for this reason alone readers of NATURE will be gratified to learn of his appointment to such a ministry rendered all the more important during the present situation. Those who know Lieut.-Colonel Moore-Brabazon personally will feel even more satisfied in that the position is now being filled by a man of courage and determination. He was formerly connected with the Ministry of Transport as parliamentary secretary during two periods covering the years 1923–27. He is, at present, member of Parliament for Wallasey.

## James Watt International Medal

THE council of the Institution of Mechanical Engineers has unanimously decided to award the James Watt International Medal to Prof. Aurel Stodola, of Zurich, on the recommendation of the Engineering Institute of Canada, the Czechoslovak Society of Engineers, and the Swiss Society of Engineers and Architects. The Medal was founded by the Institution in 1936 to commemorate the bicentenary of the birth of James Watt on January 19, 1736, and is awarded every two years to an engineer of any nationality who is deemed worthy of the highest award that the Institution can bestow and that a mechanical engineer can receive. In making the award the Institution has secured the co-operation of engineering institutions and societies in all parts of the world. The Medal is given for world-wide eminence in mechanical engineering in any direction, science or research, invention or production.

## Mr. N. W. Pirie

THE Committee of Management of the Rothamsted Experimental Station has appointed Mr. N. W. Pirie as head of the Biochemical Section of the Station. Mr. Pirie was an exhibitioner of Emmanuel College, Cambridge, and after gaining first classes in both parts of the Natural Sciences Tripos was awarded a research studentship under Sir Frederick Gowland Hopkins in the School of Biochemistry, where later he was appointed Rockefeller demonstrator. He also gained a Rockefeller Travelling Fellowship to visit California to study certain virus disease problems, but this was interrupted by the War. At Rothamsted he will be primarily concerned with the virus diseases of crops, which at present cause great and increasing losses and for which no remedies are known. He has already, in conjunction with Mr. F. C. Bawden of Rothamsted, made important and promising investigations on this subject, and has succeeded in isolating the actual viruses causing some of the diseases.

## Retirement of Dr. W. E. Collinge

DURING the twenty years of his keepership of the Yorkshire Philosophical Society's Museum in York, a post from which he is shortly to retire, Dr. W. E. Collinge has added much to the appearance and value of the exhibits there and to the scientific life of the city. The collections in the Museum are particularly rich in archæological finds, and Dr. Collinge has lost no opportunity, by museum talks and tours and by newspaper articles, of making these and the other collections under his charge a fount of enlightenment to the citizens and to many visitors from beyond the walls. His scientific work has been largely economic. Almost alone in Britain he has persistently carried on a study of the food of birds, the first results of which were collected in a modest volume in 1913, and in 1924–1927 appeared in a revised and greatly enlarged edition which remains the standard work upon the food and economic standing of British wild birds. The two editions show an interesting trend in the method of food analysis, for while the first followed the good old British plan of recording the individual items of diet, the second reveals the influence of American workers in recording foods volumetrically and thus enabling the analyses to be summarized in spectacular diagrams. It is natural that Dr. Collinge's advice on matters of bird protection should have been much sought after, and for twenty years he has been a valuable member of the Scottish Wild Birds Advisory Committee appointed to advise the Scottish Home Department in connexion with the Wild Birds Protection Acts. As a member of many societies he has taken a prominent share in the promotion of natural science and archæology in York.

## Nicholas Aylmer Vigors, F.R.S., M.P. (1787-1840)

BY the death on October 26, 1840, a century ago, of Nicholas Aylmer Vigors, M.P., the Zoological Society lost one of its most active members. Born at Old Leighlin, County Carlow, in 1787, Vigors was educated at Trinity College, Oxford, and then became an ensign in the Grenadier Guards. As such he served in the Peninsula War, was present at the battle of Barossa and was severely wounded. Returning to England he devoted himself to natural history, and especially to the study of birds and insects. As a member of the Linnæan Society he was one of the first members of the Zoological Club, from which in 1826 sprang the Zoological Society, of which he became the first secretary, and to the museum of which he presented a valuable collection of insects and birds. For several years he was the principal editor of the *Zoological Journal*. His best-known papers were those "On the Natural Affinities that

connect the Orders and Families of Birds" and "The Arrangement of the Genera of Birds". A land owner and a man of considerable wealth, he promoted the progress of science in various ways, while he also for several years sat in Parliament first for the city, and then for the county of Carlow. He was elected fellow of the Royal Society in 1826 and in 1832 was made a D.C.L. of Oxford.

### Isolation of a Heavy Sulphur

AT the hundredth meeting of the American Chemical Society, which opened at Detroit on September 9, Drs. David W. Stewart and Karl Cohen, of Columbia University, described the preparation of heavy sulphur. According to Science Service, of Washington, D.C., the researches were conducted under the direction of Prof. Harold C. Urey, head of the Department of Chemistry of the University, who received the Nobel prize for chemistry in 1934 for his work in the discovery of heavy hydrogen. Ordinary sulphur contains four isotopes; $S^{32}$ (95 per cent); $S^{34}$ (4 per cent), which is the isotope now isolated; $S^{33}$ (1 per cent); and $S^{36}$ (0·01 per cent). Separation of the isotope was achieved with Prof. Urey's counter-current scrubbing method, previously used to separate isotopes of carbon and of nitrogen. Sulphur dioxide was passed up through 150 ft. of sodium hydrogen sulphite flowing downwards. $S^{34}$ is more soluble in the liquid than the other varieties; and, at the end of the process, the emergent liquid contained about a quarter of the heavy isotope. Researches are now being carried out by Dr. Vincent du Vigneaud, professor of biochemistry in the Cornell University School of Medicine, using heavy sulphur to determine the role of the element in the chemistry of the living organism.

### Zoos in War-time

THE North of England Zoological Society has maintained the collection at Chester during the first year of the War with little less than normal standards, despite a reduced staff and an increased stock due to evacuation from elsewhere. A noteworthy event has been the successful rearing of a young bird by the pair of griffon vultures; these birds have nested annually in recent years and previously hatched a chick, but they had not before succeeded in rearing it to maturity. The young bird is now fully fledged and the Society considers this a breeding record in British aviculture. The collection has received a pair of the wolves spared when the well-known pack of wolves at the Edinburgh Zoo was destroyed. The Chester Zoo is well stocked with lions and leopards, from which it is hoped to restock the depleted zoos of Europe when peace returns. The Society has just issued its monthly reports from June in a combined publication, and notes that it was the pioneer of the animal-adoption scheme later utilized with success by London, Edinburgh and Bristol: "We feel that it is in the country's interest that we should keep the Zoos alive to fulfil once again their functions when peace returns," states the Secretary.

### Illuminating Engineering Society

THE opening meeting for the session of the Illuminating Engineering Society was held in the Royal Institution on October 8. Prof. J. T. MacGregor-Morris, emeritus professor of electrical engineering in the University of London, the incoming president, delivered an address on "The Arc as a Standard of Light". In his opening remarks he recalled the classic experiments of Sir Humphry Davy on the electric arc, conducted at the Royal Institution shortly after 1800. It was not until 1881, however, that Captain Abney suggested that, in view of its constant temperature, the arc could be used as a standard of light. Between 1889 and 1894, Sylvanus Thomson, Mr. (now Sir James) Swinburne and M. Violle made further suggestions. To Mr. A. P. Trotter, however, and to M. A. Blondel the main credit should be given for a determined attack on this problem. In the course of this work an unexpected effect, the formation of a comma-shaped rotating spot of light at the positive crater, which Prof. MacGregor-Morris described as the "Trotter rotating comma", was encountered. This phenomenon was discussed in considerable detail. One interesting conclusion that emerges from recent researches is that, provided certain other quantities remain the same, the speed of rotation is remarkably constant. The direction of rotation can be controlled, but in general is a matter of chance. The disturbing influence of the Trotter rotating comma on the candle-power emitted by the crater was also discussed. In conclusion, Prof. MacGregor-Morris affirmed his conviction that a satisfactory high-temperature standard of light would result from the use of the three-electrode form of arc, which has recently been the subject of careful study. During the meeting, the Leon Gaster Memorial Premium was given to Mr. C. Dunbar for his paper entitled "Visual Efficiency in Coloured Light".

### Science in the U.S.S.R.

AN article by Prof. M. Ruhemann, "Science and the Soviet Citizen" (*Anglo-Soviet J.*, **1**, No. 3, July 1940), describes the way in which the gulf between the scientific worker and the general public is being bridged in the U.S.S.R. Professional science is organized as an integral part of the planned economy of the country, and the Academy of Sciences, which supervises the planning of scientific research, advises the State Planning Committee on the extent of the country's natural resources and on the possibilities of their scientific exploitation, while it plans scientific research in conformity with the needs of the community as ascertained by the State Planning Committee. The Academy possesses scientific research laboratories of its own, but most State organizations possess their own research laboratories.

While it is not so much the work of the individual scientific worker as the general direction of scientific research that is determined by the needs of the community, every man of science, however theoretical his work may be, is rightly convinced that its final object is to serve the community. Every scientific worker is also encouraged to look out for technical

possibilities arising from his work and not to rest content with publishing his results in a scientific journal. The method of recruiting men of science also encourages contact between scientific workers and the general public, while the whole educational system, as well as the use made of the Press and the influence of the trade unions, is directed to the development of a scientific attitude to life. A brief account of this aspect of education in the U.S.S.R. is contained in a further article "Preparing a Scientific Nation" by Beatrice King in the same number, while Dr. C. Norris, under the title "Experimental Medicine in the U.S.S.R.", describes some of the results achieved in medical research.

### Telephone and Telegraph Statistics of the World

IN *Electrical Communication* of July 1940, tables are given of the telephone and telegraph statistics of the world compiled by the American Telephone and Telegraph Company. The tables are compiled for the year ending January 1, 1939. The amount of telephone and telegraph wire in use in this period is also given. Except in the case of the United States and Canada, the telegraph service is operated by Governments. In the United States the number of miles of telephone line operated predominantly by private companies is nearly 93 million, and Canada comes next in the North American group with 5·4 million operated by private and Government concerns. In South America, the Argentine comes first with 1·58 million miles and Brazil second with 1·13 million miles, both privately worked. In Europe, Germany comes first with 18·0 million miles, and Great Britain and Northern Ireland jointly second with 15·2 million miles, both worked by Government. In Asia, Japan comes first with 4·8 million miles Government operated, and China is second with 0·8 million miles run by private companies and Government. In Africa, the Union of South Africa comes first with 0·83 million miles and Egypt is second with 0·47 million miles, and finally in Oceania Australia comes first with 2·83 million miles and New Zealand second with 0·11 million miles, all of which are operated by Government.

If we consider the percentage of telephone wire in operation possessed by the whole world, the United States possesses 53·2 per cent, Germany comes second with 10·3 per cent and Great Britain third with 8·7 per cent. Discussing the percentage of telephone line in the whole world possessed by a country per 100 of the population, it is stated that the United States comes an easy first with 71·5 per cent, Sweden is second with 49·2 and Canada third with 48·2. The total lengths of telegraph line possessed by each country run in the following order: United States 2·3 million miles, Russia 0·8 million miles and British India 0·37 million miles.

### Oxford Electric Supply Undertaking

MR. H. G. FRASER, the city electrical engineer of Oxford and manager of the electrical undertaking, can now claim for Oxford the second position among the records of the lists showing the number of units sold per head of the population relating to the authorized undertakings in Great Britain. According to the *Electrical Times* of October 3, the two main reasons why the revenue and units sold per head of the population exceeded all previous records of the undertaking were the connecting up of the heating installation of the New Bodleian Library during the early part of the summer, and the incidence of exceptionally severe weather conditions during the last quarter of the year. These two factors outweighed the general slump consequent upon the outbreak of war and the black-out. More than four million more units were sold for private lighting, heating and cooking, and this brought the total to 34 millions. This represents 563 units sold per head of the population. The surplus at £23,910 shows an improvement of £8,316.

### Seismological Data from India

THE *Seismological Bulletin* of the India and Ceylon seismological observatories for the period July–September 1939 has just been received. It has been published by the Government of India Meteorological Department under the direction of Dr. C. W. B. Normand. An average of eleven slight shocks and tremors daily was registered during July. It was estimated at the Colaba Observatory at Bombay that the earthquakes of July 12, 18, and 20 occurred near New Guinea, south of the Nicobar Islands and in the Pacific Ocean west of the Tonga Deep respectively. The latter probably had a depth of focus near 680 km. During August an average of ten earthquakes daily was recorded. The epicentre of the one on August 8 was in the ocean to the south-west of Ceylon, according to Colaba. It was felt over a large part of Ceylon.

The earthquake of August 25 was felt in New Guinea at Rabaul and Kokopo. During September an average of seventeen shocks was recorded, the one on September 8 being the greatest in the three months. It occurred in the Aleutian Islands though on the same day there was another shock to the south of Sumatra. According to Colaba, the shock of September 6 was in Afghanistan, and the ones of September 14, 19, 22, and 25, in the sea to the south-east of the Andaman Islands, to the south-east of Lake Aral, near Smyrna, and near the Nicobar Islands respectively. Macroseismic reports from voluntary observers mention eleven earthquakes and several tremors. The greatest of these, at Dhubri, had intensity 6 on the Rossi-Forel scale on August 21, other shocks being recorded from Drosh (3), Gauhati (2), Yatung, Tibet (2+ several tremors), Chaman and Dalhousie.

### The Colombo Museum

SINCE Sir William Gregory in 1872 developed the idea of collecting exhibits illustrating the natural history, antiquities and industrial products of Ceylon, the Colombo Museum has preserved a high scientific standard while at the same time offering a centre of interest to the large number of people which visit its collections (334,528 in 1939). Although many influences have led to the preponderance of natural

history in the Museum, the report for 1939 shows that efforts are being successfully made to build up an adequate representation of the prehistory and ethnography of the island. Much of the progress of the Museum has been due to the enthusiasm and energy of two recent directors, Dr. J. Pearson, who retired in 1932, and his successor, A. H. Malpas, who retired in 1939 and to whose skill in increasing the popular attraction of the collection and encouragement of entomological, avifaunal and ethnographical surveys the report pays a warm tribute. P. E. P. Deraniyagala has been appointed acting director and is responsible for the administration report. Its brief account of the activities of the museum staff and its considerable list of donations and other acquisitions to the various groups of collections indicate that the institution continues to strengthen its position as the conservator of Ceylon interests and a centre of scientific study.

### Shrinkage of Australian Timbers

Pamphlet No. 97, 1940, of the Australian Council for Scientific and Industrial Research, written by W. L. Greenhill, is devoted to the above subject. Owing to the needs for war-time economy, photolithography instead of printing has been used in its production. The aim of the pamphlet is to give shrinkage values for the more important Australian timbers (170 kinds are dealt with). The data are presented in such a manner that they can be readily applied in industry. Sufficient information is given so that a full picture of the behaviour of the various timbers can be obtained from the point of view of shrinkage or swelling with changes of the moisture content. The correlation between shrinkage and density among different timbers is shown to be very small and is not always significant even within a single species. Data of the kind assembled in this pamphlet are an essential aid to the utilization of the timbers concerned and to their effective competition with substitutes. The testing procedure followed in determining the shrinkage values recorded in this pamphlet is essentially the same as that adopted by the American Society for Testing Materials in 1927. The specifications provide for measuring the volumetric, tangential and radial shrinkages.

### Proceedings of the Royal Society of Edinburgh

Owing to the national necessity for exercising the strictest economy in paper, and in order to reduce the expense of printing and publication, the Royal Society of Edinburgh has decided that, as from vol. 61, 1940–41, the *Proceedings* shall be published in two sections, namely, "A" (Mathematical and Physical—including Astronomy, Chemistry, Mathematics, Metallurgy, Meteorology, and Physics) and "B" (Biological—including Anatomy, Anthropology, Botany, Geology, Pathology, Physiology, and Zoology). Fellows of the Society, and institutions with which the Society exchanges publications, will benefit under this arrangement by having, in smaller compass, papers dealing with the subjects in which they specialize. No change is proposed in the present form or in the arrangement for the distribution of the Society's *Transactions*. The obituary notices of fellows, proceedings of meetings, list of fellows, prizes, etc., formerly published as appendixes at the end of each session's volume of *Proceedings* will, under the new scheme, be published separately, and will be sent normally to all fellows and to those exchanges specially desiring to receive them.

### The Night Sky in November

The moon is full on November 15 at 2·4h. U.T. and new on November 29 at 8·7h. On November 11 at 23h. Mercury is in inferior conjunction, and a transit across the sun's disk occurs. The transit is visible generally in North and South America, the Pacific Ocean and Australasia. Lunar conjunctions with the planets occur as follows: November 13d. 23h. with Jupiter; November 14d. 2h. with Saturn; November 26d. 22h. with Venus; November 27d. 3h. with Mars and November 27d. 22h. with Mercury. Three planets are in opposition during this month; on November 3, Jupiter and Saturn, their respective distances from the earth being 370 and 763 million miles. On November 16, Uranus is in opposition, its distance from the earth then being 1,725 million miles. On November 11, this distant planet will make a close approach to the 8th magnitude star B.D. +18°494. Venus is still the bright morning star rising at about 3h. at the beginning of the month and at 4h. at the end. The configurations of Jupiter's inner satellites are given in the *Nautical Almanac*, p. 628–629 and in *Whitaker's Almanack*, p. 176. Mars is now a morning star, and will pass 3° north of Spica on November 8.

### Announcements

The Lord President of the Council has appointed Prof. A. V. Hill, O.B.E., Sec.R.S., M.P., Foulerton research professor of the Royal Society, Sir Felix Pole, chairman of Associated Electrical Industries, Ltd., and Sir Robert Robinson, F.R.S., Waynflete professor of chemistry in the University of Oxford, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research. Dr. W. H. Mills, Prof. A. Robertson, Sir Albert Seward, and Sir Harry Shackleton have retired from the Council on completion of their terms of office.

The Crompton Medal, given for the best paper read before the senior centres of the Institution of Automobile Engineers during the session, has been awarded to Dr. J. S. Clarke, of Birmingham Corporation Gas Department, for his paper "The Use of Gas as a Fuel for Motor-Vehicles".

In 1939 there were 61,184 deaths from tuberculosis in the United States as compared with 63,677 in 1938. The death-rate dropped from 48·9 per 100,000 of population in 1938 to 46·6 in 1939. Except for Delaware, the death-rate in all States declined or remained within a decimal point higher than the 1938 figure.

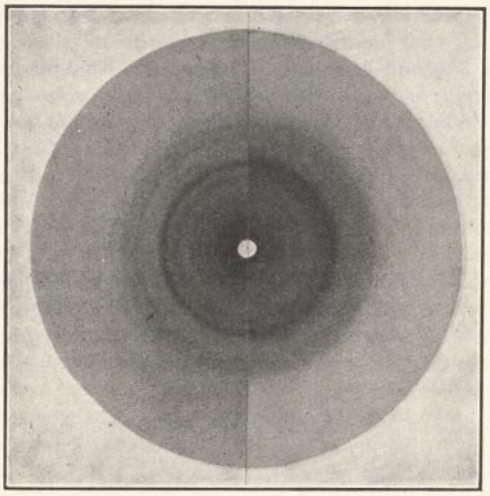
# LETTERS TO THE EDITORS

*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.

## X-Ray Comparison of Natural and Synthetic Starch

IT has recently been described[1] how starch is synthesized *in vitro* from glucose-1-phosphate by the action of an enzyme, phosphorylase, which is present in many plants. In the light of this reaction, and of



other recent enzymic and chemical data, we have undertaken a re-examination of the starch problem by X-rays. As a first step we have examined the synthetic polysaccharide formed by the action of phosphorylase from potatoes.

Natural starch gives surprisingly good X-ray powder photographs, indicating crystallites built from molecules that are probably all alike, or very nearly alike. Four principal types of photograph are known, the so-called *A*-, *B*-, *C*- and *V*-photographs, characteristic of the plant source or mode of preparation of the starch[2]. *A* is typified by wheat starch, *B* by potato starch, *C* is almost certainly a mixture of *A* and *B*, while *V* is found after precipitation by alcohol. The accompanying reproduction provides a comparison of (left) purified potato starch in the form of grains and (right) the polysaccharide synthesized by the action of potato phosphorylase on glucose-1-phosphate. The latter consisted exclusively of small grains, in which form the bulk of the synthetic product is deposited during the course of the enzymic synthesis. It will be seen that the two preparations give essentially the same pattern (*B*-pattern), even though that of the synthetic starch is not quite so sharp.

In certain of its properties synthetic starch shows a closer resemblance to the amylo-amylose fraction of natural starch than to normal whole starch[1]. A specimen of amylo-amylose (precipitated by alcohol after electrophoretic separation) was found to give a *V*-photograph, whereas a sample of the synthetic starch after precipitation by alcohol gave the *B*-photograph. Further investigation of the conditions governing the appearance of one or other pattern will clearly be necessary before we can hope to correlate the differences between types and fractions of starch with their X-ray patterns.

An important point for the elucidation of the starch problem by X-rays is the significance of the *A*-, *B*- and *C*-photographs. Are these to be traced to the existence of slightly different phosphorylases, or are they rather a function of the conditions of crystallization? There is evidence that the latter explanation is the more likely, since it is reported that the same starch may give either an *A*-, a *B*- or a *C*-photograph according to the temperature of deposition[3]; but the question obviously invites a study of phosphorylases prepared from a variety of plant sources.

W. T. ASTBURY.
FLORENCE O. BELL.
Textile Physics Laboratory,
University of Leeds.
CHARLES S. HANES.
Low Temperature Research Station,
Cambridge.
Sept. 18.

[1] Hanes, C. S., NATURE, **145**, 348 (1940); *Proc. Roy. Soc.*, B, **129**, 174 (1940).
[2] See Katz, J. R., "Die Röntgenspektrographie als Untersuchungsmethode bei hochmolekularen Substanzen usw.". (Berlin and Wien, 1934).
[3] Katz, J. R., and Derksen, J. C., *Z. phys. Chem.*, A, **165**, 228 (1933).

## Anatomical Basis of Colour Vision

ONE of the criticisms commonly made in respect of the Young-Helmholtz trichromatic theory of colour vision is the lack of any anatomical evidence for the three sets of sensory receptors in the mammalian retina which are postulated by the theory, or for the three sets of optic nerve fibres which presumably connect them with the brain. It is worth while, therefore, to direct attention to the fact that there is a possible anatomical basis for the three sets of fibres.

The lateral geniculate body (that is, the centre through which the retinal impulses are projected on to the cerebral cortex) is composed of six well-defined

layers of cells in man and the higher primates. Many years ago it was shown by Minkowski (on the basis of transneuronal degeneration following section of the optic nerve) that crossed retinal fibres end in layers 1, 4, and 6, and uncrossed fibres in layers 2, 3, and 5. More recently[1], these observations were confirmed and amplified by the study of the effects of small intra-ocular lesions of the retina in the monkey; in the course of this work it became apparent that the smallest retinal lesion which leads to a detectable change in the lateral geniculate body always involves a group of cells (of approximately equivalent size) in *all* the corresponding three layers, these cells being disposed as a straight band radiating from the hilum of the geniculate body to its convex surface. In other words, it appears that the *receptive unit* of the lateral geniculate body with respect to each retina is a narrow band of cells radiating from the hilum and involving either the cell-laminæ 1, 4, and 6 (heterolateral fibres) or 2, 3, and 5 (homolateral fibres).

From this observation it may be inferred *either*: (1) that each single retinal fibre on arrival at the lateral geniculate body divides into three terminals, each passing to one of the three corresponding cell-laminæ, *or* (2) that the conducting unit in each optic nerve in relation to the lateral geniculate body consists of three fibres arising from adjacent ganglion cells of the retina, and that of these three fibres (in the case, for example, of crossed fibres), one terminates in cell-lamina 1, a second in lamina 4, and a third in lamina 6. It may be said at once that there is no neurohistological evidence for the first alternative, and that the second, therefore, is more probably correct.

But the Young-Helmholtz theory also postulates that the conducting unit of the optic nerve (so far as colour vision is concerned) should consist of three fibres, related respectively to the sensations of red, green and violet. Hence it may be said that our experimental studies of the lateral geniculate body provide quite definite anatomical support for the theory.

Until further direct evidence is available, of course, the implication that each set of three cell-layers in the lateral geniculate body is related to the fact that normal colour vision is trichromatic can only be regarded as an interesting speculation. It is not impossible that the histological study of the lateral geniculate body of colour-blind individuals might lead to definite results, but such specimens are naturally hard to come by. There are, however, two other points regarding the normal geniculate body which are apposite to the problem. One of these is that the fully developed six-layer formation is only found in the primates, and the primates are the only mammals so far known by properly controlled testing to have full colour vision. The other point is that, in the monkey (and also in man), the full development of the six layers is only found in that part of the nucleus concerned with central vision. In the rostral portion and the lateral and medial borders of the caudal two thirds, the six laminæ merge with each other to a considerable extent, and these regions are concerned with extreme peripheral vision where the recognition of colour distinction, of course, is not possible.

W. E. Le Gros Clark.

Department of Human Anatomy,
University Museum,
Oxford.
Oct. 4.

[1] Le Gros Clark, W. E., and Penman, G. G., *Proc. Roy. Soc.*, B, **114**, 129 (1934).

## *l*-Galactose as a Component of a Polysaccharide of Animal Origin

In the course of a study of the products obtained by the methanolysis of methylated galactogen, the parent polysaccharide having been prepared from the albumin glands of *Helix pomatia*, we obtained by distillation in a high vacuum certain fractions the properties of which indicated that they consisted wholly of pentamethyl hexose, apparently 2 : 3 : 4 : 6-tetramethyl-methyl-*d*-galactoside. One of us[1] has recently investigated the $n_D^{16°}/[\alpha]_D$ (in water) relationship of mixtures of the α- and β-forms of this galactoside; on making use of these observations, it was found that the $[\alpha]_D$ values of our fractions were much smaller than was to be expected from the observed $n_D^{16°}$ values. Thus in one fraction showing $n_D^{16°}$ 1·4494, the $[\alpha]_D$ was found to be +55·6° as against the expected value of +118°. This suggested that the fraction in question must have contained only about 75 per cent of 2 : 3 : 4 : 6-tetramethyl-methyl-*d*-galactosides, together with 25 per cent of the corresponding derivatives of *l*-galactose: no sugars other than *d*- and *l*-galactoses appeared to be present from consideration of the yields of mucic acid produced on oxidation of the galactogen by nitric acid.

Careful fractionation of the products obtained by splitting methylated galactogen with methyl-alcoholic hydrogen chloride indicated that the original polysaccharide contained a total number of galactose units equal to seven, or a multiple of seven, and that of these one in every seven arises from *l*-galactose, the others being derived from the *d*-isomer. The same conclusion was reached from considerations of the final $[\alpha]_D$ observed in acid hydrolysates of galactogen itself. If the latter consisted wholly of condensed residues of *d*-galactose, a final $[\alpha]_D$ value of +80·5° (calc. on sugar present) would be anticipated, but May[2] had already reported that a value of only +53·6° is attained. He explained the discrepancy by supposing that he had to deal with "β-*d*-galactose" ($[\alpha]_D$ = + 53°), stabilized in some manner hitherto unknown. Some time ago[3], we carefully repeated May's experiment and found a final value of +56·5°, which agrees closely with that of +57·5° which can be calculated for an equilibrated mixture of six parts of *d*-galactose with one of the *l*-isomer.

*l*-Galactose, usually accompanied by the *d*-isomer, has been detected in a few biological materials of plant origin. Thus it has been obtained from Chagual gum[4], from the Japanese drug Nori[5], from quince gum[6], from flax-seed mucilage[7] and from agar[8]. So far as we are aware, however, this is the first instance in which the presence of *l*-galactose has been suspected in a material of animal origin. We therefore took steps to isolate from acid hydrolysates of galactogen a characteristic derivative of this uncommon sugar.

After neutralizing the acid and isolating the combined sugars, a quantity of crystalline *d*-galactose was isolated by fractional crystallization from 90 per cent alcohol. The residual solution was then decolourized with charcoal and evaporated to dryness, the residue being dissolved in boiling 97 per cent alcohol, from which a syrup separated on cooling. This was rejected and the material remaining in the mother liquors was recovered by evaporating the solvent. From this residue, and from *dl*-galactose, we prepared crystalline benzimidazole derivatives by the method of Moore and Link[9]. The two products

had the same characteristic crystalline form and melting point (233°, separately or mixed) and both were optically inactive. Analysis of the specimens of *dl*-galacto-2-benzimidazole provided confirmation of their identity :

| | % C | % H | % N |
|---|---|---|---|
| Product from galactogen .. | 53·3 | 6·4 | 10·0 |
| Product from *dl*-galactose .. | 53·5 | 6·3 | 10·4 |
| Calculated for $C_{12}H_{14}O_5N_2$ .. | 53·7 | 5·97 | 10·4 |

This work will be described in more detail in a forthcoming paper.

Biochemical Laboratory, Cambridge.
DAVID JAMES BELL.
ERNEST BALDWIN.

[1] Bell, *J. Chem. Soc.*, in the Press (1940).
[2] May, *Z. Biol.*, **95**, 277 (1934).
[3] Baldwin and Bell, *J. Chem. Soc.*, 1461 (1938).
[4] Winterstein, *Ber.*, **31**, 1571 (1898).
[5] Oshima and Tollens, *Ber.*, **34**, 1422 (1901).
[6] v. Lippmann, *Ber.*, **55**, 3038 (1922).
[7] Anderson, *J. Biol. Chem.*, **100**, 249 (1933).
[8] Pirie, *Biochem. J.*, **30**, 369 (1936).
[9] Moore and Link, *J. Biol. Chem.*, **133**, 293 (1940).

## Hydration of Substituted Amides of Stearic Acid

PREVIOUS work[1,2] has indicated that in hydrated stearanilide the bound water is held by a micellar structure. It has also been shown[1] that a chain containing at least sixteen carbon atoms is necessary for water-binding by anilides of normal fatty acids. Further investigation of factors influencing hydration has now been made.

5-gm. samples of derivatives of stearanilide were hydrated and examined in the manner already described[1]. In the accompanying table are recorded the percentages of bound water in a selection of hydrated compounds.

| Hydrated compound | Percentage water | Hydrated compound | Percentage water |
|---|---|---|---|
| Stearanilide | 88·5 | *o*-Carboxy-stearanilide | 21·6 |
| Stear-*o*-toluidide | 86·3 | *m*-Carboxy-stearanilide | 70·8 |
| Stear-*m*-toluidide | 71·8 | *p*-Carboxy-stearanilide | 53·4 |
| Stear-*p*-toluidide | 85·3 | Stear-diphenylamide | 0·7 |
| Stear-methylanilide | 0·3 | Stear-α-naphthylamide | 77·4 |
| Stear-*o*-nitranilide | 80·0 | Stear-β-naphthylamide | 84·9 |
| Stear-*m*-nitranilide | 80·8 | Stear-phenylhydrazide | 71·7 |
| Stear-*p*-nitranilide | 87·5 | Stearamide | 85·5 |
| *p*-Bromo-stearanilide | 81·4 | Stearic acid | 72·5 |

A study of these results shows that with certain notable exceptions all the compounds examined are capable of binding large quantities of water. Evidently the introduction of substituents into the nucleus of stearanilide has little effect on water-binding capacity, though a carboxyl group in the *o*- or *p*-position reduces the amount of water bound. Replacement of the remaining hydrogen atom of the amino group, however, effectively prevents hydration, as is shown by the fact that both stear-methylanilide and stear-diphenylamide are incapable of taking up water.

An explanation of this may be based on the assumption that the formation of a micellar structure and the binding of water by it are consequences of enolization resulting in the transformation of the -CO-NH- grouping to -C(OH)-N-. The fundamental importance of enolization is deduced from the fact that both stearamide and stearic acid become heavily hydrated and hence neither the benzene nucleus nor the nitrogen atom can be primarily responsible for the binding of water. It seems not unreasonable to suppose that the micellar structure formed has the character of a fibrillar meshwork, or felt, in the interstices of which water becomes entrapped. The bulk of the water is probably located around the -C(OH)- groups, and its presence, coupled with attractive forces between these groups in neighbouring molecules, may be largely responsible for the construction and stability of the felt. The influence of the solvent (alcohol) cannot, however, be ignored and this aspect of the problem is now being studied.

B. A. TOMS.

Department of Chemistry,
The Queen's University,
Belfast. Sept. 12.

[1] NATURE, **145**, 1019 (1940).
[2] NATURE, **146**, 266 (1940).

## A Cambridge Pleistocene Climate

MR. T. T. PATERSON's demonstration of the 'frost cracks' in the Travellers' Rest pit at Cambridge[1] affords a valuable clue to a Pleistocene climate of that region. The presence of permanently frozen ground in England within Pleistocene times has been suspected, but proof has been wanting. 'Frost cracks' in active formation are occupied by wedges of ice and they can only attain a considerable width in ground which remains frozen for many years. E. de K. Leffingwell considered the ice wedges in cracks in northern Alaska to have grown by successive annual increments of a few millimetres and he estimated that the wedges, which are up to three metres across, had taken 500–1,000 years to form[2]. Some of the Travellers' Rest fissures are nearly two metres across and they indicate a prolonged period of low temperatures.

G. Holmsen's finding that ground ice may occur where the mean annual temperature is 25° F. or lower is generally accepted[3], and from an examination of the distribution of the permanently frozen ground in Northern Canada, W. A. Johnston concludes that it is likely to occur where the mean annual temperature is "say 26° F. or lower"[4]. The present (1906–35) mean temperature of Cambridge is 49·3° F. 'Frost cracking' cannot take place beneath any considerable snow cover and the precipitation must have been low. At present (1885–1915) the annual precipitation is 21·82 inches, ground frosts occur on 112 days, and snow lies in the morning on only 12 days in the year[5].

Mr. Paterson's evidence proves the soundness of the conclusions reached by C. Reid more than fifty years ago from a study of the character of the cold fauna and flora of the Pleistocene period, that the mean temperature in the south of England was considerably below the freezing point ("probably about 30° lower than now") and "consequently all rocks not protected by snow would be permanently frozen"[6].

L. HAWKES.

Bedford College for Women
at "Springfield",
Sidgwick Avenue,
Cambridge.
Oct. 4.

[1] *Quart. J. Geol. Soc.*, **96**, 99 (1940).
[2] U.S. Geol. Surv. Prof. Paper, **109**, 211 (1919).
[3] *Norsk. Geog. Selsk. Aarbok*, **24**, 131 (1912–13).
[4] *Trans. Roy. Soc. Canada*, Sec. 4, **24**, 39 (1930).
[5] "The Cambridge Region", Camb. Univ. Press (1938).
[6] *Quart. J. Geol. Soc.*, **43**, 369 (1887).

# RESEARCH ITEMS

### Storage of Chemical Activator by Body Lipoids

A paper on "Fats and Oils as Protective Repositories of Neurohumors and other Chemical Activators" was read by G. H. Parker, of Harvard University, at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. The colour changes in catfish are controlled by three chief neurohumours, intermedin from the pituitary gland, acetylcholine and a concentrating neurohumour (probably adrenaline) from the dispersing and the concentrating nerve-fibres respectively. Of these three, the two from the nerves, acetylcholine and adrenaline, are soluble in fats and oils. Acetylcholine induces a dispersion of melanophore pigment and consequently a darkening of the fish. Adrenaline, on the other hand, concentrates this pigment and blanches the fish. When acetylcholine has been discharged for some time from the dispersing nerves, it accumulates in the fatty or lipoid constituents of the tissues about the melanophores, and in consequence continues the dispersion of pigment for some time after the dispersing nerves have ceased to act. It can be extracted in measurable amounts from dark fish skins. It escapes destruction by choline esterase by its retreat into fatty materials, where it is temporarily stored. The same appears to be true of adrenaline, another important general nerve activator. Thus the fatty or lipoid substances in the animal body may serve as storage reservoirs for agents that may be of first consequence in the animal economy. This storage activity of lipoids for important activating agents has not received the attention of biologists that it probably deserves.

### Fossil Birds of North America

In 1931 the American Ornithologists' Union included a list of fossil forms in its Check-list of North American Birds. The past nine years, however, had made many additions and some changes, and in order that these, recorded in many scattered papers, should be brought together, Alexander Wetmore has compiled a new "Check-list of the Fossil Birds of North America" (*Smithsonian Misc. Coll.*, **99**, No. 4 ; June 1940). The list runs to 81 pages, and includes 184 species of birds now extinct, including the New World toothed birds (Odontognathæ) made famous by the researches of Marsh. In addition, there are included 165 species of birds which are still living, but the remains of which have been found in Pleistocene deposits, generally in caves and in the rich fossiliferous beds of the asphalt lake of Rancho La Brea.

### Barnacles attached to Birds

A note by Granville Ashcraft records the curious occurrence of barnacles growing upon the breast feathers of living birds (*Condor*, **42**, 218 ; 1940). Two Pacific fulmars, *Fulmarus glacialis rodgersii*, were shot on the wing while they circled the Allan Hancock Foundation cruiser dredging for marine life off San Francisco Bay, California. Several dozen clusters, each containing three or four individuals of young stalked barnacles, *Lepas hillii*, were found to be attached to the barbs of the belly feathers. The occurrence illustrates the mass settling of barnacle larvæ, which must have taken place when the fulmars were persistently roosting upon the water, and since this species of barnacle is not tolerant of conditions of drought, it indicates that during the period when the barnacles were growing the birds must have been on the ocean most of the time. The largest had a capitulum 3·0 mm. long and a stalk of 1·1 mm. So long ago as 1874 Targioni-Tozzetti proposed a new generic name (Ornitholepas) for barnacles growing upon the tail feathers of *Priofinus cinereus*, but later workers regarded the specimens as only a larval cirripede in its cypris stage.

### Graptolites of Australia

Australia has taken a considerable share in developing the knowledge of graptolites and their value as indicators in the interpretation of stratigraphical zones, since Frederick McCoy was appointed palæontologist to the Geological Survey in 1856. But much of the early work has been overlooked, and R. A. Keble and Prof. W. N. Benson have done good service in recording the full bibliography and the history of research on Australian graptolites (*Mem. Nat. Mus. Melbourne*, No. 11, 11–99 ; 1939). Titles of 159 papers bearing on Australian forms are listed, and the progress of research is discussed in three periods : the first period, 1856–1892, was a preliminary period of recording and correlation with the European and American faunas ; the second, 1892–1932, introduced more detailed zoning and the recognition of an Australian stratigraphical sequence ; the third, 1932 to the present, is the period of revision and systematization. The fauna, the history of the discovery of which is summarized by the authors, is probably the most complete graptolite fauna in the world, certainly in regard to its Ordovician components, and it is remarkable that so great a similarity exists in the Upper Ordovician of Australia and of Great Britain that "with further work it may even be possible to adopt the English classification".

### Hereditary Nose-Bleeding

Recurrent nose-bleeding is inherited as a Mendelian dominant in a family of the United States. H. K. Fink (*J. Hered.*, **31**, 319–322 ; 1940) gives a pedigree involving six generations in which the affected individuals developed heavy nose-bleeding from about the time of puberty. It has been found that diet involving calcium lactate considerably alleviates the amount and frequency of bleeding.

### Linkage in the Human Sex Chromosome

T. White (*J. Genetics*, **40**, 403–437 ; 1940) reports a pedigree involving seven generations which exhibits congenital stationary night-blindness, myopia and deuteronopia. The pedigree indicates that these defects were all on one *X*-chromosome, but have on several occasions crossed over in a female. In an appendix, J. B. S. Haldane discusses the calculation of the cross-over percentage between the genes involved.

### Sodium Polyiodides

As is well known, iodine is much more soluble in solutions of alkali iodides than in pure water, and this is the result of the formation of polyiodides, for example, $KI_3$, in solution. Many of these polyiodides have been isolated in the solid form, many being anhydrous, but the potassium compounds are known only as hydrates, $KI_3$, $H_2O$ and $KI_7$, $H_2O$. G. H. Cheesman, D. R. Duncan and I. W. H. Harris (*J. Chem. Soc.*, 837 ; 1940) in a phase-rule study of the system $NaI-I_2-H_2O$ at 0° conclude that the compounds $NaI_4$, $2H_2O$ and (possibly) $NaI_2$, $3H_2O$ are stable at that temperature. The di-iodide (which may be NaI, $NaI_3$, $6H_2O$) is the first example described of a polyiodide of this type. The numbers of iodine atoms combined with one atom of sodium are both even, whereas in the potassium system the numbers are odd. Even polyiodides (for example, $CsI_4$, $2KBr_6$, $3H_2O$ and possibly $CsBr_4$), however, have been previously reported. The alternative formulation NaI, $NaI_3$, $6H_2O$, it is pointed out, would agree better with the physico-chemical evidence for a dissociated tri-iodide ion in solutions : $I'_3 \rightleftharpoons I_2 + I'$, higher polyiodide ions being formed when the proportion of iodine is high.

### Synthesis of Radioactive Lactic Acid

G. B. Kistiakowsky and Richard Cramer, of Harvard University, described this work at the annual meeting of the U.S. National Academy of Sciences held during April 22–23. Lactic acid containing the $C^{11}$ isotope in the carboxylic position was synthesized from carbon oxides produced by the bombardment of boron oxide by deuterons in the Harvard cyclotron. The oxides were converted to carbon dioxide and thence to potassium cyanide ; this combined with acetaldehyde in alkaline solution to give a α-hydroxy-propionitrile which was hydrolysed by hydrochloric acid to lactic acid. The mixture was made alkaline again, evaporated to dryness and extracted with acidic dry ether to eliminate inorganic materials. The ether phase was then extracted with water to separate lactic acid from polymerized acetaldehyde and concentrated to about 2 c.c. volume containing some 50 mgm. of lactic acid, to which 100 mgm. of ordinary *d-l* lactic acid were added when needed. The entire synthesis took approximately 1½ hr., the yield of $C^{11}$, allowing for radioactive decay, being about 30 per cent. The residual radioactivity was sufficiently strong to follow it for approximately five hours, and thus the acid could be used in biological experiments.

### Crystallization Curves of Solid Solutions

N. L. BOWEN, of the University of Chicago, presented a paper on "Nodal Points on Crystallization Curves of Solid Solutions" at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. The crystallization curves in solid solution systems characterized by a valley curve (Tallinie) on the fusion surface have been treated by Schreinemakers for the case of crystallization with perfect fractionation. He did not examine the case of crystallization curves with perfect equilibrium; but other investigators have done so, and they agree that the curves of perfect equilibrium crystallization have points of inflexion where they intersect the valley curve. On the other hand, there is no agreement among them as to the manner of location of the point of intersection with the valley curve. This confused condition suggested a new analysis of the problem, which shows that the point of intersection of valley curve and crystallization curve is determined by a simple construction, that a crystallization curve has no unique properties at this point, that some crystallization curves have nodal points but the locus of nodes is a curve which is independent of the valley curve.

### A New Conduction of Heat Phenomenon

G. W. STEWART, of the State University of Iowa, presented a paper under this title at the annual meeting during April 22–23 of the U.S. National Academy of Sciences. It is currently accepted that the transfer of energy in the conduction of heat in solids and liquids occurs by means of acoustic waves. In solids these consist of longitudinal elastic waves. In liquids it has recently been argued by Lucas that the more important carriers are transverse waves of viscosity and inertia. A new phenomenon in heat conduction has been found which is most easily interpreted by the presence of these transverse waves of viscosity and inertia. If the molecular swarms in liquid crystalline *para*-azoxyanisol are studied by means of X-ray diffraction, facts may be obtained concerning the orientation of these elongated swarms under the application of either the magnetic field or heat conduction. It is demonstrated that the swarms are oriented by the conduction of heat, their long axes perpendicular to the direction of the conduction. This phenomenon has been established by two experimenters, Holland and Reynolds, with different apparatus and methods. The orientation of the swarms corresponds to the effect of a cross-convection current. The transverse waves of Lucas may produce this result. These experiments demonstrate a new phenomenon and also add credence to the importance of the transverse waves of viscosity and inertia.

### Corrosion Resistant Alloys

H. H. Uhlig and John Wulff, of the Massachusetts Institute of Technology, discussed this subject in a paper before the annual meeting during April 22–23 of the U.S. National Academy of Sciences. Various solid solution alloys of the transition and pre-transition group elements have wide application due to their corrosion resistance. This is attributed to their passivity, which is usually explained on the basis of an impervious oxide film. Electrochemical, threshold potential and corrosion data are not explained in simple terms on this point of view. A consideration of such data for iron-chromium, iron-nickel and copper-nickel alloys shows that corrosion resistance begins at critical alloy compositions ; thus, atomic ratios of five Fe atoms to one Cr, or two Fe to one Ni are sufficient to induce passivity. This may be attributed to the ability of Cr in the Fe-Cr system to provide sharing possibilities for five electrons of the five nearest Fe neighbours, based on the assumption that Fe with one shared electron is passive. The solution of hydrogen in the surface lattice destroys passivity, the hydrogen electrons displacing Fe-Cr bonds. Chemo-sorption of oxygen may enhance the passive nature of boundary alloy compositions as well as pure metals by electron sharing similar to Cr. The present electron sharing point of view harmonizes many of the divergent theories concerning the passivity of pure metals and provides plausible explanation for the corrosion resistant alloys of the transition elements.

# DIRECTIONAL STABILITY OF SHIPS

THE two qualities which jointly may be said to constitute the steering performance of a ship are its manœuvrability and its course-keeping ability. In experimental work and full-scale trials, attention has usually been directed to the first of these.

It is recognized that the two are to some extent opposed. A vessel which answers the helm readily is likely to show a greater tendency to yaw from a straight course, even when no rudder is applied, than one which is less easily manœuvred. The relative importance of the two qualities depends on the service for which the ship is designed. Coasters and cross-channel boats require greater facility in handling than ocean-going ships which spend most of their time at sea and do not have to enter small harbours without the assistance of tugs. The lack of directional stability tends to increase the extent to which the rudder must be used to maintain a steady course, and this is known to influence the horse-power required and hence the fuel consumption for a given average speed. When automatic steering is employed, the stabilizing effect of the gyro-pilot must be sufficient to overcome any inherent lack of directional stability in the ship itself. Quantitative prediction of the vessel's properties in this respect requires experimental work on the course-keeping of the model hull.

In *Engineering* of October 4, Dr. Lockwood Taylor discusses the methods by which such tests can be carried out in practice. It is not usually feasible to give positive directional stability to any ordinary ship of normal form, in the sense that an aircraft having sufficient rear-fin area has it. In the case of a ship, the form-factors involved are principally the profile of the forefoot and the extent of the after deadwood. But as the amount of latitude in fixing these is restricted by resistance, docking and structural considerations, any slight accidental yaw that the ship may acquire tends to accentuate itself. It is difficult to make any direct measure of this with accuracy. Resort is therefore had to an indirect method involving a special technique.

The direct method is to tow the model in the ordinary way and, when a steady speed has been reached, to release it from the guides which normally prevent yawing and to record the free motion which results. An indirect measure of what the author terms the static directional stability can be got by a method suggested by aeronautical practice in wind-tunnel tests on the longitudinal stabilities of aeroplanes. The model is towed at a small fixed angle of yaw, and the corresponding ship-turning moment about amidships is measured. The greater the unstable yawing moment at a given angle, the more rapid the rate of development of a swing under free conditions.

To obtain information about the dynamic or damping moment, it is necessary to use a method in which actual swinging of the model occurs. To control the motion and render it stable and oscillatory, a torsion spring of sufficient stiffness more than to balance the unstable hydrodynamic moment is fitted at the pivoting point. The constrained model has then a definite yawing period, from which, in conjunction with the known strength of the spring, the desired information as to the variation of yawing moment with angular position can be deduced. The records obtained from the oscillation of the spring-controlled model give after analysis the hydrodynamic damping.

---

# PHYSICAL CONTROLS IN ADJUSTMENTS OF THE EARTH'S CRUST

DR. NORMAN L. BOWEN, professor of petrology at the University of Chicago, speaking on internal movements in the earth at the Bicentennial Conference of the University of Pennsylvania on September 19, pointed out that because man's activities are limited to the surface of the earth and to a short distance above and below the surface, his knowledge of the structure of the great interior bulk of the planet has necessarily been derived from such indirect evidence as the behaviour of earthquake waves passing through it. It is not surprising, therefore, that differences of opinion exist among geologists as to how the continents, oceans and mountains were formed. But upon one thing all are agreed. The earth is not and probably never has been a solid, unyielding block of material. Beneath the crust there is considerable mobility, usually slow and ponderous, to be sure, but movement nevertheless; and the mobility, all geologists are agreed, is dependent upon a gradient of temperature.

Major deformation of the earth's crust has been referred to four different types of action: (*a*) contraction of the earth as a result of cooling; (*b*) invasion of liquid magma; (*c*) interior convection currents and (*d*) migration of continents. There is the greatest diversity of opinion as to which of these actions accounts most satisfactorily for the major surface features of the earth, but whatever may be the truth, it is certain that each of them is either caused or controlled by the earth's temperature gradient.

Dr. Bowen pointed out that thermal shrinking of the earth could occur only if the earth was losing heat. Upward invasion by magma (molten rock) can only occur if there is, below the cold exterior, material at sufficiently high temperature to permit flow toward the surface and extrusion upon the surface. Convection currents can occur only if there is a temperature gradient, with hot mobile material lying below colder material. Migration of continents can only take place if there are, beneath the rigid continental masses, materials of sufficient mobility to permit sliding.

The earth's internal temperature is suggested by

the high heat (1,150°) of basaltic lavas thrown out by volcanoes, and also by measurements in bore holes. But the deepest holes have penetrated considerably less than two miles of the earth's crust, and this is such an insignificant proportion of the radius of the earth (which is 4,000 miles) that it gives only a very insecure basis for the estimation of deep temperatures.

Conflicting with the theory that the sub-crustal material is fluid (which seems necessary to account for the mobility) is the fact that it behaves towards tidal forces as would a highly rigid body. Its free transmission of earthquake waves also suggests a solid earth.

Dr. Bowen outlined efforts which have been made to reconcile these conditions. One suggestion is that the interior liquid is subject to such high pressure that it exhibits characteristics of rigidity toward forces of short duration, but 'gives' as a thick fluid under the stress of long-continued forces. Another view is that the earth is entirely crystalline, but shows mobility by granular readjustment, accomplished partly by elastic effects and partly by re-crystallization.

Dr. R. A. Daly, of Harvard, has proposed the theory that beneath the crust there is a shell of glassy basalt, above its melting temperature but held in an almost solid state by this intense pressure. When the pressure is released at any point the basalt becomes a thin fluid and erupts.

Dr. Bowen's own theory involves what is termed 'selective fusion'. He believes that the basalt is a crystalline layer held under pressure near but above its crystallization temperature. As the pressure is relieved those ingredients of the rock layer which have the lowest melting point become fluid, carrying in suspension those ingredients whch have a higher melting point and which are, therefore, still in crystalline form.

---

# PERIODICITIES IN SOLAR VARIATION REFLECTED IN WEATHER

DR. CHARLES GREELEY ABBOT, secretary of the Smithsonian Institution, in a paper at the Bicentennial Conference of the University of Pennsylvania on September 17, stated that he has found periodicities in solar variations, which range in length from 8 months to 273 months, that have continued without change of phase for at least a century. The variations under discussion do not include those short-interval sequences of rise and fall in solar variation which cover but a few days each and which govern weather changes for the subsequent two or three weeks. While these are important, he dealt with the longer cycles which have more pronounced effects on temperature and rainfall and which "through these agencies influence production, prices, and social concerns of major interest".

Observations have been made by Dr. Abbot and collaborators at stations on mountains in desert regions all over the world, where the strength of the sun's radiation can be measured with the least possible interference from local atmospheric conditions. He now has a series of measurements covering most of the days of each year since 1920, and the study of these indicates that the sun's radiation changes within the range of 0·5–1 per cent in cycles of the following lengths :

| | |
|---|---|
| 8 months | 39½ months |
| 9½ ,, | 45½ ,, |
| 11¼ ,, | 68 ,, |
| 21 ,, | 91 ,, |
| 24·9 ,, | 137 ,, |
| 273 months | |

The least common multiple of these periods is 273 months, which is approximately twice the length of the sunspot period of 11⅛ years ; it may be noted that the late Prof. G. E. Hale showed that magnetism in the sunspots has a period of two sunspot cycles.

Dr. Abbot, although his daily solar observations at the Smithsonian have been carried on for only twenty years, has been able to project these cycles back through occasional solar observations made since 1905 by the Smithsonian observers at Mt. Wilson, California, and through earlier ones made in New Haven, Copenhagen and Berlin. Thus his periodicity scheme has been checked through intervals covering more than a century.

In addition to the periods mentioned, Dr. Abbot has noted sequences of approximately 46 to 92 years which have had profound effects on precipitation, as noted, for example, by the level of Lake Huron. During the ten years following 1837 it fell 5 ft. Forty-eight years later Lake Huron began a similar, but not quite so great, ten-year fall, and then in 1929, or 92 years after the first recorded fall, there occurred another which almost exactly duplicated that of 1837. These 46- and 92-year cycles, he explained, are made up of two and four double sunspot cycles, each double sunspot cycle being 23 years.

"Although achieving moderate success in long-range forecasting by using the 23-year period and its multiples," said Dr. Abbot, "I have long hoped to get greater accuracy by building up forecasts from the effects of the individual solar periods." But the complexity of the earth and its atmosphere made this very difficult, he said, adding that "indeed the meteorologists have practically given up the use of periodicities because of unpredictable changes of phase in weather phenomenon."

But last December it occurred to Dr. Abbot that the changes of phase in weather might be caused by changes in season of the year, which, of course, are not dependent upon the sun itself but upon the movement of the earth around the sun. Since our 12-month year does not coincide exactly with any of the solar radiation cycles, obviously a point in a solar cycle does not fall on the same date every year.

"For instance," said Dr. Abbot, "if we are dealing with the 11¼ month period, its solar cause, if unchanging in phase, will gradually march in phase through all the months of the year. Only once in 15 years will it recur in the same relationship to the months of the year, that is, on the same date. May it not reasonably be that its effect on weather may

be different in January, when the northern hemisphere is blanketed with snow, and the atmospheric circulation is vigorous, from what its effect would be in the very different conditions prevailing in July ?"

Dr. Abbot tested this on nine stations scattered from Alaska to South Africa and is satisfied that the changes of solar radiation can be correlated with weather changes here on earth. Since each of the solar periodicities, whatever its length, has a certain least common multiple with respect to our 12-month year, it is possible to compute dates which occur at intervals of a certain number of years and upon which the weather effect of the given solar period should recur. The 8-month period recurs in the same phase every two years, since 24 months is a common multiple of 12 and 8.

As examples of long-range forecasting based upon these periods, Dr. Abbot said that he got a 71 per cent correlation on predicting the weather in Peoria, Illinois, for five years ahead, beginning in 1935. This, the best result thus far in a number of 5-year forecasts made for various stations, covers mean monthly values of the departures from normal precipitation. Two years ago, Dr. Abbot, at the request of Vice-President Garner, made a prediction of the precipitation for San Antonio, Texas, on the basis of the 23-year sunspot cycle, and very good results were achieved.

# ELECTRICITY PROBLEMS IN GERMANY

IT will have been noticed that the targets aimed at very frequently by the R.A.F. in Germany are electrical power stations. Two reasons for this are mentioned in an article in the *Electrician* of October 4. The first is that German industrial production, more than any other in Europe, depends on electricity, and the second that there is a great shortage of electricity due to the enormously increased demands for war production and to the exhaustion of reserves.

A few figures given demonstrate the problem which besets this part of Germany's war industry. In the year 1933, which witnessed the inception of the Nazi economy, the production of electricity was about 25,000 million kilowatt hours. Since then it has risen steadily to 36,000 million in 1935, 48,000 million in 1937, and finally 55,000 million in 1938. In 1939 still greater quantities were required, and it is unlikely that in 1940 the demand for electricity will decline. Two years ago, German experts pointed out that, owing to the special requirements for the production of substitutes and *Ersatz* articles, a consumption of some 100,000 million kwh. could be expected by 1943. This is twice as much as in 1938 and four times as much as in 1933.

As yet, no way has been found to meet these requirements. German experts themselves have left no room for doubt that the peak of production, determined by the availability of the plant, etc., has already long been reached. While the consumption of electricity increased twofold between 1933 and 1938, the productive capacity of electricity works increased only by about 12 per cent. This disproportion did not constitute a serious problem so long as there were enough reserves provided for in most of the gigantic electricity plants, built in Germany since 1918 with British and American capital. According to official statements dating as far back as the end of 1938, these reserves do not exist any longer. A report of the Reich commissioner of the power industry, who early last year was appointed by Goering to increase the production of electric power, disclosed that it was difficult to cover the industrial peak requirements for electricity in the winter of 1937–38. Since that time the problem has become more acute.

The reason for this shortage lies to a considerable extent in the increase in the production of synthetic materials, which require disproportionately large quantities of electricity. One single industrial undertaking producing such synthetic substances requires an electricity plant of some 100,000 kilowatts. From the following figures published at a meeting of the Association of Electrical Engineers in 1938, it is seen that the production of, for example, 1 ton of iron requires 100–200 kwh. ; copper, 300 kwh. ; synthetic rubber, 40,000 kwh. ; synthetic petrol, 3,000 kwh. ; textiles, 3,800 kwh. ; artificial silk, 7,000 kwh. ; aluminium, 20,000 kwh. ; and magnesium, 44,000 kwh.

Figures concerning the aluminium industry in Germany indicate that, so early as 1938, this branch produced 180,000 tons (which output is still far from satisfying Germany's war demands). The figure for magnesium was 100,000 tons, and the same quantity of synthetic rubber was also made. These substances, with synthetic petrol, which form only a part of the whole German *Ersatz* industry, require 20,000 million kwh., or two fifths of the whole 1938 consumption of power. This indicates to what extent German war production relies on electricity, and how a shortage or an interruption of electricity production is bound to hamper output.

Official estimates show that new plants of some 10 million kilowatts capacity have had to be built within a short period to meet these growing requirements. Construction on such a large scale has cost not only some 3,000–4,000 million Reichsmark, but also, a more important item, a great expenditure of time. One electricity plant cannot, in present circumstances, be constructed in less than four or five years, owing to the difficulties in the building industry and in the production of the required equipment. The shortage of skilled labour will increase these problems. The erection of power works which rely on water-power instead of steam would take still more time. For example, five years have been provided for the construction of only one part of the new electricity plant in the Tavern district of Austria which was planned shortly before the War.

Five sixths of the electricity works in Germany depend on coal, while only one sixth is water driven. Exports of British coal amounting to 20 million tons annually have now been completely stopped. Germany's iron industry alone will soon require a 30 per cent increase in coal, owing to the use of low-grade iron ores.

# PROBLEMS ARISING FROM AN AGEING POPULATION*

By DR. L. J. DUBLIN

AGEING of the American population—a result of a lengthening average life span and a declining birth-rate—is due to create serious social and economic problems for the future generations.

If we insist on lightening the burdens on ourselves by reducing the number of our children, we must be prepared to accept the consequences in terms of our social economy. We must be aware of the condition of life we are imposing on our children—namely, an obligation to care for a huge proportion of old people.

Since the beginning of the century, the birth-rate in the United States has decreased by more than one third. Immigration has been drastically cut, and during several recent years more people left the country than entered it. The mortality in the childhood ages is only a fifth of what it was three decades ago. It is these three factors which have shifted the population from youth towards the older ages. In 1850 there were 3,080,000 people in the United States who were sixty-five years of age or older, or 4·1 per cent of the population. To-day the figure is 8,418,000 or 6·3 per cent, and in 1980 it is expected to be 22,000,000, or 14·4 per cent.

In 1980, the birth-rate and death-rate are expected to meet—13 births and 13 deaths per 1,000 population—and thereafter the death-rate will be greater than the birth-rate, resulting in a declining population.

The bright side of the picture is in the improvement in death-rate. A century ago a little less than half the babies born in England and Wales were expected to reach the age of fifty. The situation was probably about the same in the United States. In 1938 four out of five male infants and five out of six female babies were expected to reach fifty. The chances of a new-born child reaching age sixty-five are to-day as great as the chances of reaching fifty were only thirty years ago, or about four out of five among white males and two out of three among white females. The continued improvements should ultimately enable three-quarters of the infants born to reach sixty-five.

A recent re-count of a group of persons born about 1876 shows that 20 per cent more lived to the age of fifty than were expected to at the time of their birth, which reflects improvement in medicine and in welfare conditions made during their lifetime; 30 per cent of those who to-day are sixty-five or older owe their survival to improvements of this kind made since they were born.

The improvements which have made this greater survival possible are reflected in the changed line-up of the leading causes of death, with tuberculosis, first in 1900, now reduced to seventh, and heart disease (an affliction mainly of the middle-aged and elderly) fourth in 1900, now elevated to first place. Cancer was the eighth ranking cause of death in 1900 and now it is second. Violence was sixth at the turn of the century and it is now third.

All this means that medical men will have an increasing number of heart and cancer patients and that measures must be intensified to hold these diseases in check. The number of blind and deaf is also due to increase, as will the number of those suffering from mental diseases.

* From a paper read on September 18 at the Bicentennial Conference, University of Pennsylvania.

# FORTHCOMING EVENT

Friday, November 1

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne) at 6 p.m.—Prof. W. M. Thornton: "Foundations of the Electrical and Mechanical Transmission of Energy" (Ninth Andrew Laing Lecture).

# APPOINTMENTS VACANT

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

RESIDENT LECTURER (WOMAN) IN GEOGRAPHY—The Principal, Training College, Darlington (October 31).

DEPUTY DIRECTOR OF EDUCATION—The Director of Education, Education Office, South Parade, Nottingham (November 2).

ASSISTANT, GRADE III (WOMAN), at the Water Pollution Research Laboratory, Watford, Herts.—The Establishment Officer, Department of Scientific and Industrial Research, Teddington, Middx. (quoting J40/10) (November 4).

ASSISTANT BACTERIOLOGIST in the DEPARTMENT of PREVENTIVE MEDICINE—The Registrar, The University, Bristol 8 (November 11).

WOMAN LECTURER IN EDUCATION—The Principal, Saffron Walden Training College, Saffron Walden, Essex.

LECTURER IN GEOGRAPHY and a LECTURER IN PHYSICS able to assist with TEACHING OF MATHEMATICS—The Registrar, Municipal College, Portsmouth.

GRADUATE MASTER to teach SCIENCE in relation to BUILDING and ENGINEERING at the Beckenham Technical Institute—The District Secretary, Kent Education Committee, 12 Beckenham Road, Beckenham.

# REPORTS AND OTHER PUBLICATIONS

*(not included in the monthly Books Supplement)*

## Great Britain and Ireland

Rubber and Agriculture Series, Bulletin No. 14: A Method for the Application of Sodium Chlorate to Bracken. By Dr. G. H. Bates. Pp. 6. (London: British Rubber Publicity Association.) Free. [1010

Proceedings of the Royal Irish Academy. Vol. 46, Section A, No. 4: Maxwell's and Dirac's Equations in the Expanding Universe. By Erwin Schrödinger. Pp. 25–48. 1*s*. Vol. 46, Section A, No. 5: Notes on the Electrochemistry of Gases. By K. G. Emeleus and Jean W. Beck. Pp. 49–64. 1*s*. Vol. 46, Section A, No. 6: Estimation of the Air–Earth Current. By P. J. Nolan. Pp. 65–76. 1*s*. Vol. 46, Section A, No. 7: The Equilibrium of Ionisation in the Lower Atmosphere. By J. J. Nolan. Pp. 77–90. 1*s*. Vol. 46, Section A, No. 8: Velocity Distributions in a Field of Force. By W. C. H. Eakin and W. H. McCrea. Pp. 91–102. 1*s*. Vol. 46, Section B, No. 4: River Liffey Survey, 3: The Growth and Food of Young Salmon. By Winifred E. Frost and Arthur E. J. Went. Pp. 53–80. 2*s*. Vol. 46, Section B, No. 5: Report on a Further Exploration (1929) of the Caves of Keshcorran, Co. Sligo. By A. M. Gwynn, F. T. Riley and A. W. Stelfox. Pp. 81–96. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [1410

## Other Countries

U.S. Department of Commerce: National Bureau of Standards, Research Paper RP 1307: Influence of Cyclic Stress on Corrosion Pitting of Steels in Fresh Water, and Influence of Stress Corrosion on Fatigue Limits. By Dunlap J. McAdam, Jr., and Glenn W. Geil. Pp. 685–722+29 plates. (Washington, D.C.: Government Printing Office.) 10 cents. [810

Bulletin of the Raffles Museum, Singapore. No. 15: A Handlist of Malaysian Mammals; a Systematic List of the Mammals of the Malay Peninsula, Sumatra, Borneo and Java, including the Adjacent Small Islands. By Frederick Nutter Chasen. Pp. xx+209. (Singapore: Government Printing Office.) 5 dollars; 11*s*. 2*d*. [1010

Annual Report on Forest Administration in Malaya, including Brunei, for the Year 1939. By J. P. Mead. Pp. iv+100+4 plates. (Kuala Lumpur: Government Press.) 1 dollar; 2*s*. 4*d*. [1010

U.S. Office of Education: Federal Security Agency. Bulletin, 1939, No. 13: Conservation Excursions. By Effie G. Bathurst. Pp. vi+106. 15 cents. Bulletin, 1939, No. 14: Curriculum Content in Conservation for Elementary Schools. By Effie G. Bathurst. Pp. vi+80. 15 cents. (Washington, D.C.: Government Printing Office.) [1410

U.S. Department of Agriculture. Circular No. 561: Importation, Rearing and Colonization of Parasites of the Oriental Fruit Moth. By H. W. Allen, J. K. Holloway and G. J. Haeussler. Pp. 62. 10 cents. Technical Bulletin No. 702: Selenium Occurrence in Certain Soils in the United States, with a Discussion of Related Topics; Fourth Report. By K. T. Williams, H. W. Lakin and Horace G. Byers. Pp. 60. 10 cents. (Washington, D.C.: Government Printing Office.) [1410

## OFFICIAL ANNOUNCEMENTS

### CHEMICAL SOCIETY RESEARCH FUND

A meeting of the Research Fund Committee will be held in November next. All persons who have received grants, and whose accounts have not been declared closed by the Committee, are informed that reports must be received by the Society not later than Friday, November 1, 1940.

Applications for grants, to be made on forms obtainable from the General Secretary, The Chemical Society, Burlington House, Piccadilly, London, W.1, must be received on or before November 1, 1940. Applications from Fellows will receive prior consideration.

Attention is drawn to the fact that the income from the Donation of the Worshipful Company of Goldsmiths is to be principally devoted to the encouragement of research in Inorganic and Metallurgical Chemistry and that the income from the Perkin Memorial Fund is to be applied to investigations relating to problems connected with the Coal Tar and Allied Industries.

### AURELIA HENRY REINHARDT INTERNATIONAL FELLOWSHIP, 1941-42

Value $1,500, given by American Association of University Women to enable the holder to carry on a year's post-graduate research, if possible in some country other than her own. Women graduates in Great Britain wishing to apply may obtain regulations and application forms from Research Applications, British Federation of University Women, Ltd., 16 King Street, Reading, Berks, to whom applications should be sent by November 11, 1940.

### DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

An ASSISTANT, GRADE III (woman), is required at the Water Pollution Research Laboratory, Watford, Herts, for indexing and abstracting scientific and technical papers, British and foreign. Candidates should have a degree or equivalent qualification in Chemistry and a good knowledge of French and German. Salary up to £240 per annum, according to qualifications and experience. The appointment would be on a temporary basis, at least in the first instance.

Applications should be made, not later than November 4, on a form to be obtained on request (by postcard, quoting reference J40/10) from the Establishment Officer, Department of Scientific and Industrial Research, Teddington, Middlesex.

**A vacancy exists for a Director of Fisheries,** Ceylon. Candidates should be under 45 years of age and possess a suitable academic degree with qualifications in Oceanography. The Director of Fisheries will be required to conduct surveys with a view to developing fishery resources and reorganizing the economic and scientific aspects of the fishing industry. A candidate with practical experience of such work in tropical waters and in modern methods of marketing and curing fish will therefore be preferred.

An applicant should give full particulars in regard to age; nationality; academic qualifications; reference to and specimens of his published fisheries research; and details of previous fisheries work; with names and addresses of two referees personally familiar with his work and character. If time permits, an application should be submitted on a form obtainable from the address given below.

The appointment is non-pensionable and will be on a three-year agreement. The salary attached to the post will be £900 rising by annual increments of £50 to £1,200. A salary higher than the initial of the scale may be offered to a candidate on account of experience and special suitability. Leave, travelling allowances, and other conditions of service will be in accordance with regulations at present in force for officers recruited on agreement for fixed terms of years. Rent allowance of Rs.120 per mensem. if married, or Rs.60 per mensem, if single, is payable if quarters are not provided. (Rs.180 and Rs.65 per mensem on reaching £1,000 per annum). If quarters are provided a rent of 6% of salary will be charged.

Further particulars and application form may be obtained, on application in writing, to the Director of Recruitment (Colonial Service), 29 Queen Anne's Gate London, S.W.1 Completed forms must reach the Director of Recruitment not later than December 10.

**Chemical Laboratory Assistant required** immediately, with experience in the preparation of apparatus, demonstration experiments, etc., up to Higher Certificate standard. Applications, stating salary required, should be addressed to: The Head of the Science Department, Stowe School, Buckingham.

**We are Consultants in Scientific Literature.** **Abstracts, Bibliographies and reports of all kinds prepared. Accurate and complete presentation of all data. Bibliographical researches. Any language. Chemistry, Biochemistry, Physics, Geology, Botany, Biology, LEWKOWITSCH BIBLIOGRAPHICAL BUREAU, Barn House, Barn Hill, Wembley Park, Middlesex: ARNold 3956.**

**MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM**
**The Laboratory, Plymouth**

The following animals can always be supplied, either living or preserved, by the best methods:

Sycon; Clava; Obelia; Sertularia; Actinia, Tealia, Caryophyllia, Alcyonium; Pleurobrachia (preserved); Leptoplana; Lineus, Amphiporus, Nereis, Aphrodite, Arenicola, Lanice, Terebella; Lepas, Balanus, Gammarus, Ligia Mysis, Nebalia, Carcinus; Patella, Buccinum, Eledone, Pectens, Bugula, Crisia, Pedicellina, Holothuria, Asterias, Echinus, Salpa (preserved), Scyllium, Raia, etc.

For prices and more detailed lists apply to:
Biological Laboratory, Plymouth. THE DIRECTOR.

Printed in Great Britain by FISHER, KNIGHT & CO., LTD., The Gainsborough Press, St. Albans, and published by MACMILLAN & CO., LIMITED, at St. Martin's Street, London, W.C.2, and THE MACMILLAN CO., 60-62 Fifth Avenue, New York, Saturday, October 26, 1940.