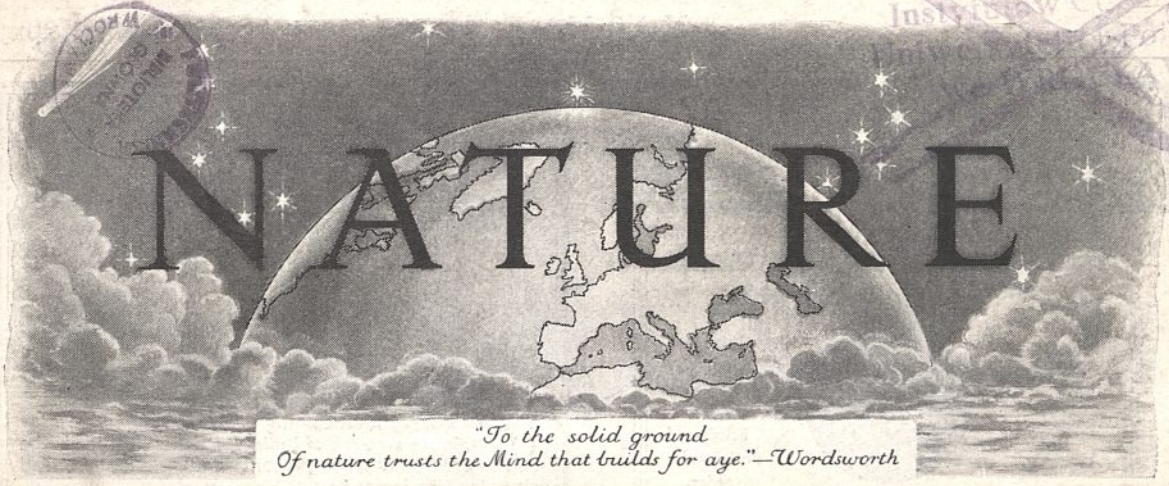

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METHODS AND AIMS IN AMERICAN ARCHÆOLOGY

ALTHOUGH archæologists in the United States welcomed the financial assistance afforded field research and excavation by the measures taken by the Federal and State Government authorities for the relief of unemployment, their satisfaction was tempered by some misgiving. It is true that it now became possible to open up sites long marked as desirable for investigation, but of which the examination had to be postponed while the funds available were devoted to purposes of more insistent urgency in their bearing upon major archæological problems. At the same time, it was recalled to how great an extent the antiquities of the remarkable and unique indigenous civilization of the Americas had suffered from amateur and untrained trophy hunting. Further, public works were being inaugurated or accelerated which would add to the destruction on a vastly extended scale. The construction of a great dam in the Tennessee Valley during the War of 1914–18, for example, had inundated twenty-three square miles of country, and to this the projected scheme of the Tennessee Valley Authority would add a further 100 square miles, both tracts taken from a territory thickly studded with relics of Indian occupation, of which so considerable a proportion would now be lost for ever to archæological study. It was evident that there was an urgent call both for trained and skilled supervisors of excavations and public works, and for a scheme of conservation to preserve as much as was possible of the evidence of antiquity for study by posterity.

As an outcome of this apprehension, the matter was taken in hand by the National Research Council. In April 1939, the Division of Anthropology and Psychology of that body appointed a committee to study the needs of American archæology. This committee was composed of some of the most active among practising archæologists of the United States ; among them were Dr. A. D. Strong, who acts as chairman, Dr. Clark Wissler, Dr. A. V. Kidder, Prof. Fay Cooper Cole, and Dr. W. S. Webb. The Committee has already published a report of a preliminary nature, of which an analysis by Dr. Carl E. Gutha, chairman of the Division of Social Sciences of the National Research Council, appeared in *Science* of December 8, 1939.

It has been pointed out recently that in the study of the indigenous civilization of the Americas, but more especially of the northern half of the continent, the distinction in method and outlook between archæological studies and ethnography and ethnology is by no means so strongly marked as it is, as a rule, in the study of Old World civilizations. On one hand, archæological methods and arguments more and more have to be applied to the reconstruction of an Indian cultural complex, while on the other hand interpretation of archæological data may be illumined by reference to the evidence of ethnography recording traditional Indian custom and belief, a source of which perhaps the fullest use has not always been made. Why Americanist studies should be peculiarly favoured in this way must be obvious. For one thing, American civilization, when once the tide of early immigrant peoples ceased to flow, remained virtually free from serious outside cultural and racial influence for some centuries—or at least so those of us would believe who are not diffusionists—until the impact of European civilization, at first of the Norsemen, though this is virtually negligible, and

afterwards of other European peoples in the late fifteenth and sixteenth centuries. Further, and partly as a consequence of this prolonged isolation, American civilization shows a remarkable continuity of development, as well as a stability of condition, which has affected not merely the indigenous population but also the development of white civilization, a fact which writers on American civilization in its broader aspect have perhaps sometimes failed adequately to stress.

If we ignore the industrial zone and areas of mineral exploitation, American civilization is still based on agriculture and animal exploitation, though it is true that the place of the hunter and the bison is taken by the cowboy and vast flocks and herds of domesticated animals. Even though corn now grows in the plains where the bison once was hunted, this implies no break in the cycle of cultural development, for even as the agriculturist in the Old World has displaced the hunter, so in America the farmer has edged the herdsman off the lands which generations of wild cattle had fertilized for his crops of corn. The readiness of the early settlers and pioneers to adopt elements from indigenous culture, many of which survive to this day, bears testimony to the influence of the continental environment in moulding the technique of living from day to day.

It is evident that some such conception of the function of archæology in Americanist studies, as illustrative of a continuous development, was present in the collective mind of the Committee in deciding on the scope and in framing the terms of the preliminary report. The sphere of interest of that report, it was felt, was best limited to "an analysis of the principles which govern the methods and procedures of American archæological research" and could most usefully indicate its basic needs.

As herein formulated, the aim of American archæology is said to be "to make the past live again; to preserve for posterity the story of the rise and spread of early cultures on the American continent and their influence on white settlement". From such studies, it is pointed out, much may be learned, not only in the field of human history, but also of such significant subjects as long-continued land utilization, cycles of climatic change and the history of important agricultural crops. It is interesting to note the implicit recognition of the fact that, given continuity of environmental and climatic conditions, an academic problem in archæology may have a practical bearing on the affairs of even such a progressive modern community as is found in contemporary American civilization.

The Committee recognizes fully that much excellent work has already been done and experience gained, as well as much valuable information gathered, through the assistance granted by Federal and State schemes for the relief of unemployment or in rescuing prehistoric records in districts about to be flooded. Yet in view of the fact that these relief projects are to be continued, and others are contemplated, it has been thought urgent that a statement should be issued at the earliest possible moment, giving the minimum requirements with which future work, whether public or private, should comply, in order to attain a standard of scientific accuracy satisfactory for the needs of archæological studies. In view of the stress laid upon general principles of archæological research and conservation, this document is of more than merely local interest.

In framing its statement of these requirements, the aim of the Committee has been to eliminate anything and everything in the nature of haphazard excavation. With this in view, it has covered every stage of the research in broad outline from its initiation, concerning which it is laid down that "a definite need should be shown for the solution of a well-defined archæological problem or for the conservation of prehistoric material placed in jeopardy by public works or other agencies, whether natural or human", down to final publication of a report which, it is insisted, should be as speedy as possible after the completion of the investigation. In regard to this latter point, however, it is emphasized that archæological investigation and 'hustle' have no affinities.

The Committee has laid down in some detail the organization for which a scientific institution or learned society must be prepared to provide when undertaking the responsibility for a research project under any one of the schemes fathered by Government authority. That responsibility cannot be regarded as ceasing with the provision of skilled archæological supervision. To this must be added the field staff, with academic training and field experience, competent to keep proper records in addition to carrying out the practical work of surveying, excavating or conducting the technical work of the laboratory, with, be it said, the complete equipment of technical apparatus, cameras, surveying instruments and the like, which each department of this work demands. A somewhat higher degree of specialization in function is

demanded than is commonly practised; but the useful principle is laid down that whereas the methods of the field and the laboratory differ, there should be one director who is supreme over both departments.

It is unnecessary to follow the Committee through all its detail of instructions. It will suffice to say that these are such as to satisfy an exacting standard. Two matters, however, may be specially mentioned. In view of the amount of detailed record required, the need of adequate clerical assistance to relieve the director and archæological staff is emphasized; and secondly, it is pointed out that in view of the need for national conservation—a basic need—not only should each site opened be excavated with the greatest care, the material carefully studied and the results fully published, but also certain sites in every area should be carefully preserved for research in the future as new techniques are developed; this last is a requirement of much wisdom, which Sir Flinders Petrie impressed upon excavators of archæological sites in the Old World many years ago.

The Committee ends its admonitions to the prosecution of such "forward looking activities" by pointing out their application, not only to academic bodies, but also to the National Park service, State historical societies, and municipalities, to which such studies should appeal as advancing the growth of national consciousness. At the same time, the soundest piece of advice given is that reserved for the last, namely, that if the foregoing minimum requirements cannot be fully met by any Federal, State, or local institution, it should not undertake archæological research at all.

Notwithstanding the different circumstances of the Old World and the New, the line of approach to their problem adopted by the archæologists of the United States is not without its lesson for their fellow-workers elsewhere. In method and technique, except as regards completeness of organization, it may be that there is little to be learned. In regard to the future of archæological studies, however, while no one can foretell what post-War conditions may bring forth, it may be assumed that greater economy of effort and a greater measure of co-operation than has prevailed hitherto will be demanded. The direction of research to crucial problems, which would seem a necessary corollary, demands a survey, no less comprehensive and no less authoritative than that now in progress in America, for which the temporary check in field work affords an opportunity.

THE RELATION OF SCIENCE TO DEMOCRACY

(1) Democracy
Today and Tomorrow. By Eduard Beneš. Pp. x+244. (London: Macmillan and Co., Ltd., 1939.) 8*s*. 6*d*. net.

(2) For Democracy
Edited by the "People and Freedom" Group. Pp. x+237. (London: Burns, Oates and Washbourne, Ltd., 1939.) 8*s*. 6*d*. net.

(3) Spiritual Values and World Affairs
By Sir Alfred Zimmern. Pp. vi+178. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 7*s*. 6*d*. net.

THE growing concern of scientific workers with the social consequences of the application of scientific knowledge, and the deepening interest in the scientific investigation of social problems, of which the formation of the new Division for the Social and International Relations of Science of the British Association is only one illustration, have been prompted at least in part by the realization that the nature of the society in which they work has a powerful influence on the direction, and even the nature, of scientific work. This, and the increasing extent to which scientific and technical factors are involved in the solution of major administrative problems in national and international affairs, have induced many scientific workers to overcome their habitual dislike or distrust of political matters sufficiently to take a much closer interest in forces which may have such a powerful influence on their own work.

While, however, the events of recent years have made the maintenance of professional integrity and independence of increasing importance if the scientific worker is to continue his disinterested and dispassionate search for truth, and at the same time have indicated the dangers attendant on his allowing himself to be drawn into party politics or committing himself to the support of policies or statements in fields of which he has no

special knowledge, the great body of scientific workers has come to realize that the very continuance of scientific work and investigation itself is linked up with the continuance of that form of political order or government which we know broadly as 'democracy'. Only in the remaining democratic countries is that freedom of thought and investigation and teaching which is the very life-blood of science, safe from violation at the behest of political dogma.

The recognition of this relation of science to freedom of thought and speech under democratic institutions led to a remarkable manifesto issued last year on behalf of American Men of Science (see NATURE, 143, 309; 1939) which can be placed alongside an earlier resolution of the American Association for the Advancement of Science. Defence of that freedom has drawn Great Britain and France into war. Even in a democracy, however, war-time exigencies may impose limitations which demand increasing vigilance if the cause of truth and freedom is to be served, and it is well that scientific workers should consider closely the relations of science to democracy, and the exact significance, advantages and dangers of political systems.

(1) Dr. Beneš's book is based on three lectures on the problems of democracy, which were delivered at the University of Chicago in March, April and May 1939. He gives us a searching analysis of the causes underlying the decline of democracy in the Europe of 1918–38, as well as of the League of Nations, which he insists is a symptom and expression of European and world democracy, and can exist and function morally only in a democratic world. The League, he urges, is the expression of the philosophy and morality of democracy—respect for the individual as the highest value in social life—as an end and not as a means. His analysis of the causes underlying the failure of the League, which he attributes mainly to the decline of the European democracies, leads Dr. Beneš to conclude that real and effective activity of the League of Nations as it is constituted to-day, or of a League based on similar principles, will only be possible when Europe and the world turn to democracy.

Dr. Beneš does not, of course, ignore other factors in the decline of the League, and his discussion of the conflict between theory and practice, of the difficulties with economic and military sanctions, and of the reserved or even hostile attitude of individual States, even when members of the League, towards its principles and policy, are highly pertinent to discussions on federation and the world order to be established after the present war. For Dr. Beneš, however, the nature of the political system is fundamental. He considers that only democracy is capable of solving justly and rightly the eternal problem of liberty and discipline in human society. Human nature and human society involve man in a continual struggle for a reasonable, well-balanced relation between collectivity and individual freedom, and for this he can contend only in a political democracy.

For reasons such as these, Dr. Beneš visualizes no compromise, or at least no stability, in a system which admits such fundamentally opposed political systems as the totalitarian State and the democracies. In his view, however, the former are temporary regimes in the slow process of adaptation to new conditions, and before the outbreak of war the authoritarian regimes were approaching breaking point. Only with the disappearance of democracy or dictatorships can peace and collaboration of nations in Europe be re-established.

Dr. Beneš's analysis of politics and leadership in a democracy gives us deep insight into his own conception of democracy. Politics in a democracy, he urges, is both a real science and a special kind of art; it is also something of a philosophy. Political science, the practical application of sociology, is a main part of sociology. It involves the study of the actual state of man in his relation to society and to his whole environment. It inquires what is regular, planned and constant in society. As a science, politics must look at the world objectively, must search for objective reality and analyse society thoroughly and widely. All social sciences, psychology and to some extent biology must thus be the concern of the politician, who should understand scientific method and be capable of analytical reasoning.

Politics, however, is not only a science but also an art, and as such has its creative aspects. Without the power of imagination, combination and synthesis no politician can create his new social reality, while as a man of science he must be a psychologist in both theory and practice. Finally, the politician must be a philosopher inquiring in which direction and by what means the adoption and changing of social reality must be accomplished. He must be able, moreover, to recognize what is and what is not possible politically.

With these ideals and requirements in the political leaders of democracy and with his insistence on moral as well as intellectual personality, it is not surprising that Dr. Beneš stresses the importance of training and selection for leadership. If a great politician and real statesman in democracy must possess a mind harmonizing these mental faculties and combine the analytical rational element, the artistic, imaginative and synthetic element, with philosophic and moral

power, leadership must be a question of good education and careful selection. To engage in politics in modern life and in a democracy without very hard intellectual work, great erudition and high comprehension of all divisions of science is impossible.

Scientific workers will welcome this emphasis on the importance of scientific training for those entering on political and administrative careers, but they should note also that Dr. Beneš is careful to point out that leadership demands something more than a man of analytical or reasoning capacity or scientific knowledge. Beyond intellectual ability, leadership involves decision and courage. Scientific learning or culture must be combined with keen intuition, and the capacity for rapid decision and action and for physical and moral courage.

On such leadership Dr. Beneš rests his hopes of dealing with the practical problems which democratic States must face in the immediate future: the reinforcement and consolidation of the executive power, and the development of new functions of the State; the establishment of better harmony and equilibrium between the judicial, legislative and executive organs in democratic rule; the redress of the weakness and deficiencies of the party and voting system, and the problems of nationalism and social reform. Such leadership alone will be equal to the establishment of a real and effective collective security and of a League of Nations which will afford the opportunity for such developments.

(2) "For Democracy" is a collective work. Its scope is wider in some ways than that of Dr. Beneš's book, for the first part of the book traces the development of democracy from the experience of Greece and Rome. If it has less to say about the League of Nations, like Dr. Beneš's book it includes an excellent short account of the modern totalitarian State and its dangers to freedom. Dr. Luigi Sturzo, the former leader of the Italian Popular Party, contributes a notable essay on democracy, authority and liberty, and this, with his concluding essay, on the future of democracy, is what scientific workers may find of most immediate appeal in the volume, though the significance of the deep-seated sense of unity pervading these writers—three French, two Italian, one German and one Spanish—revealed in these studies of democratic ideas and institutions seen through Catholic democratic eyes as a factor in movements towards the development of a United States of Europe should not be overlooked.

To Dr. Sturzo the spirit of democracy is freedom actuated in social life as correlative to authority, an authority in which the whole people shares, according to the capacities and position of each, in co-operation for the common good. It is in such a system that intellectual activities such as science can find their natural freedom of development, for that freedom which lies at the basis of democracy is also the life-blood of science. The main task in the defence of democracy to-day is the defence of freedom, and the defence of freedom is at the same time the defence of authority and of the social order.

In this defence Dr. Sturzo lays the main emphasis on education, involving not merely culture and training in the exercise or practice of political life but also in moral values. Intellectual or technical education alone offers no safeguards against the fanaticisms of the age, such as anti-Semitism. In this insistence on permanent moral values worthy of men and in harmony with the principles of Christianity, the book adds one more to the many which, like Middleton Murry's "The Defence of Democracy" or "The Price of Leadership", are stressing the necessity for a Christian basis of society if a new world order safeguarding the noblest traditions and ideals in man's inheritance, which democracy alone has preserved in the past, is to emerge out of the present chaos.

(3) Sir Alfred Zimmern's study is of an entirely different type. It makes its appeal to the scientific worker pre-eminently through its contribution to lucid thinking and its indication of the pitfalls and dangers which beset the study of international affairs. Sir Alfred, too, insists on the importance of moral and spiritual values. He appeals strongly for close study of international affairs by the ordinary citizen, but he stresses also the imperative necessity of clear and accurate thought if we are to realize a new world order which will adequately safeguard our heritage.

It would indeed be difficult to find a finer stimulus to such thinking than this compact little volume of cautionary wisdom. How many fatal mistakes might have been avoided had there been more scientific thought about international affairs in place of the disposition to regard the League as a short cut to Utopia, and to forget that it only marked the beginning of a new phase of world order, or that a League policy involved the participation and interests of many, not of one nation. What Sir Alfred says of the intellectual confusion due to the intrusion of religion into the discussion of problems on which religion by itself could offer no safe guidance has a bearing on many similar matters involved in the relation of science and society, the significance of which the scientific worker who reads this book can scarcely fail to appreciate.

There are indeed sections in this book in which Sir Alfred seems to be expanding the scientific method itself, and his chapters on the War of

1914–18 and its aftermath, on peace, on our English burden and on the Colonial problem could scarcely be bettered as an aid to lucid thinking about the problems of world order which will confront us after the present war. Apart from this, Sir Alfred insists that there are three necessary stages in the process leading from the prevailing anarchy to some form of world organization. Peace—the cessation of actual fighting—is only the first of these. The second is order, or what is sometimes called the stage of the hue and cry—the stage at which violence is prevented or punished by the public spirit of the citizen body, the leading democratic peoples. The third stage is that of law, where the habit of co-operation developed through common action in repressing violence has hardened into social rules for the conduct of what has then become a common social life.

The phrase "law and order" has probably been responsible, as Sir Alfred points out, for much false thinking in this sphere, and to convert it into real "order and law" should conduce to the lucidity essential in our thinking about a new world order. The scientific worker will, however, find neither here nor elsewhere in these three volumes the 'blue prints' of the world order which he in common with other lovers of truth and freedom desires. He will, however, find much that is stimulating, much that is corrective of confusion and much that should encourage him to take his own part in the travail out of which the order will be born. Nor should he be ungrateful for the evidence the volumes afford of the widely diverse fields in which men are turning their thoughts to such constructive purposes, and of the grounds for confidence in the power of democracy to prevail over the forces now threatening all that is noblest in man's moral, spiritual and intellectual heritage.

R. BRIGHTMAN.

HYDROCARBONS

Physical Constants of Hydrocarbons

Vol. 1 : Paraffins, Olefins, Acetylenes, and other Aliphatic Hydrocarbons. By Gustav Egloff. (American Chemical Society Monograph Series, No. 78.) Pp. 412. (New York : Reinhold Publishing Corporation ; London : Chapman and Hall, Ltd., 1939.) 45*s*. net.

IT has become almost a commonplace to refer to the tremendous advances which have taken place in the field of hydrocarbon research. A very large and prosperous industry has come into being almost entirely as the result of scientific research, and its leaders have realized that money must be devoted on the grand scale to such research if it is to continue to expand.

The relatively simple hydrocarbon with only two elements—carbon and hydrogen—and a straight-chain formula was almost despised not so many years ago by chemists busy unravelling the complex structures of the anthocyanins and the alkaloids, the purins and the proteins. To-day they are in the forefront of interest in many laboratories, largely as the result of the stimulus given to the exploration of the vast number of different hydrocarbons present in crude petroleum by industry's demand for new products.

For industrial purposes, fractions of the original crude of wide range of boiling point at first sufficed. Modern practice demands fractions of much smaller range, and the individual hydrocarbons are beginning to have possible technical significance. An exhaustive separation of the individual hydrocarbons is being effected as the result of co-operative research at the Bureau of Standards in Washington, and compounds which have hitherto received no attention are the object of experimentation.

The modern high-compression engine demands a special fuel with a high octane number, as the oil men term it. Straight-run or even cracked spirit alone does not suffice, and there is an indication that the fuel of the future will be a petrol re-formed from the hydrocarbons after cracking and catalysed synthesis. More and more the hydrocarbons are coming to be regarded as the primary raw materials for industrial organic syntheses.

The hydrocarbons are largely identified by four physical constants : melting point, boiling point, specific gravity and index of refraction. For a long time there has been an urgent need for a critical digest of all data pertaining to these. Such a systematic study has been going on in the laboratories of the Universal Oil Products Company in Chicago, and it is to be published in four volumes, of which the first is now before us. The first three volumes will contain the physical constants, whilst volume 4 will deal with their inter-relationships as well as correlating physical properties with structure.

The first part covers the open straight- or branched-chain hydrocarbons, namely paraffins, olefins, acetylenes and other aliphatics : they are

actually grouped into ten sections. The procedure adopted is described in a short introduction and the rest of the book consists entirely of tables. Everything is very clearly printed and most easy of reference.

Dr. Egloff has long been a pioneer in research in the oil industry; indeed I think he was one of the very first to envisage the future importance of hydrocarbons as opposed to mere oil. His knowledge of the subject is profound, and though it has been always freely made available to those who sought it privately, the fact that he has now consented to turn author is of inestimable service to every industry in which hydrocarbon chemistry plays a part. His previous work on the "Reactions of Pure Hydrocarbons" has already become indispensable to us as individuals; his physical constants will be consulted as often in oil laboratories as is the "Oxford Dictionary" by writers.

Such a book must necessarily be costly, though the price is of no importance in industrial laboratories in relation to the utility of the book, which is of the type which does not grow out of date and will remain a standard reference book for many years to come. It is a monument to the name of Egloff.

E. F. ARMSTRONG.

ORDNANCE AND GUNNERY

Elements of Ordnance

A Textbook for Use of Cadets of the United States Military Academy. Prepared under the direction of Lieut.-Colonel Thomas J. Hayes. (A revision of the "Textbook of Ordnance and Gunnery", by Colonel Earl McFarland.) Pp. x + 715. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1938.) 32*s*. 6*d*. net.

THIS is by no means a new book. In its present form it appeared in 1938. But like most service text-books it is a compilation which represents a more modern version of an earlier work. It is none the worse for that. On the contrary, it is well written, well and lavishly illustrated, and it is excellently produced. The index, as befits a work of reference of this extent, is full and satisfactory.

The ground covered is very wide indeed and may be briefly indicated. Three chapters on propellants, explosives and metals deal with the relative parts of physical chemistry and metallurgy. Six chapters of a more or less theoretical kind deal with internal and external ballistics, including probability, gun construction and recoil, and bombing from aeroplanes. This last indicates that the range of subjects treated is even wider than the limits which apply to the gunner. The remaining chapters, ten in number, are essentially descriptive. They cover the design of breech mechanisms, types of artillery, sights and fire control instruments, including the equipment used in conjunction with anti-aircraft artillery, gun ammunition and fuses, small arms and the corresponding ammunition, bombs and grenades; a short chapter on the properties of light armour leads to one on mechanical vehicles. These are, in the main, tanks. Carriages are described in connexion with the corresponding types of artillery, coast defence or mobile, but the subject of tractors seems to have been dismissed more summarily. Tables at the end of the book provide useful data from physical chemistry.

The mere recital of the contents of this book should serve to show how vast is the field which lies before the modern artillerist. For all its seven hundred pages this is only an introduction to the subject, and a very good one. It is intended as a text-book for the First Class in the West Point Military Academy. As such it is supplemented by lectures and shop and laboratory practice. At once it is suggested that the U.S. cadet who is destined to find his career as a gunner leaves the Military Academy with a preparation far in advance of his opposite number in Great Britain. Whether it has been sufficiently realized that modern developments have made the subject of artillery a highly scientific branch of activity, demanding the service of the most gifted and the most highly trained brains, is a question which deserves the most serious consideration. It is not, of course, to be assumed that every young American gunner absorbs all the fare that is set before him.

For the general reader and even for some whose concern with the subject is more specialized, the most interesting and valuable chapters are probably the descriptive. Naturally, American equipment, methods of manufacture and designs are treated exclusively. But under the stress of modern rivalry the types of armament employed in different countries tend in the main to close similarity. It is in points of detail that the chief differences will be found. Against a single national point of view, moreover, a compensating advantage is to be set. There is no trace here of that atmosphere of secrecy, generally futile, on which most military authorities insist. It would, of course, be unsafe to infer that the whole of American practice is revealed without any reservation whatever. But

there is a refreshing absence of that concealment which serves no useful purpose and only tends to make legitimate instruction difficult.

The chapters which deal with the mathematical theory are less satisfactory for the simple reason that they are of necessity too short to furnish more than an introduction to this aspect of the subject. They have no other noticeable fault and within their prescribed limits they are highly instructive. Thus while the account of external ballistics is so brief that the serious student will need to supplement it by consulting some at least of the standard books and original memoirs, of which a good list is appended to the chapter, the subject of yaw is treated in some detail. The effect of probability on the fall of rounds is discussed in a separate chapter. It seems curious that nowhere is the normal law of frequency more implicitly accepted than by gunners, who at the same time are very ready to reject rounds which appear to be anomalous. The inclusion of the subject of bombing from the air serves to remind the reader of the mutual relations which obtain in different countries between the army and the air force, and of the fact that the complete separation of the two forms of national defence is apt to entail some loss of a common understanding of technical problems.

Of internal ballistics it is said that "Interior ballistics is not an exact science". It is a complex problem certainly, yet the elements for its solution lie in physical chemistry and in mechanical conditions which should be capable of definition. An exact answer may not always be beyond the range of possibility. But there are two obstacles in the way. In the case of a problem which is at the same time highly complicated and of practical importance, the temptation is strong to avoid the scientific investigation of all the underlying factors and to reach the end in view, which is to predict the performance of a newly designed gun, in more summary fashion. Here, since all arsenals possess the records obtained by firing guns of many types, the empirical method of interpolation, or extrapolation, is commonly employed. But this does not mean that a more scientific treatment, in which considerable progress has already been made, can never be brought to practical perfection.

The chapter on recoil is one of the best in the book, but that on gun construction is far less satisfactory. The method of wire-winding is naturally dismissed shortly, for it has been superseded, though effective guns of this type remain in the U.S. service. The built-up gun may also be doomed to disappear. It is disappointing that the theory of auto-frettage has not been discussed at greater length, though this process of manufacture is fairly described. Both the 3-in. and the 105-mm. A.A. guns of the American service consist of an auto-fretted tube with loose-liner. But it is interesting to learn that the same service has adopted a 155-mm. howitzer which is an auto-fretted tube without liner; it is stated that this monobloc construction greatly reduces the cost and is easily replaced in the field. What steel is used in this weapon is not mentioned, and though the properties of various modern alloy steels are described no figures seem to have been given for the high elastic limits which can now be reached with increasing ease and certainty. It does not seem impossible that the process of auto-frettage with its obscure theory will go the way of other methods now abandoned, and that the gun of the future will be a simple monobloc, with or without a loose liner.

H. C. PLUMMER.

USELESS MATHEMATICS

Mathematical Recreations and Essays

By W. W. Rouse Ball. Eleventh edition, revised by H. S. M. Coxeter. Pp. xvi+418. (London: Macmillan and Co., Ltd., 1939.) 10*s*. 6*d*. net.

EVERY former reader of Rouse Ball's classic will rejoice that a new edition has been brought out. They will miss some old acquaintances, particularly the chapter on string figures, but they will find a good deal of new material, notably a chapter by Dr. Coxeter on polyhedra, and one by Mr. Sinkov on cryptography.

The book is remarkable in several respects. In the first place, although it demands no mathematical knowledge beyond elementary algebra and geometry, it brings its reader to the edge of mathematical knowledge at many points. Some of the unsolved problems treated are fundamental, such as the four-colour problem, that scandal of topology. Others, such as Kirkman's problem of the schoolgirls, will probably yield to combinatorial analysis without any revolutionary discoveries.

In the second place, almost all the mathematics is inapplicable to practice. The Admiralty staff are not likely to be presented with the problem of the three jealous husbands and the ferry-boat (p. 116) when arranging convoys, nor will the theory of mazes help the German General Staff to penetrate the Maginot Line. But parts of the chapter on polyhedra have an application to crystallography, and the theory of Latin squares has been extensively developed in connexion with

agricultural tests. The most recent work on it is indeed published, paradoxically enough, in the *Annals of Eugenics*.

"Mathematical Recreations" constitutes an addendum to every mathematical library. I can imagine no better book for a schoolboy or girl who is taking mathematics seriously. The reader will find himself introduced to advanced topics such as topology, group theory, and prime number distribution theory, without any intellectual strain, and will learn a surprising amount of mathematics without knowing it. The more advanced reader will find some novelties in every chapter. Above all, one need not read the book systematically. On the contrary, it is an excellent bedside book into which one can dip at random.

The War may discourage mathematical reading. It need not. I remember that among a row of wounded officers on the deck of a barge in Mesopotamia in 1917, the occupant of the next stretcher to my own was reading Lamb's "Infinitesimal Calculus", whilst I was reading Kelland and Tait's "Introduction to Quaternions". But systematic study is certainly difficult, and perhaps "Mathematical Recreations" would have been more suitable.

I hope to see many more editions. I may be accused of attempting to gild the lily, but here are two suggestions for the next. Since the theory of Mersenne's and Fermat's numbers is part of the theory of recurring 'decimals' in the scale of 2, I should like to see an excursus on recurring decimals in the scale of 10, pointing out, for example, why every recurring decimal with a period of 10 must have 9091 or a multiple in its denominator; and since such formulæ as $\frac{1}{4}\pi = 4 \tan^{-1} 1/5 - \tan^{-1} 1/239$ are equivalent to factorizations of $n + ni$, readers might be introduced to complex arithmetics on p. 348.

However, Dr. Coxeter knows his job better than I do, and has shown himself a worthy successor of Dr. Rouse Ball. This is the eleventh edition. May there never be a last edition.

J. B. S. HALDANE.

GENERAL ASTRONOMY

(1) Astronomy

By William T. Skilling and Robert S. Richardson. Pp. xi+579. (London: Chapman and Hall, Ltd., 1939). 15*s*. net.

(2) Exploration du ciel

Par Pierre Rousseau. (Le roman de la science.) Pp. 256. (Paris: Hachette et Cie., 1939.) 20 francs.

(1) THE progress of astronomy, as regards both the methods and results of research, is in these days so rapid that there is always room for a new and up-to-date text-book on the subject. Messrs. Skilling and Richardson's book is the most recent of several that have appeared in the past few years; and it covers the whole field of descriptive astronomy in a simple style, suitable for the general reader.

The insertion of examination questions at the end of each chapter suggests that the work was intended to afford a complete elementary course for students. Unfortunately its usefulness for this purpose is much impaired by a certain lack of the balance which should characterize a really satisfactory text-book. Thus, while the subject of solar physics is treated in considerable detail (one of the authors being a specialist in this line of research), the planetary system is dealt with in a rather perfunctory way. The minor planets, for example, are dismissed in little more than a single page, while no mention is made of the variable rotation periods of Jupiter and Saturn, or of the transparency of the latter's ring system. On the other hand, the book certainly contains much up-to-date matter of great interest and value to the student. It is well supplied with illustrations, though some of the diagrams are open to criticism. The text appears, apart from a few minor errors and misprints, to be substantially accurate, but the so-called "glossary" at the end of the book is so abbreviated as to be practically useless.

A glance through the names of astronomers quoted in the index will reveal a certain parochialism which is rather common in American scientific books. But it is perhaps a pardonable weakness, and one from which no nation seems to be altogether immune.

(2) M. Rousseau's book consists of a series of popular essays on various aspects of modern astronomy. The author's avowed aim has been to humanize the subject and to emphasize the romantic side of research. To this end he devotes considerable space to the description of the more important astronomical instruments, and of the way in which they are actually used for various purposes. This seems to us a particularly attractive way of dealing with the subject, and M. Rousseau's obvious enthusiasm can scarcely fail to communicate itself to his readers, whether they be possessed of previous astronomical knowledge or not. The book seems worthy of something rather better than its present flimsy cover, and it is a pity that the quality of the paper has ruled out the use of half-tone illustrations.

W. H. STEAVENSON.

PHYSICS IN THE GLASS INDUSTRY

BY PROF. W. E. S. TURNER, F.R.S.
UNIVERSITY OF SHEFFIELD

IT is in keeping with the transparent nature of the substance that the first physical properties of glass to receive conscious study in comparatively modern times should be the optical properties. The problem of dispersion in the simple telescope lens found a partial solution in the achromatic lens combination of John Dollond in 1758, and the subsequent development of lens systems, in which the correction of chromatic aberration is still more complete, has involved the utilization of glasses of different and precisely known refractive indexes and dispersions. The work of Guinand, of Faraday, of Harcourt and of Schott was in all cases concerned with the production of better glasses of constant optical properties, or of new glasses permitting a wider range of optical properties for use in combinations.

With the work of Schott, however, there was opened up the possibility of exploiting some of the new glasses experimented with, for purposes other than components of optical instruments. Thermometer glasses of low after-contraction were one development. The accumulation of general physical data about glass had set in at Jena, so that, between about 1883 and 1895, many data were compiled about density, thermal expansion, thermal conductivity, tensile, compression and other aspects of mechanical strength ; and although in recent times some of these data have had to be drastically revised, they led to the manufacture of a variety of new glasses for heat resistant and other purposes, and pointed to the usefulness of certain compound glasses.

For the next twenty years, the impact of physics on the industry was less exciting and dramatic, but some of the results at least contained the seeds of later important developments. Then began an altogether new period in which striking individual results of physical studies led to new types such as Pyrex and other low thermal expansion glasses ; R. W. Wood's glass ; the Corex glasses, etc., side by side with the development of revolutionary processes in which highly productive automatic machinery began rapidly to displace the hand worker. The manufacture of glass bottles and containers in thousands of types ; of sheet and plate glass ; of electric light bulbs ; of glass tubing and rod and of some types of domestic glassware has within the past twenty to twenty-five years been transferred almost entirely to highly productive automatic machines, the efficient functioning of which was, in a number of cases, achieved only after many years of development.

It is in these fields of manufacture that the bulk of the capital of the industry is locked up. That represented by optical and scientific glassware of all types is relatively insignificant. The development of several of these automatic machines was in the early years in the hands of the clever mechanic, with no background of systematic knowledge of physics and chemistry, or even of the fundamental principles of engineering. It has been the service of the physicist to work out processes of control so as to maintain constant conditions under which the machine can operate favourably. As an illustration, it may be mentioned that with one automatic machine, the temperature of the molten glass (at 1140–1160° C., according to size of article to be made) in the bath from which the machine takes its own supply many times per minute, must be kept constant to $\pm 5°$ C. ; and high-temperature pyrometry, glass-level control in furnaces holding huge quantities of the molten material, and various other problems have had to be worked out suitable for each set of conditions of operation. At every stage of mass manufacture, speed and efficiency involve fundamental knowledge, and it is not surprising, therefore, that the widespread employment of physicists and chemists has really only begun with the introduction of mass manufacture.

Some conception of the part which the physicist plays both in the development of new types of glass and in the manufacturing control of others was clearly brought out during a discussion on February 15 on the subject of "Physics in the Glass Industry", held at the Royal Institution under the auspices of the London Branch of the Institute of Physics. The contributors of papers to the symposium were Dr. Harry Moore on "Strains intentionally introduced during Glass Manufacture", Dr. W. M. Hampton on "The Spectacle and Optical Glass Industry", Dr. Eric Seddon on "Physics in the Manufacture of Glass Bottles", Dr. B. P. Dudding on "Glass for Lamps and Electronic Devices", and Dr. J. H. Partridge on "Refractories used in the Glass Industry".

In the manufacture of spectacle and optical glasses, physical methods continue in the line of traditions of fifty or sixty years ago, though with some important developments. Both types of glasses must be controlled in respect of refractive

index so that repeat meltings are kept within ± 0·001 of the desired value for well-annealed samples. The Pulfrich refractometer is normally employed for this control and has an accuracy of one in the fourth place of decimals on refractive index and two in the fifth on dispersion; but master standard prisms of optical glasses of refractive indexes and dispersions measured to a few units in the sixth place of decimals are used to control the Pulfrich observations. Modern optical glasses must also have a light absorption of not more than a fraction of 1 per cent per inch thickness, and the amount which occurs in the visible, ultra-violet and the infra-red has been the subject of close study and control, the main cause of absorption being the presence of very small amounts of iron oxide in solution. Spectacle glasses, on the other hand, may have colour dependent on the purpose for which they are intended, such as protective goggles for use by welders, and in all such cases the transmission in the three spectral regions must be determined as a routine control measurement.

The annealing of glass has received much detailed scientific and practical study during the past twenty years, in particular by Twyman and by Hampton in England, and by Adams and Williamson in the United States, in regard to general theory, and by English and Turner in regard to the relation of composition to the annealing temperature. The latter quantity is usually related to the viscosity, on which property of glass much work has been done in recent years. At the highest temperatures used in melting a glass, the viscosity is usually reduced to not more than 100 poises, but with fall of temperature the increase of viscosity is such that at room temperature it should be of the order of 10^{20}. The viscosity corresponding to annealing temperature conditions lies between 10^{12} and 10^{13} poises, rapid removal of strains, that is, rapid annealing, being possible at the lower viscosity figure or higher temperature, slow annealing resulting at the higher viscosity.

The annealing temperature chosen depends on the character of the glass, on its size and thickness and the degree of strain permissible. In mass-produced glass the object is to anneal as speedily as possible, and the higher annealing temperature is accordingly chosen. In modern glass bottle annealing, as illustrated by Dr. Seddon, the glassware is annealed and cooled nearly to room temperature in less than two hours. In the case of the Fourcault sheet glass process, producing an article of simple shape and uniform thickness, it is a matter of only a few minutes before the flat sheet, drawn out of a bath of molten glass at approximately 1000°, emerges from the annealing shaft at a temperature cool enough to enable it to be carried safely in the open air. On the other hand, in the case of large slabs of optical glass, it is not unusual, as Dr. Hampton pointed out, for the annealing process to involve heating them slowly from room temperature up to the annealing temperature in five to six days, to maintain them for 24–70 hours at that temperature and then to cool them during the first 150° below the annealing temperature at a rate of perhaps only 10° per day. In the case of a large telescope disk, such as the famous 200 in. disk, the cooling must be spread over several or many months.

Control of the distribution of strains in the flat-drawn sheet glass prepared either according to the original Fourcault process or its modification the Pittsburgh process, is important if excessive breakage is to be avoided. In either method, there is some contrivance whereby the edges of the sheet, which may be more than 100 in. wide and up to ¼ in. thick, are chilled and maintained rigid so soon as it is raised above the molten glass. This results in these edges being put into compression vertically as the temperature becomes uniform, whilst the centre develops tensile strain vertically, there being other tensions and compressions across and through the sheet. The tensile strains must not reach the breaking limit and must be so distributed as to leave the sheet substantially free from strain when, as is part of the normal operation, the edges are cut off. Dr. Moore described an elegant method now under trial of using Babinet compensators to maintain routine observations on the edges and centre of the sheet as it emerges from the drawing tower.

The physicist has also been set a problem by no means easy in the testing and control of 'toughened' glass produced by heating plate or sheet glass to a temperature some 50° C. above the annealing point and chilling it rapidly by a blast of cold air from many small orifices, the result being to multiply several-fold the forces which it will withstand before fracture. The compressive forces thus introduced into the surfaces are such that the glass sheet can be bent or otherwise deformed considerably before these compression strains are removed and replaced by tensile strains under which glass almost invariably breaks, since the tensile strength is only one eighth to one tenth of that of the compression strength. Here control may be exercised by a combination of mechanical testing methods and of the tensile strains measured optically either on pieces cut from lightly 'toughened' plate or on 'toughened' thick plates of glass convenient for edgewise examination.

The Babinet compensator has also been a valuable tool in the study and control of permissible stresses in vacuum-tight glass-to-metal seals in electric lamps and valves; and of flashed opal

glasses, Dr. Dudding having some excellent coloured slides to show of strain patterns; whilst Dr. Hampton illustrated its use in the manufacture of bifocal lenses. In such a lens the major part consists of spectacle crown glass, into a depression of which a button of glass of higher refractive index is fused, and the whole then ground down to the required curvature. Satisfactory welding is found to require, for similarity of thermal expansion, coefficients of the two glasses to within $\pm 2 \times 10^{-7}$. Since 1920, many investigations of this property have shown that the thermal expansion–temperature curve deviates considerably from a straight line and at a transformation temperature the coefficient increases several-fold. The successful solution of the problem of obtaining two glasses, or a metallic wire and a glass, of thermal expansion curves closely agreeing with one another, is a testimony to the thoroughgoing nature of the study of this subject.

Researches on the electrical properties of glasses have had various practical applications, nowhere perhaps more vitally than in the electric lamp industry. By systematic researches on the relation of composition to electrical resistance, glasses have been made available for mercury vapour discharge lamps which will permit of their operation at temperatures of 600° and yet have a resistance 300,000 times that of the simple soda-lime-silica glasses used in 1916*, and offering prolonged resistance to blackening.

Not merely in the operations of glass fabrication and manipulation but also in auxiliary processes in its melting, modern physical methods have received valuable application. In the study of the performance of refractory articles in which glasses are melted, X-ray methods of examining structure have often led to vital knowledge; and tensile strength and creep tests at high temperatures, as Dr. Partridge showed, have been of great value.

Some fields of investigation have been but little explored by the physicist. Thus, Dr. Seddon emphasized the lack of systematic information available about certain thermal properties at high temperatures, namely, specific heat, thermal conductivity and emissivity. But sufficient has been said to demonstrate how physics has assisted in transforming glass-making into an enterprising and efficient industry.

* See, for example, Dudding, B. P., *Proc. J. Soc. Glass Tech.*, 22, 43 (1938).

THE FLORA OF MADAGASCAR

By Dr. J. Hutchinson,

Royal Botanic Gardens, Kew

FEW naturalists will need reminding that Madagascar, the third largest island in the world, possesses a fauna and flora of exceptional interest. Although only 260 miles distant from the nearest point on the East African coast, its flora bears an almost equal relationship with that of the great continent and that of Ceylon, Malaya and even Australia, whilst its fauna, as pointed out long ago by Alfred Russel Wallace[1], is almost exclusively related to that of Eastern Asia. Of equal interest is the fact that the language of the natives is closely related to those of Malay-Polynesia, whilst another remarkable feature is that they do not employ skins for clothing their bodies as do the natives in Africa, but make use of vegetable fibres as do the eastern peoples.

The distribution and affinities of the animal life, therefore, and of the plants in part, indicate that Madagascar was in former times connected much more closely with the continent of Asia than it is at the present day. As is well known, there are two rival hypotheses which might account for these interesting facts, either the mythical Gondwanaland of Suess, or the continental drift of Alfred Wegener. With respect to its organic life, therefore, Madagascar ranks equally with other oceanic islands such as New Guinea, New Caledonia, St. Helena and the Galapagos in being a 'museum of antiquity'.

Madagascar is nearly a thousand miles long, has an average of 250 miles in breadth and an extreme width of 360 miles. Its area is nearly four times that of England and Wales.

The main features of the island are the great central ridge of elevated ground, the encircling tropical plains, broad on the west side, narrow on the east of the ridge, and with a long girdle of primeval forest nearly 2,000 miles in length. There is fine mountain scenery in the Betsileo country in the southern portion of the island, and in the centre the Ankaratra mountains rise to a height of 9,000 ft. within a short distance of the capital, which stands at 4,000 ft. This central portion consists of rolling moor-like hills covered principally with long grass which becomes very brown and dry by the end of summer.

The flowering season of most plants in Madagascar is October–May, that is, during the rainy season. But many do not flower until December, and the grasses and sedges mostly flower towards the colder dry season, from March to May.

The plant that probably leaves the greatest impression on the visitor is the travellers' tree, *Ravenala madagascariensis* Sonn., a banana-like plant, but more closely related to the well-known South African Strelitzia than to the banana (Musa). A beautiful flowering tree is Colvillea, a leguminous plant of the family Cæsalpiniaceæ, with sensitive leaflets like those of a Mimosa, and a dense raceme a foot long of large red flowers with rounded petals.

One of the best known Madagascar herbs is Kitchingia (Crassulaceæ) (united by some botanists with Bryophyllum), which is grown in hanging baskets in our greenhouses. It commemorates the late Langley Kitching of Leeds, a missionary who collected plants in Madagascar in 1879.

Until nearly the close of the nineteenth century we knew very little of the botany of the island. The great world-exploring expeditions up to that time and to which botanical collectors were attached had mostly given it a wide berth and proceeded direct from the Cape to Indo-Malaya and Australasia, and the opening of the Suez Canal tended to increase this neglect. It was not until 1820, when Christian teaching was commenced by the London Missionary Society, that Europeans gained access to some parts of the island. A set-back soon occurred, however, for on the death of the native King Radama in 1835, missionaries were obliged to leave the country by command of Queen Ràvavàlona, the native Christians were persecuted, and for many years all Europeans were excluded and foreign commerce brought almost to a standstill. In 1861, however, the island was reopened to European trade and missionary efforts recommenced, the independence of the country being more or less maintained until 1895, when it became a part of the empire of France.

Botanical exploration did not begin in earnest until about 1880, when large collections began to arrive at Kew from members of the London Missionary Society, mostly made by Mr. Langley Kitching, Dr. Parker and the Rev. R. Baron. The last-mentioned, for example, sent to Kew between the years 1880 and 1896 nearly 12,000 specimens (separate gatherings) of plants. These were dealt with by the late Dr. J. G. Baker, then principal assistant in the Kew Herbarium, and the novelties were described by him in the *Journal of Botany* and the *Journal of the Linnean Society*. To these two men, therefore, should be given the credit for laying the foundations of our knowledge of the flora. Baron's plants were particularly valuable because they were collected in the central higher parts of the island, especially the Imerina Province, and many of them proved to belong to genera and species hitherto unknown to science.

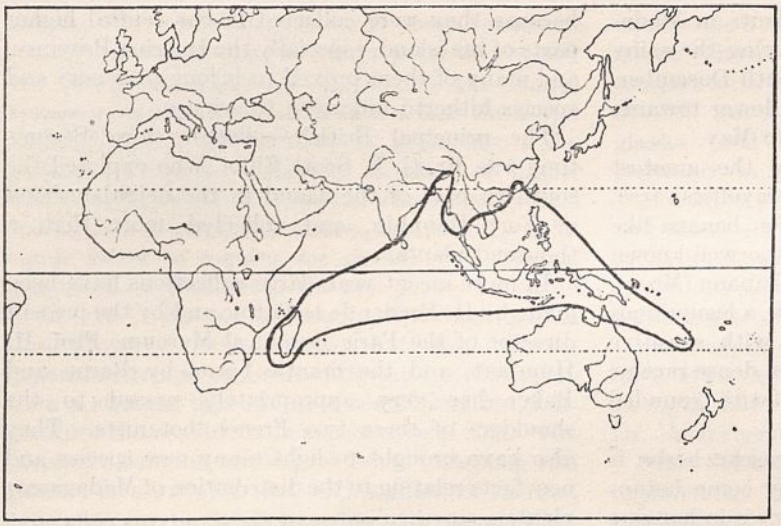
The principal British collector since Baron's time was Mr. G. F. Scott Elliot, who explored the southern part of the island in the neighbourhood of Fort Dauphin, and collected more than a thousand plants.

In more recent years large collections have been made by H. Perrier de la Bathie and by the present director of the Paris Botanical Museum, Prof. H. Humbert, and the mantle borne by Baron and Baker has very appropriately passed to the shoulders of these two French botanists. They also have brought to light many new species and new facts relating to the distribution of Madagascar plants.

In 1936 a "Flore de Madagascar" (Plantes vasculaires) was commenced under the direction of Prof. Humbert, and it would indeed be a tragedy if this important work were to be delayed because of the War. In common with other countries, after it is over, France will no doubt need as much detailed knowledge of the vegetable productions of her possessions as possible, and nothing contributes so much towards this end as a well-written and illustrated Flora such as contemplated by the Paris botanists, a portion of which has been published already[2], and further parts are in preparation.

For example, Madagascar possesses one of the most remarkable grass floras in the world, including a number of endemic genera of bamboos. Very few of them have so far been investigated for economic purposes. The soil of the plains is described as rich and very fertile and capable of supporting vast herds of cattle, and it should not be forgotten in this respect that the island is about as big as France herself. It is indeed high time that botanists should know more of the flora in a collected form, for up to the present we have only had available miscellaneous papers published in many different journals, from which it has been well-nigh impossible to obtain an adequate idea of the flora as a whole. Then, and then only, will it be possible to study the many interesting phytogeographical problems which the island presents in abundance.

I may mention only a few of the more prominent. For example, why is it that there are in Madagascar no species of Mesembryanthemum (*sensu lato*), so numerous in South Africa, when there are in the island numbers of spiny Euphorbias, Pachypodium and xerophytic Asclepiadaceæ, which are such prominent features of the South African vegetation? In addition, such typical South African genera as Halleria (a woody Scrophulariaceous



RANGE OF THE UNIQUE GENUS OF 'PITCHER PLANTS' (NEPENTHES) (AFTER HUTCHINSON: "FAMILIES OF FLOWERING PLANTS", VOL. 1).

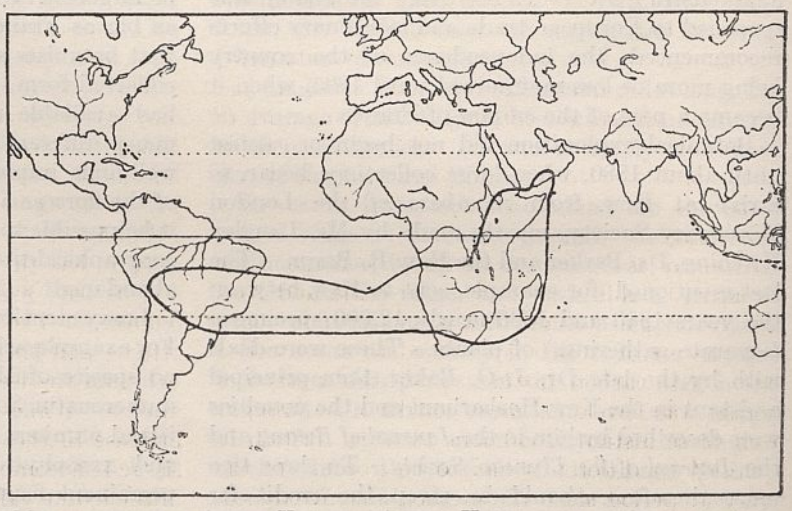
genus), Clematopsis (Ranunculaceæ), Sparrmania (Tiliaceæ), Faurea (Proteaceæ), Peddiea and Däis (Thymelaeaceæ), Kniphofia ('poker plants'), Aloe (Liliaceæ), and Aristea (Iridaceæ), are also prominent in the vegetation of Madagascar.

Again, is Madagascar the original home of the Baobab genus, Adansonia? There are more species in the island than elsewhere, for there is only one in the whole of tropical Africa, and two in northern Australia. This connexion with Australia is mysterious and is reflected again in the case of Hibbertia (Dilleniaceæ), a large Australian genus with two endemic species in Madagascar. And how did the unique genus Nepenthes (pitcher plants) get to Madagascar, all the other species being in Ceylon and through Malaya as far as New Caledonia (see accompanying map)? Ocean currents did not carry them; nor did the flight of birds; nor were the seeds borne on the wings of the wind!

Madagascar has at least two endemic families of plants. These are Chlaenaceæ, related to the great Asiatic tea family, Theaceæ, and Didieriaceæ, the latter being weird spiny plants of fantastic form and uncertain affinity, which have almost to be seen to be believed. At present we know far too little about them until they are more thoroughly investigated in the field and collected.

As stated above, the flora is only in part related to that of tropical Africa. The most striking genera common to the two regions are Brexia (Escalloniaceæ), Dombeya (Sterculiaceæ), Acridocarpus (Malpighiaceæ), Haronga (Hypericaceæ), Uapaca (Euphorbiaceæ), Myrothamnus (Myrothamnaceæ), Agauria (Ericaceæ), Psiadia (Compositæ), Landolphia (Apocynaceæ), Albizzia Sassa (Gmel.) Macbride (Mimosaceæ), and Trachylobium (Cæsalpiniaceæ), the East African copal tree, all genera or species familiar to African but unknown to Indian botanists. Most of these trees and shrubs grow in the great primeval forest which encircles the whole island at a distance of about forty miles from the coast, but which extends right to the sea at the north-west end of the island. According to Humbert, this forest is fast disappearing on account of the shifting native cultivation just as in tropical Africa, and it is of primary importance to biological science that it should be thoroughly explored and comprehensive collections made before it has been destroyed.

An interesting Madagascar-Afro-American connexion is shown by the genus Vellozia (Velloziaceæ), a distinctive monocotyledon, with shrubby stems and star-like flowers, of which there are several species in Madagascar, tropical Africa and South America, with one in southern Arabia. More surprising in this respect is the recent discovery of a new species of grass belonging to the genus Redfieldia, hitherto monotypic and known



RANGE OF THE GENUS VELLOZIA (AFTER HUTCHINSON: "FAMILIES OF FLOWERING PLANTS", VOL. 2).

only from the United States of North America. Although accepted by agrostologists, this is more likely to be due to convergent evolution such as is common in Compositæ and other large homogeneous families as Cruciferæ, Papilionaceæ, Rubiaceæ, Asclepiadaceæ, and Labiatæ. The grasses also provide a further example of the Indo-Malayan connexions of the flora, for a species of the genus Thuaria (*T. Perrieri A. Camus*), until recently known as monotypic in Indo-Malaya and Polynesia, has now been found in Madagascar.

[1] Wallace, Alfred Russel, "Island Life", 388 (1880).

[2] "Flore de Madagascar" (Plantes vasculaires), publiée sous les auspices du gouvernment général de Madagascar et sous la direction de H. Humbert, Professeur au Museum Nationale d'Histoire Naturelle. Aponogetonaceæ, by H. Jumelle (1936); Cyperaceæ, by H. Chermezon (1937); Lemnaceæ, by H. Jumelle (1937); Commelinaceæ, by H. Perrier de la Bathie (1938); Liliaceæ, by H. Perrier de la Bathie (1938); Bignoniaceæ, by H. Perrier de la Bathie (1939). (Tananarive, Imprimerie Officielle, 1936 →).

FOOD RESEARCH

By Dr. T. F. Dixon

THE Department of Scientific and Industrial Research has recently issued the annual report for 1938 of the Food Investigation Board under the chairmanship of Sir Joseph Barcroft*. The report describes experimental work carried out under the general direction of Mr. Eric Barnard, at the Low Temperature Research Station, Cambridge, with sub-stations at Covent Garden and Smithfield, the Torry Research Station, Aberdeen, and the Ditton Laboratory, Maidstone.

The most important development during the year under review has been the expansion of the work of the Board to cover research on the processing of food. A committee has been set up to consider the organization of research in this field in the interests alike of the consumer, producer and manufacturer. As soon as research on processing is considered, the question arises as to whether it should be organized on the basis of the process, for example, canning, or of the raw material, for example, fruit and vegetables or meats. The Board takes the view that it is the research on the raw material that is fundamental.

Although some work has been already carried out on the manufacture of bacon, the smoking and salting of fish and the canning of fruit, the work of the Board had previously been mainly concentrated on the problems involved in preserving the 'fresh' properties of unprocessed food during transport and storage.

Attention is directed to the progress made in the transport of chilled beef from Australia and New Zealand by gas storage, that is, in stores on board ship the air of which is enriched to a controlled extent with carbon dioxide. Until this method of storage was developed meat could not be brought from these distant Dominions to Great Britain in a chilled condition; it had to be frozen. In the five-year period since the method was introduced, the exports to Great Britain from Australia and New Zealand of chilled beef have increased nearly ten-fold to a combined annual figure of 42,500 tons. Since chilled beef has recently commanded a premium of 1*d.* a pound over frozen beef, the increased value of this meat is of the order of £400,000. The possibility of improving the 'bloom' or appearance of the meat, which depends on the condition of the layer extending inwards to a depth of about 1/10 inch, by increasing the evaporation of water from the meat during the voyage, is also being investigated. Acidification of flesh occurring after death takes place in two stages. The first, ending at *p*H 6·2, is dependent on the physiological state of the muscle and is uninfluenced by temperature. The second stage, however, is influenced by temperature and probably represents a straightforward enzymic breakdown of glycogen. Stiffening (rigor mortis) also takes place mainly during the second stage of acidification. The higher the glycogen content at death the lower will be the muscle *p*H and the firmer the flesh. Liver and muscle glycogen levels are usually much lower in pigs than in oxen.

The average value for the ultimate *p*H (twenty-four hours or more after death) of the pig psoas muscle has been used as a measure of the muscular fatigue of the animal at the moment of death. A *p*H of 6·7 is taken as indicating extreme, and a *p*H of 5·5 or lower an absence of, fatigue. Empirically it has thus been possible to detect fatigue, ascribe the reason for it and devise methods to reduce it. The psoas muscle is more affected by fatigue and therefore almost always has a higher *p*H than the less deeply seated longissimus dorsi muscle. While the bacon pig is being fattened, an increase in the percentage of fat in the muscular tissue is accompanied by a corresponding decrease in the iodine value of the fat. By greatly reducing the plane of nutrition it has been possible to reduce the fat in muscle to as little as 0·5 per cent.

* Report of the Food Investigation Board for the year 1938. (H.M. Stationery Office.) Pp. 277.

Experiments on the quality of the eggs laid by the hens, White Leghorn and Light Sussex, show that the percentage of thick white is primarily a characteristic of the individual hen and that there is no correlation between it and the season, the rate at which the eggs are produced or their weight. Any method of washing increases the number of rots in eggs, since the organisms responsible for rotting readily penetrate the wet shell, although the permeability of shells varies widely even in successive eggs laid by the same bird.

Work on the quality of kippers carried out for the Herring Industry Board shows that the quality of the kipper varies with the content of fat. The fatter the kipper the more palatable it is. A large proportion of the kippers made from herrings cured from February to early May would be made from herrings containing less than 8 per cent of fat. The abrupt and extensive rise in the content of the fat in June from about 2 per cent to more than 20 per cent has a peculiar effect on the suitability of the herring for kippering. The newly acquired fat is apparently held very loosely, runs away readily in the kiln, and the fish is very soft and easily torn, so that great care must be observed in curing. By July, however, consolidation of the fat has taken place and the fish make excellent kippers. The great variation in the composition of the herring makes it impossible to avoid great variation in the quality of kippers even should the process of kippering be rigidly standardized.

Electrometric and chemical methods have been used for estimating freshness of fish. With haddock, for example, estimation of either di- or trimethylamine can be used to determine the onset of definite staleness ; but the course of deterioration before this stage is reached can only be followed by the determination of dimethylamine using a sensitive colorimetric method. The micro-organisms causing spoilage of salted fish known as 'pink' belong to the Serratia and Micrococcus groups. The only method so far found effective for controlling 'pink' is chilling the fish to temperatures below 5° C. During the year members of the staff of the Department's Fish Research Station at Aberdeen spent a period in Norway studying at first hand the methods employed there for the handling and storage of fish and the research on the subject in progress in that country.

During the year, arrangements were made to carry out on behalf of the Government of Palestine a survey of the wastage of oranges during transport. The temperature in the holds is an important feature in the wastage of the fruit, and the main object was to ascertain how far temperature variations were responsible for the wastage and to what extent these temperatures might be improved. Experiments were also carried out on the storage conditions of Palestinian grapefruit after its arrival in England. Further successful experiments on the gas-storage of home-grown pears, apples and broccoli have been carried out. No form of storage for apples can be reckoned successful unless it conserves their flavour, and this is especially important in the case of our finest dessert variety, Cox's Orange Pippin. A full-scale demonstration was arranged to remove any doubt in the trade as to whether this variety developed its full flavour after gas storage. Twenty-six tons of Cox's Orange Pippins were put into a gas store at the Ditton Laboratory at the end of September 1937. The composition of the atmosphere of the store was 2·5 per cent oxygen, 5 per cent carbon dioxide and 92·5 per cent nitrogen and was obtained by the removal of the excess of carbon dioxide by a scrubber of commercial design together with controlled ventilation. The temperature of storage was 4° C. The store was opened on February 22, 1938, in the presence of some 150 fruit-growers and other experts. The demonstration was completely successful, the fruit being in excellent condition ; in fact 80 per cent of it was graded as 'Fancy' or 'Extra Fancy'.

On the other hand, a subsequent survey of fruit of this variety from ten representative areas has shown that the extent to which the flavour is developed depends, in the main, on the pre-storage conditions, such as soil, manurial treatment and maturity at the time of gathering. Gas-storage also lengthens the life of home-grown pears of the variety Doyenne du Comice. On removal to air after five months storage, the pears ripen in twelve days at 18·3° C. and in twenty-one days at 10° C. It is found inadvisable to store late varieties of apples together with early ripe, that is, post-climacteric varieties, since volatile substances given off by the ripe apples cause a severe 'lenticel' spotting on the other fruit not only in refrigerated gas storage but also in ordinary cold storage. This 'lenticel' spotting can be produced during storage by treating the pre-climacteric apples with ethylene (1 in 500) for 2–3 weeks early in their storage life.

Confirmation of Putterill's finding in South Africa, that ripening of the plum can be stimulated by low concentrations of acetylene, has been obtained in England for the Monarch plum. After storage for three weeks at 4° C., and removal to 18° C., stimulation of ripening by acetylene, ethylene or air which had passed over ripe plums was still possible.

Other research being carried out on behalf of the Board includes work on meat, the preparation of milk fat, the storage of eggs, bacon and hams, including the factors affecting the quality of the pig's carcass, the storage of new potatoes and other vegetables, and problems connected with canning.

OBITUARIES

Sir Hubert Murray, K.C.M.G.

BY the death, on February 27, of Sir John Hubert Plunkett Murray, lieutenant-governor and chief judicial officer of Papua, the British Empire is the poorer for an outstanding figure, and there can be few of those who came into contact with "H.E." who have not felt also a sense of personal loss.

Sir Hubert was born in Sydney in 1861, and after a brilliant university career in England, was called to the Bar. He served with distinction in the South African War; but his real life-work began when he went to British New Guinea in 1904 as chief judicial officer. When this country was placed under Australian administration as the Territory of Papua in 1906, he was appointed acting administrator and shortly afterwards lieutenant-governor. He found himself responsible for a little-known country nearly twice the size of England, populated by a thin sprinkling of white settlers and an unknown quantity of Stone Age savages.

During Sir Hubert's administration a large part of Papua has been opened up. Although as time went on his administrative duties made it necessary to delegate the work of exploration to others, he kept in personal touch with as much of the Territory as he could, and it was on a tour of inspection that he died, after two days' illness, at the age of seventy-eight. But he always regarded as his main task the guidance of the country through the difficult initial stages of adjustment. From the first, he had to contend with the clash of interests between the two types of population, "for if an administrator succeeds in holding the balance even between the white settler and the native, he is open to attack from the partisans of both, and the applause of either will often be a sign that he is acting unfairly to the other". He made it clear, however, that he considered it the duty of the Papuan Government not only to foster the interests of the whites, but also "to show how the civilization of the twentieth century can be introduced among people of the Stone Age, not only without injury to them but to their lasting benefit and permanent advancement".

Taking the long view, Sir Hubert steadily opposed the alienation of any land which appeared necessary to the welfare of the natives, and the introduction of Asiatic labour, although he faced severe criticism on the grounds that he was hampering the development of the country. To meet the reasonable demands of the white settlers for labour, he introduced the indenture system, hoping that free labour might eventually be substituted. He thought that the future of the Papuans, if they were to be more than mere labourers, lay in the cultivation of land for themselves, so he instituted a system of native plantations. He also appointed village councillors, who might gradually be given more authority. At the same time, he realized the harm that can be done to a primitive people by too swift destruction of their old life. His appointment of a Government anthropologist "to help us in reconciling an intelligent, though very backward, race to the inevitable march of civilization, and in finding the easiest way for its advance", has been amply justified.

His books, "Papua or British New Guinea" (1912) and "Papua of To-day" (1925), and his annual reports—very different from the usual lifeless documents—record, though modestly, the course of Sir Hubert's long tenure of office. Some measure of his achievement may be indicated by extracts from two addresses presented to him on the completion of the thirtieth year of his administration. This from the white residents: "Your Excellency's reputation in Native Administration is world-wide and firmly established. What is not so well known outside Papua is the patient, wise and sympathetic manner in which you have worked always for the protection and support of European industries, for the advancement of Papua as a colony, and for the welfare of every member of the community." This from the natives: "When we have come to speak to you, you have not closed your ears, nor have you frowned on us, but have received us and listened to us, and taken action for us. We have seen all the good things you have done and our happiness is great because of you. Therefore we all beg of you not to leave us, but stay here as our Governor for years to come. For we know you and how you have led us into the ways of your laws, treating white people and ourselves just the same. We know that you love us well, and we are full of love for you, our Governor."

B. BLACKWOOD.

Mr. A. L. Tonnoir

BY the sudden death, on January 27, of Mr. A. L. Tonnoir, the Australian Council for Scientific and Industrial Research has suffered an irreparable loss. This loss is shared by the many entomologists throughout the Commonwealth and overseas who have from time to time benefited by his unusually wide knowledge and experience.

André Leon Tonnoir was born in Brussels in 1885. After his formal education at school and at the University of Liège, he spent several years travelling in England, France, Germany, Italy and Spain. During this period he was able to give much of his time to his outstanding interest, entomology, and incidentally to acquire a sound knowledge of six languages. However, it was not until after the War of 1914–18, when he was appointed to the staff of the Brussels Natural History Museum, that he was able to devote his whole time to his former hobby. Like many naturalists, he was especially interested in Australia and New Zealand, and in 1921 he

accepted a commission to study the dipterous insects of the temperate zone of the southern hemisphere, a study which still occupied his leisure hours up to the day of his death.

From Belgium Tonnoir went to New Zealand, where he worked at the Cawthron Institute, the Canterbury Museum, and the Canterbury University College, until 1929, when he joined the staff of the Division of Economic Entomology of the Australian Council for Scientific and Industrial Research in Canberra. During the past ten years he has been closely associated with research on biological control of insect pests and weeds, and has also played a prominent part in the development of an intensive study of the grasshoppers in Australia. Mr. Tonnoir's numerous papers on lesser-known families of the Diptera do not adequately reflect his remarkable knowledge of insects, although they are a record of the thoroughness of his work and his outstanding ability as a taxonomist.

Tonnoir's death removes a colourful personality and a delightful colleague, but our sadness is tempered by the knowledge that he died as he would have wished, peacefully in his sleep as he rested in the shade of a tree, after a morning's collecting in the bush. A. J. NICHOLSON.

Mr. H. G. Newth

MR. H. G. NEWTH, whose death at the age of fifty-four occurred on February 17 after a long illness, went to school in Worcester and then entered the Royal College of Science, London. There he studied zoology under Adam Sedgwick and Mr. Clifford Dobell, and then became demonstrator in zoology for Prof. E. W. MacBride, a post which he held until the War of 1914–18. From 1920 onwards, he was lecturer in zoology in the University of Birmingham.

The early death of Mr. Newth will be deeply regretted by his friends in zoological and other circles, for he had a personal charm which endeared him to his colleagues and his students, generations of whom remember his clear lectures and skilled help in the laboratory. Advanced students profited especially from his embryological teaching, embodying practical experimental work on modern lines.

Mr. Newth was a master of microscopical technique and was always more than willing to help other research workers in the laboratory. His own original contributions included work on the embryology of Cucumaria and of Astropecten, on the development of Amphioxus, and on the swarming of Vorticella. Perhaps his most important research was on the mode of feeding of the ammocœte, which he showed to be different from that of any other animal (NATURE, **126**, 94; 1930). Mucus secreted by the endostyle-thyroid is moved by cilia forwards and up the peripharyngeal grooves, from which it is freed as a cone of mucous strands, uniting behind to form a mucous cord which lies free in the middle of the pharynx. This cord is continuously sucked back into the gullet by cilia in the latter. Food particles drawn into the mouth with the respiratory water current, which is maintained by muscular movements of the pharynx and of the velum, are caught in the cone of mucous strands and passed back into the gullet in the mucous cord. H. M. F.

Prof. C. Tangl

PROF. CHARLES TANGL, of the University of Budapest, died on January 10 in his seventy-first year. He received his early training in physics at the University of Budapest, where he was student, and later assistant and collaborator of Prof. Eötvös. He was appointed in 1901 as *Privat-Dozent* and in 1903 as professor of experimental physics at the University of Kolozsvár. In 1917 he became professor of physics at the Polytechnic in Budapest, and in 1921 he succeeded Eötvös in the chair of experimental physics at the University of Budapest. He was a member and president of Section III of the Hungarian Academy of Science.

Tangl's interests lay in three different branches of physical research. His early work was devoted to the study of the effect of magnetic fields upon the mechanical properties of solid bodies, especially of the effect upon elasticity. Then in several papers he published the results of his investigations upon the variation of the dielectric constant of liquids with pressure and temperature. These experiments, carried out with great care and accuracy, furnished very reliable values of the dielectric constants which are frequently cited. In a third line of work he applied quite new methods to investigate the forces at the contact surface of solid and liquid bodies; the determination of the contact force between platinum and water, in particular, should be mentioned.

Tangl was a man of outstanding personality and wide knowledge. A thoroughly critical judgment was combined with great kindness; he was a helpful friend to all who needed his advice. M. FORRÓ.

WE regret to announce the following deaths:

Prof. F. Emich, emeritus professor of chemistry in the Polytechnic Institute, Graz, an authority on microchemistry, on January 22, aged seventy-nine years.

Sir Thomas Heath, K.C.B., K.C.V.O., F.R.S., an authority on Greek mathematics, on March 16, aged seventy-eight years.

Prof. A. G. Högbom, emeritus professor of geology in the University of Uppsala, on January 19, aged eighty-four years.

Prof. Bernhard Lehmann, emeritus professor of chemistry and director of the Institute of Hygiene in the University of Würzburg, on January 28, aged eighty-two years.

Prof. W. C. Morgan, professor of chemistry in the University of California at Los Angeles, on February 9, aged sixty-five years.

Dr. A. J. R. O'Brien, C.M.G., chief medical adviser to the Colonial Office, on March 9, aged fifty-six years.

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NEW FELLOWS OF THE ROYAL SOCIETY

At a meeting of the Royal Society on March 14, the following new fellows were elected :

Dr. W. T. Astbury, reader in textile physics in the University of Leeds, distinguished for his pioneer researches into the structure of natural fibres and proteins. His chemico–X-ray technique has opened up new fields of knowledge.

Dr. G. R. de Beer, reader in embryology, University College, London, distinguished for his original contributions on the embryology of vertebrates, which are notable for their completeness and accuracy.

Dr. O. M. B. Bulman, University lecturer in palæozoology, Cambridge, distinguished for his work on Lower Palæozoic stratigraphy, especially on the morphology, ontogeny and phylogeny of the Graptolites, and their geological history.

Lord Cadman of Silverdale, chairman of the Anglo-Iranian Oil Company, emeritus professor of mining and petroleum technology, University of Birmingham, distinguished for his many public services and for his leadership—administrative and scientific—in the development of the Iranian oilfields.

Prof. G. Cook, regius professor of civil engineering and mechanics, University of Glasgow, distinguished for researches into a wide variety of engineering problems and particularly for original investigations into the stress–strain relations of metals when passing from the elastic to the plastic state under systems of combined stresses.

Dr. H. Davenport, lecturer in mathematics, University of Manchester, distinguished for his work in pure mathematics and particularly for his contributions to the theory of numbers.

Dr. C. F. Goodeve, reader in physical chemistry, University College, London, distinguished for his work in many branches of physical chemistry and particularly for his contributions to our knowledge of absorption spectra and photo-chemistry.

Prof. F. G. Gregory, professor of plant physiology, Imperial College, London, distinguished for his researches on the analysis of plant growth, especially in relation to mineral nutrition and vernalization.

Prof. A. C. Hardy, professor of zoology and oceanography, University College, Hull, distinguished for his researches on marine biology and their application to fishery problems, with special reference to the ecology of the herring and the distribution of plankton.

Dr. C. H. Kellaway, director of the Hall Institute for Medical Research, Melbourne, Australia, distinguished for his researches on snake venoms and on protective antisera.

Prof. K. S. Krishnan, Mahendralal Sircar research professor of physics in Calcutta, distinguished for his researches in optics, and especially for his study of the influence of magnetism on crystals.

Prof. R. P. Linstead, professor of organic chemistry in Harvard University, distinguished for work in synthetic organic chemistry, including reversible isomeric change, ring compounds and phthalocyanines.

Prof. O. Maass, MacDonald professor of physical chemistry, McGill University, Montreal, distinguished for his researches in physical chemistry, particularly those relating to the properties of gases and liquids, during which he has detected and studied an important and anomalous behaviour in the critical region.

Prof. H. S. W. Massey, Goldsmid professor of mathematics, University College, London, distinguished for his work in mathematical physics and particularly for his contributions to the quantum theory and its applications to physics.

Dr. B. H. C. Matthews, assistant director of research, physiological laboratory, and fellow of King's College, Cambridge, distinguished for his work on electrophysiology, particularly in connexion with the sense organs and the spinal cord, by which important factors in the mechanism of the nervous system have been revealed.

Prof. W. H. Pearsall, professor of botany, University of Sheffield, distinguished for his investigations on the determination of the factors underlying the distribution of aquatic plant communities, especially in the British lakes, and on the conditions affecting algal metabolism.

Dr. J. H. Quastel, biochemist to the Cardiff City Mental Hospital, distinguished for his work on chemical reactions in resting bacteria, the mode of action of enzymes, the chemical metabolism of the brain, and the action of drugs.

Prof. A. Robertson, professor of mechanical engineering, University of Bristol, distinguished for his fundamental contributions to knowledge relating to the stability and strength of solid and tubular struts, and to many other problems in the field of the strength of materials of engineering construction.

Dr. L. F. Spath, lecturer in geology at Birkbeck College, University of London, distinguished for his researches on the phylogeny of the Nautiloidea, the goniatites and the ammonites, and particularly on the problems of ontogeny and recapitulation in cephalopods.

Dr. W. Sucksmith, reader in magnetism, University of Bristol, distinguished for his outstanding experimental researches, particularly on the gyromagnetic effect of paramagnetics and the physical properties of ferromagnetics.

NEWS AND VIEWS

Finland and the U.S.S.R.

HOSTILITIES between these countries have ceased, and a peace has been signed which gives the U.S.S.R. substantial territorial gains. Finland loses much of her industrial and agricultural areas by this treaty, and nearly half a million of her population are being transferred from the ceded territory to other parts of Finland. The country has suffered a grievous blow, not through any lack of valour, but through the overwhelming military power of the U.S.S.R. Now the Finns have turned with characteristic courage and energy to the task of reconstruction. Towns and houses destroyed by aerial bombardment have to be rebuilt, new towns created for the transferred people, and the whole of the economic life of the country has to be restarted under the new conditions, while the defence of the new frontiers must also be organized. The Finns have saved their freedom, and on this the nation will rise again. The help in men, money and materials still so sorely needed will surely not be grudged by right-thinking peoples who have watched the struggle of this gallant democracy.

Water Pollution Research

THE Department of Scientific and Industrial Research has opened a new Water Pollution Research Laboratory at Watford equipped for work on the problems of water supply, sanitation, and the recovery and utilization of valuable materials from trade effluents of many kinds. Plans for building a research station for work of this nature have been postponed by the War, but temporary accommodation has now been obtained. Although no central research station has hitherto been available for the work of the Water Pollution Research Board, many investigations have been carried out in the last few years, on behalf of the Board, in other laboratories. Among other important work, it has been shown that certain clays and glauconitic sands found in Great Britain yield material capable of softening hard water, and that certain synthetic resins can be used to remove dissolved salts and other substances from water.

The Board has also co-operated with industry in the investigation of river pollution by beet sugar and milk factory effluents. Another important investigation was that on the effect of the discharge of sewage into the estuary of the River Mersey on the deposition of silt and other solid matter in the estuary, and an investigation is now in progress at a branch laboratory in Birmingham, in co-operation with the Birmingham Tame and Rea District Drainage Board, which has indicated that the capacity of percolating filters for treating sewage can be increased by at least 50 per cent. Communications intended for the Director of Water Pollution Research should be addressed to the Water Pollution Research Laboratory, Langley Road, Watford, Hertfordshire.

Radioactive Standards

RELIABLE standards of weak radioactivity are required in a number of fields of work; for example, by geologists, geophysicists and cosmologists concerned with the radioactive content of the materials of the earth's crust; by biological and medical investigators employing the technique of radioactive indicators or internal artificial radioactivity therapy; and in studies of radium and thorium poisoning. A committee of the United States National Research Council is endeavouring to facilitate the needs of such workers by preparing a series of feebly radioactive standards which will be analysed at a number of laboratories equipped to make such measurements. These standards will ultimately be deposited at, and certified by, the National Bureau of Standards at Washington, D.C., to be issued as working standards to investigators who may desire them.

The standards in preparation are: (1) *Radium standards*, comprising 100 c.c. solutions in sealed flasks, for use as emanation standards; and 5 c.c. solutions in sealed ampoules for use as gamma-ray standards. (2) *Thorium standards* in the form of sealed ampoules containing sublimed thorium chloride for use in preparing standard thorium solutions. (3) *Standard rock samples* consisting of a variety of finely ground minerals of certified radium and thorium content, which may be used in fusion techniques for checking methods of extracting radon and thoron from rock samples.

Drug Addiction

IN a paper read at an evening meeting of the Pharmaceutical Society on March 12, Dr. Walter B. Kennedy, a member of the Poisons Board and formerly professor of physiology in the University of Baghdad, made some interesting references to the influence of habit-forming drugs brought to his notice in the Near East and elsewhere. A topical and important aspect of drug addiction is the problem of maruanha, the name by which the hemp plant, *Cannabis sativa*, is known in the United States. Maruanha, said Dr. Kennedy, is destructive of the moral sense: "Under its influence there develops a ruthlessness rarely encountered under other conditions, and a spurious courage, or rather a complete disregard for danger and consequences which results in horrible crimes of violence—often devoid of motive. An additional danger is that the addict is often led into indulgence in the white drugs, morphine, heroin and cocaine". Another exotic drug which has lately found its way to Europe is mescal or peyote, obtained from a Mexican cactus. It is an inebriant producing even more brilliant and prolonged hallucinations than does hashish.

Dr. Kennedy referred to the excessive use of endocrine products of which evidence was seen occasionally; he mentioned in this connexion the

fashion which swept through a girls' school of taking thyroid for the purpose of securing lithe figures, a fashion which had serious results in several instances. There is a wide gap between maruanha and thyroid and a still wider one between the former and aspirin. "I may surprise some," said Dr. Kennedy, "if I refer to aspirin as a drug which gives rise to habit, and without being dogmatic I would merely give my opinion that it does". Another form of addiction, he said, was provided by certain medicated wines. Many people delude themselves with the idea that when a wine was 'medicated', it was somehow free from the stigma of what is picturesquely called the 'demon drink'. But there is no excuse for maruanha and no quarrel with the penalty which may be imposed in the State of New Jersey upon traffickers in this woeful drug, namely, thirty years imprisonment and a fine of ten thousand dollars.

Twenty-five Years of Transcontinental Telephony

IT is recalled in the *Laboratories Record* of the Bell Telephone System that on January 25, 1915, just twenty-five years ago, the first transcontinental telephone call was made across America and the east and west were united. President Woodrow Wilson talked from the White House across the country testifying to the nation's pride "that this vital cord should have been stretched across America as a sample of our energy and enterprise". The inventor of the telephone, Alexander Graham Bell, in New York, repeated across the continent to San Francisco the first words ever heard over a telephone, namely, his call to his assistant, "Mr. Watson, come here, I want you," to the same T. A. Watson who had heard them in the garret workshop in Boston in 1876. That ceremony ushered in transcontinental service twenty-five years ago. At that time it cost 20.70 dollars to call San Francisco from New York. Now it costs 6.50 dollars for a station to station call and only 4.25 dollars after seven in the evening and all day on Sunday. In 1915 it took about half an hour, on the average, to make a connexion ; now most calls are put through without 'hanging up'. The Bell System concludes by saying : "These are measures of progress in the never-ending effort of the Bell System to give faster, clearer, more useful and courteous service to the people of the United States".

Development of the Battery Vehicle

IN an article contributed to the *Electrical Review* of February 16, J. H. Cansdale states that during the last six years the number of battery vehicles has been rapidly increasing, and war-time conditions will most probably create a very much greater demand for them. In 1933, the number of battery vehicles registered in Great Britain and Northern Ireland was about 1,400, and it is estimated that the number at the beginning of this present year was about 6,500. Any service with short runs and frequent stops, particularly with loads between five and thirty cwt., is suitable for the battery vehicle. A large proportion of tradesmen's and similar services in towns and suburban districts comes within this category. The great advantages of the electric vehicle in lower running and maintenance costs are now augmented by the absence of restriction on the use of electric power for battery charging, in contrast with the present petrol restrictions.

The design of modern battery vehicles has been modelled closely on automobile practice. The weight of the battery necessitates a rather heavier frame, and special provision has to be made for accommodating the battery crates and for their easy inspection and removal. Four-wheel brakes are standard, and the drive to the back axle is by means of a propeller shaft with either a double-reduction bevel or worm gear. Pneumatic tyres of the medium pressure type have been found to give the best results by combining smooth running with economical power consumption. All the principal battery manufacturers now market special traction types able to withstand vibration and to provide heavy starting currents. Of the two principal types available, the lead-acid cell is most usually employed as its first cost is less than that of the alkaline battery. On the other hand, the latter has a life of about nine or ten years, whereas a lead-acid cell lasts only three or four, so that the difference in cost is levelled out. Owing to its higher internal resistance, the alkaline cell has a lower efficiency. For the small delivery van of the 12–15 cwt. class, the normal range of battery capacities is from 129 to 290 ampere hours. Capital costs are heavier than for an equivalent motor vehicle, but the life is approximately double, and both maintenance and running costs are considerably reduced.

Indian Sculpture and Architecture

THE Madras Government Museum has recently issued two publications, one of which is a guide to the archæological galleries of the Museum and is intended as an introduction to South Indian temple architecture and sculpture, while the second contains an illustrative series of photographic reproductions of examples of Indian sculpture, mostly southern, for use with the guide ("Guide to the Archæological Galleries". By Dr. F. H. Gravely and C. Sivaramamurti and other curators. Madras Government Press. Pp. v+48+4 plates. 8 annas. "Illustrations of Indian Sculpture, mostly Southern, for use with the Guide to the Archæological Galleries". By Dr. F. H. Gravely and C. Sivaramamurti. Pp. ii+xlv plates. Rs. 1.8). In the introductory remarks anticipating the text of the Guide, the principle is laid down that "The display of museum collections to the public aims at fostering a deep and intelligent interest in the universe of which we form a part, especially our immediate surroundings", and it is added that the arrangement and display of this section of the Museum's exhibits have been attempted in such a way as to help visitors "to recognize for themselves the general affinities and probable period of temples and sculptures they see outside". With this praiseworthy objective, the authors sketch briefly the history of Indian art from the time of Asoka and in the centuries before our era down to the 'modern' period, with

abundant references to the photographs and casts illustrating the Northern Schools, as well as to the actual exhibits from those of the South, special attention necessarily being directed to the Gupta period and Amaravarti.

No stronger plea than that afforded by these guides could be put forward for the adoption of a vigorous forward policy on the educational side throughout the museums of India. As the report of the Museums Commission showed, these institutions are already places of popular resort; but it depends upon the arrangement and administration of the museum itself whether they are mere repositories of 'curios', or really serve to bring home to the people the continuity in spiritual meaning underlying objects and buildings and structures familiar to them in their daily life. In the East, the function of the archæological museum is concerned with things of which the spirit, and sometimes, if not always, the form, is still alive.

Instructional Films in India

MR. C. F. STRICKLAND has recently published a paper on "Instructional Films in India" (*J. Roy. Soc. Arts*). They supply a ready means of education in a country which "it is not possible to make literate in the next ten years", though during that period instruction concerning good government must be acquired. Adults have to be educated and already Bengal is credited with 1,000 cinemas and 500 touring companies. But most of the films shown are non-Indian and 45 per cent of them are American. They are predominantly unsuited to Indian ideas and modes of thought. Indians do not think continually "in terms of sex emotion or crime". Some educational films are now made in India and several are on loan, but these are meant chiefly for the juvenile population. Mr. Strickland explained the requirements and limitations of the Indian adult, one of which is a pace much less rapid than that to which we are accustomed. This speed with perpetual excitement is, we note, quite unnatural, lacking the tension and relaxation which prevail in life and in the best stories of action, such as the "Three Musketeers". It is, in fact, the consequent strain on the mind which makes these pictures so easily forgotten.

Totaquina

IN a recent paper (*Asiatic Res.*, **35**, 777; 1939), M. Ciuca states that in its search for an anti-malarial preparation cheaper than quinine but equally efficacious, the Malaria Commission of the League of Nations instituted research into the efficacy, compared with that of quinine, of a certain number of secondary alkaloid mixtures, such as kinetum, chineto, cinchona febrifuge, etc., used in the treatment of malaria in various countries. Research carried out in more than 4,000 patients in malarious countries proved that the efficacy of preparations containing 60–80 per cent crystallizable alkaloids including 15 per cent quinine was equal to that of quinine alone. The Commission has given the name of 'Totaquina' to a new preparation which is a mixture of cinchona bark alkaloids containing at least 75 per cent crystallizable alkaloids and not less than 15 per cent quinine. The advantage of the new preparation is a distinctly lower price, which is mainly due to the method of extraction, while its efficacy is equal to or only slightly less than that of quinine.

Seeing at Night

A PAPER by R. G. Hopkinson, of the Research Laboratories, General Electric Co., Ltd., published in the *Electrical Review* of March 1, on "Seeing at Night", shows that valuable progress has been made on this important subject during the last few years, especially in connexion with black-out conditions. Under weak illumination, the response of the eye is quite different from that under normal conditions. So far as light is gathered by the lens of the eye and is brought to a focus upon the retina, it functions like a camera, the retina acting like a photographic plate in recording the scene for the brain to interpret. The retina is provided, however, with two separate kinds of receptor nerve cells, the 'cones', which usually respond to bright scenes, and the 'rods', which respond to dark scenes. In daylight the cones only function. With bright artificial light both rods and cones are working, the rods recording the shadows and the cones recording the highlights for the brain. Under black-out conditions the rods alone are functioning.

Black-out vision is much inferior to day vision for the following reasons. (1) The rods do not record colours, hence black-out vision is devoid of colour sensation; all colours appear as varying grades of black and grey. (2) There are fewer rods per unit area of the retina than there are cones. The effect is analogous to that of a newspaper reproduction of a photograph, which is made up of a number of dots and is therefore less clear than the original. This handicap is the more serious since it is just that region of the retina which normally receives the clearest image, the fovea centralis, where the rods are fewest. Hence, as many must have noticed at low illuminations, vision is often better around the periphery of the eye.

New Commercial Fruits in the United States

O. ATKINS writes in the *American Fruit Grower* (Dec. 1939) on the utility of the wild dryland blueberry (*Vaccinium vaccillans* Kalm) in relation to soil conservation. Experiments have shown that it has unusual erosion-resistant qualities on account of its underground shoots, which send out a mass of fine roots and bind the soil together over a large area. In addition to this useful property, the blue-black fruits promise to form a successful commercial crop, and as the plant will grow and fruit in partial shade or full sunlight it is well suited to 'hill-culture'. A systematic breeding programme is being undertaken by the U.S. Department of Agriculture and Soil Conservation Service.

The papaya (*Caprica papaya* L.), according to S. J. Lynch, writing in the same journal, is now being grown commercially in South Florida. The texture of the flesh is similar to that of a

cantaloupe, yellow to reddish-orange in colour, with a sweet musky flavour. The fruits, which vary in size from a few ounces to 25 lb. in weight, contain 5–6 per cent of sugar, no starch, and appreciable amounts of vitamins A, B and C. The proteolytic enzyme papain, which also occurs in the fruit, is used in many commercial products as an aid to digestion. Numerous food and drink products are being made from the fruit pulp. The plant will bear for three or four years, but is treated commercially as an annual, since the finest fruit is obtained in the first year. Both monœcious and dicecious plants occur, which makes standardization difficult; but breeding work is being carried out to establish uniform strains.

Poultry Rations in War-time

COMMERCIAL poultry-rearing has reached a high state of efficiency, and part of that efficiency is expressed in a standardized ration, in which only food ingredients are used which have been proved to be best suited for their purpose. Under war conditions the accustomed standardized ration must be given up, since the amount and nature of feeding stuffs available for livestock becomes restricted, partly because of a reduction in imported supplies and partly because of the wider use of home-grown cereals for human consumption. Poultry-keepers are urged to exercise the greatest economy in the use of such imported materials as maize, and in order that the accustomed ration may be replaced by satisfactory substitutes the Ministry of Agriculture and Fisheries has issued, as one of its "Growmore" Leaflets (No. 14), a summary account of materials which may be used in rearing, growing or breeding rations. The list includes thirty-one different food materials, and the feeding value and method of using each stuff is stated briefly. Single copies of the leaflet—"Poultry Rations in War Time"—may be obtained free of charge and post paid on application to the Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

Birds of the Fenland

CHANGES in the kind and distribution of the animals of the countryside which have been brought about by the progress of civilization are greater than is generally supposed, although often they are difficult to trace in detail. A short account of such changes as they have affected birds in the Fenland appears in the winter issue of *Bird Notes and News* (p. 198), the journal of the Royal Society for the Protection of Birds. In it Francis E. R. Peach, having quoted some early references to the bird-life, compares the earlier fauna with that of the present day, and shows that the general trend in the Fen area has been in the direction of a decline in ducks, geese, waders and birds of prey as drainage proceeded, and an increase in small birds such as linnets, yellow buntings and skylarks which now occupy the reclaimed marsh lands. Surely it is an omission that in dealing with the bird-history of this region the author does not refer to the invaluable "Early Annals of Ornithology", by the late J. H. Gurney, himself a Norfolk man.

Dutch Biology

A. VAN LEEUWENHOEK is known to every biologist as the name of a most eminent Dutch man of science, but we doubt whether many know that it is also the name of a worthy journal of Dutch microbiology, in spite of the fact that five volumes of it have already been published. This is in large measure due to its having appeared in the Dutch language, which has prevented its being read by more than a few English workers. We are glad to welcome its appearance in a new form. The editors and the Board of the Netherlands Society of Microbiology who are responsible for it have appreciated this difficulty, and from volume 6, No. 1, January 1940, it appears under the title *Antonie van Leeuwenhoek, Journal of Microbiology and Serology*, with English, French and German as the official languages. Thus the present number contains seven papers, five in English, one in French and one in German. Its pages are thrown open to workers of any nationality, and the editors hope that, in spite of the present inauspicious conditions, it will serve a wider public.

Demography of England and Wales

IN the third quarter of 1939, 161,201 live births were registered, or 3,119 more than the number recorded in the corresponding quarter of 1938. Of the total 6,458 were illegitimate, or 13 less than in the third quarter of 1938. The deaths numbered 103,170, and were 17,263 less than in the preceding quarter, but 568 more than in the third quarter of 1938. The mortality of infants under one year of age was equal to 39 per thousand registered live births. This rate is 8 per thousand below the average of the ten preceding third quarters and is the lowest quarterly rate ever recorded. The number of persons married in the third quarter of 1939 was 304,716, an increase of 72,084 on the number in the corresponding quarter of 1938. This number corresponds to an annual rate of 29·3 per thousand of the estimated mid-year population for 1938, and is the highest rate yet recorded.

X-Ray Photography of the Renal System

In order that X-ray photographs of the renal pelvis and ureters may be obtained, it is necessary to employ a substance which, after injection into the veins, is excreted by the kidneys and is opaque to the rays, so that a shadow picture of the excretory apparatus of the kidneys may be obtained; further, such a substance must have no harmful effect. A new preparation has been introduced by Glaxo Laboratories, Ltd., under the name of "Pyelectan", which it is stated possesses the necessary properties in marked degree. Chemically, it is the sodium salt of a complex iodine-containing dicarboxylic acid, the iodine content being 51·5 per cent. Pyelectan is claimed to have a low toxicity and to be generally well tolerated, rapidly excreted by the kidneys and yielding a dense and well-defined shadow in the renal pelvis and ureter.

Science Abstracts

THE reduction in thickness of the monthly issues of *Science Abstracts* during the last few months of 1939 will have prepared readers for a reduction of the number of abstracts in the volumes now completed for the year. Section A (Physics) contains 4,725 abstracts, a reduction of 7 per cent on the volume for 1938, and Section B (Electrical Engineering) 2,811, a very noticeable reduction of 22 per cent. Both have established for themselves international reputations as reliable records of yearly progress in the sciences with which they deal, and as indispensable to those who would keep themselves up to date.

Parliamentary and Scientific Committee

THE Earl of Dudley has been re-elected president of the Parliamentary and Scientific Committee for the year 1940. The other officers elected are : *Vice-President*, Captain S. F. Markham, M.P. ; *Chairman*, Captain L. F. Plugge, M.P. ; *Vice-Chairman*, Prof. B. W. Holman ; *Deputy Chairman*, Mr. E. W. Salt, M.P. The Committee has recently had under consideration the question of the release from military service of certain skilled technicians and scientific workers for other work of vital national importance, and also the question of suitable employment being given to technical and scientific workers who have enrolled for military service. At the next meeting of the Executive Committee of this body the question of the collection and utilization of town refuse and waste products will be considered.

Earthquakes during February 1940

AT Kew, Basle, Chur, Zurich and Neuchâtel the registrations of earthquakes tended to show that the earth was seismologically less active than normal during February 1940. At Kew only ten notable shocks were registered during the whole month, the greatest being the three of February 7, 20, and 29. At the Swiss observatories, seventeen shocks were registered, though only nine sets of readings were sufficiently clear to obtain epicentral distances, two of these being doubtful. Distant earthquakes giving consistent readings were those of February 7, 23, and 29, the four others being much nearer to the Swiss stations. Fairly good readings were obtained at Kew for the earthquake of February 23 and at the Swiss observatories for that of February 20, but epicentral distances were not determined.

The greatest earthquakes during the month thus appear to have been those of February 7 and 29. The former, according to the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association, on the basis of reports from seventeen stations, had its epicentre near lat. 52° N., long. 174·5° E., and its initial time 17h. 15m. 56s. G.C.T., with normal depth of focus. This point is immediately to the south-east of Near Island in the Aleutian Islands group and close to the undersea escarpment, where the depth of sea quickly falls to more than seven thousand metres, according to the U.S. Geographical Society map. Although the Aleutian Islands are known to lie along a seismic belt, the region appears to have been more than normally active since the 'missing' earthquake of November 10, 1938. The earthquake of February 29, according to the Zurich seismologists, had its epicentre near lat. 45° N., long. 27° E., which is in Rumania, approximately midway between Bucharest and Galati. On the same authority the earthquake just after 1 a.m. on February 9 had its epicentre near Mont Blanc, and the earthquake of February 23 in Albania. All the above epicentral determinations are tentative.

Announcements

DR. L. E. H. WHITBY has been awarded the John Hunter Medal and Triennial Prize of the Royal College of Surgeons for his research work in "Bacteriology with special reference to the Sulphonamide Compounds".

THE office of the Royal Society has now returned to the Society's apartments in Burlington House and the library is re-opened. Communications, therefore, should be directed to the Royal Society, Burlington House, London, W.1.

THE British Association announces that the grounds of Down House, Charles Darwin's home at Downe, Kent, will be open to the public free of charge from Good Friday onward, from 10 a.m. to 6 p.m.

THE sixth Australian Medical Congress, which was to have been held at Perth, Western Australia, during September 2–7, 1940, has been postponed indefinitely.

THE herbarium of indigenous medicinal plants which is being collected at Calcutta under the ægis of the School of Tropical Medicine now contains 1,500 species, or approximately 5,000 specimens. It is hoped that when the herbarium is completed it will comprise specimens of all the 2,500 medicinal plants known to be growing in India.

DURING the first six months of 1939, 313,226 marriages took place in the old German Reich, or 10,122 (3·3 per cent) more than in the corresponding period of 1938 (303,104). In the second quarter of 1939 there were 11·2 marriages for every 1,000 inhabitants. In the same period there was a remarkable rise in the number of marriages in the former Austria, namely 28,490, or 8,921 (45·6 per cent) more than in the corresponding period of 1938. In the first half of 1939 there were 59,210 marriages in the former Austria, or 28,954 (95·7 per cent) more than in the corresponding period of 1938 (30,256).

ERRATUM.—Dr. Julian Huxley points out that the title of the substance of his British and American Association Lecture published in NATURE of March 2, p. 330, should have been "Science, War and Reconstruction".

LETTERS TO THE EDITORS

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

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

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 466. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Production of Synthetic Mycorrhiza in the Cultivated Cranberry

UNDER this title, Bain[1] describes experimental investigations on mycorrhizal relationships in *Vaccinium macrocarpon*, Ait., *V. canadense*, Kalm., and two ericaceous species, reviewing and criticizing the conclusions of earlier observers in the light of his own results. In so far as the latter relate to *Vaccinium macrocarpon*, they may be summarized as follows. A fungus, specifically distinct from those associated with the other species studied, was isolated from roots of the cranberry, *Vaccinium macrocarpon*. Identity of this fungus with that forming mycorrhizal complexes in the root cells of the host was established by inoculation of the mycelium into pure cultures of cranberry seedlings growing in nutrient agar and in 'artificial soil' composed of cork and sand.

Bain describes the colonies and mycelium of this fungus as 'specifically distinct' from those isolated by him from the other species investigated, and also from those of *Phoma radicis callunæ* obtained from the Centralbureau voor Schimmel Cultures in Baarn. Its affinities and systematic position have not been determined.

Designation and acceptance of *Phoma radicis* as the mycorrhizal associate of Vaccinium spp. and members of Ericaceæ rest on the following evidence. In 1907, Ternetz[2] reported the isolation of distinct strains of what was regarded as a single fungus species from roots of a number of native ericaceous species and from *Vaccinium Oxycoccus* and *V. Myrtillus*, all growing in Switzerland. Sporing cultures of all these fungi were submitted to Lindau and Hennings in Berlin for identification and were referred by them to the genus Phoma as a new species under the name *P. radicis*. The form associated with the European cranberry, *Vaccinium Oxycoccus*, like the others, was distinguished in culture by definite characters relating especially to the numbers of pycnidia produced, manner of fruiting, and size and shape of pycnidia and spores.

In 1915, one of us[3] reported the isolation from seeds of *Calluna vulgaris* of a fungus identical in all respects with the form of *P. radicis* described by Ternetz as the mycorrhizal associate of this plant. Subsequent observations on *Vaccinium Oxycoccus* and *V. macrocarpon* were concerned only with systemic infection of the vegetative parts and seeds; isolation of the root fungus was not attempted in either species of Vaccinium. It was tacitly assumed in this paper on Vaccinium that the mycorrhizal fungus present in roots of the native cranberry, *V. Oxycoccus*, was *Phoma radicis Oxycocci* as described by Ternetz for this species in Switzerland, and this assumption was extended to the closely similar N. American species, *V. macrocarpon*, simultaneously under observation.

Although Bain's results do not necessarily constitute a direct challenge, they introduce uncertainty, as to the correctness of Ternetz's conclusions in respect to the identity of the mycorrhizal associate of *V. Oxycoccus*, and to the validity of the subsequent tacit acceptance of this view and its extension to *V. macrocarpon*; it was evident from study of Bain's paper that a re-investigation of this matter on British material of *V. Oxycoccus* was desirable. The results of such investigation are hereby placed on record.

Freshly lifted roots of *V. Oxycoccus* were washed in running water, sterilized by immersion in 1 per cent hydrochloric acid or 0·01 per cent mercuric chloride for 15–20 seconds, and rinsed repeatedly in sterilized water. Small pieces of roots so treated were then transferred to tubes of various media, including that used by Ternetz. A majority of these platings developed pure culture colonies of greyish white mycelium, becoming pinkish brown to dark brown with age. After two to three weeks growth at room temperature, these colonies fruited, forming pycnidia of various sizes in and upon the substrate. In all respects—character of colonies and mycelium, numbers and mode of formation of pycnidia, and size and characteristics of pycnidia and pycnidiospores—this fungus resembles *Phoma radicis Oxycocci* as described by Ternetz.

We are greatly indebted to Dr. J. Ramsbottom, keeper of botany, British Museum (Natural History), for examining our cultures and confirming the identity of the root fungus isolated by us with that extracted by Ternetz from Swiss material of *V. Oxycoccus*. A similar investigation is in progress on garden material of *V. macrocarpon*.

It may be added that root material treated as described by Bain, by repeated washings in distilled water without surface sterilization, gave rise in all cases observed by us to colonies of unidentified fungi, usually yellow or orange in colour.

Full discussion of Bain's conclusions in respect to this matter and to his views respecting the nature of the mycorrhizal associations in Ericaceæ must await a convenient occasion. In justice to the pioneer observations of Ternetz, it is desired to place on record these relating to the cranberry fungus as soon as possible.

M. C. RAYNER.
IDA LEVISOHN.

Bedford College,
University of London.

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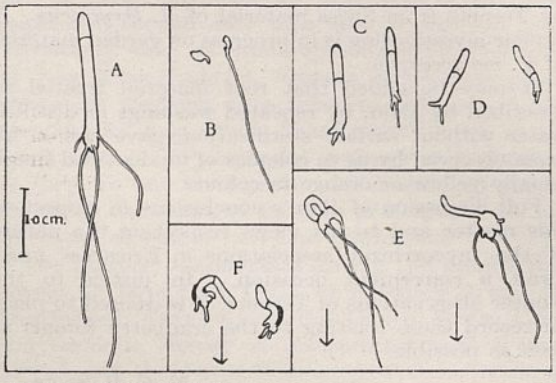
[3] Rayner, M. C., "The Biology of Fungus Infection in the Genus *Vaccinium*", *Ann. Bot.*, **43**, 55–70 (1929).

Vernalization of Fragments of Embryo Tissue

EMBRYOS of cereal grains, separated from the endosperm and cultured on a medium containing sugar, can be vernalized by exposure to a temperature of 1° C. in the same way as whole grains[1,2,3,4]. In order to locate more precisely the tissues concerned in the process, embryos of Petkus winter rye were mutilated in various ways before vernalization treatment. In this preliminary experiment only two embryos were subjected to each type of mutilation.

Treatment	No. of replicates	Condition of plants 84 days after end of treatment
A. Vernalized 6 weeks		
1. Whole embryos	7	All past anthesis.
2. Stem apex and fourth leaf retained	2	Both with ears emerged.
3. Scutellum removed	2	One vegetative, one shooting.
4. Scutellum and shoot apex removed	2	No plants obtained.
5. Scutellum and roots removed	2	One with ear emerged, one shooting.
6. Scutellum and coleoptile removed	2	One with ear emerged, one vegetative.
B. Vernalized 2 weeks		
1. Whole embryos	14	All vegetative.

The fragments were planted on agar medium containing 2 per cent sucrose, vernalized at 1° C. for six weeks, and after eight further days growth on the medium at a temperature of approximately 18° C., were large enough to be planted out. The appearance of the fragments at the end of the vernalization period is shown in the figure. The removal of the coleoptile has the curious effect of promoting hypertrophy of the tissue about the roots, and there is, in addition, a lack of gravity perception in the first leaf. Possibly the latter effect is simply due to the absence of the mechanical support of the coleoptile, but it is interesting to note that whole embryos, germinated on 2 per cent sucrose with the addition of 1/10,000 hetero-auxin solution, show a similar failure of gravitational response as well as the hypertrophy of the coleorrhiza (see accompanying figure, *F*).



CAMERA LUCIDA DRAWINGS OF EMBRYO FRAGMENTS AT END OF SIX WEEKS VERNALIZATION AT 1° C. *A*, COMPLETE EMBRYO; *B*, STEM APEX AND FOURTH LEAF INITIAL; *C*, SCUTELLUM REMOVED; *D*, SCUTELLUM AND ROOTS REMOVED; *E*, SCUTELLUM AND COLEOPTILE REMOVED; *F*, COMPLETE EMBRYOS GROWN FOR SIX WEEKS AT 1° C. ON MEDIUM CONTAINING 1/10,000 HETERO-AUXIN (FOR COMPARISON WITH *E*. IN *E* AND *F* THE ARROW INDICATES THE DIRECTION OF THE GRAVITATIONAL PULL).

Only those embryos from which the stem apex had been removed failed to produce green plants, but their roots continued growth in the sucrose medium for many weeks. Plants arising from the isolated stem apex were dwarfed; each consisted of a main stem and one tiller, and in one the main axis bore an ear on a stem about four inches high, with six leaves. The progress towards flowering made by each plant during 84 days from the end of vernalization is shown in the table; no further observations were made. Comparison with plants grown from embryos vernalized for two weeks makes it clear that vernalization treatment has accelerated flowering but that the process was less effective than in the case of complete embryos.

O. N. PURVIS.

Research Institute of Plant Physiology,
Imperial College of Science and Technology,
London.

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Permeability of Insect Cuticle

ONE of the major problems in research on insecticidal action concerns the correlation of the toxicity of an insecticide with its chemical and physical properties. Very little progress has hitherto been made when relatively non-toxic carriers have been used. This is mainly due to the fact that too little physiological significance has been attached to the mode of action of the carriers in relation to the toxic principle under investigation.

A study of the toxicities of various constituents of heavy naphtha to the nymphal and adult stages of the bed-bug, *Cimex lectularius*, L., has shown that the toxicity of unsaturated compounds, such as indene, may be materially increased by the addition of non-toxic mixtures of paraffins and cycloparaffins. The assumption that the unsaturated compound was assisted through the cuticle by the more apolar substances present in heavy naphtha led to an investigation of the general physiology and permeability of the insect cuticle. The results show that feebly dissociating compounds of high dielectric constant penetrate the cuticle much more readily in the presence of relatively apolar substances of low dielectric constant, the main region of induced penetration being at the cuticle-hæmolymph interface. This generalization applies both to fumigant and contact action, and may be conveniently illustrated by a model experiment, using as test insects, larvæ of the blowfly, *Calliphora erythrocephala*, Meig.

When a larva is immersed in ethyl alcohol, penetration through the cuticle and tracheal system takes place very slowly, and the insect generally remains active for at least an hour. The effect of paraffins of the kerosene type is even less pronounced, and loss of reaction to a mechanical stimulus may take two hours or more. With a mixture of ethyl alcohol and paraffins, penetration of the alcohol is so rapid that the insect dies within a few seconds, swells perceptibly, and eventually bursts within four to six

minutes. A peculiar swirling effect is noticeable in the region of the cuticle, which is due to the passage of water from the insect. This results in the paraffins being thrown out of solution in the immediate vicinity of the insect, and finally leads to a partial separation of the two components throughout the whole volume of the liquid, the degree of separation depending on their relative proportions in the mixture. Mechanical blockage of the spiracles does not materially affect the nature of the results.

The mechanism of penetration has been studied for the cuticles of several species of insects, and an account of this work, together with various insecticidal applications, will be published in due course.

There are two primary layers in the insect cuticle : an inner chitin layer, which consists essentially of a mixture of chitin and protein, and a thin outer lipoid layer. The present work has shown that this outer layer is relatively impermeable to polar compounds such as ethyl alcohol and acetic acid. The chitinous layer, however, is relatively permeable to both polar and apolar compounds, depending on the type of compound and the particular nature of the cuticle. The permeability of the lipoid layer to polar compounds is greatly increased by the presence of apolar substances. Thus, when a mixture of ethyl alcohol and paraffins is applied to the cuticle, the polar compound will penetrate the outer lipoid layer and then diffuse into the insect through the chitinous layer, the rate and extent of this diffusion being more pronounced than the diffusion of water in the reverse direction. In experiments on Calliphora larvæ, the insects burst before equilibrium was attained. With any particular mixture, the diffusion is governed by mutual solubilities and the pathological changes occurring in the various tissues. The permeability of the cuticle as a whole to polar compounds is increased in *both* directions by the presence of apolar substances. This increase is more pronounced in the direction lipoid layer – chitin layer, than in the opposite direction.

The relation between polarity and induced penetration of one or more substances has been worked out for a large number of compounds, and applies generally to polar substances of feebly dissociating properties, such as alcohols, fatty acids, phenols, nitrogen heterocyclic bases, ammonia, and hydrogen cyanide. Induced penetration appears to be negligible for such strongly dissociating compounds as neutral salts and mineral acids.

The results obtained are in agreement with the work of Alexandrov[1] and Morozov[2] on the permeability of the insect cuticle to various substances acting *singly*. The present work shows a close analogy with the work of Yonge[3] on the permeability of the integument lining the foregut of the decapod crustacean Homarus. So far as can be ascertained, no mechanism for induced penetration has previously been suggested. Fulton and Howard[4] have shown by injection methods that the toxicity of derris inside the insect may vary with the nature of the oil carrier used. This may be correlated with Yonge's suggestion that the permeability of the integument in the Crustacea shows a close resemblance to the permeability of the membrane of the living cell.

Bliss[5] has recently discussed the action of two poisons jointly, and has devised a classification based on relative toxicities of mixtures determined at several dosages. The present work shows that the carriers of the poisons cannot be neglected and that each constituent of a mixture may contribute to the toxicity of the whole even though it may, by itself, have no obvious toxic effect.

This statement is based on work begun under the ægis of the Medical Research Council Bed-bug Committee. Its extension is being carried out by means of a grant made to the Imperial College by the Department of Scientific and Industrial Research. I am especially indebted to Dr. N. F. Sarsfield for his assistance on the chemical side of the work.

H. HURST.

Imperial College of Science
and Technology,
Biological Field Station,
Slough.
Feb. 28.

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[3] Yonge, C. M., *Proc. Roy. Soc.*, B, **120**, 15–41 (1936).
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Chronological Sex-Ratios in Drosophila

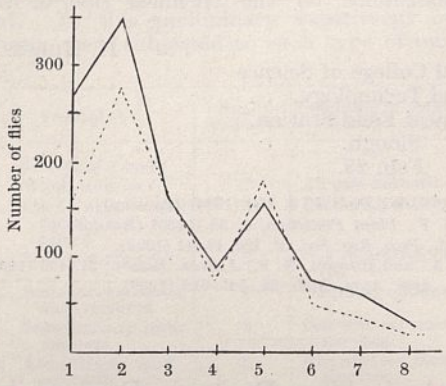
ANALYSIS of the results of observations on *Drosophila melanogaster* involving several thousands of flies substantiated previous observations in connexion with the daily variation in emerging frequency of males and females respectively of the criss-cross generation involving the sex-linked genes *y* and *w*.

Generally, cultures in which the parents were kept for forty-eight hours yielded mostly females on the first and second days of emerging. But on the fourth day of emerging the sexes evened up in numbers and on the fifth day the males outnumbered the females, the sex-ratio dropping below 50 per cent in favour of the males. The respective percentages of the total of females emerged for the first and the following seven or eight days (that is, until the culture is exhausted) were found to be approximately 30 ; 23 ; 15 ; 10·3 ; 12 ; 6·4 ; 0·5 ; 2 ; etc. The corresponding percentages of the total of males emerging were 15·7 ; 18·5 ; 15·7 ; 13 ; 24 ; 8·1 ; 2·8 ; 2·2 ; etc. (The chronological female percentages (sex-ratios) were : 68 ; 58 ; 51·5 ; 49·4 ; 36·1 ; 46·9 ; 18·2 ; etc.)

From these percentages it will be seen that 53 per cent of all the females and only 34 per cent of all the males emerged during the first two days. Also it will be seen that the highest percentage, namely, 24 per cent, of all males was realized on the fifth day of emerging, when the males outnumber the females. The second highest daily count of males was obtained on the second day of emerging, namely, 18·5 per cent of the total number of males. After the fifth day of emerging there was a relatively sharp decline in the number of flies emerging, reaching its lowest point on the seventh day. On the eighth day a slight arrest in this decrease was seen. From the fourth to the seventh day the males outnumbered the females. The female figures also showed a slight rise in numbers emerging on the fifth day, while an arrest in decrease seemed to occur on the eighth day of emerging.

Observations on similar lines were made on the mutant stock yellow body colour (*y*), white eyes (*w*) (see accompanying illustration). The daily percentages of the totals of emerged females and males respectively were : 22·5 ; 29·1 ; 13·6 ; 7·2 ; 13·8 ;

6·2; 5·0; 2·5; etc., and 16·8; 28·8; 17·2; 7·7; 18·6; 5·0; 3·7; 1·7; etc. Here the female curve also showed a high peak on the second day and another but slightly lower peak on the fifth day of emerging. This fifth day female peak was much more pronounced than that of the criss-cross generation mentioned above. The difference between the number of females and males for the fifth day was consequently not so large as in the case of the criss-cross generation.



Data treated on similar lines and obtained from observations on *Drosophila melanogaster* (wild) and *Drosophila simulans* (wild) showed a pronounced second day peak for both sexes but no fifth day peak. Hereafter there was an unarrested decline. The females were in the majority, more or less to the same degree for every day of emerging. The daily percentages of the total of females and males respectively for *Drosophila melanogaster* were: 28·7; 40·9; 19·5; 9·2; 1·1; 0·27; 0·27; and 22·8; 35·7; 26·0; 12·5; 0·6; 0·3; etc. The corresponding percentages for *Drosophila simulans* were: 18·6; 32·3; 15·7; 13·2; 8·4; 5·7; 2·8; 1·9; etc., and 11·4; 35·8; 20·0; 14·3; 8·6; 3·9; 2·6; 2·6; etc.

It is important to note that especially for the criss-cross generations involving the sex-linked genes *y* and *w*, and probably also other sex-linked genes, the sex-ratio may be inherently different from the first to the last day of emerging.

The percentage of females for the consecutive days of emerging of the criss-cross generation were: 68; 58; 51·5; 49·4; 36·1; 46·9; 18·7; 55·1; etc., the average being approximately 51·6.

G. ELOFF.

Department of Zoology,
University of the Witwatersrand.

Chromosome Numbers in *Sclerostachya fusca*

Sclerostachya fusca A. Camus (*Saccharum fuscum* Roxb.) is a grass closely related to *Saccharum spontaneum* and similar to it in habit. It is distinguished from Saccharum by its rachis being tough instead of fragile and by its pedicelled spikelets being female instead of hermaphrodite. (The sessile spikelets in both are hermaphrodite.)

This grass grows in association with *Saccharum spontaneum* in Assam and Orissa. I collected several clones from both these localities in 1937. The peasants use it extensively for roofing and making framework for their mud houses, as well as for fencing. It goes by the names of *yekkada* and *ikra* in these provinces.

The Orissa form proved to have 48 chromosomes, and the Assam form, which was of larger habit, had 96 chromosomes.

Most of the Andropogoneæ, including *Saccharum officinarum*, have 10 as their basic number. Exceptions to this are Miscanthus with 36 chromosomes and the dibasic *Saccharum spontaneum* in which forms with $x = 6$ and $x = 10$ have been found.

The doubling within the species is analogous to the condition of *Saccharum spontaneum* with its west-to-east transition from 48 to 112 chromosomes[1]. The discovery of another genus, more closely related to Saccharum than Miscanthus, with the basic number of 6, makes it easier to understand the origin of the dibasic cultivated sugar canes.

E. K. JANAKI-AMMAL.

John Innes Horticultural Institution,
Mostyn Road,
Merton Park,
London, S.W.19.
Feb. 29.

[1] Janaki-Ammal, E. K., "Triplo-polyploidy in *Saccharum spontaneum* L.", *Current Sci.*, **8**, 74–76 (1939).

Amœba lescheri (= *Chaos lescheri*): a New Species of Amœba

EARLY in 1938 I discovered a new species of Chaos (better known as Amœba in Great Britain) which I propose to name *Chaos lescheri* = *Amœba lescheri*, to honour the memory of Mary Adela Lescher, founder of Notre Dame College, Glasgow. A full account of the life-history of this amœba will appear in the *Quarterly Journal of Microscopical Science*. The amœbæ of the genus Chaos are large and form pseudopodia that are sub-cylindrical, blunt and filled with granular endoplasm throughout. Conspicuous longitudinal ridges and grooves are characteristic of the ectoplasm. *Amœba lescheri* is readily distinguished from the other species of Chaos by its crystals, which are square prisms (maximum size 2 μ). Outsized spherical individuals attain a diameter of 525 μ, creeping individuals a length of 600 μ. The average for the former is 350 μ and for the latter 400–500 μ.

Translucency in amœbæ is a factor of age and physiological condition, depending to a large extent on the cytoplasmic inclusions. Having regard to these considerations, *Amœba lescheri* is more translucent, as it is also slightly smaller than *A. proteus* Y[1]. The shapes assumed by the contrasting amœbæ also differ, more of the bulk of the cytoplasm being concentrated in the pseudopodia of *A. lescheri*. Normally there is present one nucleus, discoid in shape. Alternate aspects of the nucleus, 'plan and elevation', are presented to the observer as the nucleus is subjected to the streaming movements of the endoplasm. Frequently the nucleus has the appearance of a biconcave lens. Since it normally lies in the peripheral endoplasm it is quickly found in a microscopical preparation of the living animal. The chromatin is distributed on an achromatic network and takes the form of regularly arranged blocks under the nuclear membrane distinct from, and slightly separated from,

the rest of the network where the chromatin is not so regularly distributed.

There is one contractile vacuole (42 μ) which empties very deliberately after having moved to the posterior end. Nutritive spheres vary in size from 1 μ to 7 μ, depending on the age of the amœba, which feeds voraciously on ciliates, flagellates and rotifers. Excreta, including crystals, are gathered into a large vacuole in which a violent commotion is set up, the contents being shot explosively out of the vacuole.

A. lescheri has a marked tendency to send its pseudopodia in all directions even when more or less imprisoned under a cover slip. After having gripped the substratum and moved definitely in one direction on one, two or three pseudopodia, it loosens itself by forming radial pseudopodia and floats about. It may later return to the creeping position.

Fission of the cytoplasm may easily be observed. Spherical individuals are often binucleate. Two daughter sets of pseudopodia formed on one such floating binucleate individual indicate the onset of fission. The two daughter amœbæ use the floating debris to separate themselves as they float away. There is no thin connecting strand of protoplasm—the break is clean-cut. Under favourable conditions of environment *A. lescheri* divides once in twenty-four hours and is a good subject for 'pure-line' experiments.

One of us (Sr. C.) has investigated the cytology of the nucleus. In contrast to *A. proteus* Y. the number of nuclei never exceeds two. The average diameter is 42 μ. There is great diversity in the size of the chromatin blocks where the chromatin is more voluminous and not so immeshed in achromatic network as in *A. proteus* Y. Division in the nucleus is *amitotic*.

MONICA TAYLOR.
CATHERINE HAYES.

Notre Dame,
Dowanhill,
Glasgow.
Feb. 10.

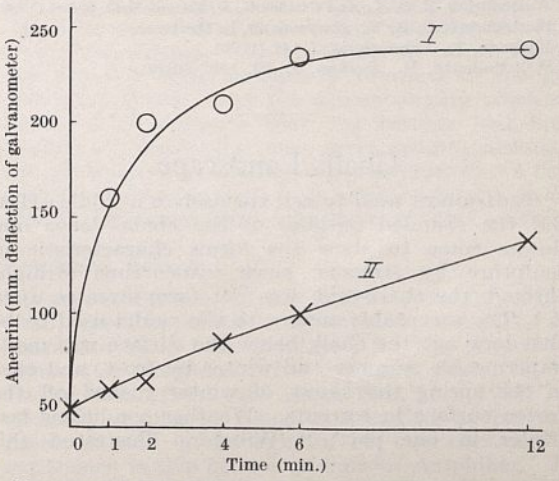
[1] Carter, Lucy A., *Proc. Roy. Phys. Soc. Edin.*, **20** (1919).

Cause of the 'Activation' of the Carboxylase System by Free Aneurin

ABOUT two years ago, Ochoa[1] made the remarkable discovery that decarboxylation of pyruvic acid by alkaline washed yeast, Mg++-ions and cocarboxylase is stimulated by pure aneurin and by some derivatives of the pyrimidine part of the aneurin molecule. We have now discovered the mechanism of this stimulating action by performing some aneurin and cocarboxylase determinations by means of the thiochrome method[2]. All experiments have been carried out with baker's yeast, dried at 25° C., supplied by Distillers Co., Ltd., Epsom, with which aneurin exhibits a strong effect as compared to many other yeasts[3].

When aneurin and cocarboxylase are determined about one minute after adding cocarboxylase to a suspension of alkaline washed yeast in phosphate buffer, *p*H 6·2, a considerable part of the quantity of cocarboxylase added appears to have been converted into aneurin already. The amount of aneurin still increases rapidly during the first minutes after incubating the suspension in a bath at 28° C. From these findings some conclusions could be drawn: (1) a phosphatase, very active at *p*H 6·2, is present in alkaline washed yeast; (2) no experiment performed with this yeast, to which cocarboxylase was added, has been carried out in the absence of free aneurin; (3) the amount of cocarboxylase really acting is always much smaller than the amount added and supposed to act. These results led us to the hypothesis that Ochoa's aneurin effect might be caused by the inhibition of the phosphatase action by aneurin, namely, one of the reaction products of cocarboxylase hydrolysis. So the aneurin would not actually stimulate the carboxylase system, but only inhibit a reaction destroying cocarboxylase.

The following experiment has fully confirmed this hypothesis. As we met with some difficulties concerning the thiochrome method, when it was applied to a very large amount of aneurin in proportion to the amount of cocarboxylase present, this experiment was carried out with 2-methyl-4-aminopyrimidyl-5-methylaminodihydrochloride instead of aneurin.



FORMATION OF ANEURIN FROM COCARBOXYLASE BY ALKALINE WASHED YEAST, SUSPENDED IN PHOSPHATE BUFFER, *p*H 6·2.
CURVE I IN THE ABSENCE OF THE PYRIMIDINE PART OF THE ANEURIN MOLECULE; CURVE II IN THE PRESENCE OF THE PYRIMIDINE PART OF THE ANEURIN MOLECULE.

A sample of dried yeast was washed with sec. sodium phosphate in the usual way for a manometric cocarboxylase determination. The suspension in phosphate buffer, *p*H 6·2, was divided into two equal parts. One of these parts was supplemented with an amount of 2-methyl-4-aminopyrimidyl-5-methylaminodihydrochloride, giving maximal 'activation' (200 γ per 100 mgm. yeast), and both parts were allowed to react with cocarboxylase (5 γ per 100 mgm. yeast). Aneurin and cocarboxylase were determined at the times plotted in the accompanying graph. These curves, showing the velocity with which aneurin is formed, clearly demonstrate the inhibiting effect of the pyrimidine derivative on the phosphatase action. The curves showing the velocity of the decrease of the quantity of cocarboxylase are exactly the mirror-images of the curves of the accompanying graph; they are omitted to save space.

We believe we can explain all observations concerning the influence of aneurin on the carboxylase system from the point of view developed here; for example, the different sensitivity to aneurin of different kinds of washed yeast[3] (different amounts of phosphatase); the influence of the temperature

of the phosphate solution used for washing the yeast[3] (destruction of phosphatase at higher temperature); Lipmann's observation[4], fully confirmed in this laboratory by Mr. Eitje and Mr. Hiegentlich, that aneurin is without any effect, when it is added to the yeast suspension some minutes after the addition of cocarboxylase (cocarboxylase destroyed already before the inhibition of phosphatase by aneurin); no stimulating effect of aneurin observable with Weil-Malherbe's purified carboxylase[5] (absence of phosphatase).

We wish to thank Prof. B. C. P. Jansen for his kind interest in our work.

H. G. K. WESTENBRINK.
D. A. VAN DORP.
Laboratory for Physiological Chemistry,
University, Amsterdam.
Feb. 3.

[1] Ochoa, S., NATURE, **141**, 831 (1938); see also Ochoa, S., and Peters, R. A., *Biochem. J.*, **32**, 1501 (1938).
[2] Westenbrink, H. G. K., and Goudsmit, J., *Enzymologia*, **5**, 307 (1938).
[3] Westenbrink, H. G. K., *Enzymologia*, in the press.
[4] Lipmann, F., *Enzymologia*, **7**, 142 (1939).
[5] Weil-Malherbe, H., *Biochem. J.*, **33**, 1997 (1939).

Chalk Landscape

GEOLOGISTS used to ask themselves a riddle: How did the rounded outlines of the chalk denes and downs come to show the forms characteristic of sculpture by streams, since water runs straight through the chalk and does not form streams upon it? The acceptable answer to the riddle used to be that long ago the chalk below the surface was made impermeable summer and winter by frost, and that in the spring the snows of winter rushed off the frozen surface in torrents. Weather conditions last winter in our part of Wiltshire illustrated this strikingly in a way which the oldest inhabitant does not remember to have seen before. My house is in a dene in the chalk sloping gently to the Kennet for nearly two miles, with downs on each side. It will be remembered that there was first sharp frost with heavy snow-falls, then a few days thaw, and then again sharp and prolonged frost. The effect of this, no doubt, was to seal the chalk with a layer of absorbed and frozen water. During the second and prolonged frost there was the now celebrated incessant deposition of dew in the form of ice, and of snow, making a big accumulation of water on the top of the frozen layer. Then came the final thaw. With it, for the first time within living memory, a stream appeared and flowed briskly down the dene, doing a little water sculpture on its way and leaving some tiny deposits which will make good Combe rock in the future.

How rare such an occurrence is under modern conditions is shown by the fact that my house is built in the very bottom of the dene. So it gave difficulties to the stream, out of which it could find no better way than to run straight through the house from the front door to the back.

During the second great frost the young trees were so weighted with solid ice that the tops of many were bent to the ground and old trees had great boughs broken—a strange sight but one not unseen before, for a student points out to me these passages in a letter of Erasmus:

"Deinde grando, tum et pluvia, quae simul atque terram arboremve contigit protinus in glaciem concreta est. Vidisses arbores glacie vestitas adeoque pressas ut aliae summo cacumine imum solum contingerent, aliae ramis lacerae. Jurabant nobis e rusticis homines natu grandes se simile nihil unquam in vita vidisse antea."

Lockeridge KENNET OF THE DENE.
March 1.

Points from Foregoing Letters

A RECENTLY published account by H. F. Bain describes the isolation from unsterilized roots of *Vaccinium macrocarpon* growing in America of a mycorrhizal fungus specifically distinct from the *Phoma radicis* isolated by Ternetz from sterilized roots of native Swiss species of Vaccinium in 1907. In view of this discrepancy, M. C. Rayner and I. Levisohn have investigated British material of *Vaccinium Oxycoccus*, and now record that the fungus isolated by them from sterilized roots of this species agrees in every particular with that isolated by Ternetz.

O. N. Purvis has successfully vernalized fragments of winter rye embryos consisting of the stem apex and one leaf initial only, by culturing on a suitable medium for six weeks at 1° C. The response was less than that of whole embryos to similar treatment.

The toxicity of poisons used in insecticides depends primarily on the physico-chemical relations of the toxic principle and the carrier. H. Hurst finds that feebly dissociating compounds of high dielectric constant penetrate the cuticle of insects more readily in the presence of relatively apolar substances of low dielectric constant, the main region of induced penetration being at the cuticle-hæmolymph interface.

Data obtained by G. Eloff in connexion with daily counts of offspring from Drosophila cultures in which parents were left for forty-eight hours, pointed in the case of the criss-cross generation to a high emerging frequency on the fifth day of counting, especially accentuated in the case of the males. In the case of pure yellow-white cultures of *D. melanogaster* the females also showed a strong fifth day peak. The phenomenon, which is probably associated with lowered viability, was absent in the case of wild cultures of *D. melanogaster* and *D. simulans*.

A new species of Amœba of the genus Chaos has been isolated and cultivated and is briefly described by M. Taylor and C. Hayes. *Amœba lescheri* is slightly smaller than *Amœba proteus* Y., which it resembles in many ways. The nucleus, which is discoid and situated in the peripheral endoplasm, divides amitotically. Fission of the cytoplasm can take place while the amœba floats and occurs once a day.

H. G. K. Westenbrink and D. A. van Dorp have investigated the cause of the apparent activation of the carboxylase system by free aneurin. In their opinion it is caused by the inhibitory effect of aneurin on the hydrolysis of cocarboxylase by phosphatase, present in the alkaline washed yeast.

RESEARCH ITEMS

Rostro-Carinate Stone Implement from Rhodesia

IMPLEMENT-bearing talus on the lower slopes of the Gwelo Kopje, Southern Rhodesia, known for some years to students of Rhodesian prehistory as the source of a sequence of stone implements in which flake implements are associated with *coups de poing*, has now produced an undoubted rostro-carinate which is described by Neville Jones (*Trans. Rhodesia Sci. Assoc.*, **37**; 1939). The implement is of special interest as it is the best example of the form as yet found in Southern Rhodesia, and its occurrence in a deposit which contains no evidence of fracture from natural causes after deposition gives added weight to the claim for the human manufacture of this type of implement. It is the only unmistakable rostro-carinate found at Gwelo. The form is characteristic in that it is fairly symmetrical and broadest at the posterior end, from which it tapers to a sharp point, which imparts to it a beak-like appearance. The ventral surface is unflaked and presents the natural weathering. Parallel with this is the small dorsal platform, originally triangular, from the apex of which the keel begins and extends to the top of the 'beak'. The sharp-edged keel is strongly curved in elevation, fairly true to the median line and is slightly sinuous in plan. It is formed by the removal of a wide flake on each side. The weight is 1 lb. 6 oz. Though there is no evidence of comparative age, it may be claimed, from analogous finds at Hope Fountain, to be a tool of early type.

Studies of American Cities and States

A STUDY of American cities and States by methods which have proved valuable in the study of individual persons has been published by E. L. Thorndike (*Annals N.Y. Acad. Sci.*, **39**, 213–298; 1939). Variations and correlations in institutions, activities and the personal qualities of the residents have been obtained for each city in the United States having a population of more than 30,000 in 1930, but excluding the cities of more than 500,000, except Milwaukee, and the three resort cities, Atlantic City, Miami and St. Petersburg. The 296 different items examined covered population and growth, value of public property, literacy, expenditure on public services, sales and prices, rents, salaries, mortality figures and vital statistics, occupational data, membership of institutions, etc. The data show very great variation in important features of life and welfare, and for each city and State composite scores have been computed which may be used as indexes, respectively, of the general goodness of life for good people in the community in question, the *per capita* income of its residents and their personal qualities of intelligence, morality and care for their families.

Growth and Feeding of Young Herring

S. M. Marshall, A. G. Nicholls and A. P. Orr have continued their studies on the growth and feeding of young herring in the Clyde (*J. Marine Biol. Assoc.*, **23**, 1939). The last paper dealt with growth from spawning to metamorphosis; the present paper gives the results of an attempt to continue the work from metamorphosis up to the formation of the first winter ring. Two distinct groups were met with. The first, obtained during July 1936–May 1937, were caught inshore; the second, of which only a few catches were taken, in 1937 and 1938, were caught offshore. The second group is shown to be of the same origin as those discussed in the previous paper. Details are given of counts of vertebræ and lengths for race determination, size and growth, weight, chemical composition and food. A series of hauls made over a night showed that the herrings were most abundant inshore at dusk and dawn and contained most food during 7–11 p.m. The food was examined throughout the year and compared with the plankton hauls. Copepods, as is usually found, formed the main diet, but other organisms were at times plentiful, coinciding with their abundance in the plankton. Thus when cirripede larvæ were common in the plankton, the stomachs were full of them; this was also the case with Cyphonautes. With Calanus it was different, this copepod being frequently common in the gut and quite absent from the accompanying plankton hauls, which suggests that the herring had been feeding offshore before they were caught, although the presence of typical littoral plankton shows that they fed inshore as well. In general the results of the food investigation agree with those of other workers.

Amphibian Anatomy

VARIOUS features of the skeletal elements of the skull, hyoid apparatus and vertebral column of the Amphibia have been employed for the purpose of systematic diagnosis. In a recent paper, L. S. Ramaswami (*Proc. Ind. Acad. Sci.*, **10**; 1939) has critically examined these as recorded in previous literature and in the light of his own considerable experience in five genera of anurous Amphibia. He has already published a series of detailed observations on this subject (1932–37), and the present paper serves in some respects as a summary of these. A number of criteria previously used are shown to be of no use, and the author concludes with a detailed list of the characters that can be used in the Ranidæ, Rhaophoridæ (Polypedatidæ), Microhylidæ, Bufonidæ and Pelobatidæ.

A New Species of Rose

THE expedition of Captain F. Kingdon Ward to Tibet in 1924 resulted in the introduction of several rose species to European horticulture. One of these, No. 6101, was provisionally named *Rosa Sweginzowii* var. *inermis*, but Mr. B. O. Mulligan, who has examined several shrubs now in cultivation in England, considers it to be a new species, which he has named *R. Wardii* (*J. Roy. Hort. Soc.*, **65**, Pt. 2; February 1940). A full diagnosis is given. The rose is attractive from a garden point of view, bearing white flowers with striking red centres.

Filterable Viruses

A USEFUL review of the filterable viruses of animals and plants has recently been published by L. J. Davis (*Proc. Rhodesia Sci. Assoc.*, **37**; September 1939). Consideration is given to modern findings under the various headings of filtration, microscopy, possible culture, pathology and host relations, chemical composition, and resistance to inhibiting

agents. Perhaps the most interesting section, however, is that on the nature of viruses. The question "Are they Animal ?" is dismissed somewhat summarily, and the evidence as to their vegetable or mineral nature leads to the general conclusion that "viruses, or at least some of them, while manifesting the properties of living matter may actually occur in a form never before known to be compatible with life, a kind of non-cellular life".

Bacteriophage and Plant Lysins

THE origin of the mysterious bacteriophage, the transmissible agent which dissolves living bacteria, has never been accounted for. It was discovered by Twort and arises spontaneously in cultures of bacteria under certain conditions. D'Herelle maintains that it is a living ultra-microscopic agent, others believe that it is a chemical agent, capable of regeneration, analogous to a plant virus. In a paper communicated to the American Association for the Advancement of Science at Columbus, Ohio, in December last, Roy C. Thomas suggests a possible mode of origin. He finds that a non-specific lysin or 'dissolving' agent is found in many plants. It is inactivated by heating to 56° C. for thirty minutes, and has much the same action upon bacteria that bacteriophage has. When this lysin comes into contact with bacteria susceptible to its action, a change occurs resulting in the formation of a transmissible lytic principle similar to bacteriophage ; it is not inactivated at 60° and only partially at 65°. It is suggested that this is the origin of the bacteriophage, at least in plants. With regard to corn wilt bacteria, with which much work was done, a bacteriophage can be obtained for any strain which does not contain one, and a phage developed for a culture is highly specific for it.

Fluorescence of Diacetyl

KALLE (*Naturwiss.*, **25**, 61 ; 1937) observed that when aqueous diacetyl is irradiated with violet or near ultra-violet light it exhibits a vivid green fluorescence which increases from zero to a constant saturation intensity. Almy, Fuller and Kinzer (*J. Chem. Phys.*, **8**, 37 ; 1940) have shown that this delay is caused by the quenching action of dissolved oxygen which is ultimately consumed. On outgassing, the fluorescence appears immediately in its full intensity. Oxygen and carbon dioxide quench the fluorescence temporarily. They also found that diacetyl vapour exhibits fluorescence. The fluorescence spectra of both are identical with that of acetone excited by 3130 A., but, in contrast to diacetyl, the fluorescence of acetone rises gradually from zero intensity. This is explained by assuming that the fluorescing molecule in both instances is diacetyl. The fluorescence of acetone will then grow in intensity as the concentration of diacetyl in it increases. Further, acetone is excited by 3130 A., which does not affect diacetyl. This is considered due to the formation of diacetyl molecules excited by collisions of the second kind, diacetyl with excited acetone molecules, or by a three-body collision of diacetyl with two combining radicals. The fluorescence spectrum of diacetyl was found insensitive to changes in diacetyl pressure (0·1–50 mm.), temperature (10°–100°), and exciting wave-length (3650 –4358 A.). The ratio of intensity of fluorescence to light absorbed is independent of the pressure, and the intensity is linearly proportional to the exciting intensity at constant pressure. The quenching of fluorescence by oxygen follows the Stern-Volmer law over the range in which the fluorescence falls to 20 per cent of the initial intensity ; at higher pressures the intensity falls more rapidly than is expected. The life-time of the fluorescing molecule is estimated as 10^{-5} sec.

Insulation Stresses in Transformers

A PAPER read by J. L. Thomas to the Institution of Electrical Engineers on February 22 discusses the stresses in the insulation of transformers, with special reference to surges and electrostatic shielding. The normal working voltage per turn on even the largest transformer is not likely to exceed about 100 volts. Hence the amount of inter-turn insulation required for normal working conditions is ample when compared with the minimum considered necessary mechanically. The established standards of high-voltage tests, which originally had an empirical origin, have resulted in major insulation proving itself generally adequate by satisfactory service records even in districts subject to severe lightning. At the present time, the principal application of 'non-resonating' shielding is in connexion with transformers for exceptionally high voltages of 220 kv. and above. The mathematical theory shows that the effect of the shielding is to reduce the space harmonics, and in particular the higher harmonics, and so to reduce the peak voltage gradients. Oscillograms are shown of a large number of tests on the effects of shielding. In all cases the shields have been shown to effect a substantial improvement. Results are given of tests on a three-phase 88 kv.–8,000 kva. transformer in oil. The large effects produced by 'chopped' impulses on inter-coil voltage transformer windings with and without shields are shown. The author shows that shielded winding makes possible an economical design in which it can be ensured that inter-cell failure under impulse conditions will not occur before major insulation breakdown.

Meteor Observations from India

MOHD. A. R. KHAN, Begumpet, Deccan, has sent an account of his observations of meteors in 1939. Altogether he recorded the paths of 1,233 meteors and these included members of some of the major showers. The maximum display of Orionids was attained on October 19, a total of eight being observed between 21h. 30m. and 22h. 30m. ; on October 17 only two were seen and on October 18 five. Two of the latter were very bright, with magnitudes — 1 and — 2·5. On November 13, 27 meteors were observed between 22h. and 23h. but only 5 of these were Leonids. On November 14, out of 13 meteors observed from 20h. 45m. to 21h. 30m., there was one Leonid, and on the following night during watches extending over 1h. 15m., out of 8 meteors there were 5 Leonids. On November 16, during a watch of 45m., a total of 30 meteors was observed, 5 of which were Leonids. On December 12, in a watch of 2h. 10m., a total of 74 meteors was seen, 15 of which were Geminids. Although most of these were faint, as is usual with this shower, there were three bright meteors, of magnitudes 1, 0, and — 3 respectively. On December 14 watch was maintained for 1h. 20m., and 10 Geminids were observed, 4 of which were fairly bright. Careful watches were kept on October 9 at different times for Giacobinids, but none was seen ; on the following night clouds rendered observations useless.

INDIAN SCIENCE CONGRESS ASSOCIATION

MADRAS MEETING

THE DECCAN TRAPS: AN EPISODE OF THE TERTIARY ERA

AT the dawn of the Tertiary era, vast outpourings of basaltic lavas covered immense regions in the north-western United States, in the old Thulean province which extended from Greenland to Scotland and Ireland, and in the Deccan. In estimating the exact geological age of these lavas, much depends on the interpretation of the fossils (chiefly plants) from interbedded sedimentary deposits. Recent work on the interbasaltic flora of the Hebrides was summarized by Sir Albert Seward in his presidential address to the British Association at Dundee in 1939, and now Prof. B. Sahni, presiding at the twenty-seventh Indian Science Congress held in Madras during January 2–8, has discussed the Inter-Trappean flora of the Deccan.

Fissure eruptions, Prof. Sahni thinks, may once have spread sheets of lava over some half million square miles, and even after continuous erosion for millions of years the Deccan Traps still cover an area of 200,000 square miles. Thickest along the west coast (six to ten thousand feet), their abrupt ending gives no measure of their extension over a tract of land that foundered into the Arabian Sea.

The flora is known mainly from sediments in the Nagpur and Chhindwara districts of the Central Provinces, occurring between some of the lowest and oldest flows in the whole series; the plant-bearing beds at Rajahmundry on the east coast are also low in the series. No Inter-Trappean beds have yet been discovered in the middle part, and the lava-flows may have issued in such rapid succession that there was no time for extensive colonization or deposition of sediments. (The plant-bearing beds of western Scotland are also found between some of the basal flows.) At Bombay Island the upper members of the Deccan Traps include sedimentary beds yielding a pigmy frog and other organic remains, but no plants have yet been recorded. The highest Traps are in places covered by marine beds of known Eocene age, which fixes an upper limit for the age of the series.

The view that the Traps were poured out during the Cretaceous is not supported by the fossils. One of the most conclusive single pieces of evidence is the occurrence of fruits belonging to the brackish-water stemless palm Nipa, a plant characteristic of Eocene beds at many points near the shores of the former Tethys Sea, for example, in the London and Paris basins, in Poland, southern Russia and Egypt. The palms, known from numerous fruits as well as from abundant petrified wood, dominated the Inter-Trappean flora; although this family arose in the Cretaceous period, it did not become prominent until after the Tertiary era had begun. The abundant charophyte fruits support an early Tertiary age, while the water-ferns, unknown from pre-Tertiary rocks, are represented by a beautifully preserved Azolla.

Numerous other elements in the flora are of botanical rather than geological importance; they include fungi belonging to the Perisporiaceæ and Sordariaceæ, many types of spores, and various dicotyledonous fruits.

GALACTIC DYNAMICS

For his presidential address in the Section of Mathematics, Prof. A. C. Banerji chose as his subject "The Development of Galactic Dynamics and Some Allied Problems". Under this heading was considered a wide selection of the mathematical researches that have been made into the effects of rotation on gravitating masses.

The survey began with the classical researches concerning the stability of spheroids and ellipsoids of uniform density, and went on to a discussion of the pear-shaped figure, while the later work of Jeans on the analogous behaviour when the mass is compressible was also touched upon. The possibility of extending the treatment to the case of a fluid under more general physical conditions led to the recent investigations by Milne, Bhatnagar and others on the distortions that a fairly small rotation would cause in polytrophic distributions, and in particular Chandrasekhar's results for double stars. The work by Eddington in which any spherical distribution can be discussed by means of a variable polytropic index was considered next and reference was made to the special feature of this method, that many properties are intermediate between the corresponding properties of the two spheres whose polytropic indexes are the extreme values of the variable polytropic index.

Turning to the problem of rotating nebulæ of galactic dimensions, the discussion was commenced by describing Hubble's classification of the various observed types. Before proceeding to the problem presented by the spiral arms of nebulæ, the difficulties found by Jeans concerning the impossibility of the formation of stars in an equilibrium configuration of a nebula were brought forward. As for the theories of the spiral forms of the arms, Jeans's point-mass model was considered first to demonstrate the difficulty that the existence of stars is incompatible with the necessary gaseous structure of the nebulæ. The results obtained by E. W. Brown that spiral arms could persist for long periods only under very artificial systems of forces were quoted next, and in the same category were taken the more speculative suggestions of Vogt and Lambrecht postulating cosmical repulsion in the galaxies. Proceeding to our own galaxy, it was suggested that the differential rotation may be an indication of instability in the outer regions.

Arising out of the question of the formation of spiral arms, Prof. Banerji said that it is first necessary to decide whether in Newton's second law the impressed force is proportional to the mass times the acceleration *or* to the rate of change of momentum, and various opinions on this point were cited. The existence of interstellar matter and its possible dynamical effects completed the account given of galactic problems.

In conclusion, Prof. Banerji referred to the recent advances in the theory of the origin of the solar system. It was explained how the former difficulties relating to angular momentum had been resolved by Lyttleton, starting with the hypothesis that the planets were formed from a companion star to the sun during an encounter with an intruding star.

The effects of tidal friction in bringing about some of the detailed features of the solar system were briefly discussed, as, for example, the suggestion that the slow rotation of Venus can be explained by supposing that Mercury was formerly a satellite of this planet, and that the retrograde satellite of Neptune arose as a result of an encounter between two direct satellites, of which one escaped as an independent small planet (Pluto), and the other was diverted into a retrograde orbit.

MAGNETIC STUDIES OF AROMATIC MOLECULES

Prof. K. S. Krishnan delivered the presidential address to the Section of Physics, taking as his subject "The Diamagnetism of the Mobile Electrons in Aromatic Molecules".

Prof. Krishnan pointed out that our knowledge of aromatic molecules, particularly benzene, has been extended very considerably during the last few years by the quantum-mechanical treatment of the linkages and valency electrons and by the experimental determination of the symmetry and normal modes of vibration by means of infra-red and Raman spectra. It is now known that in benzene one electron of each carbon atom is mobile and can move from carbon to carbon, conferring on the molecule magnetic properties somewhat similar to those of free electrons in metals.

Outlines were given of the theories of paramagnetism of an electron gas and of diamagnetism of a free-electron gas ; and the experimental data on graphite were reviewed with special reference to the temperature variation of magnetic anisotropy. These data verify Landau's view that quantization of the motion of free electrons in the magnetic field leads to a balancing between the diamagnetic and paramagnetic contributions, and that the temperature-independent diamagnetism of the free-electron gas is one third of its paramagnetism.

Mobile electrons in aromatic molecules are free to move anywhere in the ring ; this is the same as postulating resonance between canonical structures, five of which are required for benzene, whilst for naphthalene 42 and for anthracene (or phenanthrene) 429 are necessary. Mobile electrons in aromatic molecules give rise to abnormal diamagnetism in the direction perpendicular to the plane of the ring and, consequently, to large diamagnetic anisotropies. For single crystals of such magnetically anisotropic molecules, if the magnetic constants are known, orientations of the molecules in the crystal lattice can be deduced, or, conversely, if molecular orientations are known from X-ray data, the principal magnetic constants of the molecules can be calculated. This calculation supports the theory when applied to sixteen aromatic molecules, and the contribution of mobile electrons is approximately proportional to the number of benzene rings in the molecule. These mobile electrons also give rise to optical effects, fluorescence and absorption, in both of which it is the component parallel to the molecular plane which is active. Not only are mobile electrons associated with benzene rings, but also with other conjugated ring structures, for example, cyanuric trichloride and phthalocyanine.

The address concluded with a brief consideration of theoretical calculations of the magnitude of diamagnetic anisotropies.

ROLE OF CHEMISTRY IN FORESTRY

Dr. S. Krishna, presiding over the Section of Chemistry, covered a wide range of topics in his address upon the role of chemistry in forestry. His topic is very suitable to current conditions, as it directs attention to the many ways in which Indian sources of supply, of drugs, dyes, tanning material and the raw material for many industries might be drawn upon, with increased income for the country and a diminished demand for imports. The work of the chemist was reviewed in connexion with production, conservation and utilization, but perhaps the main emphasis was placed upon the latter.

Very interesting Indian examples were cited of differences in chemical constitution and of economic importance, which had remained unrecognized by the systematist. In the Kurram valley (North-West Frontier Province) two varieties of *Artemisia maritima* grow side by side, one of which yields nearly 2 per cent of santonin but the other has none ; only later was it noted that the young plants of the valuable forms had reddish stems, while the others were green at this stage. Four varieties of *Eucalyptus dives* exist, morphologically indistinguishable, but yielding oils with piperitone content ranging from 5 to 50 per cent. In connexion with seasoning, problems of timber impregnation were discussed, and attention was also directed to the recent Russian experiments using ultra-short waves.

Considerable attention was given to the possibility of increasing forest revenue by greater utilization of minor products. Baluchistan forests, run at a deficit for more than thirty years, have recently become solvent on the sale of Ephedra. Although many minor products would not repay harvesting on a large scale, they may have possibilities if organized on the lines of 'cottage industries'. Amongst minor 'forest' products, grasses and bamboos have supplied most revenue, particularly for the production of the better grades of paper. Another minor product available to prevent present imports is turpentine, now obtained from the oleoresin of *Pinus longifolia*. This is not so rich in pinene content as the turpentine from other species of pines such as *P. excelsa* ; when such sources are tapped, they would be available for conversion into camphor, at present wholly imported.

Dr. Krishna advocated the formation of an association to stimulate the cultivation and utilization of medicinal plants in India, in order to promote the utilization of India's very valuable drugs, sources of many of which are found in India's forests.

THE UPPER CRETACEOUS AND LOWER EOCENE

Prof. L. Rama Rao, in his presidential address to the Section of Geology, took as his subject "Recent Advances in our Knowledge of the Upper Cretaceous and Lower Eocene Beds of India, with special reference to the Cretaceous-Eocene Boundary".

During the past few years several geologists, working in various parts of India, have made material contributions to our knowledge of the stratigraphy and palæontology of the uppermost Cretaceous and Lower Eocene rocks of this region. Much new light has thus been thrown upon the position and nature of the Cretaceous-Eocene boundary and upon questions of palæogeography.

The Ranikot beds, long ago recognized as the basal division of the Eocene in Sind, have been shown to be of pre-Ypresian age. They are now known to be much more widely distributed than was formerly supposed, occurring also in the North-West Frontier Province, the Salt Range, Kashmir, Tibet, Burma, and western Iran. In the Samana Range (North-West Frontier Province) the Hangu Shale, with its rich fauna, seems to constitute the lowest fossiliferous horizon of this formation anywhere known; it is separated from Upper Cretaceous deposits by a conformable series of beds which, however, have yielded no fossils. A similar transition from the Cretaceous to the Eocene seems also to exist in Burma and possibly in Tibet.

In the Peninsular area interesting discoveries of fossils have recently been made in beds intercalated in and underlying the Deccan Trap; their study has led to the conclusion that the Trap belongs to the Lower Eocene rather than to the Cretaceous, as formerly supposed. The well-known Infra-Trappean bed of Rajahmundry would appear to lie almost upon the border-line between the Cretaceous and the Eocene. Prof. Rama Rao's own researches have led to the important new discovery of Lower Eocene beds overlying the Cretaceous in the Pondicherry district. Especial reference was made to the study of the fossil algæ of many of the rocks under discussion, as this work is proving of great help in their correlation.

In discussing, next, the geography of early Eocene times, Prof. Rama Rao visualizes, in the west, an arm of the ancestral Indian Ocean stretching northward so as to cover Sind, Baluchistan, parts of the Punjab, the North-West Frontier Province, and Kashmir; and dividing, in the north, into two branches, which extended respectively to Iran and Tibet. A second arm of this sea, situated to the east of India, extended northward into parts of Assam and Burma. Reference was made to the divergent views of various authorities as to whether there was direct communication with the Mediterranean Sea of that period.

In his concluding remarks, Prof. Rama Rao pointed out that the great geographical changes which heralded the incoming of Tertiary times must everywhere have affected the balance of marine life; hence a normally evolving succession of forms may not have persisted even in those parts of the sea where sedimentation was uninterrupted.

Geography in National Planning

The Section of Geography and Geodesy was formed on the occasion of the Jubilee meeting at Calcutta in January 1938, when its sessions were attended by a strong delegation from Britain. The president this year of the Section was Dr. S. P. Chatterjee, and in his presidential address he directed attention to the part which should be played by geographical studies in national planning.

A stock-taking of resources on a provincial basis is an essential pre-requisite of any work of national reconstruction, and that there is no country in the world where there is a greater need of a detailed land utilization survey than India. The assertions that in Bengal, which is selected for study as Dr. Chatterjee's native province, the land is deteriorating, soils losing fertility, marshes and lakes increasing in area at the cost of good arable lands, and river-borne sediment failing to build up the land, all require substantiation. The official statistics, skilfully shown in cartographic form, show that only one third of British India (contrasted with nearly half of 'Indian' India) is actually cropped. In Bengal, which in places supports a *rural* population, albeit in a condition very near the starvation level, of a thousand persons per square mile, no less than one quarter of the whole province is classed as fallow and cultivable waste, whilst less than half is actually cropped.

Dr. Chatterjee has clearly appreciated his training both in the French school and in Britain, and has attacked the problem on a regional basis. He gives the preliminary results of a survey carried out in the past two years and suggests a division of Bengal into ten regions. As frequently happens, the local cultivators know and appreciate small differences in soil and the local names (mainly based on texture) have been used to divide the new alluvium into ten types the distribution of which is shown on an instructive map.

As Chatterjee says, "since national planning means a conscious effort of man to change his environment in the best national interest, it is rational to be equipped with a thorough and accurate knowledge of the type, historic growth and present distribution of the various factors that go to form our cultural landscape, which is the subject matter of geography", and on this basis he appeals for an All-India organization for conducting a geographical survey.

(*To be continued*)

AIR CIRCULATION OVER INDIA

A MEMOIR of the India Meteorological Department (26, Part 10) by K. R. Ramanathan and K. P. Ramakrishnan, entitled "The General Circulation of the Atmosphere over India and its Neighbourhood", is probably the most complete account that has yet appeared of the average winds and temperatures in the upper atmosphere over India in each month of the year.

The observations of upper wind made with the aid of pilot balloons at observatories, and those of cloud movement, together with the measurements of temperature aloft by sounding balloon made at Agra, Poona and Hyderabad, form the basis of the discussion. Mean isotherms for various levels up to 6 km. were obtained partly from the changes of wind with height, from which the mean magnitudes and directions of the temperature gradients were calculated, and partly from the mean temperatures at the different heights for the three upper air observatories, supplemented in some cases by temperatures measured at Peshawur or Quetta. Although in theory it is sufficient, having obtained a chart of temperature gradient, to have the vertical distribution of temperature at only a single station in order to be able to draw the absolute values of the isotherms, in practice, the computations being only approximate

at every stage, the accuracy of the final picture was increased by having means of temperature at several places.

The results are set out in 74 plates, the mean air movement being taken up to 8 km. The main features of the upper wind and temperature distribution in the different months are discussed and then summarized (pp. 192–207). The most striking feature of the circulation is the regular seasonable movement of the upper wind system, which in the summer half of the year is from south-east to north-west and back, and in the remainder of the year is mainly from north to south and back. The smallness of the month to month movement from December to April or May is taken to signify that cooling and heating of the ground over India by radiation does not greatly modify the circulation, the big changes being caused by the northward penetration and the subsequent retreat of moist air from the southern hemisphere with its attendant rainfall.

Other striking features brought out by this study are the modifying influence of the Himalayas up to a height of 6 km., and the fact that regions of heavy rainfall become regions of high temperature and divergence of air movement above 6 km. The mean winds derived from cloud movement have a much larger northward component than those derived from pilot balloons, which last require absence of cloud so that the balloon can be followed. A true picture of average conditions cannot therefore be obtained from either method alone.

ECONOMICS OF WAR-TIME EXPORT TRADE

A VALUABLE broadsheet "Exports in War" issued by Political and Economic Planning (P E P) reviews the question in relation to the economics of war and the principles upon which the export policy of Great Britain should be based. The object of exporting at all is to save man-hours, and in war-time to avoid mortgaging the future by the sale of overseas securities. Because of our limited ability to pay for imports in exports or foreign securities and our restricted capacity to ship them over, there must be discrimination between different types of demand for imports, giving priority to those which are most urgent from the point of view of winning the war.

The broadsheet stresses the basic importance of applied intelligence in exports; in war, it is particularly important to concentrate on those goods the selling price of which includes least matter and most mind, and the seller's market which is being created by the War should be utilized to grade up export industries instead of clinging to older and less profitable lines. Similarly, every opportunity missed of improving productive efficiency is a drag on the national effort. If new layers of demand are continually tapped and labour and capital progressively transferred to more and more advanced processes or products, the shrinkage of formerly important export industries can be faced without dismay. Moreover, if we make the inter-allied economic arrangements between France and Great Britain work effectively, we shall not only have won the war but made also the greatest possible contribution towards winning the peace.

These agreements between France and Great Britain are outstanding among the actual War-time economic measures. With the joint committees on economic co-operation covering the supply and purchase of munitions, food and raw materials, shipping policy and economic warfare, they should lead to one economic policy for the two countries. This is specially true of exports. The three major elements in any export policy are the export potential, the available markets and the foreign trade policies. The nature of the export potential is the most important in a sellers' market, but exports cannot be left to take care of themselves after the needs of the armed forces and of the civilian population have been met, but must be recognized as a priority of the first importance. Among the opportunities for expansion of our exports at present, the broadsheet stresses those in machinery to complete unfinished German contracts, and those in cotton textiles, locomotives and coal.

The effect of the contraband control on export policy must next be recognized. The purpose of such control is to impede the supply of vital commodities to the enemy. This has now been extended to exports, so that Germany's direct overseas trade should soon be virtually destroyed. Particularly in Latin America, the control has created new markets for Great Britain, and for this our bargaining position is in general strong.

The second aspect of economic warfare consists in the extension of the effects of the blockade to the Continent, so as to cripple Germany's trade with those neutrals with whom contact can still be maintained. The object of promoting British exports to European countries is to turn the tide of trade heavily against Germany by raising the prices of neutral products. This involves a careful study of the strategy of economic warfare, if Germany is to be prevented from importing from neighbouring countries. Strategic purchases, for example, of Rumanian oil involve British exports to pay for them. Sound export policies, moreover, can only be framed after the fullest information about markets and resources has been obtained, and such policy covers every aspect of exporting from production to marketing, including the use of bilateral or multilateral methods of approach to markets, import or export subsidies.

A large-scale purchasing programme makes a survey of the export potential more urgent, and the existence of these Anglo-French programmes is an important factor for world producers. Overseas Governments will require to know that resources are available to supply the necessary goods if they are to continue to sell to Britain, and also that exports have priority over alternative demands. The importance of paying sufficient attention to the needs of the non-self-governing colonies is stressed in the broadsheet, which adds one further plea to the many already advanced for a co-ordinator of trade policy with sufficient political status, including access to the Cabinet, to secure the full and coherent use of Great Britain's immense resources for acting as a centre of world economic expansion.

PRODUCER GAS FOR MOTOR VEHICLES

THE recently published "Report of the Committee on the Emergency Conversion of Motor Vehicles to Producer Gas" (London : H.M. Stationery Office, 1940. 9*d*. net) conveys conclusions only. The Committee, set up by the Mines Department in May 1937, carried out extensive experimental work, including bench tests and road tests under normal operation and under scientifically controlled conditions, from which it can be inferred that a considerable body of quantitative information was derived. The data, however, have not been published; presumably it was not desirable to give details of the work at the present time.

Road trials with commercial producers showed that, subject to certain inherent limitations, producer gas is a satisfactory fuel for transport vehicles. The Committee was impressed by the difficulties encountered and the special conditions attending such an emergency as was envisaged, and therefore undertook the design of a simple producer which would be suitable for the conversion of existing vehicles, capable of rapid production at low cost and required only such metals, plant and labour as were likely to be available in war-time.

Although on the Continent considerable numbers of vehicles have been operated by producer gas, the small amount of progress made in Great Britain is put down to increased capital maintenance and servicing costs, reduction in power output with the consequent upsetting of operating schedules, reduced pay load and the difficulty of obtaining suitable fuel. The artificial disadvantages due to such vehicles being placed in higher tax and lower speed-limit categories are probably more potent considerations. It is stated that the vehicles operated by the Committee have covered a distance of more than 170,000 miles, but no information is adduced regarding these trials. Nor are any figures given of the results obtained in Continental practice, although several members of the Committee had already studied the use of producer gas vehicles on the Continent, and close watch was kept on developments taking place abroad.

The design, which the Committee states is not suggested as necessarily representing finality, appears to be suitable for vehicles up to 6 tons gross weight of 3–4 litres engine capacity. Grave difficulties in operation were found to follow relatively minor constructional defects, and failure to adhere strictly to the dimensions laid down has frequently led to trouble. The design as outlined appears to have the merit of simplicity from the point of view of manufacture and lends itself to mass production. It is suitable for use with low-volatile anthracite and certain low-temperature cokes, and may be mounted on the vehicle itself or on a trailer as thought best in each individual case. We are informed that full details regarding the plant and its working can be obtained from the Director, Fuel Research Station, London, S.E.10.

There are among the conclusions reached by the Committee several valuable items of information such as the availability of different classes of suitable fuel, effective methods of gas filtration and the classes of service for which gas producer vehicles can be most economically used.

EXPLOSIVE ACTIVITIES OF A JAPANESE VOLCANO

THE volcano Kusatu-Sirane suddenly became active with a remarkable explosion on November 27, 1937, and from that time until October 1938 it was studied in great detail by T. Minakami (*Bull. Earthquake Res. Inst.*, Tokyo Imp. Univ., 17, Part 3, September 1939, pp. 590–623). The volcano was very active during December 1937, and January and February 1938. It was more calm from April until August 1938, but became active again from the latter part of September. A rather violent explosion occurred on October 5, 1938, and after that date large quantities of gas were ejected, while ash was scattered near the *Y* crater. At the same time, volcanic pulsations and volcanic micro-earthquakes occurred and these were still continuing in February 1939.

So far as situation on the earth's surface is concerned, the active fissure differed from the fissure of previous activity of October 1932. The hypocentres of the micro-earthquakes were found to be at a depth of 1·7 km. According to geothermic measurements, the region of high temperature was restricted to the narrow zone along the active fissure. From observations of the water-level of the hot spring pond in the crater, it was concluded that the quantity of water that filtered through the fissure at the bottom of the pond amounted approximately to 750 tons a day. The gas ejected from the crater was mostly aqueous vapour, though on several days during May and October 1938 large quantities of evaporated sulphur were emitted with the steam. Boring showed that the floor of the *Y* crater consisted of alternate layers of precipitated sulphur, volcanic detritus and ash.

The presence of the sulphur gave the estimate of 444° C. for the temperature of the vapour, though often it was below this temperature. The quantity of seeping water would affect this, as would the supply of heat from the subterranean origin. Judging from the distribution of volcanic detritus, the pressure of gas at the time of the principal explosions under discussion was almost 150 atmospheres, which is slightly less than that of the explosion of October 1932 as calculated by T. Matuzawa.

H. Tsuya suggests that these explosions were phenomena near the earth's surface resembling those of a geyser.

SEVENTY YEARS AGO

NATURE, vol. 1, March 24, 1870

The Transits of Venus in 1874 and 1882

"A PARLIAMENTARY paper issued at the close of last session gives some information on what is intended to be done in the matter of the great approaching astronomical events of 1874 and 1882. . . . For the proper observation of this event [the transit of 1874] the Astronomer Royal informs us that it will be necessary, after making allowance for all the aid that may be expected from foreign and colonial observatories, to organise expeditions to the following five stations :—(1) Oahu (Sandwich Islands), (2) Kerguelen's Island, (3) Rodriguez, (4) Auckland (New Zealand), (5) Alexandria. At the first three of these stations . . . it will be necessary to make preparatory observations for twelve months, in order to ascertain the absolute longitudes of these places, which are not exactly known. . . .

"But what I wish to call attention to at the present moment is the valuable opportunity thus afforded for still further augmenting the importance of this event to the progress of science generally, by converting these proposed astronomical expeditions into expeditions for general scientific observation. . . . The additional expense of attaching two or three qualified Natural History observers (or at any rate collectors) to these three expeditions could not be very great. The numerous American and Russian exploring expeditions are invariably accompanied by zoological and botanical collectors, nor is the money required to publish the results obtained by them grudged by the Governments of these countries. Even poverty-stricken Austria did not send the *Novara* round the world without a competent corps of naturalists. . . . Far from lagging behind, wealthy England ought to take the lead in such cases. . . .

P. L. S."

Conductivity of Copper

"SIR WILLIAM THOMSON [Lord Kelvin], having had his attention directed to the very great differences that exist in the conducting quality of copper wire professing to be of the 'highest conductivity', had a large number of specimens carefully tested and the following are some of the results obtained—the quality is indicated by the resistance of a metre length weighing one gramme. The best specimen was one supplied by M. Bréguet, Paris, of which the resistance was ·153 of an ohm per metre weighing one gramme. Specimens from English manufacturers varied as follows :—·165, ·169, ·171, ·178, ·206, ·213, ·221. Seven specimens labelled 'highest conductivity', stood as follows :—·156, ·182, ·201, ·205, ·223, and ·258. As it is to the interest of all scientific men that the copper wire used in electrical instruments shall be of the best quality, there should be general co-operation to discourage as much as possible the use of inferior copper. Variations in conductivity like those in the samples of copper mentioned above would produce instruments varying to the extent of 40 per cent."

MISS GARRETT has been admitted as a member of the medical staff of the East London Hospital for Children, and was appointed one of the physicians on Wednesday last. This is the first hospital in Great Britain which has recognized in this manner the female medical movement.

APPOINTMENTS VACANT

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

SECOND ASSISTANT BACTERIOLOGIST AND PATHOLOGIST—The Clerk of the County Council, County Buildings, Stafford (March 28).

TEACHER OF GENERAL ENGINEERING subjects, including Engineering Science, Drawing and Mathematics, etc.—The Clerk to the Governors, South-East Essex Technical College and School of Art, Longbridge Road, Dagenham (March 29).

TEMPORARY ENGINEERING ASSISTANT in the Waterworks Department of the Halifax Corporation—Mr. J. Noel Wood, Waterworks Engineer, Gibbet Hill, Halifax (March 30).

LECTURER IN VETERINARY PHYSIOLOGY AND BIOCHEMISTRY at the Veterinary College, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (April 2).

GRADUATE LECTURER to teach MECHANICAL ENGINEERING subjects in the Plymouth and Devonport Technical College—The Education Office, Cobourg Street, Plymouth (April 6).

LECTURER IN THE MINING DEPARTMENT of the Doncaster Technical College—The Acting Chief Education Officer, Education Offices, Doncaster (April 10).

PROFESSOR OF ZOOLOGY—The Registrar, University College of Wales, Aberystwyth (April 15).

TEACHER OF ENGINEERING subjects—The Principal, Technical Institute, Ladywell, Dover.

LABORATORY SUPERINTENDENT of the Government of Nigeria Medical Department—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/9173).

DEMONSTRATOR IN PHYSICS—The Dean, Guy's Hospital Medical School Office, Sherwood Park, Tunbridge Wells.

TECHNICAL ASSISTANT (Male) to the Adviser in Economics to the West Midland Province—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 1, No. 1 : On a Problem concerning Matrices with Variable Diagonal Elements. By Walter Ledermann. Pp. 17. (Edinburgh : Robert Grant and Son, Ltd. ; London : Williams and Norgate, Ltd.) 1*s.* 6*d.* [272

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 1, No. 3 : The Normal Œstrous Cycle of the Ferret—The Correlation of the Vaginal Smear and the Histology of the Genital Tract, with Notes on the Distribution of Glycogen, the Incidence of Growth, and the Reaction to Intravitam Staining by Trypan Blue. By Prof. W. J. Hamilton and J. H. Gould. Pp. 87–106+3 plates. (Edinburgh : Robert Grant and Son, Ltd. ; London : Williams and Norgate, Ltd.) 4*s.* [272

Other Countries

New Zealand. Report of the Tenth Australian-New Zealand Cancer Conference held at Wellington, New Zealand, 15th to 17th February 1939. Pp. 44+A10+B14. (Wellington : Government Printer.) [262

Memorie del R. Istituto Lombardo di Scienze e Lettere. Vol. 24, Fasc. 1 : Contributi alla teoria delle connessioni, 2 : Connessioni di specie superiore, fondamenti analitici calcolo del vitali generalizzato. Memoria del Prof. Enea Bortolotti. Pp. 40. Vol. 24, Fasc. 2 : Contributo allo studio delle reti per comunicazioni elettriche. Memoria di Giovanni Cocci e Rinaldo Sartori. Pp. 41–124. Vol. 24, Fasc. 7 : Carta archaeologica delle stazioni enee emiliane a occidente del Reno. Memoria della Prof. Pia Laviosa Zambotti. Pp. 295–418. (Milano : Ulrico Hoepli.) [262

Carnegie Institution of Washington. Year Book No. 38, July 1, 1938, to June 30, 1939 ; with Administrative Reports through December 15, 1939. Pp. xxii+394. (Washington, D.C. : Carnegie Institution.) 1 dollar. [272

Report of the Aeronautical Research Committee, Tôkyô Imperial University. No. 184 : Über Radiator (1). Von Daizo Nukiyama, Jiro Mikura und Yuzo Akishino. Pp. 439–470. 50 sen. No. 185 : The Forces on a Plane Aerofoil in a Wind Tunnel of the Gottingen Type, with Special Reference to Approximate Formula for the Lift. By Susumu Tomokita and Hazimu Umemoto. Pp. 471–558. 1.10 yen. (Tôkyô : Kôgyô Tosho Kabushiki Kaisha.) [272

U.S. Department of Agriculture. Farmers' Bulletin No. 1102 : The Crow in its Relation to Agriculture. By E. R. Kalmbach. Revised edition. Pp. ii+22. (Washington, D.C. : Government Printing Office.) 5 cents. [272

Smithsonian Miscellaneous Collections. Vol. 99, No. 2 : Geologic Antiquity of the Lindenmeier Site in Colorado. By Kirk Bryan and Louis L. Ray. (Publication 3554.) Pp. iv+76+6 plates. (Washington, D.C. : Smithsonian Institution.) [272

Contributions from the Physical Laboratories of Harvard University for the Year 1938. Series 2, Vol. 5. Pp. vi+45 papers. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press.) 21*s.* 6*d.* net. [272

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OFFICIAL ANNOUNCEMENTS

BRIGHTON SUMMER SCHOOL IN ANIMAL BIOLOGY

2nd to 15th AUGUST, 1940

The course is intended as an introduction to Biology, and as a refresher course for teachers of the subject. Laboratory and field work. Director: Prof. L. E. S. Eastham, M.A., M.Sc., Professor of Zoology in the University of Sheffield, assisted by specialists. Prospectus of F. H. Toyne, Education Officer, 54 Old Steine, Brighton.

SWINEY LECTURES ON GEOLOGY

UNDER THE DIRECTION OF THE BRITISH MUSEUM (NATURAL HISTORY)

A course of twelve lectures on *"Geology and Early Man"* will be delivered by Mr. T. T. Paterson, Fellow of Trinity College, Cambridge, and Curator of the University Museum of Archæology and Ethnology, in the Linnean Society's Rooms, Burlington House, Piccadilly, W.1, on Fridays and Mondays at 3 p.m., from March 29 to May 10, 1940, excepting Friday, April 19.

HERIOT-WATT COLLEGE, EDINBURGH

PROFESSORSHIP OF CHEMISTRY

The Governors invite applications from British Subjects for the PROFESSORSHIP of CHEMISTRY, which will shortly become vacant owing to the retirement of Professor T. Slater Price, O.B.E., D.Sc., F.I.C., F.R.S. The Professor is Head of the Chemistry Department, which includes Day and Evening courses of study. The person appointed will be required to take up his duties on September 1, 1940. Teaching experience and works experience in some branch of Industrial Chemistry or Pharmacy is desirable. Salary £1,000 by £50 to £1,200. Particulars may be obtained from the Principal at the College, to whom applications should be sent by April 16.

J. CAMERON SMAIL,
Principal.

SIR WILLIAM DUNN SCHOOL OF PATHOLOGY, OXFORD

Glass-blower required with experience of scientific glass-blowing and some knowledge of care of instruments.
Salary £4 to £5 per week according to experience.

GUY'S HOSPITAL MEDICAL SCHOOL

Applications are invited for a Demonstratorship in Physics for the term beginning on April 15, 1940.
Full particulars and conditions of appointment can be obtained from the Dean, Medical School Office, Sherwood Park, Tunbridge Wells.

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