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Physical Training and National Well-being

THERE are undoubtedly some who will see a connexion between the Government's campaign for improving the health of the people of Great Britain by physical education and the difficulty experienced by the War Office in obtaining recruits of a sufficient standard of physique for the army. Although, perhaps, the Government proposals have been a little over-advertised, a balanced and scientific attempt to improve the physique and health of the nation is so long overdue that we need not mind from what quarter the final stimulus is supplied.

It should not be overlooked that recent reports of the Commissioners for the Special Areas have insisted upon the need for physical training and recreation, while at the same time they have stressed the need for simultaneous attention to nutrition. In the memorandum which has been issued explaining the Government's proposals for the development and extension of the facilities available for physical training and recreation, it is admitted that bodily fitness depends on two essential elements, nutrition and physical training. Action has already been taken in many ways with regard to the former, and the present proposals are accordingly limited to the latter problem.

The proposals outlined in the memorandum include the establishment of two National Advisory Councils, one for England and Wales, and one for Scotland, to survey the field and to advise as to the best methods of meeting the needs and the lines of general advance. The personnel of these Councils has already been announced and includes representatives of many associations of physical culture of one sort or another, such as Scouts and Guides, the Young Men's and Young Women's Christian Associations, boys' clubs,

girls' clubs, the League of Health and Beauty, the English Folk Dance and Song Society, the Margaret Morris movement, etc. Two grants committees are to be established through which, subject to the approval of the responsible Minister, grants will be payable. The National Advisory Councils will organize local committees to develop and co-ordinate the work in various localities and to advise the grants committee on the distribution of local grants. A National College of Physical Training is to be established, and in addition to a grant to the National Playing Fields Association, an interim grant to the Central Council of Recreative Physical Training is proposed. Legislation will be introduced to enable the grants committee to make grants to voluntary bodies and to local authorities, and to empower local authorities to provide community centres, to remove limitations on their present powers of providing physical and social facilities, and to empower county councils to contribute towards the cost of county district councils in the exercise of their powers under the Bill and their power of providing swimming baths.

It is beyond question that the existing provision of facilities for physical training and recreation in Great Britain is both insufficient in amount and sporadic in incidence, being sometimes lacking where most required, and, hampered by want of funds for development, is unable to do more than touch the fringe of the problem. Indeed, the main criticism of the scheme so far advanced is that certain classes of the community are too inadequately nourished to participate in physical training or recreation without risk of further physical deterioration.

To this objection, it is no complete answer that

the problem of nutrition is being handled elsewhere. The question of the physical condition of the people must be studied and handled as a whole on scientific lines, and all the relevant factors must be taken into simultaneous account. In the Special Areas, and probably in certain other districts or sections of the community, the development of physical training facilities can do no more than follow the improvement of nutrition and general health, or at the best proceed with it and the need for a constructive and well thought out policy in national health can scarcely be better illustrated than in passages of the Commissioner's recent report.

It would be a tragedy, however, if criticism of this type, or the attention which has since been given to the White Paper on Rearmament, led the nation to lose sight of the ideals and the political philosophy which inspire the present proposals. They will fail of their purpose unless the fullest use is made of them by the existing agencies, whether voluntary bodies or local authorities. Their essential task is not merely to provide facilities sufficiently attractive to make an effective appeal to the people of the country. It is primarily to create in the public mind a realization of the value of physical fitness for its own sake.

This, even more than the fact that the scheme is an attempt to extend to all classes certain physical advantages that are now enjoyed only by the more favoured classes, is the most significant aspect of the Government scheme. Although the country is comparatively well off for voluntary institutions to improve the physique of the mass of the people, the State has done nothing beyond the school age. The recognition that the duty of the State extends beyond the school in this field is not merely an advance in democracy: it is essentially an attempt to achieve a better adaptation of the citizen to his environment in a society dominated by power production.

The new conception of public health which we encounter here is not that inspired by the totalitarian States, even if they have been responsible for some of the first, though perverted, experiments in this field. Its force derives primarily from the necessity of the State intervening to afford the citizen fuller opportunity of physical and mental development in an era when economic forces inherent in an age of power production have severely circumscribed such opportunities and enhanced their importance.

The need for biological adaptation in industrial civilization has so far largely been overlooked, despite a brilliant chapter on this theme by Lewis Mumford in "Technics and Civilisation". None the less, the attempt must be made if man is to regain the mastery of the machine and reap the advantages in the way of an ampler life which that mastery would offer to all. The retreat to the primitive inherent in certain modern dictatorships makes the problem the more urgent. Civilization cannot be run by barbarians, and the refusal of the totalitarian State to face the basic and difficult problems involved in the transition from the historic forms of capitalism and the limited original forms of the machine to an economy centred on life is the more serious through the threat it offers to human motive power, its discouragement of co-operative and creative thought and the disinterested research on which technical achievement as well as spiritual progress rest.

The life and prosperity of this nation, as of all civilized European nations, depend, as Bavink has wisely reminded us, on the measures which we are willing to take against the processes which are destroying our racial health. Such measures must of necessity depend upon insight into the causes of the processes. The very stress and strain under which we live to-day forces us back to the Greek ideal of life as a unity, if we are to avoid racial decay and degeneration and social measures which are really anti-social, in promoting the well-being of one set or generation of individuals at the expense of the whole nation and of human civilization. That the present proposals in Great Britain should be submitted by the President of the Board of Education rather than by the Minister of Health is indeed a hopeful sign. It indicates that the Government recognizes not merely the value of physical fitness itself but also the intrinsic relations of mind and body.

If we cannot have a healthy mind without a healthy body, apart from the glaring exceptions of genius to every general rule, or a sane and judicious electorate which has the poison of disease or physical feebleness at work within, equally we cannot have a really healthy body without a healthy mind. The Greek ideal of an active healthy body postulated a corresponding activity of the mind.

Accordingly, the Government scheme wisely recognizes the need for taking account of the many varieties of temperament which may make one man's joy in a particular physical exercise another

man's boredom, and refrains from any attempt at a uniform or a compulsory system. To introduce the element of compulsion, in fact, would be to endanger just that willing interest of the mind from which any course of physical training derives half its value. The scheme is thus poles asunder from the compulsory schemes introduced in the totalitarian States, which all too plainly are closely related to military training. The recognition that the best defence of a State is not in walls but in the health, vigour and character of its individual citizens, men and women alike, need no more imply the denial of individuality than it did in ancient Greece. On the contrary, as the scheme rightly insists, it is only as individualism has its sway that the ideal of fitness, whether physical or mental, can be fully realized. Physical and mental well-being is primarily a duty the individual owes to himself and not to the State. He or she best serves the State by realizing the best in himself or herself in a happy balance of mind in which duty is also happiness, liberty makes its own discipline and life becomes an active pleasure instead of a passive existence.

The contribution of the State is accordingly essentially one of co-ordination, the removal of obstacles and the provision of facilities where required. It is important to note that the last by itself may be quite inadequate. Many critics of the scheme who stress the importance of dealing with the questions of malnutrition and housing are not detracting from the value of the present proposals, but emphasizing the necessity of dealing with national health in accordance with a definite co-ordinated plan conceived on wide and generous lines. In such a plan, the Factories Bill at present before Parliament, for example, will find a place, both in respect of its bearing on the employment of juveniles and in the elimination of overtime, industrial disease and other conditions which undermine the health of workers in industry.

It is interesting to note in this connexion two recent precedents for this conception of public health. Recommendations for the prevention of disease recently submitted to the National Health Insurance Committee by the National Physical and Mental Welfare Advisory Board of New Zealand include the suggestion for the replacement of the present Health Department and Mental Hospitals Department by a National Health Department, in which not merely the medical profession but also sciences such as applied biology, chemistry, dentistry, economics, education, ethics,

eugenics, hygiene, nutritional physiology, psychology, physics, sociology, etc., are represented in accordance with the principle that the prevention of physical, mental and moral disability and the maintenance of national health require the aid of many branches of science. For this purpose the appointment in each local centre of a man or woman with the synthetic mind, which is not a common characteristic of medical men or other scientific specialists, is recommended.

Even more significant, however, is the system by which the former Social Democratic Municipal Government in Vienna succeeded during its fifteen years rule in changing the population of a town badly shaken by the vicissitudes of a lost war and by the effects of blockade, starvation, poverty and disease into probably the fittest town population of Europe. This welfare and youth protection organization of the Vienna municipality was the best thought out and most efficiently organized single system in the world. Its standard was a good deal higher than any yet known in England, and amounted to a refusal to accept poverty as a reason why any of Vienna's citizens should be unhealthy or lack means for enjoyment.

If the scheme unfortunately no longer exists since the new rulers came to power after February 1934, its details and organization should not be forgotten, above all by scientific workers, whose tradition and responsibility alike it is to urge unceasingly upon the Government the idea of a creative and thinking mind, no less upon national health than in the expenditure of enormous sums on armaments. Not merely from the point of view of the co-ordination of different branches of science in the service of national health, nor from the point of view of securing adequate expenditure on scientific research in this field, whether in physical training itself, in problems of nutrition, housing, industrial disease and safety, but above all from the point of view of the stimulus to intelligence and character which is inherent in a well-conducted scheme, this question of physical training and national health commands the attention of scientific workers. The support which the present scheme may be expected to claim from them, however, should not lead them to overlook the wider and more fundamental questions, or to cease their pressure upon the administration to secure on an ever-increasing scale the free and maximum employment of scientific knowledge and research in the service of the health and welfare of the community.

Nerve, from Amphioxus to Man

The Comparative Anatomy of the Nervous System of Vertebrates, including Man

By Prof. C. U. Ariens Kappers, Prof. G. Carl Huber and Prof. Elizabeth Caroline Crosby. Vol. 1. Pp. xviii+864. Vol. 2. Pp. xii+865-1845. (New York: The Macmillan Co., 1936.) 63s. net.

THIS comprehensive work, of nearly 1900 quarto pages carrying more than 700 text-figures, has grown out of Prof. Ariens Kappers' "Comparative Anatomy of the Nervous System", of now more than fifteen years back. The present is a new treatise, retaining however the orientation which Prof. Kappers' earlier treatise had in view. The collaboration of the joint authors has been happy in extending the first-hand touch of the book with current research and research material to both sides of the Atlantic. The Amsterdam Institute of Brain-Research and the Laboratory of Comparative Neurology of the University of Michigan have each supplied their special contributions to the making of the work. But the whole compilation is one harmonious exposition directed throughout to the same main objects, and viewed from a single steady point of view. A bibliography, impressively liberal in scale, is appended to each chapter. The several chapters are themselves of almost monographic proportions, but their scope is always kept broad.

The work may be taken to address, for the most part, readers of two classes. Research workers will assuredly find it indispensable. These it will help to check their own findings and views against a well-balanced presentment of the present state of knowledge. It is exemplary in giving chapter and verse from its authorities. There will further be those who, versed in human anatomy, desire a general background of the neurology of vertebrates against which to set it, giving evolutionary perspective. For these the anatomical side of what they want is provided here better than by any other single work we know. Its volumes will long remain a welcome source of authoritative reference.

The authors begin with an account of the morphology of neurones and of the synapses between them, and the opening chapter includes a presentation of the theory of *neurobiotaxis* as that stands to-day. The theory states that a nerve-cell migrates, or strictly that the body of the nerve-cell shifts, toward a nerve-path from which it is receiving predominant excitation. The topography of nerve-cells in the central nervous organs affords examples of this. Thus

associated activity tends to draw two nerve-cells together. Dr. Ariens Kappers will always be remembered in neurology as the earliest observer to put forward as an immediate problem how it is that the several kinds of neurone come by their characteristic individual shape. Most of us were content simply to accept the fact and use it gladly for identifying a cell which did this from a cell which did that, and the shape was clue to the direction of nervous transmission through it. But, as geotropism influences the tree and its branch-pattern, Kappers asked what tropism it might be directs the neurone's branches. He discusses this here, and leans towards explanation by galvanotropic processes. It is a subject seeming to beg for experimental observation with the micro-needle of Chambers in embryonic tissue-cultures such as those of the Harrison laboratory.

The work then continues to climb the nervous system stage by stage, and devotes its chapters to successive levels reaching finally the forebrain. Facts and assessments rich in neurological interest are met with as this course is followed. In dealing with the spinal cord, attention is directed to its being in birds actually more primitive than it is in many of the reptiles. Short local paths are against long brain-ward paths are more abundant in the former than in the latter. So voluminous is the group of spinal motoneurones for the pectoral muscle in most birds that it goes by the name of the 'flying centre.' The mammalian spinal cord is as characteristically mammalian as is the mammalian brain. Its brain-ward tracts climb to higher levels of the brain than do their submammalian homologues. Its paths for fine tactile discrimination and muscle-sense are larger than in the submammals and largest of all in man. They are on their way to the great receiving station in the brain, the thalamus, reaching it by relay. Still further marked is this character as followed in downward paths from brain to spinal cord. There are the mid-brain tracts, tecto-spinal and rubro-spinal, the former actually on 'relay' to the viscera as well as skeletal muscle. In addition, a wholly new path descends from the motor field of the brain cortex to the spinal cord to synapse there, via a relay, with the motoneurones of the neck and limbs. This path is in the monkey more than twice as ample as in the dog, and in man as compared with monkey is again far larger still. It typifies the greater grip of the brain cortex on the behavioural acts of man and the greater disablement in man following on cortical injury.

The reviewer has to resist temptation to stay too long over the several fields offered by a detailed and interesting book. Under "Co-ordinating Apparatus" the inferior olive and its 'complex', with their bearings on neck-movement and neo-cerebellum, are very clearly and fully traced. Passing upward, the cerebellum itself is given a penetrative analysis. No part of the brain repays comparative review more worthily; that is allowed it here, and with more than competence. But the problem of how cerebellar symptoms in disease come to be what they are remains still the puzzle it so long has been. It is pointed out that as to cerebellar localization, two disharmonious patterns seem to co-exist, one receptive illustrated by the entrant paths, one mapped out in muscular regions and movements, the two seeming disparate.

Coming to the diencephalon and telencephalon, which are for the non-technical reader what we may suppose he would regard as the brain proper, the account goes forward with its wealth of detail to reach a final chapter of two hundred pages on the cortex in the mammalian brain. It is brought home to us, if need were, that it is to the mammals that life owes this supreme nervous product. We see how the birds, a newer outcome of evolution, are in a sense back-sliders from the path of promise to real progress. They, although starting later, did not follow the lead given by the mammalian stock in making a cerebral cortex. They have developed a brain on another line. They have exalted instinct with its triumphs of performance but its fixities, rather than humble 'trial-and-error' with its adaptability and, despite its humility, its orientations toward 'reason'.

A fully detailed account is given of the remarkable development of the cortex in the mammalian stock up to and into man. Stress is laid on the close correspondence found between the neo-cortex, which in man is the overwhelmingly larger part of the cortex, and the underlying dorsal thalamus. If we might venture an analogy between the concepts of modern cerebral neurology and the old doctrines of Aristotle's "De Anima" as they echo down the Middle Ages and into the earlier Renaissance, for example with Jean Fernel, it would be to find a likeness between *sensorium commune* and the great complex of the thalamus.

The fields of the cortex which ripen late in the human brain are those which appear late in phylogeny. Some of them were wont to be thought purely cortical in the sense of possessing connexions only with the cortex itself. They are, however, now known to follow what seems indeed a universal rule in being connected with the great subjacent 'exchange', the thalamus, the general receiving station.

The treatise is anatomical, and rightly keeps rather strictly to that scope. Such inferences as it allows itself on function come perhaps with the more impressiveness. It stresses that removal of considerable portions of the total mass of the cortex including the motor fields does not seriously interfere with the normal motor activity of lower mammals such as the rat, yet the destruction of merely a small portion of a certain region of the cortex in man produces a paralysis from which only slight improvement is noted over the course of years. Rats almost completely decorticated are able to learn the brightness discrimination habit in approximately the same time as do normal rats. But in man the destruction by disease of a large area of the cortex commonly brings idiocy.

The human cortex forms the climax, as well it may and indeed must. The preface at the beginning of the first volume had been careful to set forth that, in the descriptions which would follow of the inner urge underlying the development of the brain and nervous system generally, no teleological principle was implied. Each stage of development is an end within itself. "The development is here entelechic," meaning by entelechy an inherent organic property, not a property apart from the organism.

That no reference is made to the difficulty of relating to cerebral structure what is commonly regarded as the greatest of all its functions, mind, is natural enough. Admirable and comprehensive the treatise is; it by those very qualities marks the more definitely the gap between the description of nervous structure and of mind. Nerve and thought, the more we learn about each of them the more different each seems from the other. The more we know about the brain the further it seems to get from mind, because chemistry and physics do not lead there. Matter, however carefully anatomized, does not take us thither. An anatomical treatise may, however, well be excused from raising this question.

The authors are to be congratulated on producing a thoroughly authoritative work, in every way a memorable treatise. That Dean Huber of the University of Michigan did not live to see its completion is a matter of deep regret. Prof. Kappers and Dr. Elizabeth Crosby in their preface pay warm tribute to him as a colleague. The volumes are excellently issued, on paper not too heavy, with liberal type and admirable text-figures, for the most part original to the work. The sole misprint we have noticed is on p. 1663. The whole production with its impressive array of marshalled facts and its clear and judicious exposition is a contribution to its subject for which every neurologist will be grateful.

Organic Chemistry in Theory and Practice

(1) **Essential Principles of Organic Chemistry**
By Prof. Charles S. Gibson. Pp. viii+548. (Cambridge: At the University Press, 1936.) 18s. net.

(2) **Organic Chemistry: the Chemistry of the Compounds of Carbon.** By Prof. L. J. Desha. (International Chemical Series.) Pp. xv+750. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 21s.

(3) **Practical Organic Chemistry:**
By Dr. F. G. Mann and Dr. B. C. Saunders. Pp. xiii+403. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 8s. 6d. net.

(4) **An Introduction to the Preparation and Identification of Organic Compounds**
By Prof. R. D. Coghill and J. M. Sturtevant (International Chemical Series.) Pp. xiii+226. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 10s. 6d.

(1) and (2). The chief problem that faces authors of text-books of organic chemistry is that of selection of what is worth while from the vast mass of original literature. In books of moderate size, choice and arrangement of topics are all-important, and the reviewer's task is to consider whether they have been made with proper regard to the theoretical and practical development of the science. In this respect, the authors of both these books may be considered to have succeeded.

The standard is roughly that of a first-year university course, and the books serve as general surveys, which prepare the student for more specialized work. Only where the method is particularly valuable, as in the tautomerism of acetoacetic ester, has a problem been approached from the historical point of view. References are wisely omitted; for here they would only disturb the continuity, and needlessly increase the size. The authors have realized that a text-book of organic chemistry is something different from a suitably abridged version of Beilstein's "Handbuch"; theirs has been a more philosophic approach in which essential principles are emphasized, and in which descriptions of compounds and reactions are presented only in so far as they illustrate them. Thus the subject is taught as a science, and not merely as a technique. The old subdivision into aliphatic and aromatic has been largely abandoned, the grouping being according to function. Aliphatic and aromatic hydrocarbons

are treated together, so that the fundamental similarities and differences may be appreciated. Derivatives then follow in their appropriate groups of ketones, acids, amines, etc., with accounts of modern developments appearing in the proper context.

Prof. C. S. Gibson, as befits a teacher at a great hospital, stresses particularly the biological side of the subject. The properties and reactions of biologically important compounds such as lecithin and adrenaline are described at length, and the special value of the book to medical students is enhanced by the full treatment accorded to amino-acids, carbohydrates and purines. A number of representative preparations, and an appendix on practical methods are given. The too frequent use of footnotes is injudicious; for many are too long, and their subjects might well appear in the main text.

Prof. L. J. Desha in particular makes frequent reference to industrial methods, and is alive to the importance of catalytic and high-pressure processes. His book, which is rather wider in scope, includes under the title of "Special Results of Certain Structures" a convincing treatment of such themes as tautomerism, re-arrangements, colour and dyeing. It concludes with a long section on plant and animal products, so that students may have a better knowledge of the "composition of the food they eat, the clothes they wear, and the bodies thus fed and clothed". But even here, Prof. Desha is more concerned with the industrial significance of the products. Special features of his book are the questions at the end of each chapter, and the charts showing the inter-relationships of compounds.

(3) and (4). In his foreword to the first of the two practical books, Sir William Pope reminds us that the "vast superstructure of organic chemical theory" has been based on careful experimental work. It is significant therefore that the four authors confess that the students do not readily link in their minds the 'paper' chemistry of the lecture room, and their own efforts in the laboratory. With this salutary thought, they set out to effect that essential liaison between theory and practice, and they should achieve a large measure of success. Both books may be recommended for the important reason that the authors write from their own experience of large classes, and have borne in mind the cost of materials, the time available, and the convenience of operations. Both pay special attention to safety precautions not only by

prefatorial injunctions, but also by appropriate warnings in the text. Preparations have been carefully chosen, with the view of illustrating reactions and also giving practice in a wide variety of operations. Each is prefaced by a theoretical discussion, and is concluded by an account of the reactions of the product. The modern method of teaching aliphatic and aromatic chemistry together has aided in their selection and arrangement.

The English work is much longer and more comprehensive; in addition to preparations and identification, it deals very fully indeed with quantitative analysis, and has a useful section on practical enzyme chemistry. It is so composed that its earlier pages can introduce the subject in schools, whilst it should prove useful to honours

degree students. The very full accounts of practical operations should be of great value in large classes where personal supervision is limited. Every student of organic chemistry will require this extremely low-priced book.

Special emphasis is laid by the American authors on the section dealing with the identification of compounds. They justly point out that a wide experience in practical chemistry, including incidental preparative work, can be gained by it, especially in the important matter of the manipulation of small quantities. They have exercised great care in the preparation of this section, and they claim that their methods, which have been thoroughly tried out at Yale, prove interesting as well as instructive to students. L. P. W.

Evolution of Kingship

Kings and Councillors :

an Essay in the Comparative Anatomy of Human Society. By A. M. Hocart. (Egyptian University Collection of Works published by the Faculty of Arts, No. 12.) Pp. 306. (Cairo: Egyptian University; London: Luzac and Co., 1936.) 4s. 6d.

MR. HOCART has already written an interesting work on the evolution of kingship; and here he deals further with the subject. Starting from the primitive man's desire to control Nature for his own benefit, as expressed in a ritual that mimics or prefigures the fulfilment of his wishes, he finds the prototype of the king in the leader of the ceremonies—the *choregus*, as we may say. Not very explicitly, since he prefers not to enter into the psychology of symbolism, he supposes the protagonist to become somehow identified with his objective, namely, Nature and all that it yields in support of human life; while, by a like process of identification, he is made equivalent to the cult-object as represented by animal, tree, victim, idol and so on. It is explained that "the essential thing in worship is not reverence but identity"; so that killing the king in solemn sacrifice is all in the day's work.

Such identity, it is added, consists in the fact that all alike are "receptacles of the same spirit, life, or whatever you may choose to call it". As owners of the various receptacles, the worshippers are apparently in a position to enjoy to the full this spirit or life at large in the universe, though but at second hand; since it is the splendour of the king that "provides the hard-driven peasant

with escape from his drab drudgery"—so much so that, if he realizes that he is but contributing to its upkeep, he will pay his taxes willingly, just as he should in duty welcome the privilege of paying tithes.

Meanwhile, the evolution of kingship would seem in certain respects to have been a degradation in the light of the early notion that a king is meant to reign rather than govern. In place of the undifferentiated quest for life of primitive times which takes concrete shape in the divine king as in an image, the modern world has by specialization narrowed down the aims of the social life as religious or civil, rather than as both together; so that in becoming administrative the higher offices of State lose in representative significance. For the rest, we are assured that "we vastly exaggerate the importance of government in our society", seeing that it is self-help that really governs. As for certain recent developments of the political leader, Mr. Hocart must, if he would follow ancient precedent, allow his claim to infallibility, but might likewise insist that an euthanasia goes suitably with that prerogative.

Taken as a whole, this essay is very suggestive, and it will come as a revelation to many that practical politics not only have had a mystical background, but even to-day may depend on the traditional sanctities of life for their subconscious motive. It is a pity that the author goes out of his way to "abjure the method of Tylor and his successors". He has inspiration enough to fill his chapel without pitting himself against the fathers of the church. R. R. M.

An Introduction to Nematology

By B. G. Chitwood and M. B. Chitwood. Section 1, Part 1. Pp. 53. (Baltimore, Md.: Monumental Printing Co., 1937.) 2.50 dollars.

THE Nematode worms, although forming a large class which includes many economically important species, usually receive little attention in zoological textbooks. The appearance of a comprehensive account of them in the English language is therefore to be welcomed, and the work, of which this is the first part, will probably contain many surprises for zoologists unfamiliar with the great mass of recent work on the group.

The first chapter contains a semi-popular account of the occurrence, mode of life and economic importance of the Nematodes, and a brief outline of the history of their study. There follows a short summary of their general structure, which might with advantage have been written rather more simply and with fewer technical terms of very recent origin. The next two chapters are devoted to detailed accounts of the cuticle and hypodermis and of the musculature and body-cavity, and will doubtless be followed by chapters on the other organs and systems.

Two "outline classifications" are included, the first containing short definitions of subclasses, orders, suborders and superfamilies, the second still briefer definitions, but extending to subfamilies. The classification adopted embodies advanced views which have not yet stood the test of criticism, and it may be doubted whether the primary division of the class into "Phasmidia" and "Aphasmidia", based on the presence or absence of a pair of small sense-organs on the tail, will prove generally acceptable. The authors' views on taxonomy need not, however, detract from the usefulness of the work.

The text is printed in double columns of rather small type, which some will find a disadvantage, but is profusely illustrated with good figures. A useful feature is the separate bibliography at the end of each chapter or section.

H. A. B.

Logging—Transportation :

the Principles and Methods of Log Transportation in the United States and Canada. By Prof. N. C. Brown. Pp. xv+327. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 20s. net.

PROBABLY about two million people in North America are dependent on the timber industry. This is at present carried on entirely in virgin forests, though replanting and conservation are safeguarding them for the future. Obviously Nature alone cannot have developed either roads or navigable streams in such parts, and it hence becomes clear that half the cost of board or beam is absorbed in its transport; hence this text-book specialized solely to this one question. The operations after felling are the assemblage of the tree trunks at convenient spots (skidding) and the long-distance transport to the saw mills. Up to the present, the cheapest and most convenient means of transport have been streams and rivers, but these are unsuitable to the heavier hardwoods; and much of the standing timber now

lies at higher elevations and remote locations. The question is one of the value of the timber: whether it will pay for the necessary horse or power tractors or chutes to assemble it for water flotation or for rail. The whole book is the story of the engineers' ingenuity in the adaptation of their needs to local topography, and they are the class who will appreciate this admirable and well-illustrated book.

A Manual of Practical Anatomy :

a Guide to the Dissection of the Human Body. By Prof. T. Walmsley. New edition. In 3 Parts. Part 1: The Head and Neck. Pp. viii+357+3 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1936.) 12s. 6d. net.

THE study of practical anatomy remains, along with instruction in clinical examination, the best of the scientific disciplines to which the medical student is subjected. Each, however, must discard what is redundant, useless or unnecessary, and each must adopt new methods when they are better. In anatomy much useless information has been assembled and taught about the relations of one structure to another. On the other hand, much valuable information about the structure and function of the body has not found its place. For many purposes the X-ray machine is better, more informing and more accurate than the method of dissection.

The present book is shorter than others, and does something to lessen the drudgery of the student. By keeping to illustrations that are simple it remains a dissecting manual, and in furnishing outlines to be filled in by the student it uses a valuable device for learning. The value of the X-ray method of studying anatomy is shown by the reproduction of X-ray films. The skilful use of small print helps the student to evaluate better the information he is acquiring.

This useful and straightforward dissecting manual is a contribution towards a more satisfactory presentation of the anatomy of the human body.

A History of Fishes

By J. R. Norman. Second edition. Pp. xv+463+8 plates. (London: Ernest Benn, Ltd., 1936.) 15s. net.

FIRST published in 1931, this book is by now sufficiently well known and appreciated to render a lengthy review unnecessary. A veritable encyclopædia on fish-life, profusely illustrated by Lieut.-Col. W. P. C. Tenison, it is a most interesting and useful volume which most specialists and many laymen would like to have on their bookshelves. Hitherto, the published price of 28s. net has prevented this, but the recent issue of a photo-lithographic reproduction of the original work, at the much more favourable price of 15s., will enable many more to purchase a copy. Comparing this second edition with the first, it must be admitted that the print has lost quality in the process of reproduction, although the general result is surprisingly good. The binding, however, would seem to leave something to be desired, since the plates (at least in the reviewer's copy) will soon become detached, including the most attractive photograph of the angel fish which forms the frontispiece.

Meteorites and the Craters on the Moon

By Dr. L. J. Spencer, C.B.E., F.R.S.

SEVERAL views have, from time to time, been put forward to explain the origin of the remarkable series of shallow craters on the surface of the moon. One of these is that they were formed by the impact of meteorites. Two main objections to this view have been frequently stated. It is said that all meteorites would not have fallen in a direction perpendicular to the surface to produce craters of a circular outline: many must have fallen obliquely and formed oval craters. Again, it is often asked: Why is the earth's surface not pock-marked in the same fashion? A study of meteorite craters and of meteoritic showers¹ on the earth's surface shows that both these objections are without justification.

Since the discovery of the meteorite craters at Henbury in Central Australia² in 1931 and at Wabar in Arabia³ in 1932, it has been clearly demonstrated that these are not craters of impact or percussion, but that they are explosion craters. The kinetic energy of a large mass of iron (nickel-iron) travelling at a high velocity, was suddenly transformed into heat, vaporizing a large part of the meteorite and some of the earth's crust, so producing a violent gaseous explosion, which formed the crater and back-fired the remnants of the meteorite. Such an explosion crater will be circular in outline whatever be the angle of approach of the projectile. The materials collected at the Wabar craters afford the clearest evidence that very high temperatures prevailed. The desert sand was not only melted, yielding a silica-glass, but this boiled (b.p. about 3,500°C.) and was vaporized. The meteoritic iron was also in large part vaporized, afterwards condensing as a fine drizzle. Minute spheres of nickel-iron, of the same composition as the meteorite, are preserved in the bubbly silica-glass. In some portions these are present to the extent of about two million per cubic centimetre of the glass. The fact that these minute spheres show a bright and highly polished surface suggests that the earth's atmosphere was blown aside in the fiery blast.

On the earth's surface, only five really certain examples of meteorite craters are yet known. These are all associated with fragments of meteoritic iron. Stony meteorites have not been found around any crater, despite the fact that, of observed meteoritic falls, 95 per cent are stones. Irons form only 5 per cent of observed

falls; but they account for 82 per cent of 'finds' of which the fall is not recorded. The friable stony meteorites are usually broken up in the earth's atmosphere, and fall as a shower of stones. Only a really large mass of iron can possibly give rise to a crater. Near the largest known iron meteorite, the Hoba in South-West Africa, weighing 60 tons (or 100 tons allowing for the surrounding zone of iron-shale), there is no sign of a crater.

Astronomers, who revel in large numbers, tell us that some twenty million meteors enter the earth's atmosphere every day. The majority of these are assumed to be the size of a pea or a grain of sand. But perhaps they may be much larger, for the ablation of material from the surface of a meteor must be enormous. In any event, those that reach the earth's surface must have been very much reduced in size; and the number actually collected each year averages only five. We have to be thankful that our atmosphere extends for at least a hundred miles above the earth's surface.

On the moon, with the absence of an atmosphere, conditions are very different. Meteorites there will encounter no check on their velocity. They will not be reduced in size, and stony masses will not be broken up. They will strike the surface at 20 or 40 or more miles per second. An astronomically small body with a radius of 100 feet and consisting of nickel-iron with a density of 7.7 will have a mass of very nearly a million tons and a kinetic energy measured by $\frac{1}{2}mv^2$. When this is arrested, something is going to happen. Part of the energy will be expended in penetrating and compressing the materials on the surface of the moon. This pressure will be released with explosive violence and moonquake waves will result. But a large part of the energy will be transformed into heat, vaporizing the meteorite and adjacent materials, and causing a violent gaseous explosion.

The idea of such a gaseous explosion was anticipated before the discovery of the Henbury and Wabar craters in a remarkable paper which has only now come to my notice and which appears to have been generally overlooked. In 1924, A. C. Gifford⁴ compared the craters on the moon with the Arizona crater, and he concluded that they are explosion craters. The energy of a meteorite travelling at 20 miles per second he

calculated to be 123,900 calories per gram, and at 40 miles per second to be 494,700 cal./gm.; compared with the energy of dynamite of about 1,100 cal./gm. He assumed that the meteorite would penetrate to a depth of two miles in the moon's crust (but this is surely too deep), and calculations for various velocities (0.01–0.32 miles per second) of the ejected materials gave for the resulting craters diameters of 0.197–202 miles across the rim. He further showed that a central peak will be formed inside the crater, and that the amount of material ejected may be fifty or sixty thousand times the mass of the meteorite.

S. Mohorovičić⁵ in 1928 also concluded that the lunar craters are explosion craters, but he attributed them to explosive volcanic action. By exploding charges buried in cement powder, he produced craters with a striking resemblance to those on the moon, some of which show the central peak and the outer radial streaks. Similar craters were also produced by Alfred Wegener⁶ by throwing spoonfuls of cement powder on to a level surface of the same material; and he concluded that the lunar craters were formed merely by the impact of meteorites. Robert Hooke in his "Micrographia" (London, 1665, p. 243) compared the craters on the moon with those formed by the "eruption of vapours" on the surface of "a pot of boyling Alabaster", and with those formed by dropping bullets on to wet "Tobacco-pipe clay". He rejected the analogy of impact, for, as he naively remarks, "it would be difficult to imagine whence those bodies should come." In his day, reports of the fall of stones from the sky were discredited by scientific men. These experimental craters are shallow saucer-shaped depressions with a steep inner slope at the rim and a gentle slope outside, just as is seen in meteorite craters. Larger artificial craters of the same kind are formed by high-explosive shells and military mines.

The bright streaks radiating for hundreds of miles from some moon craters, for example, Tycho and Copernicus, but casting no shadows and conspicuous only at full moon, present a difficult problem. These craters may perhaps be due to the fall of large meteoritic irons, the density of which is 7.7, as compared with 3.5 of stones. The vaporized metal probably condensed as millions of tiny spheres, as at Wabar. (An astronomical calculation will give the number of such spheres, 0.01 mm. in diameter, that could be produced from, say, a million tons of metal!) The force of gravity on the moon being only one sixth of that on earth and there being no air resistance, such particles might be projected for great distances by the explosion. Experimental explosion craters show rays of material beyond

the crater rim; Mohorovičić obtained rays a metre in length outside a crater 3.6 cm. in diameter. It may be suggested that these bright streaks on the moon are areas covered by tiny spheres of shining metal. Some support to this view is given by the fact that the ratio of the number of craters showing bright rays and spots to those without these features is of the same order as the ratio of the numbers of irons and stones that reach the earth. Craters that show no bright rays and spots can then be supposed to have been formed by the fall of stony meteorites.

The darker areas or 'seas' of the moon show fewer craters, and some of those around the borders are broken. These areas perhaps represent lava-fields of more basic lava from fissure eruptions, comparable with the plateau basalts of the Brito-Arctic region, the Columbia River in the western United States, and the Deccan in India. (The density of basalt, 2.8–3.1, is less than that of the moon as a whole, 3.3.) Such areas must be of later date than the broken craters and the surrounding mountains; but earlier than the fewer perfect craters within the areas, and also earlier than the bright streaks running across them from craters outside. The mountains are no doubt the result of crustal movements following shrinkage; and are earlier than the lava-fields. The several craters evidently belong to different periods. Some were no doubt formed when the moon first had a solid crust. Except when engulfed by lava-fields, these features will persist, for, in the absence of water and an atmosphere, there can be no denudation, as takes place on the earth. The effects of insolation and desert weathering must, however, be particularly severe—a point that does not seem to have been realized. With the sudden changes in temperature from the very hot day to the very cold night, each with a duration of half a lunar month, rocks will be exfoliated and crystals cracked along their cleavages, and all materials on the surface will be reduced to a fine powder.

On the earth, the few known meteorite craters are of recent formation, though none within the historic period. The same is true of the fall of the eleven known larger masses of meteoritic iron, ranging from the Hoba of 60 tons to the Cranbourne of 3½ tons in the British Museum collection. These will be destroyed by weathering and all traces of them obliterated by denudation long before the next geological period. Fossil meteorites are not known; nor is there any probability of any ever being found. The argument based on the absence of pitting on the earth's surface could never have come from a geologist.

Considered as volcanoes, the lunar craters can be compared only with explosion craters.

None of them shows a cone reaching as high as the outer rim. Further, these cones are usually craterless, and more of the nature of a central peak. In nearly all the craters the rim is complete. In the few good examples of terrestrial volcanic explosion craters, formed by the blowing away of the cone of a typical volcano, the rim is always broken. The Monte Somma rim extends only half-way round the new Vesuvius, and the rim of Krakatoa is very irregular. The quiescent type of the Hawaiian volcanoes have craters of irregular outline. Photographs of a model of Vesuvius and the volcanoes of the Phlegrean Fields have been given to show an apparent similarity to the lunar craters; but the photographs, being taken in plan, are misleading, for these volcanoes are actually cones rather than depressed craters. Terrestrial volcanoes are distributed along lines of weakness in the earth's crust; whereas the craters on the moon are scattered about promiscuously, as if from a pepper-pot.

A point that perhaps invalidates the meteorite theory is that there is no evidence of the formation of craters on the moon at the present time. An

apparent variation in the size and brightness of the small crater mapped as Linné affords the only doubtful evidence of any change. Nevertheless, meteorites are still falling on the earth, in spite of the protecting atmosphere; and presumably they must also be falling on the moon. In earlier periods it is evident that the meteoritic bombardment must have been much more intense. Maybe the larger stray masses of the solar system have already been gathered up. On the earth during historic times there has been no catastrophic fall, except perhaps that on June 30, 1908, at a spot in central Siberia, almost as inaccessible to us as the moon itself, and of which precise information is still lacking.

¹ Details are given in recent papers in the *Mineralogical Magazine*, and abstracts of recent literature in *Mineralogical Abstracts*.

² NATURE, 129, 781 (1932).

³ NATURE, 129, 932 (1932).

⁴ Gifford, A. C., "The Mountains of the Moon." *New Zealand J. Sci. Tech.*, 7, 129-142 (1924); and recapitulation in 11, 319-327 (1930). See NATURE, 126, 379 (1930).

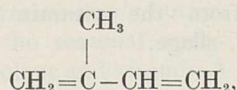
⁵ Mohorovičić, S., "Experimentelle Untersuchungen über die Entstehung der Mondkrater: ein neuer Beitrag zur Explosionshypothese." (Croatian with German summary.) *Archiv za Hemiju i Farmaciju, Zagreb*, 2, 66-76+4 plates (1928).

⁶ Wegener, A., "Die Entstehung der Mondkrater." (Sammlung Vieweg, Heft 55, Braunschweig, 1921).

Pigments Associated with the Fatty Tissues of Plants and Animals*

By Prof. I. M. Heilbron, F.R.S., and A. E. Gillam

TURNING now to a brief consideration of the question of the biogenesis of the carotenoids, their structure reveals an obvious connexion with isoprene



a hydrocarbon that may be regarded as the fundamental unit from which numerous important plant products are elaborated, as a result of the regular combination of individual units. The fact that the carotenoids are symmetrical necessitates, however, the assumption that they are built up in the plant, not on this simple plan alone, but by the union of two molecules of an intermediate compound containing twenty carbon atoms. According to Karrer, this may be the alcohol phytol, $\text{C}_{20}\text{H}_{30}\text{OH}$, which constitutes approximately one third of the chlorophyll molecule. Condensation of two phytyl residues could thus theoretically give rise to lycopene from which, by simple ring closure, the carotenes would be produced.

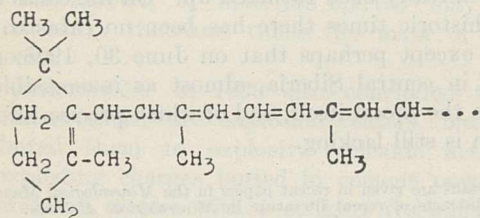
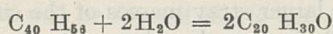
In conclusion, the physiological importance of

these pigments in the economy of life must be considered. So early as 1919, Steenbock advanced evidence of a possible connexion between carotene and vitamin A, the physiologically important substance found in all liver oils, notably those of the cod and halibut. This is essential for growth, for in its absence young animals cease to grow, and ultimately die. More specific effects due to vitamin A deficiency are the eye disease, xerophthalmia, decreased resistance to respiratory infections and night-blindness. This latter affection is completely curable in a few days by the absorption of food rich in vitamin A; its cause appears to be related to the fact observed by Wald that the vitamin plays an essential role in the visual perception which occurs on the retina of the eye. The vitamin itself forms an almost colourless highly viscous oil which is notable for its intense absorption band at 328 m μ , and the characteristic blue colour which it gives with antimony trichloride. It is thus clear that the pigment carotene cannot itself be vitamin A, but, as established by von Euler in 1929, it can nevertheless replace the typical vitamin in the animal organism. Complete clarification of this apparent anomaly was reached when Moore conclusively

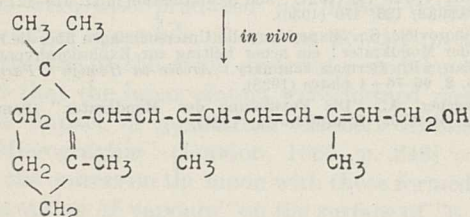
* Continued from p. 615.

demonstrated that if carotene is fed to rats suffering from vitamin A deficiency, it is converted into the colourless vitamin, which appears in the liver.

The structure of vitamin A has been established, and its formation from carotene may be represented by the following equation, although the exact mechanism of conversion is still obscure :



$\frac{1}{2}$ β -Carotene



Vitamin A

Arising from the foregoing, it follows that animals are primarily dependent upon the carotene of grass for their supply of vitamin A. The full appreciation of this fact opens up interesting problems for mankind, and much experimental work is being carried out in order to make use of this new knowledge.

Of the many studies which have been made of the variations in the carotene and vitamin A content of milk as affected by the diet, breed, age, etc., of the cows, I need only mention a few carried out notably by Steenbock in America, by Messrs. Imperial Chemical Industries, Ltd., at their experimental farm in Berkshire, as well as in our own laboratory.

Palmer and Eccles were the first to prove that the yellow colour of butter is mainly due to carotene. The further discovery that butter also contains vitamin A and that the two pigments can be quantitatively evaluated by spectroscopic methods opened the way to the investigation of the factors controlling the quantities of these substances in milk and butter. The actual amounts normally present in milk fat are extremely small, namely, carotene 1-20 parts and vitamin A 2-20 parts per million. In collaboration with Prof. J. C.

Drummond of University College, London, Dr. R. A. Morton of Liverpool University, and Dr. S. J. Watson of I.C.I. Agricultural Research Station, we have, during the past few years, been examining the possibility of maintaining the high vitamin content of summer milk throughout the winter. We have ascertained that by employing grass, artificially dried in specially designed driers, in place of part of the concentrates usually given to stall-fed cattle in the winter, both the vitamin A and carotene content of milk (and hence of butter) can be maintained at nearly the level usually regarded as peculiar to summer samples. In a particular experiment, one group of Shorthorn cows was stall-fed on a normal diet throughout a whole winter, whilst another group had a dried grass supplement replacing part of the concentrates. Vitamin A and carotene were determined in the milk fats once a month and the results, expressed graphically in Figs. 1 and 2, leave no doubt as to the efficacy of the dried grass supplement.

Similar experiments have been carried out with A.I.V. silage instead of dried grass. This particular silage is made by storing the fresh grass in a silo and conserving it by sprinkling with dilute acid, the process being due to A. I. Virtanen of Finland.

The following results are typical of those obtained with this fodder. A group of thirteen pure-bred South Devon cows were stall-fed for five weeks on an ordinary winter ration of hay and concentrates. They were then placed on a diet containing 40 lb. of A.I.V. silage per cow per day for five weeks, and afterwards transferred back to the control ration for another five weeks. The colour, carotene, and vitamin A values of the resulting butters are shown in Table 4 and clearly demonstrate—from the vitamin A angle—the value of A.I.V. silage.

TABLE 4

EFFECT OF A.I.V. SILAGE IN THE RATION, ON COLOUR, CAROTENE AND VITAMIN A CONTENT OF MILK FAT. (SOUTH DEVON COWS.)

	Ration	Date of sample	Yellow Colour (Lovibond units)	Carotene (mgm. % fat)	Vitamin A (mgm. % fat)
1st Period	Control				
	5 weeks	Jan. 25, 1933	4.0	0.10	0.18
2nd "	A.I.V. silage				
	5 weeks	March 1, 1933	8.4	0.27	0.41
3rd "	Control				
	5 weeks	April 7, 1933	2.8	0.11	0.24

Although the vitamin A activity of a butter can in general be roughly correlated with its yellow colour, we have found that this is only strictly true when comparing butters from the same breed of cow. Thus when Shorthorn or Ayrshire cows were fed on a ration rich in carotene, the yellow colour rose to a maximum above which the further addition of carotene in the diet would not increase it. The Shorthorn butter was, however, always somewhat more yellow than that

obtained from the Ayrshire cows. The traditionally high yellow colour of the milk in Jersey and Guernsey cattle is due to their having a higher 'ceiling value' for carotene in their milk-fat than any of the other breeds. Experimental results indicate, however, that although Shorthorn milk-fat is normally paler than that from the Guernsey cow, the gross vitamin A activity is about the same; this is due to the fact that the milk of the Shorthorn has a slightly higher proportion of the true vitamin A.

The figures in Table 5 were obtained by spectrophotometric examination of the milk fats of pure-bred Shorthorn and Guernsey cows kept on the same diet at the National Institute for Research in Dairying. Parallel biological tests for gross vitamin A potency carried out by Dr. S. K. Kon showed that the butters of the two breeds were indistinguishable at each of the three seasons.

The differences in carotene and vitamin A content of the milk of different species of animals are exemplified by the Guernsey cow and the goat; for the latter, in striking contrast to the former, gives a butter which is almost dead-white in colour. Despite the almost total absence of carotenoids in goat's butter, it nevertheless contains vitamin A in amount only slightly lower than that of an average cow's butter.

Although the seasonal variations in the colour and vitamin A content of milk and butter are actually directly due to the presence or absence of carotene in the diet, that is, fresh green grass is necessary to produce good yellow butter, there is one exception to this generalization. Whatever the breed of cow or the season of the year, the colostrum is usually 10-20 times richer in both vitamin A and carotene than is the normal milk. The quality falls rapidly from the first day after calving and reaches normality again in about a week. This richness in vitamin A is therefore quite consistent with the traditional belief in the high food value of colostrum, and furnishes another remarkable example of the way in which biological processes provide for special circumstances

in the life of the organism. These phenomena have been shown to be exactly paralleled in the human subject.

Examples of the relative vitamin A values of ordinary and colostrum milk are given in Table 6, the results having been obtained in the course of the experiments described above.

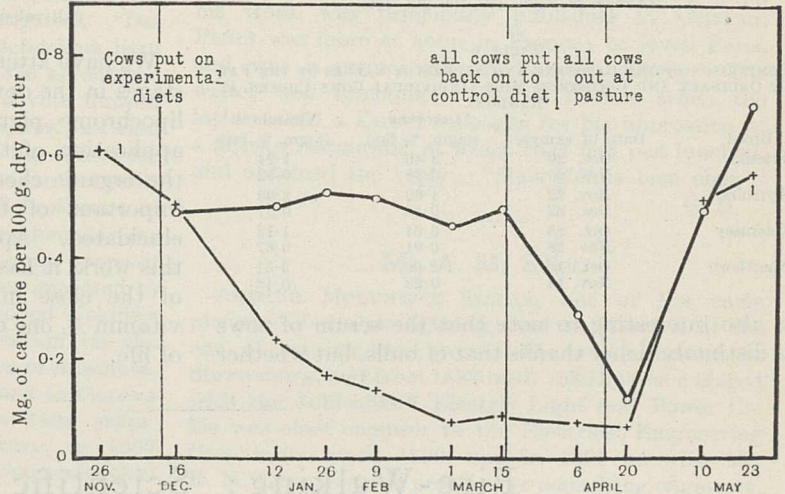


Fig. 1. CAROTENE OF THE BUTTERS
+ — +, control ration. o — o, artificially dried grass ration.

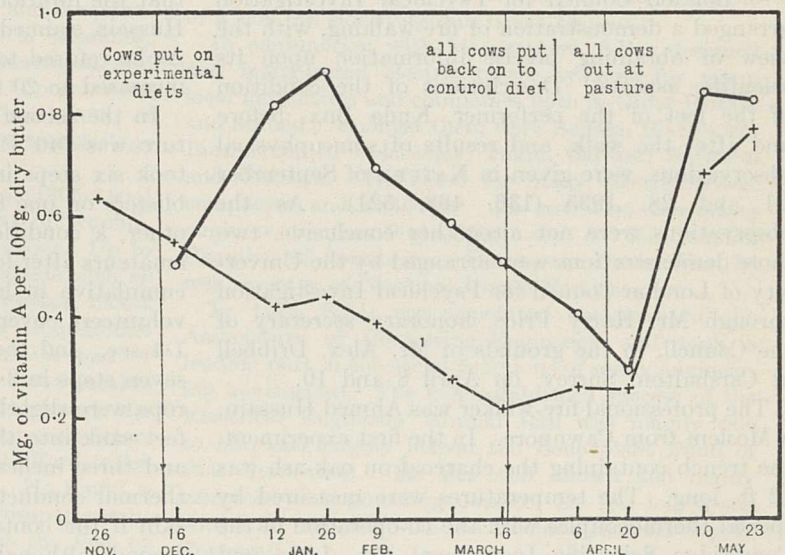


Fig. 2. VITAMIN A* OF THE BUTTERS
+ — +, control ration. o — o, artificially dried grass ration.

Examination of the carotene and vitamin A values of milk-fat leads to a consideration of the vehicle by which the carotene of the food is transported to the udder of the cow, namely, the blood serum. Studies of bovine blood sera have shown that the carotene and vitamin A

* Results expressed here and throughout this article are based on the assumption that pure vitamin A has an intensity of absorption of $E_{1cm}^{1\%} 328 m\mu = 1600$.

vary with the amount of carotene in the food, thus being richer in summer than in winter. It

TABLE 5
CAROTENE AND VITAMIN A VALUES OF SHORTHORN AND GUERNSEY BUTTER FATS UNDER IDENTICAL CONDITIONS OF FEEDING

	Shorthorn		Guernsey	
	Carotene	Vitamin A	Carotene	Vitamin A
Summer	0.78	1.10	2.24	0.89
Autumn	0.67	0.93	1.80	0.70
Winter	0.19	0.39	0.50	0.34

(Values as mgm. per 100 gm. fat).

TABLE 6
COMPARISON OF THE CAROTENE AND VITAMIN A VALUES OF THE FAT OF ORDINARY AND COLOSTRUM MILK (INDIVIDUAL COWS CHOSEN AT RANDOM)

Breed	Date of sample	Carotene (mgm. % fat)	Vitamin A (mgm. % fat)
Friesian	Oct. 20	3.40	1.24
	Nov. 20	0.38	0.52
Ayrshire	Nov. 22	4.60	2.96
	Dec. 22	0.18	0.37
Guernsey	Oct. 28	3.61	1.13
	Nov. 28	0.91	0.67
Shorthorn	Oct. 13	2.90	3.51
	Nov. 13	0.28	0.48

is also interesting to note that the serum of cows is distinctly richer than is that of bulls, but whether

this is due to a genuine sex difference or to different conditions of management has yet to be ascertained (cf. Table 7 due to Gillam and El Ridi).

TABLE 7
CAROTENE AND VITAMIN A IN COW'S BLOOD SERA (AVERAGE VALUES)

	Cows		Bulls	
	Carotene	Vitamin A	Carotene	Vitamin A
Winter	0.40	0.13	0.08	0.05
Summer	1.11	0.29	0.42	0.14

(All values as mgm. per 100 ml. of serum.)

We have attempted in the foregoing to trace the stages in the development of our knowledge of the lipochrome pigments and to show how, by the application of the elegant methods now used by the organic chemist, the constitution of the more important of these natural polyenes has been elucidated. Apart from the intrinsic interest of this work, it has led to the fundamental discovery of the close interrelation between carotene and vitamin A, one of the indispensable key substances of life.

Fire-Walking: Scientific Tests

EIGHTEEN months ago, the University of London Council for Psychical Investigation arranged a demonstration of fire-walking, with the view of obtaining precise information upon its scientific aspects. Descriptions of the condition of the feet of the performer, Kuda Bux, before and after the walk, and results of some physical observations, were given in *NATURE* of September 21 and 28, 1935 (136, 468, 521). As the observations were not altogether conclusive, two more demonstrations were arranged by the University of London Council for Psychical Investigation through Mr. Harry Price, honorary secretary of the Council, in the grounds of Mr. Alex. Dribbell at Carshalton, Surrey, on April 8 and 10.

The professional fire-walker was Ahmed Hussain, a Moslem from Cawnpore. In the first experiment, the trench containing the charcoal on oak-ash was 12 ft. long. The temperatures were measured by special thermocouples with the co-operation of the Cambridge Scientific Instrument Co., Ltd., and were shown to be 575° C. on the surface and 700° C. inside. After examination and tests for chemical treatment, Hussain walked the trench in 1.3 sec., showing no signs of injury. He then repeated the walk leading three amateur volunteers with the claim that they would be immune from burning. They were, however, all burned to a varying but slight degree. A further two volunteers then performed the walk separately and unaided. They were also slightly burned, and where the number of steps had been uneven, the foot that had been

down most often was most affected. This indicated that the injurious effect was cumulative, although Hussain claimed that he could walk any distance. As he refused to retrace his steps, the trench was increased to 20 ft. for the second experiment.

In the second experiment, the surface temperature was 740° C. and the inside 750° C. Hussain took six steps in 2.3 sec., and this produced five blisters on one foot and marked erythema on the other, a condition closely resembling that of the amateurs after four steps. The effect was therefore cumulative in his case also. One of the former volunteers covered the distance in four steps and 1.4 sec., and then later, in rope-soled shoes, took seven steps in 3.6 sec. The frayed portions of the rope were slightly scorched at the edges only. The feet sank into the ash to a depth of between two and three inches, and it seems clear that its poor thermal conductivity prevents damage to normal skin if the contact-time is less than about half a second, although the small flames within it will produce singeing of the hairs. This time corresponds with that of one quick step: two steps with the same foot could only be done without injury by the practised professional, and three steps was beyond his limit.

This small difference between amateur and professional, together with observations made during the experiment, make it very unlikely that any hypothesis of a special induced mental state is required, such as is, of course, maintained by the Indian performers.

Obituary Notices

Prof. A. Pictet

THROUGH the death, on March 12, of Amé Pictet, Swiss chemists have lost their doyen, and organic chemistry one of its foremost investigators. Descended from a family of bankers, Pictet was born at Geneva on July 12, 1857, and in 1876 he entered the local university. In deciding to devote himself to scientific investigation, he followed a Swiss patrician tradition which has given us, to name but a few, De Saussure the physicist and De Candolle the botanist, both citizens of Geneva, the Bernouilli brothers and the two cousins Sarasin, respectively mathematicians and oceanographers of Basle. After some years of study at Geneva under Marignac, Pictet migrated to Dresden, then to Bonn, where he attended Kekulé's lectures and wrote a doctor's dissertation on the esters of tartaric acid, under the direction of Anschütz. After further study in Paris, he returned to Geneva and became in 1882 *Privatdozent*, in 1894 extraordinary professor of organic chemistry, in 1897 ordinary professor of biological and pharmaceutical chemistry, and ultimately professor of inorganic chemistry.

Pictet's early work on heterocyclic compounds, such as phenyl indole, phenanthridine and isoquinoline was connected with his interest in alkaloids, dating from the time of his doctor's dissertation, and showing itself more fully in his book "Constitution chimique des alcaloïdes végétaux", Paris 1888, of which a second edition (1897) and several translations appeared.

The synthesis of nicotine by Pictet (1895-1904) attracted universal attention, like that of tropine, completed by Willstätter a few years earlier. Up to that time, only a few quite simple alkaloids such as coniine, had been synthesized. From nicotine, Pictet passed on to the still more complex isoquinoline alkaloids, and his syntheses of laudanosine and of papaverine, both in 1909, are among his most notable achievements. About 1912, Pictet abandoned the study of the alkaloids; questioned many years later, he gave as the reason that he could not afford to let his students waste expensive material. He found a new field in the extraction of hydro-aromatic substances from coal by benzene, and was the first to study coal tar produced at low temperature in a vacuum. This led him to distil starch and cellulose under reduced pressure, when (in 1918) he obtained a large yield of lævoglucozan, $C_6H_{10}O_5$, an anhydride of glucose prepared previously in small quantity by Tanret from certain glucosides. Then, entering further into the field of carbohydrates, he synthesized maltose and lactose, and published in 1929 a synthesis of cane sugar. The latter work could not be confirmed by others and it would appear that, in his old age, Pictet was duped by his collaborator; some two years later he retired from his professorship.

Pictet was a corresponding member of the Paris Academy of Sciences, an honorary fellow of the

Chemical Society of London, and an honorary member of the Dutch Chemical Society. Although until the foundation of the *Helvetica Chimica Acta*, his work was principally published in German, Pictet was more at home in France; he loved Paris, and was a connoisseur of French cookery. The writer well remembers Pictet's disdain when the latter asked a Dutch colleague for his impression of a famous restaurant, at which they had just lunched, and obtained the reply: "Mais c'était bien cher!"

G. B.

Mr. A. M. Sillar

ARTHUR MOLYNEUX SILLAR, one of the early pioneers of electric lighting, died on March 6 at the age of seventy-two years. He was educated at Shrewsbury, and from 1882 until 1886 he was engaged with the Jablochhoff Electric Light and Power Co. He was chief engineer to the Electrical Engineering Corporation until 1890, and in 1895 he with Mr. E. M. Lacey started practice as consulting engineers. His firm carried out the electrification of the Blackburn tramways in 1897, and in 1902 completed the Bournemouth tramways, this being the first example of a side rail slot system in Great Britain.

In conjunction with his partners, Sillar designed and inaugurated electric power systems for many local authorities and companies both in Great Britain and abroad. Amongst them were Belfast, Blackburn, Bournemouth, Colchester, Pekin, Salford, Swindon and Tientsin. He acted for many electric power companies and railways. He was also consulting engineer to the Post Office and to the London Chamber of Commerce. During the Great War, he was director of National Gauge Factories.

In 1922, Sillar was appointed chairman of the Association of Consulting Engineers, and took a leading part in the social functions of many engineering institutions. The long-established success of the Electrical Engineers' Annual Ball was mainly due to him and largely helped the Benevolent Fund of that Institution. He was well known and highly esteemed in engineering circles. He has left a son who is an engineer with the Calcutta Electric Supply Corporation.

WE regret to announce the following deaths:

Sir Henry Hadow, C.B.E., principal of Armstrong College, Newcastle-upon-Tyne in 1909-19, vice-chancellor of the University of Sheffield in 1919-30, on April 9, aged seventy-seven years.

Dr. William T. Hornaday, formerly director of the New York Zoological Park, known for his work in connexion with the protection of wild life, on March 6, aged eighty-two years.

Prof. Sydney Young, F.R.S., formerly professor of chemistry in Trinity College, Dublin, on April 8, aged seventy-nine years.

News and Views

World Congress of Faiths (Continuation Movement)

As a result of the first World Congress of Faiths held in London in July 1936 (see NATURE, 138, 1; 155) a Continuation Movement to promote further the objects of the Congress was inaugurated with the Maharaja Gaekwar of Baroda as international president and Sir Francis Younghusband as chairman. It is now announced that a week-end intensive Congress will be held at Oxford on July 23-27, when the subject for deliberation will be "The World's Need of Religion". Addresses for discussion will be delivered by members from the different religions, and devotional meetings will be led by representatives of the various faiths. A symposium on "Can Politics replace Religion?" will be conducted from three distinctive points of view, and at a public meeting to be held in the Oxford Town Hall on the evening of July 24 addresses will be given on the subject of "The World's Need of Religion". It may be recalled that the Congress was organized to promote a spirit of fellowship among mankind through religion, and "to awaken and develop a world loyalty, while allowing full play for the diversity of men, nations and faiths". It is, therefore, essentially a movement that is both international and inter-denominational in the broadest sense of the term.

At the successful London meeting, a large number of distinguished and representative members of the great religious faiths of the world were present, and spoke in support of the objects of the Congress, more especially in so far as they were directed to the promotion of world peace through the co-operation of men of the spirit in all countries and of all faiths. Since, however, the spirit of fellowship, which it is believed by promoters of the Congress is latent in man, needs to be intensified if it is to work out its effect to the full, the Continuation Movement seeks support with that end in view. Particulars of the Oxford meeting, at which accommodation for members will be provided at Balliol and Somerville Colleges, forms of application for membership, etc., are to be obtained from the Secretary, World Congress of Faiths, B/M Congress, London, W.C.1.

Cultural Contrast and Government in India

THE debate in the House of Lords on April 8 on the situation in India arising out of the inauguration of the new constitution made apparent, in the gravity of the issues shown to be involved, the need for a common idiom as between races and creeds such as is sought by the World Congress of Faiths. The lucid and well-balanced statement by the Marquess of Zetland in particular brought into high relief the justice of the frequently repeated contention that, in the clash of culture contact, understanding grounded on a knowledge of local culture and history

alone can alleviate and remove the inevitable misconceptions and friction, which arise in the fusion of mutually alien civilizations. In India, the freedom of democratic institutions, notwithstanding the misgivings expressed by those who claimed with reason an understanding of Eastern mentality, has been bestowed upon an oriental community, which has behind it a lengthy tradition, extending over centuries and even thousands of years, of submission to autocratic control. The resulting conflict, if the intransigence of the extremists of the Congress Party be ignored, is expressed on one side in Mr. Gandhi's explanation and amplification of the demand for the unqualified and unconstitutional abrogation of the powers of the Provincial Governors, and on the other in Lord Lothian's letter to *The Times* of April 6 and Lord Zetland's speech in the House of Lords. On one hand, the British Government and the British people are willing and anxious now that the die has been cast, to give every freedom to the peoples of India to win their way through responsible government to a position of independence within the Empire, yet they are at a loss before the naive simplicity of the over-subtle Eastern mind; on the other hand, Mr. Gandhi, who, whatever opinion may be held of his policy and political methods in the past, embodies, especially in the eyes of his co-religionists, all that is best and highest in Hindu culture, in common with others of his creed is unable to enter into an understanding of an honestly intentioned generosity which rests upon no legal bond as he understands it.

Hours of Employment of Young Persons

A SERIOUS gap in our social legislation is exposed by the report of the Committee on the Hours of Employment of Young Persons. Since the Factory and Workshop Act of 1901 and the Shops Act of 1934, limits have been set to the number of hours during which a young person may work, as well as to the amount of overtime and night work. A large class, estimated by the Committee at 125,000, still remains which is not covered by this legislation and is liable to be grossly overworked. This class consists mainly of van boys, hotel pages, messengers, cinema ushers, and the like. The chief objections to these forms of employment are that they are often spread out over long hours, that in busy periods there is no limit to the possible overtime that may be demanded and that often the jobs lead nowhere. That such a position should arise in so new an industry as the cinema industry indicates how sadly overdue is a real attempt to deal with recruitment on quantitative as well as qualitative lines, and the whole report strengthens the case for a scientific approach to the question of recruitment. The recommendations of the Committee include fixed hours, intervals for rest, weekly holidays,

strictly limited overtime for young persons more than sixteen years of age and its prohibition for those less than sixteen, as well as prohibition of night work for a period of 11 hours, and it is considered essential that immediate steps be taken to give statutory protection to the unregulated young persons covered by the Report. It is recommended that the regulation of the hours of work of those employed in connexion with factories, docks and warehouses should be entrusted to the Factory Department of the Home Office and, for the remainder, to the local authorities responsible for administering the Shops Acts.

Traffic in Women and Children in the East

A CONFERENCE of Central Authorities in Eastern Countries on the Traffic in Women and Children in the East opened at Bandoeng, Java, on February 2, as the outcome of investigations in 1930-31 by the League of Nations' Commission of Enquiry into the Traffic in Women and Children in the East. This Commission established that the international traffic in Oriental women and girls in the Near, Middle and Far East is, in the aggregate, large. The bulk of this traffic is Asiatic women from one country to another, mainly in victims of Chinese race, Japanese, including Korean and Formosan, coming next in numerical importance, and other nationalities being very much less represented. Traffic in Occidental women to the East, with certain exceptions, chiefly in the Mediterranean Near East, has markedly decreased. The agenda of the Conference consisted of six points covering the chief suggestions of the report for closer collaboration between central and other authorities; and between authorities and voluntary organizations; the protection of migrants, especially minors, victims, or potential victims, of the traffic; the employment of women officials; the question of the continued existence of licensed or tolerated houses, which are the chief agents of internal and international traffic in the Indian and Pacific Oceans; and problems involved in the position of women of Russian origin in the Far East. Nine Governments, including the United Kingdom (Governments of the Straits Settlements, Federated Malay States and Hong Kong), China, France, India, Japan, the Netherlands, Portugal, Siam and the United States of America participated, as well as representatives of the International Criminal Police Commission.

Exhibition of Chemical Engineering

AN exhibition, Achema VIII, devoted to chemical technology, in which nearly three hundred firms have already arranged to take part, will be held in Frankfurt-on-Main on July 2-11. Concurrent with the exhibition will be held the National Congress of German Chemists, the semi-centenary of the Verein Deutscher Chemiker, thereby providing the organizers of the exhibition with a unique opportunity of establishing the importance of the chemical engineer to the modern industrial community. The Hohenzollernplatz near to the University has been selected as the site of the exhibition, which will be housed in

four separate buildings. In the first of these buildings, having a floor area of 125,000 square feet and subdivided into three sections, termed Halls I, II and IIa in the official foreword, will be shown scientific apparatus including measuring, regulating and laboratory equipment, technical plant constructed from non-metallic materials, as well as machines for the manufacture, machining and shaping of synthetic materials. Two buildings, namely Hall III, having a floor area of 20,000 square feet, and Hall IV, with a floor area of 100,000 square feet, will be used to display technical equipment on a large scale such as machines and complete plants for the chemical and associated industries and similar exhibits. The last building is again subdivided into two parts, namely Hall IIIa with a floor area of 10,000 square feet which will be devoted to that part of the chemical industry engaged on the production of, and spinning of, artificial fibres, and Hall IIIb with a floor space of 5,000 square feet in which will be shown the publications of the various German scientific associations and societies. Arrangements have also been made for special meetings, conducted tours, showing of industrial films, excursions for visitors to the exhibition. Further information can be obtained about the meeting by application to the Deutsche Gesellschaft für Chemisches Apparatewesen EV, Achema Bureau, Berlin W 35, Potsdamer Strasse 103a.

Broadcasting in 1936

A REVIEW of the activities of the British Broadcasting Corporation during 1936 is given in the tenth annual report of the Corporation, which has recently been issued as a white paper (Cmd. 5406. London: H.M. Stationery Office. 6*d.* net). The year 1936 was conspicuous in the first instance because three successive kings were involved in turn in certain of the broadcast programmes. The report contains details of the outstanding items in a wide variety of programmes broadcast throughout the year, during which the home transmitters were in operation for 71,123 hours, of which the proportion of breakdown periods was 0.031 per cent. The corresponding aggregate time for the Empire transmitters was 16,577 hours, an increase of more than forty per cent on the figure for 1935. Apart from the maintenance of the stations and plant required for these services, the activities of the B.B.C. on the engineering side included the putting into service of the high-power transmitter at Lisnagarvey in Northern Ireland, the completion of a similar transmitter at Burghead in the north of Scotland and the construction of a medium power transmitter at Beaumaris in Anglesey, which has been put into service in the current year. Good progress has also been made with large-scale extensions to the Empire Station at Daventry. These include the commencement of a third transmitter of considerably higher power than those now in operation; together with the erection of additional masts for an improved aerial system, which is the outcome of experiments carried out at the Empire Station since it was first put into service in 1932.

Mention must also be made of the considerable experimental and engineering work involved in the equipment of the London Television Station at Alexandra Palace towards the end of the year under review. The report concludes with a summary of the financial position of the Corporation as at December 31, 1936.

The Need for Motor-car Inspection

REVISED regulations for the construction and use of motor vehicles in Great Britain have just been issued by the Ministry of Transport. They provide, among other matters, for the testing of brakes, steering gear, etc., of a vehicle on the road. In about a dozen of the States forming the U.S.A., it is compulsory for motorists to have their cars inspected to see that they comply with safety regulations. According to a recent note issued by Science Service, of Washington, D.C., it is an even chance whether the motorist will find that his car falls below the requirements for safety on the road or not. The most common fault is bad brakes, but it is not unusual to find that lights are out of focus and wheels out of alignment. In some cases, the owner finds that it would cost him more than his car is worth to make the repairs and so it is relegated to the scrap heap, an action which may possibly have saved the lives of other people as well as his own. Last year in Pennsylvania alone, nearly 15,000 of the vehicles were found to be decrepit, and quietly passed out of circulation. Whenever inspection laws are passed in a State, it has been noticed that there is a great decrease in the number of 'collegiate' models which run on the roads on four wheels with no brakes. It is impossible to say what percentage of highway accidents can be attributed to mechanical defects of the cars, as after a wreck there is little left to test. It is reasonable to conclude that when about half the cars in a State have faulty brakes, they are to blame for some of the tragedies which occur. Because cars are fitted with good tyres and good brakes initially, we are apt to forget that the average car on the road is nearly five years old and is generally slightly shaky. Railway trains and air liners, operated by experts, have to pass a rigid inspection to see whether they are safe. Motor-car drivers are usually amateur mechanics; it is rash to assume that their equipment is safe.

Education in Canada

CANADIAN education, as seen in the course of a four-months winter visit, was the theme of a paper read by Dr. F. H. Spencer, late chief inspector, Education Department, London County Council, before the Royal Society of Arts on November 11 last, and recently made available in print. Although the purpose of the visit was to lecture on English, not to investigate Canadian education, and Dr. Spencer disclaims any title to be listened to as an authority on this subject, his comparisons of school buildings, organization, teacher-training and university extension work in Canada and in England are enlightening, even though admittedly superficial. The most

satisfactory of his impressions was of the prevalent enthusiasm for popular education, and the most unsatisfactory was of excessive regimentation alike in the primary and in the secondary schools. He was struck by the importance of the service rendered by the universities through their extension departments, and especially their correspondence courses, to remote but interested and ambitious students in the backwoods. The travels of the university extension tutors in the winter into such remote regions provide them with a stimulating adventure—an experience to which a counterpart has sometimes been found in Great Britain, for remoteness is not always to be measured in miles. In the course of the discussion following the reading of the paper, Prof. Krug of Mt. Allison, New Brunswick, observed that there have been few more worthy contributions to Canadian education and to Empire unity than the visit paid to Canada last year by a group of British school administrators and inspectors; a visit which made, he said, a really deep impression.

Physiology and Hygiene in Education

THE place of physiology and hygiene in general education has yet to be effectively established. Intellectual assent has been generally accorded to Herbert Spencer's dictum—that such a course of physiology as is needful for the comprehension of its general truths, and their bearings on daily conduct, is an all-essential part of a rational education—but those responsible for curricula have not so generally given practical effect to such assent. The subject has lately been investigated by Dr. J. P. Rogers for the United States Office of Education. In his report on "Instruction in Hygiene in Institutions of Higher Education" (Washington, D.C.: Government Printing Office, 10 cents), he observes that only a third of the colleges and universities require attendance at a course in hygiene by their students, and it is rare that any instruction concerning the human body is furnished in the last three years of secondary school work. He quotes some interesting criticisms by university authorities of the methods of instruction in use: one president remarks "my observation has been that this course has been too technical and not sufficiently practical. *I have yet to find an instructor who can put the information in a practical way*". It takes an artist, says Dr. Rogers, to fill such a requirement, and the best teacher of hygiene is the master and not the servant of that body of tradition which passes for 'science' in his day.

Extension of Scientific Buildings in Oxford

A FORECAST of extensions of scientific departments in Oxford is contributed by Dr. A. S. Russell, of Christ Church, to the spring number of *Oxford*, the journal of the Oxford Society. Within three or four years, a new physics laboratory for Prof. F. A. Lindemann will, it is hoped, be put up in the Parks, when the Clarendon Laboratory, now occupied by him, could be adapted to the uses of the Department of Geology now inadequately housed in the Museum. These improvements are expected to be closely

followed by the erection of a great new physical chemistry institute. "The Oxford school of chemistry will then be without doubt the finest in the Empire". The article ends with a plea for the award of college fellowships to more of the best of the young men holding University posts in science, especially in the less popular sciences—engineering, zoology, botany, geology. The same number of *Oxford* has noteworthy articles on "Politics or Poetry?", on university camps for the unemployed (which have amply justified the money and effort expended on them), and on women as housing estate managers on the Octavia Hill system.

Medical Research in South Africa

MUCH important research work is summarized in the annual report of the South African Institute for Medical Research for 1935. The use of a 'mixed vaccine' for the prevention of pneumonia among the Rand native miners has been continued with encouraging results. In the Biochemical Department, a strange finding was that the leaf of a plant belonging to the yam family contained forty times as much iron as spinach. Lucerne has been found to be suitable for human consumption as an anti-scorbutic, and several mines are now including this plant as part of their vegetable ration. The influence of South African snake venoms, previously tested on animal tumours, has now been tried on human cancers. Cobra venom often produced a relief of pain in cases of cancer, but not always; and no permanent beneficial effect resulted. There was no evidence that African snake venoms had any action on the majority of malignant tumours in man. Rodents to the number of 2,026 were examined for presence of plague infection, of which 51 were found to be infected with *B. pestis*.

Standardization of Microscope Fittings

IN order that the microscope objectives of different makers might be interchangeable for use with the microscope stands of other makers, the Royal Microscopical Society of London drew up in 1858 a specification for the screw thread of objective and of nose-piece. This specification was revised in 1896, 1915 and 1924, and in its final form has been generally adopted by microscope makers at home and abroad. In view of the increasing use of apparatus above the eyepiece, a committee of the Society has now drafted specifications of standard sizes for the external diameter of the eyepiece end of the draw-tube and limits for the outside diameter of the eyepiece shoulder; these have been adopted by the Council of the Society and are detailed in the December issue of its journal (*J. Roy. Micro. Soc.*, 56, 377-380; 1936).

The Smithsonian Institution

THE report of the secretary of the Smithsonian Institution for the year ended June 30, 1936, refers to the continuation of the study of the relation of weather to changes in the sun's radiation. Two papers by Dr. C. G. Abbot appear to prove that the

short interval changes of solar radiation are of major influence on the weather for at least the following two weeks. To test this promising method of weather forecasting, seven additional observing stations are required, but a bill to provide funds for this purpose passed by the Senate was rejected later. The Division of Radiation and Organisms has continued its work on the dependence of carbon dioxide assimilation in wheat upon the wave-length of radiation as well as its experiments on the effect of ultra-violet rays on algae and of light of different wave-lengths on the growth of tomatoes. An extremely sensitive and quick-acting spectroscopic method has been developed for measuring the concentration of carbon dioxide, as well as a highly sensitive robust thermocouple. The Institution has also published the latest results of the high-altitude rocket experiments of Dr. R. H. Goddard, whose earlier work it supported for twelve years. In the most recent trial flights, the liquid-propelled rocket attained a height of 7,500 ft., its automatic stabilizer keeping the flight vertical. Sales of the Smithsonian Scientific Series continue to increase, and in addition to a summary of the work of the Institution and the financial report, the present report of the secretary includes appendixes giving more detailed accounts of the work of the National Museum, the Bureau of American Ethnology, the International Exchanges, the National Zoological Park, the Astrophysical Observatory, the Division of Radiation and Organisms, the Smithsonian Library, the National Gallery of Art and the Freer Gallery of Art.

National Museum of Wales

THE twenty-ninth annual report, for the year ending September 30, 1936, of the National Museum of Wales, gives evidence of steady progress. By an increase of £500, the Treasury annual grant for the year was raised to £17,375, and a detailed report, furnished to H.M. Treasury by the Council, and pointing to the increased expenditure necessitated by the opening of the east wing, had the effect of inducing an allocation of £18,500 for the current year and a promise of £20,000 per annum as from April 1, 1938. The increased grant has enabled the Council to found a Specimens Purchase Fund, to be applied to the purchase of collections or specimens of outstanding importance as the need arises, and to create a Department of Folk Culture and Industries, which was responsible for a special temporary exhibition of Welsh furniture. At that exhibition nearly a hundred examples of furniture, made or used in Wales, and ranging from Tudor to Georgian times, were gathered together. The list of free public lectures displays refreshing variety, and the installation of a 16 mm. sound film apparatus should add to the popularity of the Reardon Smith Lecture Theatre.

Dairy Research in Scotland

THE seventh annual report of the Hannah Dairy Research Institute, Kirkhill, Ayr, contains an account of the developments, finance, and research work of

the Institute during the year ending March 31, 1935. An important development has been a study of practical problems connected with grass conservation, made possible by a commercial grass-drying plant placed at the disposal of the Institute by the Agricultural Research Council. The condensing and drying of milk and the manufacture of canned milk products have also been investigated. Research work includes experiments on the nutritive value of milk for calves, the biochemistry of milk secretion, and studies on bovine tuberculosis, contagious bovine abortion and bovine mastitis. The pasteurization of milk and the bacteriological grading of milk have also been investigated. An inquiry into the consumption of milk by children of school age is in progress. As regards finance, State contributions and grants provide £8,000 a year, but an additional £2,000 per annum is required if the Institute is to carry through its full programme of work.

Social Services in the Soviet Plan for 1937

ACCORDING to the Soviet Union Year Book Press Service, the provisions of the 1937 Plan for the national economy of the U.S.S.R. in regard to the cultural and social services include the following: *Science*. 924.2 million roubles (about £93 million) for the maintenance of scientific institutions in 1937, as against 797.5 million roubles (£80 million) in 1936. Out of this sum, 245 million roubles (about £25 million) will be expended on general capital construction for the needs of science, to include an expenditure of 40 million roubles (£4 million) on putting up new buildings to house the institutions of the All-Union Academy of Sciences, and 25 million roubles (about £3 million) for the building of the All-Union Institute of Experimental Medicine. *Health Protection*. A sum of 7,528.1 million roubles (£753 million) for health protection in 1937, as against 5,803.5 million roubles in 1936. This sum includes an expenditure of 1,000 million roubles on buildings. The number of hospital beds in 1937 will be increased to 619,800, as against 564,000 in 1936; maternity beds to 11,078, as against 6,000 in 1936.

Truth and Propaganda

AN article by Prof. M. Polanyi in *The Manchester School*, 7, No. 2, entitled "The Struggle between Truth and Propaganda", although a somewhat polemic criticism of S. and B. Webb's "Soviet Communism: a New Civilization", is of wider interest through its plea for a more determined stand by scientific workers and other intellectual workers for free and impartial criticism against propaganda. Unless thinkers make a fresh stand everywhere, regardless of political consequences, for the criticism which is freely admitted in a democracy, truth will remain powerless against propaganda, the power of which has been immensely enhanced by new means which scientific discoveries and their application have put in its hands. The reconciliation of rival social doctrines, which alone can save Europe from destruction, cannot be attained except through tolerance and the acceptance of truth and facts, no matter how unpalatable or disconcerting to particular theories.

Germany and Science: Yesterday and To-day

A CORRESPONDENT has pointed out that the speech at the Heidelberg jubilee by Reichsminister Rust, which was referred to in NATURE of January 16, p. 98, stands in poor contrast to an equally proud speech of Helmholtz delivered in 1869 (*Les Mondes*, 21, 552). Speaking at Innsbruck at a gathering of German scientific workers and medical men, he claimed that Germany held the first place in the development of natural sciences because the German *savants*, unlike their French and English colleagues, could proclaim truth as they found it, without regard to the opinion of the world, to social and religious prejudices. Our correspondent remarks that there was more of Athens than of Sparta in such men.

Prof. H. E. Armstrong

THE familiar and welcome figure of Prof. H. E. Armstrong has been missed in scientific circles for several months; and his caustic comments upon contemporary views and events—both scientific and unscientific—have similarly been absent from the pages of NATURE and of other periodicals. Though, however, general physical weakness prevents Prof. Armstrong from moving about and attending meetings in the way he has done all his life, yet he still takes active interest in progressive work of every kind and asks his friends not to hesitate to communicate with him. He enters his ninetieth year on May 6, and maintains the indomitable and fearless spirit which has always characterized him. "I should like", he wrote a short time ago to an old friend, "to start over again in the hope that knowledge may be so made use of that some measure of tolerance and common sense will be infused into the nations."

Seventh International Congress of Genetics

THE following communication has been received from Prof. Otto L. Mohr, of the Anatomical Institute, University, Oslo, chairman of the International Committee for Genetics Congresses: "The VIIth International Genetics Congress which was going to be held at Moscow, U.S.S.R. this summer has been postponed. According to the information received from the Organization Committee, a number of scientists and institutes have requested this as they wished to be better prepared for the congress. The Academy of Sciences and the Organization Committee have now extended an invitation to hold the congress in Moscow in August, 1938. Conforming with the mandate given to the Permanent International Committee for Genetics Congresses, the entire matter will be put before this committee for decision. At present it is certain that no International Genetics Congress will be held in 1937."

British Empire Cancer Campaign

AT the quarterly meeting of the Grand Council of the British Empire Cancer Campaign held on April 12, the following grants, totalling £2,900, were made, in addition to the bulk grants of last November and January: £1,000 to be placed at the disposal of

Dr. F. Dickens, director of research of the North of England Branch of the Campaign, at Newcastle, for the continuation of the special short-wave investigations being carried out under his direction on behalf of the Scientific Advisory Committee at headquarters; £1,200 for the purchase of a plaque of radium in use by Dr. F. G. Spear at the Strangeways Research Laboratory, Cambridge; an additional grant of £300 for the calendar year 1937 to the Westminster Hospital; an additional sum of £300 to Mr. F. C. Pybus for the salaries of his assistants and expenses during the second half of 1937 and a grant of £100 to Dr. L. H. Gray, at Mount Vernon Hospital, in connexion with the neutron investigations.

Rockefeller Travelling Medical Fellowships

THE Medical Research Council has been entrusted by the Rockefeller Foundation of New York with £3,000 annually, for three years in the first instance, for the award of travelling fellowships in medicine to candidates in the United Kingdom. This benefaction renews an arrangement which had been successful during an earlier period, but which had latterly been interrupted during a revision of the Foundation's general policy. These Rockefeller fellowships are intended for graduates who have had some training in research work in clinical medicine or surgery or in some other branch of medical science, and are likely to profit by a period of work at a chosen centre in the United States or elsewhere abroad before taking up positions for higher teaching or research in Great Britain. Five or six fellowships will be available annually, and applications for the academic year 1937-38 will be invited in May. It is of interest to recall an analysis which was made, at the end of the previous ten-year period, of the positions occupied by the seventy men and women who had completed their tenure of Rockefeller Fellowships awarded by the Council. This showed that twelve were professors in universities, that thirty-six others occupied whole-time positions for teaching and research, and that a further sixteen held part-time appointments of the same kind.

Announcements

SIR WILLIAM BRAGG will deliver the forty-third James Forrest Lecture before the Institution of Civil Engineers on April 27, at 6 p.m. The title of Sir William's lecture will be "The Crystal and the Engineer".

PROF. J. CHADWICK will deliver the twenty-eighth Kelvin Lecture before the Institution of Electrical Engineers on April 22 at 6 p.m. The subject of the lecture will be "The Elementary Particles of Matter".

THE triennial Burton Memorial Medal of the Royal Asiatic Society has been awarded to Sir Arnold T. Wilson. The Burton Memorial Lecture will be given by him at the Society's rooms on May 27, when the Medal will be presented by Dr. Bertram S. Thomas.

THE following appointments in the Colonial Service have recently been made: A. W. Hart, veterinary

officer, Nigeria; S. H. Shaw, geologist, Palestine; I. E. James (agricultural officer), senior agricultural officer, Nigeria; A. S. Richardson (senior agricultural officer, Tanganyika), deputy director of agriculture, Uganda; R. S. Pelly (assistant conservator of forests, British Honduras), assistant conservator of forests, Sierra Leone; F. G. Taylor (telegraph engineer, Railway Department), wireless engineer and broadcast officer, Sierra Leone.

PROF. A. BESSEMANS, pro-rector of the University of Ghent, has been elected member of the German Academy of Natural Sciences at Halle.

DR. WALTHER HORN, director of the German Entomological Institute, has been nominated corresponding member of the Finnish Entomological Society and honorary academician of the Museum of La Plata.

THE Corbalan Melgarejo prize founded in Chile to honour the memory of Dr. Ramon Corbalan Melgarejo, author of the Sanitary Codex of Chile and first director-general of the Health Service of the Republic, has been awarded by the Medical Society of Chile to Joaquin Luco Valenzuela.

THE French Association for Researches on Hearing and Deafness has recently elected M. Auguste Lumière as president. The Association consists of medical practitioners, acoustic technicians, hygienists and all interested in the campaign against deafness. The life subscription is 500 francs and the annual subscription 50 francs. Further information can be obtained from the general secretary, 143 bis Promenade des Anglais, Nice.

A MUSEUM has recently been founded at Lennep in Rhenish Prussia, the birthplace of Wilhelm Conrad Röntgen, illustrating the significance of X-rays and the development of Röntgen technique.

THE fifth International Hospital Congress, in which more than fifty countries will take part, will be held in Paris on July 6-11. Further information can be obtained from the Secretariat, Administration de l'Assistance Publique, 3 Avenue Victoria, Paris IV^e.

THE seventeenth Congress of Anthropology and Prehistoric Archaeology will be held at Bucharest on September 1-8 in the Palace of the Faculty of Law. Further information can be obtained from the general secretary, Prof. Nicolas Minovici, Institut Medico-légal, Bucharest, or from the Secretariat, Institut international d'anthropologie, 15 rue de l'Ecole de médecine, Paris.

ANOTHER volume of "Researches published from the Wards and Laboratories of the London Hospital" for the year 1936, has been issued by the Publications Committee (London: H. K. Lewis and Co., Ltd. 7s. 6d. net). The papers selected cover a wide field, and are valuable contributions to medical science.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He 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.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 677.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Effects of Traffic Disturbance and Night Illumination on London Starlings

THAT the breeding period of birds with a relatively brief annual reproductive season could be shifted to any time of the year by manipulating lighting conditions, regardless of temperatures, was first shown in 1924¹. The subject has since been investigated by numerous other workers, but a specific answer as to how the light induces the effects that can be so

Nine years ago, an attempt was made to induce winter development of the gonads in the migratory finch, *Junco hyemalis*, by substituting periods of activity without light for periods of artificial illumination. The apparatus and results were fully described in these columns². On account of the lateness of the season (March 17–April 28) it seems possible that the striking results obtained could have been due in part to the fact that recrudescence of the organs, having already begun under the influence of lengthening days, proceeded under the stimulus of forced exercise, and that the results might have been different if undertaken earlier in the winter.

The experiment has now been repeated with the same apparatus and the original species, the Canadian junco (males only), but commencing on January 4, 1937. The only window of the room used was shuttered nightly from 5 p.m. until 9 a.m. A small electric bulb at the level of the ceiling was the sole source of illumination, and its rays could not fall directly either on to the control or experimental birds, their cages standing on the floor under opaque shades. The bulb burned for longer periods nightly, commencing always at 5 (except for the first week when the room was shuttered at 4) and continued the first day for 7½ minutes, 15 the second, 22½ the third, 30 the fourth, and so on until 11 p.m. had been reached on February 28, when the last birds were killed for examination. Synchronously with the burning of the light, a mechanical device gently disturbed the experimentals and prevented them from falling asleep for an additional 7½ minutes daily. The controls slept without interruption from 5 o'clock onwards.

The outcome is illustrated in Fig. 1. The result is not as striking as on the previous occasion even though the total time involved was longer (eight weeks as against six), but recrudescence of the testes was nevertheless induced among the experimentals. Those of the control have remained at the winter minimum and show not the slightest effect of the artificial illumination to which the bird was exposed for two months.

Bissonnette³ repeated this undertaking on starlings, but found that he could not induce development of the gonads by compulsory exercise in dim light. He did, however, get two specific results. One was excess of the pigmentation that is so characteristic of starlings' testes in the early stage of development: the other was a speeding up of the rate of recrudescence when his birds, after periods of compulsory exercise, were thereafter exposed to increased periods of light of much greater intensity.

It occurred to me during the present winter, on reaching London and noting hundreds of starlings roosting on various public buildings in the West End, that the feeble light falling on them at most of their roosts must be far below the intensity shown by

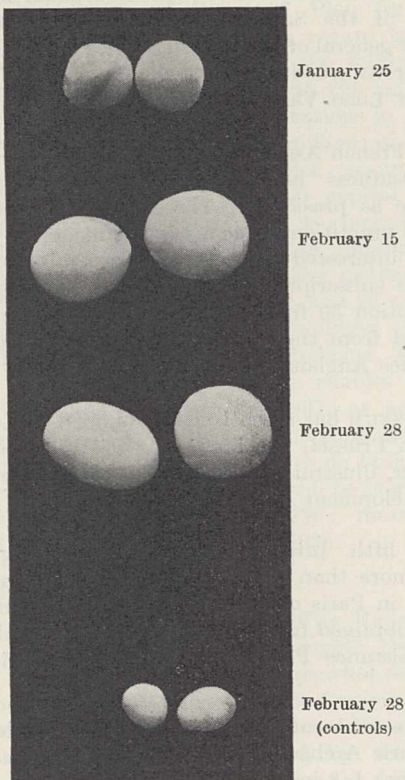


Fig. 1.

TESTES OF JUNCOS. \times APPROX. 15.

readily demonstrated has not yet been found. While it has been shown that the principle applies widely to birds, some forty species of which have now been examined by various investigators, it has also been shown to be effective in certain mammals, reptiles, amphibians and fish. Evidence that light falling on the eye, or other receptor, stimulates the pituitary, which in turn activates the gonads, is gathering weight, but is not yet wholly convincing.

various investigators to be effective in inducing development of the gonads in birds. Practically all of them, however, were roosting over main traffic routes and were being sufficiently disturbed by the din and tumult below them to stay awake intermittently until the small hours of the morning. It was decided to collect samples for examination early in January, but when the time came, difficulties inherent in the general situation came with it. Collecting birds at night in the centre of London was more easily said than done, and it was finally February 10 before a dozen birds from a West End roost had been procured for examination. Some forty country birds have also been obtained for comparison. The results are illustrated in Figs. 2 and 3.

We have since determined that at the spot from which the London birds were obtained, the needle of a Weston lightometer (registering foot candles) fails to record even a vestige of a flicker. I am informed by the makers of the light involved that it is a 1,500-watt tungsten filament lamp and that the red values, considered by Bissonette as of particular potency in their effect on gonad stimulation, are probably 10 per cent *below* those of a smaller and less-efficient bulb of the same nature. Such bulbs were used in my original experiments and have been adopted by most other investigators.

A review of this topic in its entirety is in preparation. Space required for an adequate discussion precludes the possibility of doing so here, but it seems worth while to put the facts on record for the consideration of others.

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¹ Rowan, Wm., "Relation of Light to Migration and Developmental Changes", *NATURE*, **115**, 494-95 (1925).

² Rowan, Wm., "Reproductive Rhythm in Birds", *NATURE*, **122**, 11-12 (1928).

³ Bissonette, T. H., "Studies on the Sexual Cycle in Birds. IV. Experimental Modification of the Sexual Cycle in Males of the European Starling (*Sturnus vulgaris*) by Changes in the Daily Period of Illumination and of Muscular Work", *J. Exp. Zool.*, **58**, 281-418 (1931).

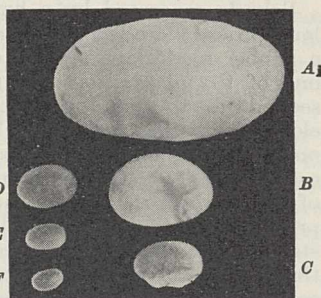


Fig. 2.

TESTES OF STARLINGS. A, B, C: LONDON BIRDS (FEB. 10). D, E, F: COUNTRY BIRDS (FEB. 17-26).
× APPROX. 2.

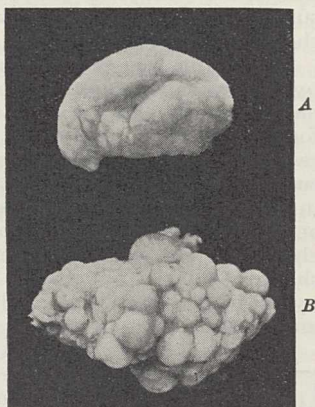


Fig. 3.

OVARIES OF STARLINGS. A, BEDFORDSHIRE BIRD (FEB. 17); B, LONDON BIRD (FEB. 10).
× APPROX. 5.

Equilibrium and Kinetics in the Gaseous State and in Solution

Diene syntheses are reversible associations of the type $a + b \xrightleftharpoons[k_d]{k_f} c$. The equilibrium constant $K = \frac{k_f}{k_d} = B \exp HR/T$ has been measured for four of these reactions.

- (1) cyclopentadiene + α -naphthoquinone \rightleftharpoons cyclopentadiene- α -naphthoquinone.
- (2) cyclopentadiene + benzoquinone \rightleftharpoons cyclopentadiene-benzoquinone.
- (3) cyclopentadiene + cyclopentadiene \rightleftharpoons dicyclopentadiene.
- (4) cyclopentadiene + acrolein \rightleftharpoons endomethylene-tetrahydrobenzaldehyde.

The results of the measurements are in Table 1.

TABLE 1.

Reaction No.	Measurements in	$B \times 10^7$ l./gm.-mol.	H kgm.-cal.	Temp. range
1	Benzene	1.8	16.9	8-79°
2	Benzene	8.3	17.7	8-79°
3	Paraffin Gas	13	16.8	0-175° 25-100°
		1	17.9	
4	Gas	6.8	18.4	108-242°

Values of B between 10^{-6} and 10^{-7} l./gm. mol. are observed in both states and hence the statistical probability of the formation of c from a and b , whether in the gas phase or in solution, is of the same order of magnitude for all the reactions. Also H , the heat of reaction, is nearly the same for all four diene syntheses, a value of about 17 kgm.-cal. being observed in both states.

The B and H values for Nos. 1¹, 2¹ and 4², and for No. 3 in paraffin solution¹ were obtained by determining the temperature dependence of k_f and k_d . In order to obtain B and H for No. 3 in the gas phase the solubilities, L , of gaseous cyclopentadiene and dicyclopentadiene in paraffin were determined over a range of temperatures. $L =$ concentration solution/concentration gas = $C \exp \lambda/RT$ where the non-exponential term C is a measure of the statistical probability of dissolution, and λ is the heat of solution. Van't Hoff's equation connecting the equilibrium constant in two states with solubilities was used in the form $B_g \exp H_g/RT = B_s \frac{(C_a^2)}{(C_c)} \exp (H_s + 2\lambda_a - \lambda_c)/RT$ where the subscripts g and s refer to gas and solution and a and c refer to cyclopentadiene and dicyclopentadiene respectively. The following values were obtained: $C_a = 1 \times 10^{-3}$, $\lambda_a = 7.13$ kgm. cal., $C_c = 2 \times 10^{-5}$, $\lambda_c = 13.1$ kgm. cal. The non-exponential term of the solubility is larger for cyclopentadiene than for dicyclopentadiene, and the heat of solution of cyclopentadiene approximately equals half the heat of solution of dicyclopentadiene.

TABLE 2.

Measurements in	A (l./gm. mol.-sec.)	Activation energy E (kgm.-cal.)	Temp. range
Gas ³	1.3×10^6	16.7 ± 0.8	80-150° C.
Paraffin	13.0×10^6	17.4 ± 0.5	0-172° C.

It was found that the reaction, 2 cyclopentadienes \rightarrow dicyclopentadiene is homogeneous and bimolecular

both in the gaseous state and in paraffin solution, and that the Arrhenius equation $k_f = A \exp - E/RT$ is obeyed. The 'constants' of the equation are given in Table 2.

The solubility of the gaseous *cyclopentadiene-cyclopentadiene* transition state in paraffin is defined by the ratio concentration solution / concentration gas = $C_t \exp \lambda_t/RT$ and can be estimated, using the following relationships which were deduced by Evans and Polanyi⁴ and Wynne-Jones and Eyring⁵.

$$C_t \sim \frac{A_s}{A_g}(C_a)^2 \text{ and } \lambda_t \sim E_g - E_s + 2\lambda_a.$$

Here C_t is a measure of the statistical probability of dissolution of the transition state, λ_t is the heat of solution, and the subscripts g and s refer, as above, to gas and paraffin solution.

As the solubility of *cyclopentadiene*, the kinetic A values and the activation energies are known, it follows that

$$C_t \sim 1 \times 10^{-5} \text{ and } \lambda_t \sim 14 \text{ kgm.-cal.}$$

If these values are compared with the non-exponential solubility term and with the heat of solution of *di-cyclopentadiene*, it can be seen that the solubilities of the transition state and of the product are similar.

We are greatly indebted to Prof. C. K. Ingold for his continued interest in this work.

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Cf. Wassermann, *J. Chem. Soc.*, 1928 (1936); *NATURE*, **138**, 369 (1936).

² Kistiakowsky and Lacher, *J. Amer. Chem. Soc.*, **58**, 123 (1936).

³ Kistiakowsky and Mears give 6.5×10^8 and 12.7 , *J. Amer. Chem. Soc.*, **58**, 1060 (1936).

⁴ *Trans. Farad. Soc.*, **31**, 875 (1935); **32**, 1333 (1936).

⁵ *J. Chem. Phys.*, **3**, 492 (1935).

Origin of the Cochlear Effect

In 1934 Hallpike and Rawdon-Smith advanced a tentative theory to account for the production of synchronous potential waves within the mammalian

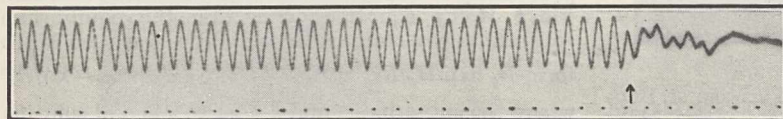


Fig. 1.

CATHODE RAY OSCILLOGRAM SHOWING RESPONSE FROM FROG'S SKIN TO PURE TONE STIMULUS OF FREQUENCY 140 \sim PER SEC. SOUND SWITCHED OFF AT ARROW. TIME MARKER: SMALL DOTS = 0.01 SEC.

cochlea, in response to auditory stimuli¹. According to this, the potential waves were held to be set up by movements of a membrane, thought to be polarized, and bounded on either side by the cochlear fluids. It has now proved possible to show that a membrane, polarized in such a fashion, will in fact yield potential waves of the required type.

The apparatus employed was arranged in the following manner. A piece of the skin of the common frog was stretched over the mouth of a glass tube approximately 1 cm. in diameter. The mouth of a second tube was caused to press lightly over this,

in such a way that a fluid-tight seal was produced. The two tubes were then filled with frog's Ringer solution at pH 8. Into each tube a small platinum electrode was sealed so as to dip into the solution. It was then found that a steady potential of some 35 millivolts existed across the electrodes, and therefore across the skin, in the manner first demonstrated by du Bois Reymond².

Sounds generated by a heterodyne oscillator and loudspeaker were led by means of pressure tubing to a rubber membrane sealing off the opposite end of one of the glass tubes. The opposite end of the second tube was left open. On attaching the platinum electrodes to the input of a high-gain amplifier, the output of which was connected to a cathode ray oscillograph tube, it was found that potential waves of considerable magnitude (up to 0.5 millivolt) were produced by a stimulus of low frequency. As the stimulus frequency was increased, the efficiency of the mechanism fell off, as would be expected from a consideration of the inertia of the fluid system employed, many times greater than that of the mammalian ear.

The record shown in Fig. 1 was obtained using a stimulating frequency of approximately 140 \sim per sec. Its close resemblance to oscillograms produced in a similar fashion by the mammalian ear may be noted. A further point of similarity is provided by the fact that the application of ether to the skin abolished this effect; abolition of the steady potential previously referred to also ensued.

It is felt that this demonstration that a polarized membrane will yield such an effect lends indirect support to Hallpike and Rawdon-Smith's original theory.

Changes in frog skin potential were first observed by Motokawa³ to arise from variations in the pressure head across the skin; a similar variation was observed for alteration of tension in the skin. Motokawa's results, and further data obtained here, indicate that such changes in potential are primarily due to changes in the values of the internal 'short-circuiting' (or local action) currents. These changes in turn result from changes in the local, and therefore also in the total, skin resistance. Support is lent to this contention by the fact that the required changes in total resistance can, in fact, be readily demonstrated.

From this evidence it appears that the potential waves recorded in response to acoustic stimuli may perhaps be ascribed primarily to such variations in local resistance, these in turn resulting from variations in pressure head and/or in tension set up by the vibrations communicated to the skin by the fluid with which it is surrounded. It is not impossible therefore that

the cochlear effect may also be ascribed to some such mechanism.

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¹ Hallpike, C. S., and Rawdon-Smith, A. F., *J. Physiol.*, **83**, 2, 243 (1934).

² Reymond, du Bois, "Unters. über Thier. Elektr.", (ii), 2, 9 (1857).

³ Motokawa, K., *Jap. J. Med. Sci. Biophys.*, **3**, 117 and 145 (1933).

Phase-Velocity of Electro-Magnetic Waves along the Ground

In a recent publication, Colwell and his co-workers have recorded the results of experiments to determine the group velocity of electro-magnetic waves along the ground¹. These experiments indicated that the speed with which a short pulse of radiation passed along the ground between two points situated some kilometres apart was considerably less than the velocity of light in free space. Their measurements were made on frequencies in the neighbourhood of 2,000 kilocycles per second.

In view of these results, it appeared to us that it would be of considerable interest to measure the phase-velocity of waves travelling along the ground. Apparatus was available at the Radio Research Station, Slough, with which such measurements could be made on a certain band of frequencies.

The apparatus consists essentially of a pair of similar aerials placed a known distance apart in the path of the wave and some means of comparing the phases of the signals induced in the two aerials. In the apparatus used, the output from each aerial was applied, after suitable amplification, to a pair of deflecting plates on a cathode ray tube. The fluorescent spot is thus subject to two deflections at right angles, these deflections being proportional to the signals in the two aerials respectively. The amplifiers and aerial circuits are first adjusted so that when equal and cophasal fields exist at the two aerials, the figure traced out on the oscillograph is a line at 45° to the axes of deflection of the spot. This preliminary adjustment is carried out by radiating a signal on the frequency to be used in the measurements, from an oscillator located midway between the aerials, it being assumed that in these circumstances equal and cophasal fields exist at the aerials. When a c.w. signal is received from a distant point on the line joining the aerials the figure traced out on the oscillograph tube is in general an ellipse, from which it is possible to determine the phase difference between the fields at the two aerials, and hence deduce the phase velocity of the wave passing between the two aerials.

If d = distance between aerials (cm.); f = frequency of wave (cycles per sec.); ψ = phase difference between signals in the two aerials (degrees); c = phase velocity of wave (cm. per sec.), it is easily seen that

$$\psi = \frac{360 d}{c f} \quad \text{or} \quad c = \frac{360 d f}{\psi} \quad \text{cm. per sec.}$$

The aerial system used consisted of a pair of vertical aerials spaced 34.9 metres apart. Measurements were made on signals from a portable transmitter located about a mile from the receiving system, on the line of the aerials. The results are given in Table 1.

TABLE 1.

Frequency	Phase-Velocity
2.50 Mc./sec.	3.05×10^{10} cm./sec.
2.90 "	3.10×10^{10} "
3.29 "	3.00×10^{10} "
5.95 "	3.00×10^{10} "
7.60 "	3.10×10^{10} "
10.92 "	2.75×10^{10} "
11.70 "	2.80×10^{10} "
11.70 "	2.85×10^{10} "
15.05 "	2.90×10^{10} "
Average	2.95×10^{10} "

Over the range of frequency between 2.5 Mc. per sec. and 15 Mc. per sec. the measured velocity is seen to lie very close to the value 3.0×10^{10} cm. per

sec. There is no indication of a marked change in velocity with frequency, from which we may deduce that the group velocity of waves along the ground is also within a few per cent of 3.00×10^{10} cm. per sec., that is, the velocity of light.

The accuracy of these results depends on the accuracy with which the distance between the aerials and the frequency can be measured and on the accuracy of the process of 'lining-up' the aerials. The measurement of distance was made to an accuracy better than 0.5 per cent and the measurement of frequency was made with a sub-standard wave-meter to an accuracy better than 1 per cent. It is considered that the accuracy with which the 'lining-up' process could be carried out and the accuracy of the measurements made on the ellipse are such that the overall accuracy is about 5 per cent or slightly better.

It remains to note that the observed values show discrepancies from the value 3.00×10^{10} cm. per sec. of more than the estimated experimental accuracy. These cannot be due to the effect of waves reflected from the ionosphere since at these ranges such waves would be incident vertically and would not affect the aerial system. The possibility of direct pick-up on the transmission lines coupling the aerials to receiver or on the receiver is ruled out by the negative results of direct experiments to test this. The possibility still remains of re-radiation from disturbing bodies near the receiving aerials.

It should be observed that, while these results are not in agreement with those of Colwell, Hall and Hill, the measurements made by them refer to a pulse which has travelled some kilometres, and which may not have remained quite close to the ground all the way, while our measurements refer to the velocity of the wave actually as it passed between two aerials on the ground.

These experiments were carried out as part of the programme of the Radio Research Board, and this note is published by permission of the Department of Scientific and Industrial Research.

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¹ Colwell, R. C., Hall, N. I., and Hill, L. R., *J. Franklin Inst.*, **222**, 551-562 (1936).

Cosmic Ray Showers

In the current theories and experiments, the question whether a cosmic ray shower is produced in a single elementary process or rather in a succession of many elementary processes is still open to discussion. For example, the discussions of Geiger and Fünfer¹, and of Bhabha and Heitler² are based on the latter idea, while that of Heisenberg³ represents the former point of view. In the first case, the shower contribution from different layers of producing material would be linear to its thickness, provided the latter is sufficiently small, while in the second case, on the contrary, a quadratic relation between the shower frequency and the thickness is to be expected.

Using the arrangement *A* of Fig. 1, in which at least three particles are necessary to cause a simultaneous discharge, Morgan and Nielsen⁴, later

Watase and Kikuchi⁵, have confirmed the quadratic increase in the initial portion of the Rossi curve, as it is shown by Curve *a*. In continuation of the investigations on this problem, Curves *b* and *c* are obtained by using the arrangements *B* and *C*. In case *B*, simultaneous discharges in four counters were recorded, while in case *C* those of five counters were registered. We see that the quadratic character becomes less prominent as the number of counters of which simultaneous discharges are counted increases.

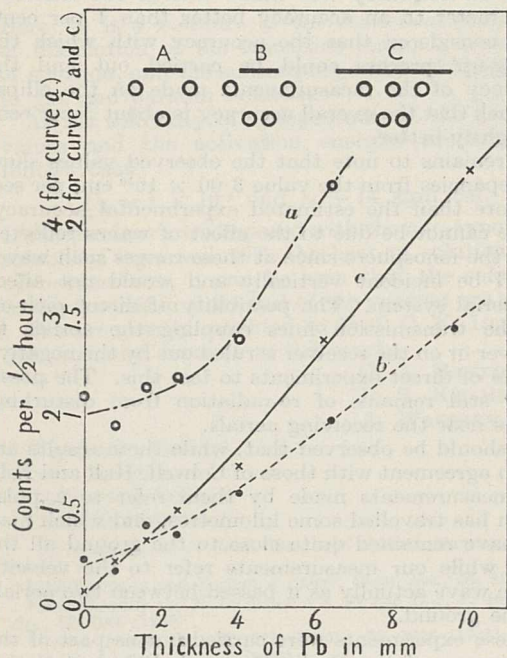


Fig. 1.

These facts show that a shower consisting of a large number of particles can be produced by a single elementary process. The quadratic character in the case of three counters may be explained by the existence of soft radiations of tertiary origin. As the efficiency of the counter for these radiations is much lower than for the direct secondaries, their contribution decreases very rapidly with the increasing number of discharges recorded simultaneously.

The present results do not exclude the existence of showers produced by a succession of elementary processes, but show clearly that the latter is not necessary for the production of a shower containing a large number of particles; or, in other words, there exists an elementary process in which many particles are produced simultaneously, as suggested by Heisenberg.

My thanks are due to Prof. S. Kikuchi for guidance throughout this work.

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Action of Iron Oxide on the Emission Spectrum of Nitrogen-Mercury Systems excited by α -Rays

DURING a research on the synthesis of ammonia at room temperature under α -ray bombardment and in presence of Fe_3O_4 , we have found that the gas surrounding the α -particle source emitted a relatively intense green glow. The α -particle source was radon in a small thin glass bulb, through the walls of which the α -particles could pass. The phenomenon is only observable when the iron oxide is reached by the α -rays, and has been bombarded for several hours in a stoichiometric atmosphere ($\text{N}_2 + 3\text{H}_2$). When a certain amount of iron oxide has been thus in some manner promoted, it remains active in subsequent experiments, even if between two experiments it has been brought into contact with air.

With pure nitrogen the green cold flame increases in intensity, hydrogen seeming to have a simple diluting effect. If radon is mixed with the stoichiometric gas, the glow is only to be seen in the neighbourhood of the magnetic oxide in a layer about one centimetre thick. On shaking, the luminosity spreads throughout the whole tube, and becomes brighter. When after shaking the tube is placed in a horizontal position, the light fades, starting from the end no longer containing the oxide and going towards the other end, until after some twenty minutes it is confined to a zone of one centimetre over the iron oxide. If the glow was emitted by iron oxide dust suspended in the gas, it would start settling in the higher part of the vessel and not on the end opposite to the oxide. The glow is thus to be ascribed to the gas phase.

The light was still visible with α -particle sources as weak as 3 millicuries. Increase of pressure and temperature intensifies the luminosity. Admission of even very small quantities of air by carefully opening the stopcock of the vessel was immediately followed by the extinction of the glow. The glow appears only in the space irradiated by the α -particles, and disappears within a small fraction of a second after irradiation.

Spectroscopic study gave us the nitrogen bands. Some of them (those marked with an asterisk) have already been observed by Sir William and Lady Huggins¹ or Himstead and Meyer², in the spectrum of the light emitted by a radium bromide crystal.

Second positive N_2 group	Group (NO)
*3159	2595.7
*3371	2722.2
*3577	2859.5
3805	*2977
4059	

Research was continued in two directions.

(1) The first working hypothesis was that the glow was similar to the green light produced in Strutt's experiments, when a current of active nitrogen met a current of nitric oxide, with formation of the peroxide. In the present case, nitric oxide could be formed by the action of bombarded Fe_3O_4 on excited nitrogen. All attempts to produce the green glow by bringing currents of nitric oxide and nitrogen in contact under α -ray bombardment have failed.

(2) The second hypothesis was that the phenomenon was associated with the presence of mercury vapour. Analogous green glows have been observed when mercury vapour in presence of foreign gases is illuminated by a mercury vapour lamp (Phillips³, Wood⁴, Donat⁵). What seems quite new in our case is the action of iron oxide. This hypothesis is backed

¹ Geiger, H., and Fünfer, E., *Z. Phys.*, **93**, 543 (1935).

² Bhabha, H. J., and Heitler, W., *NATURE*, **138**, 401 (1936).

³ Heisenberg, W., *Z. Phys.*, **101**, 533 (1936).

⁴ Morgan, J. E., and Nielsen, W. M., *Phys. Rev.*, **48**, 773 (1935).

⁵ Watase, Y., and Kikuchi, S., *Proc. Phys.-Math. Soc. Japan*, **18**, 210 (1936).

by observation of the increase of intensity (about thirty times) of the Hg line 2536.7 in presence of Fe₃O₄ bombarded by α-rays. Spectra in the visible region show an important increase of the visible triplet 5461, 4358, 4047, in presence of the iron oxide, and especially of the 5461 green line which is not visible at all when Fe₃O₄ is not present.

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¹ *Proc. Roy. Soc., A*, 72, 196, 409 (1903); 76, 488, 130 (1905).

² *Phys. Z.*, 6, 688 (1905); 7, 672 (1906).

³ *Proc. Roy. Soc., A*, 89, 39 (1914).

⁴ *Astrophys. J.*, (1907) and 54, 149 (1921).

⁵ *Z. Phys.*, 29, 345 (1924).

Eddy-Current Resistance in Fluids due to Rotation

THE well-known 'Larmor analogy' between the deflecting force exerted by a magnetic field upon the motion of electrically charged bodies and the 'Coriolis' force which similarly deflects a moving body relative to a rotating system of reference, suggested to me that the resistance to motion due to electrical eddy currents experienced by a conducting body rotating in a magnetic field should be paralleled when a rotating body of fluid is given a second rotation, for example, about a second non-parallel axis. The experiment, which was demonstrated at the recent meeting of the Australasian and New Zealand Association for the Advancement of Science in Auckland, N.Z., does, in fact, rather strikingly exemplify the gyro-magnetic analogy. A spherical vessel of metal or glass, filled with water and provided with an axle that turns in horizontal bearings and rotated (long enough for the water to take up the rotation) comes very rapidly to rest if set up on a rotating table—or even if the frame in which the bearings are set is turned while held in the hand.

With a glass bowl, the actual eddy currents in the water are made conspicuously visible by the movement of bubbles formed from the residual air when the bowl is not completely filled.

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Fossil Pollen in Scottish Jurassic Coal

I HAVE recently made an examination of the microspore content of a sample of coal of Jurassic age that occurs at Brora, Sutherlandshire. The seam rests upon strata of the Estuarine Series (*g*⁷), and has as its 'roof-bed' Kellaways Rock (*g*¹⁰). The seam proves to have a rich content of pollen, principally of genera of conifers belonging to the Abietineæ, but, in addition, it is interesting to record the presence of pollen of the types that characterize the Nymphaeaceæ among the dicotyledons.

Water-lily pollen possesses certain characters that make recognition of the type easy. These characters are illustrated diagrammatically in Fig. 1, and may briefly be summarized as follows:

- (1) A narrow furrow region (*f*), which in form is ring-shaped or open at one or both ends.
- (2) A region, the operculum (*o*), enclosed by the furrow ring, in area always less than a hemisphere. The exine of the operculum may differ from that of the part of the grain outside the furrow ring in being distinctly thinner or differently ornamented (1,*d*).
- (3) In the smoother *Castalia* species (1,*d*), the

exine tapers in thickness towards the furrow ring, merging with the latter without a marked rim.



Fig. 1.

(4) In the genus *Nelumbium* (1,*e*) a third furrow is present, differing slightly in shape from those bounding the operculum. A very distinctive feature of *Nelumbium* pollen is that when viewed from the poles, the furrows do not divide the grain into three equal parts, as normally do the three furrows in other dicotyledonous types. In other words, bilateral, not trilateral, symmetry characterizes the *Nelumbium*

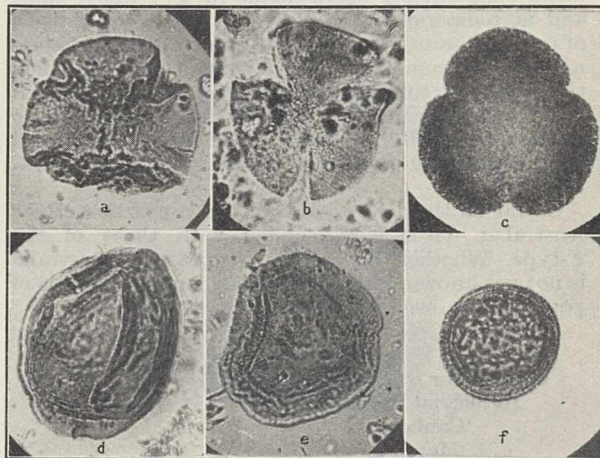


Fig. 2.

- (a) *Nelumbium* TYPE, JURASSIC COAL, BRORA; POLAR VIEW SHOWING OPEUCULAR FURROWS.
 - (b) *Nelumbium* sp., TERTIARY COAL, SCOTLAND, POLAR VIEW.
 - (c) *Nelumbium nuciferum* GAERTN., MODERN SPECIES.
 - (d) *Nelumbium* TYPE, JURASSIC COAL, BRORA; LONGITUDINAL VIEW, SHOWING THIRD FURROW (CENTRE) AND OPEUCULUM.
 - (e) *Castalia* TYPE, JURASSIC COAL, BRORA; SHOWING OPEUCULUM AND BOUNDING FURROWS.
 - (f) *Castalia crassifolia* HAND.-MAZZ., MODERN SPECIES; OPEUCULAR FURROWS ON EITHER SIDE.
- ALL FIGURES × APPROX. 325 DIAMETERS.

type. As this distinction is probably a primitive feature, it may be expected to occur more frequently in fossil than in modern pollen types, and it should therefore be looked for in all work in fossil pollen, particularly the more ancient the material under examination.

As I think is evident from the photographs reproduced in Fig. 2, the water-lily pollen in the Brora coal already shows clear differentiation into the types characteristic of the modern genera *Nelumbium* and *Castalia*. Other genera of the Nymphaeaceæ may also be present. Except for some forms possibly representing *Magnolia* and its allies, no other dicotyledons appear to be represented.

JOHN B. SIMPSON.

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March 16.

An F-Type Potato Virus in Australia

THE F-type of potato virus recently described by Clinch, Loughnane and Murphy¹ and Murphy and Loughnane² is evidently widely distributed. At Canberra in January 1936 a virus which was carried without symptoms in a number of solanaceous hosts was recovered from potatoes with a slight acubia mottling of the foliage. The variety of potato was supplied under the name Arran Crest, but its characters were rather those of Arran Pilot. No tuber necrosis was noticed. The virus was recovered a number of times over a period of a year from the tubers of these plants, and from second generation plants grown from the tubers. The presence of the virus did not protect the potato plants from infection with Y-type viruses, and various other hosts containing it were infected with X virus and X + B without difficulty. It caused severe necrosis on pepper at mean temperatures below about 70° F.; above that, and at temperatures too low for the strong growth of pepper plants, the symptoms were milder. *Solanum nigrum* was found to be an important host on which the virus sometimes produced a very faint and transitory vein-clearing or mottle, but generally no symptoms at all. It could, however, be recovered from apparently unaffected plants in high concentration.

So far as they were studied, the properties of the Australian virus corresponded with those of the F-type. Whether this group is important in Australia is not yet known, although viruses causing necrosis of pepper have been recovered from several sources.

J. G. BALD.

Division of Plant Industry,
Council for Scientific and
Industrial Research,
Canberra.
March 2.

¹ Clinch, Phyllis, Loughnane, J. B., and Murphy, P. A., *Sci. Proc. Roy. Dublin Soc.*, 21, 431 (1936).

² Murphy, P. A., and Loughnane, J. B., *Sci. Proc. Roy. Dublin Soc.*, 21, 419 (1936).

Interfertility Phenomena of the American and European Forms of *Panus stypticus* (Bull.) Fries*

Panus stypticus (Bull.) Fries is a small coriaceous agaric which grows usually on the wood of deciduous trees, and is found both in Europe and North America. Although alike morphologically, a striking difference exists between the American and European forms, namely, the former is luminous and the latter is non-luminous¹. Since they were known to differ in this character, a study of the two forms in relation to their pairing reactions and the method of inheritance of the factor for luminosity was undertaken.

Monosporous mycelia were isolated from single fruit-bodies of *Panus stypticus* collected at Timagami, Ontario; Ottawa, Ontario; and Lake MacDonald, Quebec (in Canada); at Dresden, Darmstadt and Potsdam (in Germany); at Sigless in Austria; and at Wageningen in Holland. Series of pairings in all possible combinations of monosporous mycelia from each of these fruit-bodies have shown that both the American and European forms of this fungus are heterothallic and tetrapolar. These results were published in the Progress Report of the Dominion Botanist for the years 1931-34², and have been confirmed by Vandendries' work with the European form³.

* Contribution No. 491 from the Division of Botany, Experimental Farms Branch, Department of Agriculture, Ottawa, Canada.

By pairing monosporous mycelia derived from different sources, it has been found that both the American forms and the European forms are fertile among themselves and that the American form is completely interfertile with the European form² (Fig. 1).

		6004							
		AB		ab		Ab		aB	
		12	15	22	27	6	9	10	26
AB	1	+	+	+	+	+	+	+	+
	19	+	+	+	+	+	+	+	+
ab	12	+	+	+	+	+	+	+	+
	25	+	+	+	+	+	+	+	+
Ab	23	+	+	+	+	+	+	+	+
	26	+	+	+	+	+	+	+	+
aB	13	+	+	+	+	+	+	+	+
	20	+	+	+	+	+	+	+	+

Fig. 1.

TABLE SHOWING THE RESULTS OF PAIRING EIGHT MONOSPOROUS MYCELIA OF THE LUMINOUS AMERICAN FORM OF *Panus stypticus*, +6004, AND EIGHT MONOSPOROUS MYCELIA OF THE NON-LUMINOUS EUROPEAN FORM, +5122. THE PLUS SIGN INDICATES THE PRESENCE OF CLAMP CONNEXIONS.

In sixty-eight pairings of monosporous mycelia of the luminous American form with the non-luminous European form, the diploid mycelium produced has been isolated and found to be luminous; that is, in the mycelium of the F_1 generation, luminosity is dominant. If sporophores are obtained from these paired cultures, the monosporous mycelia from them will be tested to determine the method of inheritance of the factor for luminosity in the F_2 generation.

RUTH MACRAE.

Division of Botany,
Central Experimental Farm,
Ottawa.

¹ Buller, A. H. R., "Researches on Fungi", 3, 408 (1924).

² Macrae, R., Rept. Dominion Botanist, 1931-1934, 60 (1935).

³ Vandendries, R., *Bull. Soc. myc. France*, 52, 54 (1936).

Water and Fat Content of Tsetse Flies

IN his recent letter to NATURE on this subject¹ Mr. R. W. Jack emphasizes the importance of excluding the weight of fat in tsetse flies when calculating the percentage of water found in them.

I came to the same conclusion early in 1935, and communicated my opinion to Prof. Buxton in a letter dated April 2 of that year. My complete findings for 1935, when more than 800 flies were examined by me, were published in 1936².

In Table 1 my results for 1935 are summarized. It will be observed that with increasing hunger the percentage of water in gross body weight shows a rise. But with fat eliminated from both wet and dry weights the percentage of water shows a slight fall after stage II of hunger, though the variation from stage to stage is now much less than before. The males, other than young males, are divisible into four stages of hunger by external characters—gorged, replete, intermediate and hungry.

Table 1 refers to flies (*Glossina morsitans*) collected in the field.

TABLE 1.

Category	Fat, per cent of dry weight	Gross water per cent	Water, per cent of non-fatty weight
<i>Males</i>			
Stage I	25.87	62.19	69.55
Stage II	35.28	60.96	70.83
Stage III	24.53	63.62	69.89
Stage IV	14.56	64.77	68.43
Young	15.93	68.88	72.63
<i>Females</i>			
Mature	16.84	64.44	68.73
Young	15.25	68.92	72.36

Just-fed flies are normally inactive in Nature, but from laboratory experiments it is found that these contain nearly 75 per cent water in non-fatty body weight, the percentage of water in blood. By rapid excretion, water is eliminated immediately after feeding, up to 8 mgm. being removed in the first quarter of an hour.

The results are interpreted in the following way :

Fat is synthesized after feeding, and reaches a maximal proportion in stage II of hunger. Thereafter it diminishes until the next meal (stage III or stage IV). During the inactive period immediately after feeding the water content is depressed below the normal 70 per cent of fatless weight, and as it rises towards the normal, activity is resumed in late stage I. Thereafter the percentage is maintained close to 70 per cent, but falls slightly as hunger increases and loss of water can no longer be made good. It appears that death from 'starvation' occurs when the percentage falls to about 65 per cent.

In wild, young flies, for some unexplained reason, the percentage is higher at about 72½. My colleague, Mr. W. H. Potts, finds that in just-emerged individuals it is even higher.

To summarize the significant differences in the first and third numerical columns of Table 1, stage II is in each case significantly different from all the others. Stages I and III are indistinguishable from each other but significantly different from the rest, except that in the third column the old females, because of high variance, are not quite distinguished from stage I males. Stage IV and all females and young males are indistinguishable as to fat percentage; in water percentage of fatless weight the young flies are distinct from all the others, but the sexes of young flies and of hungry males and old females are respectively indistinguishable. (Females taken in Nature are nearly always hungry.)

It is of interest that Buxton and Lewis³ in Northern Nigeria found 63 per cent water in gross weight for wild male *G. submorsitans* and 60 per cent for wild females. These figures become 69 per cent in both cases when fat is eliminated from wet and dry weights. It is likely that some of these females were partly pregnant, as such flies have a higher fat content and therefore a lower percentage of water in the gross body weight.

Mr. Jack's point, that, when the proportion of water is so high, a small change in the ratio may indicate important losses, is well made.

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Tanganyika Territory.

¹ NATURE, 139, 31 (1937).

² Proc. Zool. Soc., (4), 811 (1936).

³ Phil. Trans. Roy. Soc., B, 224, 205.

Effect of Centrifuging on *Amæba proteus* (Y)

In *Amæba proteus*, the cytoplasmic bodies are the nutritive spheres, crystals, neutral red bodies, mitochondria, sudanophil fat and a single contractile vacuole.

Fig. 1 illustrates the stratification of the various cytoplasmic components according to their specific gravity after centrifuging. Fat (F) and the contractile vacuole (CV) being the lightest, occupy the centripetal position. Next is clear cytoplasm (C), then the mitochondria (M) followed by a layer of neutral red bodies (NR), a layer of crystals (CRY) and the nutritive spheres (NS) which are the heaviest component of the cell and occupy the extreme centrifugal position. The nucleus (N) occupies a position in between the crystals and the nutritive spheres, and the chromatin (CR), being the heaviest material in the nucleus, collects towards the heavy side of the cell.

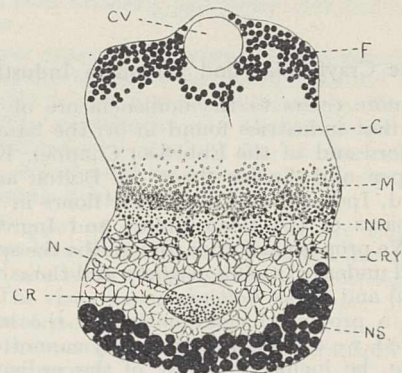


Fig. 1.

The nutritive spheres contain glycogen as a form of reserve food material. It is very interesting to note that no homologue of the Golgi apparatus appears to exist in *Amæba proteus*, and that the wall of the contractile vacuole does not blacken with osmic acid even after prolonged periods.

B. N. SINGH.

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March 5.

Excretion from Leguminous Root Nodules

VIRTANEN^{1,2}, using pea, vetch and clover, has amply confirmed the suspicion of some earlier workers by showing that under certain conditions (for example, in sand culture) there is an excretion of fixed nitrogen in the form of amino-acids from the nodules of these plants into the rooting medium. It does not follow that this finding may be extended to leguminous plants in general. In experiments carried out as an extension of published work³, and with the assistance of Mr. I. W. Prentice, I have been unable, by analysis of the rooting medium, to find evidence of excretion of fixed nitrogen from the nodules of soya bean plants at any stage in development, although extensive fixation occurred within the nodules. The plants were grown in open sand-cultures, initially sterile.

These negative results may be due, not to the absence of excretion, but to (a) excretion being

quickly followed by re-absorption by the roots, or to (b) the excreted substances in the soya bean differing from those in the types examined by Virtanen in that they are volatile—the sand was dried at 30°–40° C. prior to analysis. These two and other possibilities are being examined.

The earlier work of Stallings⁴, who concluded that there is an excretion from soya bean nodules of ammonia, presumably in organic or inorganic combination, will be considered in a later fuller publication, together with other literature.

G. BOND.

Department of Botany,
University, Glasgow.
March 23.

¹ Virtanen, A. I., *NATURE*, **138**, 880 (1936).

² Virtanen, A. I., *J. Soc. Chem. Ind.*, **54**, 1015 (1935).

³ Bond, G., *Ann. Bot.*, **50**, 559 (1936).

⁴ Stallings, J. H., *Soil Science*, **21**, 253 (1926).

The Crayfordian and Boltonian Industries

THIS note refers to the nomenclature of the prehistoric flint industries found in (a) the basal gravel at Crayford and of the Ebbsfleet Channel, Kent, (b) the Upper and Lower floors in Bolton and Co.'s brickfield, Ipswich, and (c) similar floors in the sub-aerial loams of the Bean Valley and Ingress Vale, Kent. We propose in future to describe the specimens classified under (a) as *Crayfordian*, and those classified under (b) and (c) as *Boltonian*.

From a prolonged examination of the industries mentioned, we are satisfied that they cannot, without prejudice, be included in any of the ordinary subdivisions of prehistoric flint implements. Thus, the industries in question each includes Clactonian, Levalloisian, and hand-axe features, and it is not possible, therefore, to describe them by the usual nomenclature. The characteristics and geological age of these industries will be described before long, but we think it desirable that their new titles, which we hope will be generally adopted by archaeologists, should be made public now.

We would point out that the specific names *Crayfordian* and *Boltonian* are based solely upon the characters of the flaked flints of the two industries, and do not connote any particular geological age for the specimens.

J. REID MOIR.

J. P. T. BURCHELL.

Magnetic and Electrical Dimensions

My chief reason for desiring to reply to Prof. Howe's letter on this subject in *NATURE* of March 13 is that the last paragraph of the letter gives the impression, inadvertently I presume, that the implications of the adoption of Ampère's theory of magnetism had been considered fully by the International Committee when they made the recommendation that *B* and *H* were to be considered respectively in the roles of effect and cause, and their ratio μ therefore as an entity having physical dimensions. This is not the case.

Prof. Howe and I and all other members of the British Association Committee upon the subject were invited in 1934 to attend the meeting of the

International Committee in London by the courtesy of the late Sir Richard Glazebrook, chairman of the International Committee. We were all made parties to the above recommendation, and at the time there seemed to be no alternative to an arbitrary resolution, although had we studied Maxwell's treatise more carefully we might have been more cautious.

It was not until January 19, 1935, that I showed in a letter to *NATURE* that the adoption of Ampère's theory opened up an alternative mathematical solution which makes μ undimensional, and I followed this by a paper to the British Association meeting at Norwich confirming this result and showing that I got complete support from Maxwell.

I have received a large correspondence about the conclusions of this paper. In September 1935 I received from Sir Richard Glazebrook a letter in which he writes: "To my mind Maxwell's theory, as developed in his book, is based on the two-fluid theory of magnetism. I have not considered how far the adoption of Ampère's theory, which no doubt is nearer the truth, modifies this but will consider the matter when I have a little leisure." It is greatly to be regretted that Sir Richard's untimely death deprived us of his considered opinion upon this important question.

From my correspondence with Prof. Howe, I can see that his main objection from the first to my conclusions has been the mathematical nature of the arguments. To my mind, the whole electrical science is the mathematical machine which he derides in his last letter, that wonderful machine which has produced the electromagnetic theory of light, to which is due the discovery of the quantum theory and all the other developments of modern theoretical physics. All that is fed into this machine consists of the empirical laws and the definitions of the various entities and constants. Now Prof. Howe would have us jettison the machine and the unit-pole upon which several of our definitions are founded, and does not propose to provide us with equivalents. Even if equivalents were ready for adoption, is there any possibility of getting them adopted by the scientific world in the month or two before the fate of the dimensions of μ is decided?

Dealing with the purely physical character of μ , consider the coils of a wattmeter. If the current coil is energized, we get a magnetic field surrounding it, which we denote by *H* at every point. If now we energize the voltage coil, the nature of the magnetic field has not altered but only its magnitude and direction. If, on the other hand, we introduce a little piece of iron instead of energizing the voltage coil, this little piece of iron, according to Ampère's theory, consists of a multitude of atomic electrical circuits, each of which is equivalent to a voltage coil. In what respect does the physical nature of the magnetic field then differ from that which existed when the voltage coil was excited? According to the two-fluid theory of magnetism, they are different in the iron, but now that the two-fluid theory is discarded and there is only one medium to be considered, namely, empty space, is there any reason for maintaining the results of a discarded theory? According to Ampère's theory, *B* and *H* differ only in magnitude and direction, but are physically identical.

JAMES B. HENDERSON.

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March 22.

IN his letter in NATURE of March 13, Prof. Howe avoids the very plain question put to him by Sir James Henderson. That question is: "What justification has he for writing $\mu \equiv 1/A'$?" The only suggestion put forward by Prof. Howe is that "the forces between magnetic poles and those between electric currents must involve the same property of

space". But that condition is equally met by writing $\mu \equiv A'$ —which is Henderson's proposal. In view of the strictures in Prof. Howe's review, it is clearly incumbent upon him to face this issue, and make his reasons for his choice as clear as those of Sir James; and I hope that he will do this.

WILLIAM CRAMP.

Points from Foregoing Letters

NEW experiments on the winter development of the gonads in the migratory finch, *Junco hyemalis*, under the influence of artificial illumination are described by Prof. Wm. Rowan. The author also submits photographs showing that starlings in the West End of London have in winter larger testes or ovaries than those in the country. He finds, however, that the light intensity at night, at the spot where the London birds roosted, was below that known to induce development of the sex organs, and he suggests that in this case the effect may be due to the noise which keeps the birds intermittently awake until the early hours of the morning.

The non-exponential and the exponential terms of the equilibrium constant and of the bimolecular rate constant of the reaction 2 cyclopentadienes \rightleftharpoons dicyclopentadiene and of similar associations have been measured in the gas phase and in solution by Dr. G. A. Benford, Miss B. S. Khambata and Dr. A. Wassermann. They compare the solubility of cyclopentadiene and of dicyclopentadiene with the solubility of the cyclopentadiene-cyclopentadiene transition state.

Indirect support for Hallpike and Rawdon-Smith's membrane theory of origin of the cochlear component of the Wever and Bray effect has been obtained by O. Gatty and Dr. A. F. Rawdon-Smith, who have shown that potential waves of similar characteristics can be obtained from isolated strips of frog's skin, immersed in Ringer's solution. A type of artificial cochlea was constructed, and from this synchronous potential changes were recorded, in response to sound.

W. Ross and E. C. Slow have measured the phase velocity of radio waves (of frequency 2.5–15 Mc. per second) travelling along the ground, by observing the shape of the ellipse traced by an oscillograph to which was applied the suitably amplified output from two similar aerials placed a known distance apart. Though the observed values, for the phase velocity of the radio waves investigated, differ slightly from the velocity of light (possibly due to re-radiation from disturbing bodies near the receiving aerials), these variations are small and without marked dependence upon frequency. The authors conclude that the group velocity of radio waves along the ground is also within a few per cent of 3×10^{10} cm. per sec., which is not in agreement with the findings of Colwell and his co-workers.

Curves showing 'coincidence' discharges in 'counters' arranged in groups of three, four and five, indicating the number of cosmic ray showers as affected by the thickness of the material (lead) in which they are produced are submitted by Y. Watase. The curves obtained by means of the groups of four and five counters are nearly straight lines, and show that some, at any rate, of the showers are produced by a single elementary process, as suggested by Heisenberg. The curve obtained with three counters

is of a quadratic type, which may mean that in some cases a succession of elementary processes is involved, or the quadratic character may be due to the presence of soft radiation of tertiary origin.

A. Luyckx reports that when nitrogen and iron oxide are simultaneously irradiated by α -rays, an intense green glow is emitted by the gas. Spectroscopic study shows that mercury lines are only observable in presence of nitrogen; iron oxide increases their intensity, and causes new mercury lines to appear.

A simple experiment showing how a rotating fluid comes rapidly to rest when given a second rotation non-parallel to the first, is described by Prof. Kerr Grant. The experiment was devised as an analogy to the resistance to motion, due to electrical eddy currents, experienced by a conducting body rotating in a magnetic field.

The 'F-type' of potato virus recently isolated in Ireland has been found by J. G. Bald also in Australian potato plants with a slight 'aucuba' mottling of the foliage. The virus causes necroses on pepper. *Solanum nigrum* acts readily as host for the virus, showing no symptoms except an occasional transitory vein-clearing or mottle.

Panus stypticus (Bull.) Fries, as found in North America and in Europe, is shown by Miss Ruth Macrae to be heterothallic and tetrapolar. The two forms are fertile among themselves and with each other. When monosporous mycelia of the luminous American form and the non-luminous European form are paired, the diploid mycelium produced is luminous.

A table showing the water and fat percentage of tsetse flies of different ages and at different stages of hunger, is given by Dr. C. H. N. Jackson. The author had come independently to the same conclusion as R. W. Jack concerning the importance of excluding the weight of fat when calculating the percentage of water, and gives instances showing that the new way of calculating the water content gives more significant results.

Dr. G. Bond reports that analysis of the sand in which soya bean plants had been grown failed to give evidence of excretion of fixed nitrogen from the root nodules of the plants. Prof. Virtanen has shown that such excretion takes place in the case of peas, vetch and clover.

Sir James Henderson, continuing the discussion on the dimensions of electrical and magnetic concepts, points out that insufficient consideration was given by the International Committee in arriving at their decision concerning those factors. He reiterates his contention that taking Ampère's theory into consideration, the magnetic field H , and the magnetic flux B , differ only in magnitude and direction and are physically identical, so that their ratio μ , the magnetic permeability, is undimensional.

Research Items

Spirit Beliefs in Suriname

IN the course of a detailed account of the folk-lore of the negroes of Suriname (Suriname Folk-lore: by Melville J. Herskovits and Frances S. Herskovits, *Columbia Univ. Contrib. Anthropol.*, 27), based on material collected in Dutch Guiana in 1928 and 1929, it is pointed out that the essential factor in the beliefs of the Paramaribo town negroes, is divination, for through the work of the diviner all the elements of their system are drawn together, explained and controlled. These elements are four in number: the *akra* or soul, the *winti* or the gods, *obia* and *wisi*, good and evil magic, and the spirits of the dead. *Winti*, the negroes say, means wind. It is in every place, and is the air we breathe. The spirit too is everywhere. The term defines the gods and spirits, which rule the universe; among the bush negroes gods are usually termed *gadö*, and in both city and among the bush negroes other terms are encountered. Although among the bush negroes a term for Supreme God frequently occurs, it is seldom that a sky-god is invoked in the town. The only reference is in the dance to the seven gods of the sky, the thunder gods. The earth gods are headed by the Earth Mother, who even in ritual is referred to by this euphemism, and is named correctly only in songs sung by those under possession. The Earth Mother has a large number of these 'strong' names, used only by initiates and in ritual performance. This variety of names may be due to the fact that the negroes are descendants of ancestors who hailed from very different parts of Africa. While other *winti* receive offerings only from their own devotees, the Earth Mother receives from all. The most prevalent type of *winti* among women are those associated with the snake. While some snake spirits may enter into possession of men, others possess women only. This seems to be connected with childbirth and the belief that ancestor spirits may make use of the snake. Other *winti* are connected with the river, or the bush, living in the ground, in trees and in holes. *Winti* may be acquired by inheritance, by choice of the spirit, or through the 'bad magic' of an enemy.

Expectation of Life in a Moth

MESSRS. RAYMOND PEARL and John R. Miner contributed a series of life tables for the pecan nut case-bearer moth (*Acrobasis caryæ*), of which a reprint has been received, to "Mélanges Paul Pelseuer" (*Mem. Musée Roy. d'Hist. Nat. Belgique*, ser. 2, fasc. 3; 1936). The details upon which the computations are based were taken from studies made on the insect by S. W. Bilsing and published in 1927. It appears that the proportional distribution of the imaginal life of the female moths into pre-reproductive, reproductive and post-reproductive phases, when compared with the equivalent divisions of the life of the human female, shows that the post-reproductive phase is substantially equally proportional in the two cases, while the *Acrobasis* female spends more than double the proportional amount of time in the pre-reproductive phase as compared with the human female. The mean duration of life of the moth shows an evident tendency to increase in the three successive

generations after the first one. The female moths in all groups tend to be longer lived than the males by amounts that are probably significant. The relative variability in duration of life is roughly the same as that found in closely inbred strains of *Drosophila*. The above paper is part of a series of studies on life duration in the lower organisms: among insects complete life-tables have only as yet been calculated for the cockroach (*Blatta*) and *Drosophila*.

Root Systems

THERE is a general discussion of the technique of exposing and recording root systems by T. K. Pavlychenko in the *Canadian Journal of Research*, 15, No. 2, February 1937. This account describes much American work, but makes no mention of the studies of root systems of fruit trees carried out for some years at the East Malling Research Station, reports of which have been published in the *Journal of Pomology*. The author then describes the soil block washing method which has been developed at the University of Saskatchewan. All thorough methods of exposing and measuring root systems are of necessity laborious, and make big demands upon time and material; but this method, in which the roots are removed in soil blocks in specially constructed cases and then first soaked and freed from soil by constant gentle washing in a stream of water, must have been most successfully developed to judge from the photographs of root systems published. It is a little staggering to see the total length of the root system of a single wild oat plant, grown free from competition over a period of eighty days, estimated at fifty-four miles! The root systems of three-year-old plants of slender wheat grass, brome grass and crested wheat grass are estimated at 9.9, 65.2 and 315.4 miles respectively.

Necrotic Lesions of Virus Diseases

THE virus diseases known as tobacco mosaic and aucuba or yellow mosaic, produce local necrosis upon the leaves of *Nicotiana glutinosa*. Brown spots, visible by the unaided eye, appear about two days after inoculation. A short paper by Dr. F. M. L. Sheffield (*Ann. App. Biol.*, 23, No. 4, 752-758; 1936) traces the appearance of these areas where the tissue is killed. Necrotic material begins to form first between the lower epidermis and the spongy parenchyma tissue of an infected leaf. It later extends upwards and outwards, until, about 72 hours after inoculation, all the cells in the immediate neighbourhood are dead. The virus is isolated within the necrotic area. The outer cells of the necrotic region are killed before the virus reaches them, and the virus cannot, apparently, traverse this dead tissue.

Indian Lac Research

AMONG the investigations commenced in February 1930 at the Indian Lac Research Institute were experiments which aimed at the improvement of the villagers' ordinary methods of exploiting the kusum tree (*Schleichera trijuga*) as a lac host (*Lac Research Institute Bulletin*, Nos. 15 and 20. Criterion Printing Works, Jackson Lane, Calcutta, 1936). In Bull. 24,

Mrs. Dorothy Norris, director of the Institute, discusses the success attained. By adopting the methods of pruning and cropping advocated, the kusum tree can be utilized in lac cultivation to much better advantage than under the rather crude methods of the Indian ryot (peasant). The hot weather crop (July) is known as *Jethwi* and the cold weather (February) as the *Kusmi* crop. The lines for the treatment of the tree were laid down in *Bull.* No. 15 and have proved highly successful. Trees pruned in February 1930 were ready for infection in February 1931, yielding a good crop of lac in July 1931, with a brood yield ratio of 1 : 3.1. A year later (the trees are rested for a year) in July 1932 the trees were again ready for infection and were cropped in February 1933, giving a brood ratio of 1 : 3.7. In February 1934 the trees were again ready for infection and gave a crop in July 1934 with a brood yield ratio of 1 : 3.2. In July 1935 the trees showed no sign of sickness or over-use, and were again infected and the crop, obtained in February 1936 was excellent in quality and gave a brood ratio of 1 : 3.1. It will be seen that these experiments were started six years ago only, and will require to be carried on for a much longer period to establish definite cropping figures; since so far only two *Jethwi* and two *Kusmi* crops have been compared.

The Arun River and Himalayan Uplift

THE Arun is one of those Indian rivers which rises north of the Himalayas and flows eastward, before turning southward and flowing through the Himalayas in a series of gorges between Mount Everest and Kangchenjunga. The theory that the river is an example of ordinary consequent drainage and that it has cut back and captured Tibetan drainage has been advocated by Hayden, Heron and others. The alternative explanation, that it is antecedent to the Himalayas and has maintained its course by vigorous erosion has also been suggested and is argued by Dr. L. R. Wager in a paper in the *Geographical Journal* of March. Dr. Wager pays particular attention to the remarkable Yo Ri gorge and the main gorge eleven miles lower down. In its upper course, the Arun flows over soft sedimentaries and forms a wide valley, but at the Yo Ri gorge it reaches hard gneiss in the Nyonno Ri anticline. This explains the change in form of the valley. West of the gorge lies the low pass of Kuyok La. Dr. Wager argues that if the original surface on which the Arun flowed had been anything like the present one, the river would have flowed through this pass. Since it did not do so, the Arun must have been established in its course before the present form of the land. The Tista River farther to the east probably shows a comparable history.

Temperature and Sunshine in the British Isles

Two interesting publications of the Meteorological Office have just appeared (London: H.M. Stationery Office). The first (No. 407) is entitled "Averages of Temperature for the British Isles" (1s. 3d. net), and the second (No. 408) "Averages of Bright Sunshine for the British Isles" (1s. net). In each case, the averages refer to periods ending in 1935, and are for individual months and the whole year. These averages correspond to some extent with the old 'normals', which were averages for a period, 1881-1915, which was assumed to be a whole Brückner cycle of weather, the length of which cycle was taken to be 35 years.

As such a small part of our weather vagaries are consistent with such a cycle, it is doubtful whether very much is gained by using 35-year averages as representative of normal conditions. There is much to be said besides for having averages, such as these new averages, which do not include years like the early 'nineties, when the old-fashioned kind of winter with weeks of skating turned up fairly regularly each year. It is hard to give a satisfying definition of a 'normal'. If it is based on a short period, it will be objected to as too small a statistical sample. If the period is made very long, other critics will say that our climate has altered since the earlier years of the long period. Yet standards of reference of some kind seem necessary. For example, unless official forecasts give the actual range of temperature that is expected, which can scarcely be hoped for when places at different heights and different distances from the sea have to be grouped into a single 'district', the forecaster has to use expressions like 'cold' or 'rather cold', and these mean cold compared with the normal for the season. Those members of the public who want to know precisely what is implied must have averages of the kind given in these two booklets.

Viscosity of Air

G. KELLSTRÖM (*Phil. Mag.*, March) has made a new determination of the viscosity of air, using the viscous drag between concentric rotating cylinders. The mean value for the viscosity at 20° C. was found to be 18200×10^{-8} c.g.s. units. This value is about 0.7 per cent higher than the one used by Millikan in his determination of the electronic charge by the oil-drop method, and a substitution of the new value in Millikan's work raises the value of e from 4.770×10^{-10} to 4.818×10^{-10} E.S.U. The error in the viscosity data may therefore account for the difference between the oil-drop value of e and that obtained from absolute wave-length measurements of X-rays, namely, 4.805×10^{-10} E.S.U. (cf. *NATURE* 137, 655; 1936).

The Mysterious Number 137 Again

AS mentioned in *NATURE* of May 23, 1936, p. 877, Euler and Koekel, working on a form of Born's unitary field theory, obtained the value 82.4 for the dimensionless pure number the explanation of which Born has declared to be the central problem of natural philosophy. An estimate of 130, which is much closer to the experimental value 137.2, has now been obtained by L. Infeld (*Proc. Camb. Phil. Soc.*, 33, 70; 1937) by using a different action function. It is shown that most of the consequences of the unitary field theory at first developed by Born and Infeld hold good for a whole range of action functions, all giving a static solution with central symmetry and finite energy, both for the electric and magnetic field, and reducing to Maxwell's action function for weak fields. That chosen by Born was distinguished by perfect symmetry between the electric and the magnetic field. A paper, not yet published, by Infeld and B. Hoffman will lay down a physical criterion to determine which function should be chosen. An even wider generalization of part of Born's electrodynamics has been made by P. Weiss (*ibid.*, 33, 79; 1937), who shows that every self-conjugate analytic function of a complex variable characterizes an electrodynamic field theory of the type proposed by Born. More stringent physical conditions, not yet available, are needed to thin out this over-luxuriant growth.

The Solar and Magnetic Conditions Associated with Recent Auroras

By the Rev. J. P. Rowland, S.J.

AS already noted in NATURE (Feb. 13, 20 and 27), notable displays of the aurora were observed on January 7 and February 3, and it was anticipated there might be a recurrence after the 27-day interval of solar rotation on March 2. Weather was generally cloudy or overcast and unfavourable for observation on the last-mentioned date, but Mr. W. N. Craig, of Fortrose, Ross-shire, writes that an observer near Cambridge reported seeing the aurora between 20h. and 21h., with a maximum brightness at 20h. 45m. U.T., and another observer at South Queensferry, near Edinburgh, in a small clearing at 19h. 45m., noted the sky to be brighter than usual. Two persons near Stonyhurst, in a brief partial clearing of the sky, reported seeing auroral rays between 20h. 20m. and 20h. 30m., and an observer in the vicinity of Preston noted indications of aurora with rays, between 23h.

As Mr. Housman points out, it appears that in general the arch forms during an easterly swing of the magnet, and dissolves into an outburst of streamers and other luminous effects at or near the end of the easterly swing. It also appears from these observations, that auroral features may be seen when there is very little disturbance of the magnets, though a greater disturbance accompanies a more vivid display, as on February 3.

Mr. Craig mentions an aurora seen in Maine, U.S.A., "in the middle of December", but as no date is given, it is not possible to correlate this with the magnetic conditions, which were, in fact, remarkably quiet throughout the month, with the exception of a moderate disturbance on December 27 and 28. The auroral display of October 16, 1936, discussed by Prof. Vegard in NATURE of November 28 (p. 930),

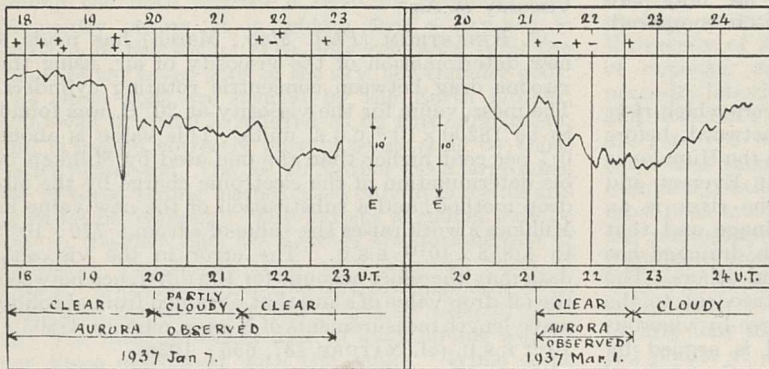
was accompanied by a very notable magnetic disturbance, lasting from October 16d. 15h. to 17d. 7h., with oscillations in declination of 28' between 18h. and 20h., a rapid easterly deflection of 23' at 22h. 30m., and a range of 39' over the whole disturbance.

When we come to consider the relation of these phenomena to solar activity, we are on less sure ground. According to generally accepted theory, both auroras and magnetic disturbances are attributable to the emission of streams of corpuscles from disturbed areas on the sun, which travelling with high velocity under the action of

radiation pressure enter the earth's upper atmosphere, and there set up ionization currents and electrical discharges in the rarefied gases, which manifest themselves in the disturbance of the earth's magnetic field, and the glows of the auroral light. The frequency of both auroras and magnetic storms, and the mean annual magnetic ranges, show a close correlation with the 11-year sunspot cycle, and both show a recurrence tendency after 27-day intervals, corresponding to the mean solar rotation period.

When we come, however, to the consideration of individual correspondences, the position is not so clear. There are cases where large sunspots cross the disk without any obviously corresponding magnetic disturbance, and conversely, magnetic disturbances occur when there are no spots on the sun. It should be remembered that sunspots are not the only manifestation of solar activity, and magnetic disturbances may be associated with the presence of faculae, bright or dark flocculi, and eruptions on the disk, which, at the limb, would be seen as prominences. In the case of magnetic disturbances which are apparently associated with individual spots, statistical investigations show that the magnetic disturbance may occur from 1-2 days before to 3-4 days after the central meridian passage of the spot, corresponding to mean corpuscular velocities of 1,100-270 miles per second.

There is good ground for believing that the recent



and 23h. 25m. On the other hand, Mr. W. B. Housman, director of the Aurora Section of the British Astronomical Association, observing over the Solway Firth from Seaton, Cumberland, reports: "On March 2nd there was no aurora seen throughout a cloudless night here, observations being at very frequent intervals". On the Stonyhurst magnetic traces there was a moderate magnetic disturbance from 18h. 40m. to 19h. 40m., after which conditions were quiet, with only very slight movements.

On March 1, however, a prolonged and bright quiescent aurora was observed at Stonyhurst, from 20h. 45m. to 23h. 30m., which was especially bright between 21h. 30m. and 23h., extending to an altitude of 35° or 40°, gradually fading away to a slight glow by 23h. 30m. when observation ended. This aurora, and that of January 7, were observed in great detail by Mr. Housman at Seaton, and from a correlation of his log with the Stonyhurst magnetic declination traces, some interesting inferences may be drawn. This correlation, as made by Mr. Housman, is shown in the diagram above; the signs + and - above the declination trace, indicate respectively when a homogeneous arch was in being at the time indicated, and when the arch dissolved into streamers and luminous activity. The sign ‡ indicates the existence of a double arch, during the large easterly deflection of the magnet between 19h. 15m. and 19h. 30m. on January 7.

auroras and accompanying magnetic disturbances were due to the activity of a region of the sun centred in approximately lat. 10° S., long. 200° . In this area, the centre of an enormous spot group, extending over 8° in latitude and 16° in longitude, crossed the sun's central meridian within 4° of the centre of the disk at approximately midnight of January 30-31. It was therefore in a most effective position for a roughly radial stream of corpuscles to be intercepted by the earth, and the magnetic disturbance and aurora of February 3 must be attributed to it. The same region crossed the central meridian on January 3 and February 26, in each case showing a spot of moderate size, the times of central meridian passage being Jan. 3d. 9h. and Feb. 26d. 18h. respectively, and it is reasonable to suppose that the phenomena of January 7 and March 2 were associated with this area. The aurora and magnetic disturbance of March 1 were probably not associated with this area, but with a small group of spots in lat. 11° S., long. 228° , which crossed the central meridian on Feb. 25d. 0h. If these inferences are correct, the time intervals between the central meridian passages of the spots and the respective auroras, and the deduced corpuscular velocities are as follows:

Date of Aurora.	Time Interval.	Corpuscular Velocity.
Jan. 7.	4d. 10h.	250 miles per sec.
Feb. 3.	4d. 19h.	220 " " "
Mar. 1.	4d. 22h.	217 " " "
Mar. 2.	4d. 0h.	280 " " "

On February 25 there was an extensive belt of spot groups stretching almost across the disk in the northern hemisphere of the sun, but as there was no corresponding sustained magnetic disturbance, these groups appear to have been magnetically comparatively inactive, probably on account of their distance from the centre of the disk, which averaged about 20° . A large naked-eye spot in lat. 9° N. crossed the central meridian on March 2d. 0h., but

it is unlikely that this was associated with the aurora on that day or the previous one, both on account of the lack of the requisite time interval, and because, owing to the backward tilt of the sun's axis, it was 16° from the centre of the disk, where it would be less effective. It may, however, have been responsible for a moderate magnetic disturbance on March 5.

Mr. Craig suggests that the aurora of October 16, 1936, may belong to the same series as the recent displays, but this seems unlikely, as it would involve a mean interval of 27.5 days, corresponding to the solar rotation period in latitude 20° , whereas the spots involved in the recent cases had a latitude of 10° , with a rotation period of 27.05 days. A spot of appreciable size in lat. 12° S., long. 225° crossed the central meridian on October 11.8, and may have been responsible for the aurora and magnetic storm of October 16. As this position is very nearly the same as that of the group which has been suggested above as probably responsible for the display of March 1, it would appear that these two occurrences may be considered as belonging to a separate series different from that of the displays of January 7, February 3 and March 2. This case, however, illustrates the difficulty of assigning individual correspondence between solar and terrestrial phenomena, for on October 12 a sporadic group of small spots crossed the central meridian in lat. 18° N., which, owing to the forward tilt of the sun's axis at that time, was only 12° from the centre of the disk, and therefore in a more favourable position to produce terrestrial effects than the southern spot, the distance of which from the centre was 18° .

With the approach to the time of sunspot maximum, conditions for the production of the aurora are likely to be frequent during the next two years, but owing to the decreasing hours of darkness, conditions for observing the displays will not be favourable until next autumn or winter, when it is to be expected many displays may be seen.

The Development Commission

THE twenty-sixth report* of the Development Commissioners, covering the year ended March 31, 1936, reviews the expenditure from the Development Fund on agricultural and rural economy, fisheries, the construction and improvement of harbours and on the acquisition of land for road improvements. Advances recommended from the Fund amounted to £555,201 on agricultural and rural industries and £85,925 on fisheries as against £402,859 and £88,109, respectively, in 1934-35. For the maintenance of agricultural research, advisory services for farmers, experiments on field crops and livestock and the provision of buildings and equipment £421,762 was advanced as against £361,691 in 1934-35. Of this, £285,984 was advanced to the Ministry of Agriculture and Fisheries, £67,101 to the Department of Agriculture of Scotland and £16,982 to the Agricultural Research Council, in addition to £43,000 to the latter Council for capital expenditure.

The advances to the two Agricultural Departments include £198,170 for maintenance grants to Research Institutes in England and Wales and £40,966 for those in Scotland. The total provision recommended during the year for research and advisory activities in agriculture in Great Britain amounted to £369,977, a generous figure in comparison with State assistance to other industries, although even at this figure research expenditure only amounts to about 0.14 per cent of the value of the year's output.

For the first time since 1931 a considerable sum was approved for the erection of new buildings at institutions engaged in research or agricultural education. Grants have been approved for this purpose to the Studley College for Women, the Royal Agricultural College, Cirencester, the University College of North Wales, Bangor, the Midland Agricultural College, the Avoncroft Agricultural College, and the Royal (Dick) Veterinary College, Edinburgh. Assistance given to rural industries has three principal aims: the provision of technical advice for craftsmen by the Rural Industries Bureaux; the interest of

* Development Commission. Twenty-sixth Report of the Development Commissioners, being for the Year ended the 31st March 1936. Pp. 184. (London: H.M. Stationery Office, 1937.) 3s. net.

local residents, usually members of Rural Community Councils, in the welfare of village craftsmen; and the employment by Rural Community Councils of a Rural Industries Organizer. Details of the work of the Rural Community Councils and of the Rural Industries Bureaux are included in the report.

Although the Commissioners are not directly concerned with the provision of work for the unemployed, assistance has been given to two admirable schemes relating to land cultivation—the Allotment Scheme of the Society of Friends and Central Allotments Committee and the Land Settlement Association. Stress is laid upon the experimental character of these schemes for converting the unemployed industrial worker into an independent landholder and on the need for organization in this field if our natural resources are to be used to full advantage. Assistance has also been given to the Agricultural Camps Committee.

While the agricultural section of the report is concerned only with administrative matters, the section on fisheries includes an account of work reviewed by the Commissioners' advisory committee on fishery research as well as progress reports submitted by the directors of institutions receiving grants in aid of fishery investigations. The difficult situation at Armstrong College, Newcastle-upon-Tyne and the Dove Marine Laboratory, Cullercoats, since the financial emergency of 1931, due to the fact that the staff were partly engaged in 'directed' research on the local herring fishery and on pollution in the Tyne for the Ministry of Agriculture and Fisheries, for which the Minister's vote was drastically reduced, has been met by initiating a new grant period of five years in the form of a single block grant towards the total maintenance expenses of the Laboratory. Tribute is paid to Prof. Hobson's determination and ability in overcoming the difficulties and re-organizing research and to the value of the Laboratory in supplementing the fishery researches of the Ministry. Continued support of Prof. A. C. Hardy's investigations at University College, Hull, on the influence of plankton on fisheries is recommended; and reference is made to the development at Conway through investigations on shellfish of a cleansing process for mussels which eliminates the danger of carrying typhoid, and this process has been adapted to the

purification of oysters. Other investigations in this field are concerned with the reliability of bacteriological methods for the routine testing of shellfish for sale, and grants have also been given for the development of freshwater fisheries, including investigations of salmon and sea-trout.

Grants for fishery research are made from the Development Fund either to the Fishery Department for 'directed' researches on problems immediately affecting the economic development and exploitation of fisheries, or to universities, colleges and marine laboratories for 'free' research, with the object of increasing our knowledge of the animal and plant life of the sea in relation to its whole environment. In the first category fall the important investigations on the difficult problems connected with herring fisheries, which differ for England and for Scotland. In Scottish waters the Fishery Board's investigations have shown that the shoaling of the herring on the drift-net grounds in early summer is associated with the search by groups of fish from different sources and of different types for the rich food-plankton then present in northern waters. In the great autumn fishery off Yarmouth and Lowestoft, however, the fish are on a migration preliminary to spawning and the shoals are not feeding. The investigations of the English Fishery Department have led to the issue of much more accurate forecasts of this autumn fishery. Other directed investigations have been concerned with inshore fisheries such as the population of small plaice in sand bays on the east coast of Scotland with a view to determining how far the stock needs protection by regulation of fishing. Diseases of freshwater fish, such as furunculosis, have also been studied, while among the 'free' researches assisted may be mentioned Dr. H. B. Moore's investigations on animal and plant life of the sea-shore, the cause of the dying out of eel-grass or grass-wrack and on artificial hatching and stocking of salmon fisheries.

Enough has been said, however, to indicate the wide range and importance of the Development Commissioners' contribution to scientific research. Equally it would seem that the Development Fund contains possibilities of co-ordinating the national effort in research, which might well be applied in very much wider fields.

The Chemist in Industry

THE Society of Chemical Industry concerns itself very largely with the practical application of chemistry, and in the main operates through its subsidiary groups, of which there are four, and its numerous sections in Great Britain, in the Dominions and in the United States. Once a year, at the annual general meeting, the Society as a whole meets at the headquarters of one of the sections and like the British Association it visits the Dominions and the United States from time to time. This year the annual meeting will be held at Harrogate, though Leeds is the headquarters of the Yorkshire Section, and next year the meeting will be in Canada. At these meetings the business of the Society is dealt with, addresses are delivered, a few papers are read,

works and places of interest are visited, but the social atmosphere predominates.

About a year ago, however, the Council came to the conclusion that some matters of general interest to chemists and the chemical industry as a whole could only be dealt with at conferences specially convened, and accordingly it appointed a strong committee with Dr. Wm. Cullen as convenor to give effect to its decisions. The Manchester Section was anxious that the first conference should be held there, and no more appropriate place could have been chosen.

As the subject chosen for the symposium held on April 2, namely, "The Chemist in Industry", was somewhat wide, and indeed vague, it was decided

that there should be two sessions, one in the afternoon and the other in the evening, at which sub-divisions of the general subject should be discussed. The subject of the afternoon session was the "Induction and Functions of the Chemist", and that of the evening session, "His Influence and Reward".

Eight short papers were prepared and all were published in advance of the meeting in *Chemistry and Industry*. In addition, reprints were available at the meeting. Two *rapporteurs* were appointed to summarize the papers, namely, Dr. R. H. Pickard, director of the Shirley Institute, for the afternoon session, and Mr. C. J. T. Cronshaw, managing director of the British Dyestuffs Corporation, for the evening session. In the unavoidable absence of Lord Leverhulme, president of the Society, Mr. W. A. S. Calder, a past president, presided over the conference.

By adopting this arrangement, practically the whole of the time available was devoted to the discussions, and it may be said that the speeches on the whole were excellent. The immediate point under discussion was seldom lost sight of, and so far as the first session is concerned, it looks as if the Committee would be in a position to come to definite conclusions which it is hoped will be helpful to the universities and colleges on one hand and industry on the other. As might have been expected, the discussions centring around the subject for the evening session were less helpful, but inspiring nevertheless.

No attempt will be made to summarize these discussions here. In due course they will no doubt be published, together with the conclusions of the Committee, but it is quite clear that the symposium has justified itself, and others will no doubt follow in due course.

The following is a list of the writers of the papers, all of whom were requested to confine themselves, so far as possible, to their own experiences: *Afternoon Session*: Dr. J. J. Fox (Government Chemist); Prof. J. C. Philip (Imperial College of Science and

Technology); Mr. F. Scholefield (College of Technology, Manchester); Mr. C. M. Whittaker (Courtaulds, Ltd.). *Evening Session*: Mr. H. Ballantyne (Lever Bros., Ltd.); Mr. G. E. Collins (Shirley Institute); Dr. A. E. Dunstan (Anglo-Iranian Oil Co., Ltd.); Mr. J. Rogers (Imperial Chemical Industries, Ltd.).

It will be observed that the writers of these papers covered a very wide field, from both the academic and industrial points of view, and though the whole field could not be covered, this defect was remedied largely by the discussion in which twenty-five persons, all men of standing, took part.

It is just as impossible to summarize the papers as the discussion, but one or two points have emerged:

(a) For certain classes of work, graduate chemists do not appear to be sufficiently trained in manipulative technique, possibly through the attempt to put too much into the curriculum.

(b) There has been too little contact between industry and the teaching institutions generally.

(c) There is a large demand for chemists whose training from the start is along definitely technical, as opposed to purely academic, lines.

(d) For success in other walks of life, such as administration, business, salesmanship, and even finance, chemical training forms just as good a background as any other.

Probably the most striking statement made during the symposium was by Mr. C. M. Whittaker, who said: "In my experience there are just as many fools walking about with high academic qualifications as there are able men walking about with lesser academic qualifications, but of greater ability and deserving of greater financial reward."

In this connexion the views of many of the speakers, which seemed to be endorsed by the very large audiences present, were that the avenues to inclusion in the profession should not be closed in the slightest degree to those who had the desire to better themselves.

Forestry in the Gold Coast

THE annual report of the Forestry Department of the Gold Coast for the year 1935-36 (Accra: Govt. Printing Dept., 1936) by Mr. R. C. Marshall, conservator of forests, is written in non-technical language and gives evidence of progress in the introduction of a sound forest administration.

Cocoa forms one of the staple exports of the Colony, and the protection of a certain area of forests in the right situations is indispensable to this industry. It has been established by the research work carried out under the Cocoa Research Scheme at the Imperial College of Tropical Agriculture in Trinidad that an even moisture status is one of the characteristics of a good cocoa soil, and environmental studies have demonstrated that the moisture status of both soil and atmosphere have important bearings on crop productivity. The chief function of shade trees in cocoa cultivation is to provide a buffer against fluctuations in environmental conditions. This lesson was learnt many years ago in Madras and Ceylon in connexion with coffee and the tea gardens and other forms of planting cultivations.

The clearing of large blocks of forest and the hacking which took place in those remaining in the neighbourhood led to serious erosion, desiccation of the soil and so forth; this led to heavy losses and considerable areas going out of cultivation. If the conditions in the Gold Coast are to be adequately preserved, where such preservation is not altogether too late, "the requirements of this industry need to be considered from time to time by the Forest Agricultural Departments in collaboration with the Administration".

Mr. Marshall considers three types of protection forest reserves as required in the Colony: (a) head-water reserves, (b) barrier reserves, and (c) shelterbelt reserves. It is said that reservation has been so far concentrated on (a) the protection of headwaters and (b) the barrier reserves situated between the edge of the closed forest zone where it marches with the drier open (savannah) forest; the idea being to stay the encroachment of dry conditions. During the year, the chief attention has been paid to what are termed (c) the shelterbelt reserves. These latter are to be

oriented so far as possible at right angles to the prevailing wind and spaced at intervals through the countryside: their function is to protect agricultural cultivation, especially cocoa; to assist in maintaining the necessary environment of a closed forest climate, and to afford additional lines of defence against the encroachment of open-forest conditions. How far this aspiration will be possible in view of the considerable area of forest which has already been swept away or reduced to a condition in which it will prove useless for the purpose in view it is impossible as yet to say. But this matter has not been taken up any too soon.

It is apparent from the report that the Conservator has been able to increase considerably his gazetted staff (from 12 in 1934 to 18 in 1936) and is making progress in an even more desirable matter—that is, in “bringing the Forest Department district organization into line with the political district organization which itself follows tribal distribution as far as possible. At present forest districts consist of two to three political districts”.

With a strengthened staff, the Conservator rightly decided that the first work to deal with was the selection, demarcation and cultivation of the forest reserves still demanding constitution, and a considerable amount of work in this connexion was undertaken during the year.

With the sub-division of the country into definite forest districts, each to be in charge of an assistant conservator of forests, the management of the forest districts will receive more attention and the advance in the introduction of working plans will prove feasible, when sufficient stock mapping of the growing stock in the forests has been accomplished.

Fuel will be required so far as can be foreseen in increasing amounts in the Colony, both for domestic consumption and for power in connexion with water-work schemes. The exotics *Cassia siamea* and the Indian neem are both giving satisfactory results, as elsewhere in West Africa. Good fuel wood is successfully produced in seven years or less. The total area of fuel plantations amounts to 1,000 acres, the greatest area at Achimota, where the highly successful School is situated, within a short distance of Accra, the capital on the Coast. Other plantations of the same type exist at Cape Coast, Kumasi and other centres. Assistance is also given by the Department in connexion with water-works schemes. The sustained supply of fuel to the mines is proving a more difficult matter.

The report has some interesting remarks on the subject of the prevalent practice of firing the so-called open or savannah forest lands and shifting cultivation. It is the most informative forest report on the Colony which has appeared for some time.

Oak-galls in Theophrastus

PROF. GUSTAV SENN, of Basle, has published a short but interesting note on this subject (*Verh. Schweiz. Naturforschende Gesellschaft*, Solothurn, p.372; 1936). Theophrastus mentions, in his “*Historia Plantarum*”, no less than ten species of oak-galls. Some are well known and unmistakable, such as the common Turkey or Aleppo gall; and one, or the insect which produces it, *Andricus Theophrasteus*, bears the old Greek’s name. But no one seems ever to have studied the Theophrastean account as a whole, and even Sir Arthur Hort made no attempt to identify the several species. Prof. Senn finds little difficulty in doing so, and the result is a remarkable testimony to Theophrastus’s diagnostic skill.

The ‘little gall’ with which the account begins (H.P., 3, 7, 4) is the valuable Aleppo gall, or ‘ink marble’, formed by *Cynips tinctoria*. The common ‘black resinous’ gall is the Bassorah gall, made by *C. insana*; it is the only one with a coat of resin. A scarce one, very hard in texture, mulberry-like in form, is identified by Prof. Senn as the gall of *C. culiciformis*. Another, phalliform in shape, growing into something like a bull’s head at one end and with a hard interior like an olive-stone, is identified as the gall of *C. Quercus-Tozæ*. Fluffy balls, serving for lamp-wicks, are the woolly or cotton galls of *Andricus Theophrasteus*, akin I suppose to *A. ramuli*; and other hairy or bristly galls, covered with sweet honey-drops in spring, but quite useless, are those of *A. lucidus*. Certain stalkless galls, looking like a cluster of leaf-scales and growing in the axil of a leaf or twig, are the hop galls or artichoke galls of *A. fecundator*. The rare, elongated, close-textured foliaceous balls are the galls of *A. multiplicatus*; and,

last of this catalogue, the clear juicy globules, growing on the midrib of a leaf, are the well-known currant galls of *Neuroterus baccarum*.

In another passage (H.P., 3, 3, 8), Theophrastus mentions, with the same brief accuracy, the galls which the tanner uses and the black ones which serve for the dyeing of wool; these being, once again, the Aleppo galls of *C. tinctoria* and the Bassorah galls of *C. insana*. A little gall, something like the Aleppo gall but smoother, and of no commercial value, is in all probability the oak-marble, or oak-apple, of *C. Kollari*. Connold, in his “*British Oak-galls*” says of it: “*C. tinctoria* bears a very close resemblance to *C. Kollari*, and many specimens of the latter might easily be mistaken for the Aleppo gall”; but the latter, he adds, yields 40 per cent of tannin, while *C. Kollari* gives only 17 per cent. This last identification may be a little doubtful, but the other nine oak-galls mentioned and characterized in a word or two by Theophrastus are easily and safely identified. The fact is that, great philosophic biologist as Aristotle was, Theophrastus was far ahead of him as an observer and recorder of species from a modern botanist’s point of view.

Sir Thomas Browne, in his notes on the “*Natural History of Norfolk*” (ed. T. Southwell, 1902), found on the oak just about as many galls as Theophrastus knew, and characterized them with equal skill. His “*Juli pilulæ*”, little balls on the flower catkins, are a form of the currant gall; his *excrementum lanatum* is a woolly gall; and his *capitula squamea jaceæ amula*, ‘little scaly heads like the heads of knapweed’, are without doubt our hop or artichoke galls.

D. W. T.

Science News a Century Ago

Heathcoat's Steam Plough

IN the *Gentleman's Magazine* of 1837, under the date April 18, it is said: "A deputation named by the Highland and Agricultural Society of Scotland met at Red Moss, near Bolton, according to appointment, to inspect the steam plough invented by Mr. Heathcoat, M.P. for Tiverton, and working under the direction of Mr. Parkes, Engineer. The deputation was composed of the Marquess of Tweeddale, Vice-President, Sir John S. Forbes, Mr. Oliphant, M.P., and other Members, with Mr. Gordon the Secretary. The machine has been made by Mr. Heathcoat, to operate in the first instance on moss, in which it is very efficient. The engine is of 15 horse-power, and the plough is attached by a band of the width of about two inches. The length of the furrow in the ground operated upon was 304 yards, breadth 18 inches and depth 9 inches. The furrows were cut on an average in four minutes and a half, which is equal to about half an acre turned over by the hour. The deputation, and many other gentlemen present, from different parts of the United Kingdom, expressed themselves highly gratified by the efficiency of the machinery."

John Heathcoat (1783–1861) was famous as the inventor of lace-making machines, and had a mill at Loughborough which was destroyed during the Luddite riots of 1816. After this, he removed to Devonshire and in 1832–59 represented Tiverton in Parliament. His plough was patented in 1832.

Natural History Collections from New Zealand

IN *The Times* of April 19, 1837, is the following note from a correspondent: "It will, perhaps, not be uninteresting to your readers who are lovers of natural history to know that the bark *Guiana* arrived this morning from Van Dieman's Land, on board which is a young naturalist (whose name I did not learn) who has been out to Van Dieman's Land and New Zealand, collecting in the various branches of natural history. I was favoured with a sight of his splendid collection of insects, shells and bird skins; but more particularly with three fine living opossums, one of which is white, the only one which has left its native woods. As they are to be deposited for a short time in the Surrey Zoological Gardens, previous to their removal to the country, this paragraph in your valuable and widely circulated paper will give many naturalists an opportunity of seeing them previous to their removal. I also saw a box containing from 400 to 500 roots, of the curious and splendid terrestrial orchidæ of the above countries, many of which are new and will be a grand acquisition to our gardens; they are valued at the sum of £700."

David Douglas's Observations in America

WHEN David Douglas (1798–1834), a Scottish botanical collector, was killed in the Sandwich Islands, he left various manuscripts which ultimately came into the hands of Major (afterwards General Sir) Edward Sabine (1788–1883), brother of Joseph Sabine (1770–1837), secretary of the Horticultural Society, to whom Douglas had been recommended by Sir W. J. Hooker. The manuscripts consisted of several volumes of lunar, chronometrical, magnetic, meteorological and geographical observations, and

these formed the subject of a paper entitled "Observations taken on the Western Coast of North America by the late Mr. Douglas" read to the Royal Society on April 20, 1837, by Major Sabine.

Douglas began life as a gardener, and was sent to the United States as a collector first in 1824. After his return home, to make himself fit to render service to geographical and physical science, he began to study the principles of science and the methods of observations, and at one time worked at these subjects for eighteen hours a day. The observations he left in manuscript included among other things observations of the magnetic dip and intensity at various stations in North America and the Sandwich Islands.

Comparative Anatomy of the Brain

AT a meeting of the Royal Institution on April 21, 1837, Mr. Solly, of St. Thomas's Hospital, gave a lecture on the comparative anatomy of the nervous system and especially of the brain, and illustrated his views by reference to a number of well-executed drawings. Avoiding all minute details, he confined himself to the leading parts of his subject, of which he conveyed a very clear idea to his audience. He commenced with some remarks on neurine and its two kinds—the pulpy and the fibrous—whose offices he explained, and then proceeded to trace the nervous system, from the state in which it exists in the lowest kingdom of Nature in which its existence has been demonstrated, up to that in which it is found in man. In doing so he explained the most interesting points in the nervous system throughout the various divisions of the animal kingdom, and how the different senses are more or less developed according to the wants of each individual, as for instance, the sense of sight in birds. He also demonstrated most clearly that the simplest forms in which it has been possible to detect the nervous system are accurate types of its more complicated forms, and ended by briefly explaining the anatomy of the human brain. (*London Medical Gazette*, April 29, 1837.)

Conditions in Germany

THE following extract is taken from an editorial article in the issue of the *British Annals of Medicine* for April 21, 1837:

"Germany at present is in a very anomalous position. Her people are the best scholars in Europe, but they are without political freedom; they know nothing practically of representative self-government. The descendants of Arminius remain passively obedient to the princes under whose feet they happen to be born; and if in the different states the burthen bears unequally, this depends in no way on the will of the people, but on the accidental temper of the government. Government—paternal government—is carried to a revolting extent. Absolute ministers dictate to the people—a full-grown adult people—what they shall read. Only a certain number of foreign newspapers can enter Prussia, the press is submitted to censorship; an Austrian student could under no pretext obtain permission to visit France or England. Schönlein, Oken, Arnold—names which pronounced before a German student make his countenance light up with recollections of glowing thoughts and revelations of Nature—the most illustrious men have been driven, for liberal opinions, from their natural spheres—from the unnatural country, of which they were the glory, and are the shame."

University Events

CAMBRIDGE.—At Trinity College, the electors to the Wyse studentship in social anthropology have awarded a studentship of £300 for three years to Gregory Bateson, of St. John's College.

It is announced by the Philosophical Society that the adjudicators for the Hopkins Prize for the period 1930-33 have awarded the prize to Prof. P. M. S. Blackett, for researches on cosmic radiation.

ST. ANDREWS.—At the graduation ceremonial to be held on June 30, the honorary degree of LL.D. is to be conferred on the following, among others: Dr. W. O. Kermack, Royal College of Physicians, Edinburgh; Dr. Angus MacGillivray, ophthalmic surgeon, Dundee; and Sir Arthur Rose, chairman of the Carnegie Trust for the Universities of Scotland.

Societies and Academies

Paris

Academy of Sciences, March 8 (*C.R.*, 204, 733-828).

MARCEL GODCHOT and M^{lle}. GERMAINE CAUQUIL: The molecular transpositions obtained in the dehydration of 4-methylcyclohexylisopropylpinacone.

N. GUNTHER: Nuclei of the Fourier type.

LUCIEN MALAVARD and JOSEPH PÉRÈS: The corrections for the walls in the case of a tunnel of elliptical section.

ALBERT MÉTRAL and FRANÇOIS RAYMOND: A method of measuring the resistance exercised by the air on a railway train.

JEAN DUFAY: Nitrogen lines in the spectra of comets.

JEAN ROUBAUD-VALETTE: The equations of the photon.

RENÉ DUGAS: Quantum mechanics and the last multiplier according to Jacobi.

ERNEST BAUMGARDT: The ultra-sound yield of piezo-electric quartz.

NICOLAS KÜRTI, PAUL LAINÉ and FRANZ SIMON: Experiments on the thermodynamic scale of temperature below 1° K. Results of experiments by the method of adiabatic demagnetization using the large Bellevue magnet.

DOUCHAN AVSEC and MICHEL LUNTZ: Some new forms of electro-convective vortices.

M. HAÏSSINSKY and M^{me}. H. EMMANUEL-ZAVIZZIANO: The preparation of thin layers of titanium by the electrolytic method. Details of a method of preparing thin films of metallic titanium on a lead cathode, of a thickness about 0.1-0.2 mgm./cm.².

PIERRE MESNAGE: The molecular emission spectra of some metallic salts. Description of results obtained with manganese chloride, ferrous bromide and ferrous iodide.

M^{lle}. HOÀNG THI NGA: The photo-voltaic effects of the naphthalene diamines.

MARCEL CHATELET: The partial precipitation of cobalt by ammonia in excess and the formation of cobaltammine ions.

J. BÉNARD and GEORGES CHAUDRON: The preparation of ferrites by the substitution of ferrous ions in magnetite.

RENÉ DELAPLACE: A method of analysis of saturated and unsaturated gaseous hydrocarbons under very low pressures. Application of the method of fractional distillation of the liquid gases under low pressures, with subsequent separation of the saturated and unsaturated gases by chemical means.

JENS BOE and M^{lle}. MADELEINE GEX: Modifications of the spectra of aqueous solutions of phenyl-pyruvic acid as a function of the pH and of the time.

ALBERT PORTEVIN and PIERRE CHEVENARD: The cooling transformations of steels.

MARCEL PRETTRE: The heterogeneous combustion of mixtures of carbon monoxide and oxygen on a vitreous surface.

JEAN BARON and PAUL LAFFITE: The influence of nitrogen on the inflammation of diethylether. The results obtained for the variations of the temperature of inflammation of mixtures of ether, oxygen and nitrogen produced by varying the proportion of nitrogen present are in agreement with the theory of chain reactions.

CHRISTIAN AALL: The influence of the impurities silica, alumina and magnesia on the melting point of calcium carbide. The experimental results are given graphically: the curves showing the lowering of the melting point have not the same form.

M^{lle}. DENISE HIBERT and CLÉMENT DUVAL: Cobaltic chloride. Of various methods available, the best consists in treating a suspension of cobaltic oxide in ether with dry gaseous hydrochloric acid, afterwards removing the ether and excess of acid with a current of dry air.

RENÉ SUTRA: The formation of acetone derivatives of the mercaptals.

M^{lle}. SIMONNE CAILLÈRE: A special mode of alteration of anorthite and a calcium variety of thomsonite.

MARCEL GIGOUT: The Palæozoic series of Adrar n'Dgout (Marrakech Atlas).

EDMOND SAURIN: The Trias of the Phu-Tinh-Gia sheet (North Annam).

LÉONCE JOLEAUD: The very recent morphological evolution of a group of archaic Ungulata, the Damans.

FRÉDÉRIC MARIE BERGOUNIOUX: The faunal relations between the fossil Chelonians of Spain and France.

PIERRE DANGEARD: The zones of marine Algae of western Morocco.

PAUL DE GRAEVE: The evolution of puric nitrogen during germination.

HENRI GAUSSEN: Young forms and future evolution.

M^{lle}. FERNANDE FLOUS: The transmission of characters in the hybrids of firs.

CONSTANTIN DAWYDOFF: A new metanemertean belonging to a purely marine group, from the Grand Lac of Cambodia.

LÉON BINET and M. V. STRUMZA: Variations of the resistance to anoxhæmia according to the degree of narcosis.

LÉON KÉPINOV: Synergy of adrenalin and of the pituitary hormone. The mechanism of the glycolytic action of adrenalin.

ANDRÉ PAILLOT: The polyembryonic development of *Amicrophus collaris*, a parasite of the larvæ of *Euxoa segetum*.

M^{me}. VÉRA DANTCHAKOFF: The effects of sexual determinism in a feminized male.

ANDRÉ DOGNON, WLADISLAS KOPACZEWSKI and STANISLAS MARCZEWSKI: The absorption of ultra-violet rays by the serum and anaphylaxy.

M^{me}. RAYMONDE DUVAL and JEAN MARIE LE GOFF: The detection of small quantities of cobalt in human urine. The cobalt is concentrated by electrolysis and detected by the α -nitroso- β -naphthol reagent.

NICOLAS BEZSSONOFF and M^{lle}. MÉLANIE WOLOSZYN: The duality of the oxidized forms and the polarization of vitamin C shown by two reversible reactions with phosphomolybdic acid.

LÉOPOLD NÈGRE and JEAN BRETEY: The anti-tuberculous immunization of the ape by injection of tubercle bacilli from smooth colonies.

FERNAND ARLOING, ALBERT MOREL and ANDRÉ JOSSERAND: New researches on the action towards cancers of the soluble organo-metallic complex compounds of ascorbic and dehydrascorbic acids, where the iron is replaced by copper or titanium.

JEAN NAGEOTTE: Remarks on the surgical repair of losses of traumatic substances of the peripheral nerves.

Amsterdam

Royal Academy (*Proc.*, 40, No. 2, 1937).

F. K. T. VAN ITERSOM: Separation of substances by flotation. Mathematical treatment which shows that the greater the angle of contact the better the flotability of a substance.

J. A. SCHOUTEN: The differential geometry of groups of contact transformations (1). Doubly homogeneous treatment of contact transformations.

F. M. JAEGER: The relative and absolute spatial configurations of isomorphous optically active complex salts (2). Comparison of the tri-diamino salts of cobalt, rhodium and chromium.

F. M. JAEGER and L. BIJKERK: Investigations on the complex salts of the racemic and optically active cyclohexanediamines with trivalent cobalt and rhodium (2). The complex tricyclohexanediamine rhodium salts.

A. H. BLAAUW and MISS H. G. KRONENBERG: The epoch of the flower formation of the hyacinth and Darwin tulip in Holland and in southern France.

C. S. MEIJER: Products of Whittaker functions.

J. POPKEN: An arithmetic property of certain integral functions.

J. A. BARRAU: Self-projective point-casts in space.

A. L. T. MOESVELD: Fundamentally wrong methods for establishing the non-existence of polymorphy.

J. H. C. MERCKEL: Relations between the melting points, boiling points and critical magnitudes and the number of carbon atoms in homologous series.

C. H. ANDREAS: Plant growth hormone and growth of the aerial roots of *Vitis gongyloides*.

F. FLORSCHÜTZ: Palæobotanical investigation in connexion with a supposed human settlement on the plateau of the Belgian peat moor (Houtes Fagnes).

H. D. M. BURCK: Fauna of the Bartonian in Eastern Holland.

G. H. VOORWIJK: Foraminifera from the upper Cretaceous of Havana, Cuba.

A. E. WALKER: Experimental anatomical studies of the topical localization within the thalamus of the chimpanzee.

W. J. ROBERTS: Detection of gold in the brain and in the fetuses of animals injected with sanocrysin.

F. KRÜGER: "Cellophane" as a substitute for kymograph paper.

A. DE BUCK: Some observations on the salivary and stomach secretion of *Anopheles* and other mosquitoes.

C. VISSER: A certain class of conformal mappings.

Cracow

Polish Academy of Science and Letters,
January 11.

ST. LORIA and J. KLINGER: The diffraction of electrons of average velocity.

TH. BANACHIEWICZ: The calculation of determinants with the aid of Cracovians.

L. CHROBAK and J. CHOJNACKI: The striped spots of Laue radiograms. The lines on the spots of the Laue photographs are due to the characteristic spectrum emitted by the anticathode.

K. DZIEWONSKI, W. GUMULKA and J. MOSZEW: New studies on compounds of the type of 2-aryl-4-amino or 4-hydroxyquinolines.

J. LILPOP: New plants from the Permo-Carboniferous in Poland.

MME. J. JANISZEWSKA: The third and fourth stage of the development of the larvæ of *Contraecum aduncum* of the intestine of the flounder.

L. W. WISNIEWSKI: The evolutive cycle and biology of *Parafasciolopsis fasciolemorpha*.

M. GATTY-KOSTYAL, MME. M. PASZKOWSKA and Z. ZAKRZEWSKI: The influence of certain plant substances on the growth of grafted tumours. The aqueous extract of the tissues of a representative of the family Polyporaceae, of species not yet exactly defined, has an intense inhibitive action of grafts of sarcoma on mice and rats.

H. GROSSFELD: Metabolism and amœboid movement. The conditions producing visible amœboid movements in the Metazoa.

Moscow

Academy of Sciences, *C.R.*, 4, No. 9, 1936.

M. KREIN: Differential oscillating operators.

P. KALANTAROV: Selection of a system of units for measuring electromagnetic and mechanical values.

M. KONDAKOVA and M. KACNELSON: 1-Ethyl-2-methyl-valeric acid.

M. KACNELSON and B. DUBININ: Researches in the series of normal acids with long chain closed by a cyclohexyl or a cyclopentyl (1). Cyclohexylvaleric acid and its derivatives.

M. KACNELSON and M. KABAČNIK: Some derivatives of lupinine.

M. KACNELSON and J. L. GOLDFARB: Synthesis of the furanic isomer of cocaine (methyl ester of 2-furoyleggonine).

M. P. GERČUK and M. KACNELSON: Preparation of anhydrides of naphthenic acids.

G. ČELINCEV and E. OSETOVA: Amide condensations. Preparation of benzoylacetone by condensation of N_1N -diphenylacetamide with acetophenone.

CH. S. KOŠTOJANC and T. I. BEKBULATOV: Comparative study of the importance of respiratory rhythm for the condition of the central nervous system.

A. A. ISAKOVA: The problem of the nature of the action of bacteriorrhizal micro-organisms on plants. The action of the micro-organisms is of the hormonal type.

T. I. PRIVOLNEV: Respiratory rhythm during the segmentation of eggs of *Lampetra fluviatilis*.

G. A. SCHMIDT: (1) Development of the external gills from the ectoderm in Anura and from the entoderm in Triton. (2) Differences in the induction abilities of the organizing centre in Urodela and Anura.

Forthcoming Events

Monday, April 19

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Captain A. DUNLOP: "The Dadessa Valley".

Tuesday, April 20

INSTITUTION OF CIVIL ENGINEERS, at 6.—Prof. S. M. Dixon, G. Fitzgibbon and M. A. Hogan: "The Flow of the River Severn, 1921–1936".

Thursday, April 22

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. J. Chadwick, F.R.S.: "The Elementary Particles of Matter" (Kelvin Lecture).

Friday, April 23

ROYAL INSTITUTION, at 9.—Prof. H. Mark: "The Synthesis of Large Molecules".

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS, April 19–24.—Second International Congress to be held in London.

Sir William Bragg: President.

FARADAY SOCIETY, April 22–24.—General discussion on "The Properties and Functions of Membranes, Natural and Artificial" to be held in University College, Gower Street, London, W.C.1.

Appointments Vacant

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

LECTURER IN CHEMISTRY in the Woolwich Polytechnic, London, S.E.18—The Secretary (April 20).

ASSISTANTS (grade II) at the Royal Aircraft Establishment, South Farnborough, Hants.—The Chief Superintendent (April 23) (quote Ref. 342/B).

ASSISTANT INVESTIGATOR (roof control and haulage) for the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, S.W.1 (April 23).

LECTURER IN MATHEMATICS AND ELEMENTARY PHYSICS in the Polytechnic, Regent Street, London, W.1—The Director of Education (April 26).

LECTURER IN BIOLOGY in the Polytechnic, Regent Street, London, W.1—The Director of Education (April 26).

RESEARCH CHEMIST for the Bone Research and Development Association, Ltd.—Prof. W. A. Bone (April 26).

ASSISTANT INVESTIGATOR for the Safety in Mines Research Board—The Under-Secretary for Mines, Establishment Branch, Mines Department, Dean Stanley Street, London, S.W.1 (April 27).

SCIENTIFIC OFFICERS and ASSISTANTS (grades I, II and III) in the Chemical Defence Research Department, 14 Grosvenor Gardens, S.W.1—The Chief Superintendent (April 28).

ASSISTANT (grade II, aeronautical materials) at the Royal Airship Works, Cardington, Bedford—The Superintendent (April 30) (quote Ref. B. 352).

JUNIOR SCIENTIFIC OFFICER in the Headquarters Office of the Department of Scientific Research, 16 Queen Street, S.W.1—The Establishment Officer (April 30) (quote J. 37/9).

THREE TECHNICAL OFFICERS (electrical engineering), ONE ASSISTANT (grade II, physics or electrical engineering), and TWO ASSISTANTS (grade III, physics or electrical engineering), in the Signals Experimental Establishment, Woolwich Common, S.E.18 (April 30).

PROFESSOR OF ORGANIC CHEMISTRY in the Egyptian University, Abbassia, Cairo—The Dean of the Faculty of Science (April 30).

ASSISTANT VETERINARY OFFICER for the Essex County Council—The Clerk of the Council, County Hall, Chelmsford (May 1).

LECTURER IN MECHANICAL ENGINEERING in the Derby Technical College—The Clerk to the Governors (May 10).

JUNIOR ENGINEER at the E.M.I. Laboratories—Electric and Musical Industries, Ltd., Employment Department, Hayes, Middlesex.

TEMPORARY ASSISTANT ENGINEERS, ENGINEERING ASSISTANTS, and JUNIOR ENGINEERING ASSISTANTS for trunk road survey of the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1.

Official Publications Received

Great Britain and Ireland

The Teaching of Science in the Education of the Citizen. By Prof. Lancelot Hogben. Pp. 16. (London: National Union of Teachers.) [233]

The Second Conference on Mechanized Farming, Rhodes House, Oxford, January 5–8, 1937. Report of Discussions. Pp. 37. (Oxford: Institute for Research in Agricultural Engineering.) [243]

The Ramblers' Federation Handbook: Official Year-Book of the Ramblers' Federation (Manchester and District) for 1937. Vol. 4. Pp. 81–164+10 plates. (Manchester: E. Royce, 5 Byrom Avenue.) 1s. net. [303]

The Journal of the Institute of Metals. Vol. 59. Edited by G. Shaw Scott. Pp. 323+22 plates. (London: Institute of Metals.) 31s. 6d. [313]

The Future of our Population? By Dr. C. P. Blacker and D. V. Glass. Pp. 31. (London: Population Investigation Committee.) 6d. [313]

National Smoke Abatement Society. Proceedings of the Conference held at the Science Museum, South Kensington, October 1936. Pp. 114. (Manchester: National Smoke Abatement Society.) 2s. [14]

Other Countries

Institut de France: Académie des Sciences. Annuaire pour 1937. Pp. 416. (Paris: Gauthier-Villars.) [253]

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 15: Authority of State Executive Agencies over Higher Education. By John H. McNeely. Pp. iii+57. (Washington, D.C.: Government Printing Office.) 10 cents. [253]

Report of the President of the Carnegie Institution of Washington for the Year ending October 31, 1936. Pp. 72. (Washington, D.C.: Carnegie Institution.) [253]

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 89. The Occurrence of Flints and Extinct Animals in Pluvial Deposits near Clovis, New Mexico. Part 4: Report on Excavation at the Gravel Pit, 1936. By John Lambert Cotter. Pp. 16+7 plates. (Philadelphia: Academy of Natural Sciences.) [303]

Smithsonian Miscellaneous Collections. Vol. 95, No. 21: The Dependence of Carbon Dioxide Assimilation in a Higher Plant on Wave Length of Radiation. By W. H. Hoover. (Publication 3406.) Pp. ii+13+3 plates. Vol. 95, No. 23: On the Corrections to be applied to Silver-Disk Pyrheliometry. By C. G. Abbot. (Publication 3409.) Pp. ii+7. (Washington, D.C.: Smithsonian Institution.) [303]

Bulletins of Indian Industrial Research. No. 6: The Preparation of Alumina and Sulphur Dioxide from Bauxite-Gypsum Mixtures. By Dr. V. S. Dubey, M. B. Rane and M. Kanakaratham. Pp. ii+7. (Delhi: Manager of Publications.) 3 annas; 4d. [303]

Indian Forest Records (New Series). Vol. 2, No. 8: Some New Carabidae from India. By H. E. Andrewes. Pp. ii+177–180. 4 annas; 5d. Vol. 2, No. 9: Immature Stages of Indian Coleoptera (20) (Carabidae). By J. C. M. Gardner. Pp. ii+181–202+4 plates. 1 rupee; 1s. 9d. (Delhi: Manager of Publications.) [303]

Nyasaland Protectorate: Geological Survey Department. Bulletin No. 5: The Chilwa Series of Southern Nyasaland; a Group of Alkaline and other Intrusive and Extrusive Rocks and Associated Limestones. By Dr. F. Dixey, W. Campbell Smith and C. B. Bisset. Pp. 85+7 plates. (Zomba: Government Printer.) 5s. [303]

Carnegie Institution of Washington. Year Book No. 35, July 1, 1935–June 30, 1936, with Administrative Reports through December 11, 1936. Pp. xxxiv+424. (Washington, D.C.: Carnegie Institution.) [303]

Mémoires de la Société géologique et minéralogique de Bretagne. Tome 3: Contributions à l'étude géologique des Îles de la Manche et du Trégorrois. Pp. 100+5 plates. (Rennes: Institut de Géologie; Jersey: The Museum.) 30 francs; 5s. [303]

U.S. Department of Agriculture. Circular No. 418: Parasites and Predators of the Mexican Bean Beetle in the United States. By N. F. Howard and B. J. Landis. Pp. 12. (Washington, D.C.: Government Printing Office.) 5 cents. [303]

U.S. Department of Agriculture: Soil Conservation Service. Topsoil: its Preservation. Pp. 24. (Washington, D.C.: Government Printing Office.) 10 cents. [303]

University of Minnesota: Agricultural Experiment Station. Technical Bulletin 116: Studies on the Freezing Process in Insects. By R. W. Salt. Pp. 41. (Minneapolis: University of Minnesota.) [303]

Obras completas y correspondencia científica de Florentino Ameghino. Vol. 24: Indices generales. Edición oficial ordenada por el Gobierno de la Provincia de Buenos Aires. Dirigida por Alfredo J. Torcelli. Pp. 732. (La Plata.) [303]

U.S. Department of Agriculture. Miscellaneous Publication No. 256: Early Erosion-Control Practices in Virginia. By A. R. Hall. Pp. 31. (Washington, D.C.: Government Printing Office.) 10 cents. [313]

Geological Survey of Southern Rhodesia. Provisional Geological Map of Southern Rhodesia. Revised edition. 34 in. x 30 in. (Salisbury: Geological Survey of Southern Rhodesia.) [313]

Catalogues, etc.

Catalogue of Important Botanical and Gardening Books (including Floras and Cryptogams). (No. 256.) Pp. 40. (London: Dulau and Co., Ltd.)

The Brown-Firth Research Laboratories. Pp. 72. (Sheffield: Brown-Firth Research Laboratories.)

Médecine et Sciences anciennes. (Bulletin No. 3.) Pp. 16. (Paris: Émile Offenbacher.)