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Vaccination.

VACCINATED persons, when exposed to the same risk of taking smallpox as unvaccinated persons, are attacked at a lower rate, and those who are attacked die at a lower rate than persons who have not been vaccinated. No one who is acquainted with the direct and collateral evidence doubts that this is a generally true proposition, unless they are on *a priori* grounds convinced that vaccination must be nonsense. As Prof. Major Greenwood pointed out to the Royal Statistical Society on Feb. 18, direct numerical evidence of the lower attack and lower fatality rates of vaccinated persons has been obtained whenever the distinction between vaccinated and unvaccinated has been recorded. Recent advances in understanding have all confirmed our belief in the efficacy of vaccination as an individual prophylactic.

Jenner thought that cow-pox (vaccinia) and smallpox (variola) were distinct diseases, and such has been the uncritical general opinion almost to the present day. It was accepted on all hands that an attack of smallpox, either naturally contracted or imposed by deliberate inoculation, was a fairly efficient protection against a second attack. But it naturally seemed a little strange that protection could be obtained by an attack of another disease, and there were no clear analogies of this non-specific immunisation: measles protected against measles, chicken-pox against chicken-pox, distemper against distemper; and it is not altogether surprising that acute men like Charles Creighton came to the conclusion that vaccination was quackery.

Was Jenner right, however, in his original interpretation of his facts? The modern view is that he was not, and that what he called cow-pox on the cows' udders and dairymaids' hands was in fact smallpox. No one now knows exactly what cow-pox was or is: the disease, if it ever had an independent existence, is almost or quite unknown nowadays. Equally, the original sources of the strains of virus used for making vaccine lymph for human use are not always known, or at any rate the information is not available for the interested public. In some instances, however, they are admittedly derived from human variola, and it seems most likely that all or nearly all human vaccination is actually performed with smallpox material cultivated in the skins of calves, sheep, rabbits, monkeys, or some combination of these and other animals. In short, vaccination to-day is essentially the same as the inoculation of the eighteenth century: we still protect against small-

pox by inoculating with smallpox, only we use a milder strain of virus, which has to a large extent lost its particular capacity to cause serious illness and death in man by being adapted to grow in other species of animals. There is, therefore, nothing surprising or repugnant to general principles in the fact that 'vaccinia' protects against variola. Their identity has been fully confirmed by the intensive studies and animal experiments made in recent years by Gordon, Tulloch, and others.

Though, however, the efficacy of vaccination in protecting the individual is beyond question, it is by no means so certain that the great diminution of smallpox in western Europe in the closing years of the nineteenth and early years of the present century was due to wholesale vaccination, or that its communal efficacy is such that it may rightly be imposed upon reluctant people. It seems fairly certain that compulsory vaccination in infancy, followed by periodical re-vaccinations in later life, if rigidly enforced with no exceptions of any kind, would obliterate smallpox in the inhabitants of Great Britain and render occasional importations from abroad innocuous. But would it be worth while? The experience of Leicester shows that the frequent introduction of smallpox into a town where infant vaccination has been systematically neglected does not, in fact, lead to widespread and murderous epidemics. It has also to be recognised that, on the modern standard of healthiness, vaccination is not a wholly negligible event. It often leads to distasteful malaise, rarely to serious illness, very occasionally to death, and something of this price would doubtless have to be paid for complete security against smallpox. The type, too, of smallpox which has been prevalent in Great Britain during the last few years (and which is possibly the indigenous English form) is quite a mild disease, not much worse than chicken-pox or even vaccinia. This naturally makes people think more lightly of the disease than they used to, though it is obviously unwise to be sure that the mildness of type will never evolve into the form which caused the horrors of the eighteenth century, and still exists in the East and elsewhere, and is always liable to be brought into Great Britain.

With such a conflict of considerations, public health administration plainly has a difficult problem to solve. To abandon vaccination would save a few lives and a good deal of inconvenience, and it might lead to no harm: on the other hand, it might result in serious disaster. The majority will probably agree with those who prefer to be on the safe side.

Hydrodynamics.

(1) *Grundlagen der Hydromechanik.* Von Prof. Leon Lichtenstein. (Die Grundlehren der mathematischen Wissenschaften in Einzeldarstellungen mit besonderer Berücksichtigung der Anwendungsgebiete, herausgegeben von R. Courant, Band 30.) Pp. xvi + 506. (Berlin: Julius Springer, 1929.) 38 gold marks.

(2) *Leçons sur l'hydrodynamique.* Par Prof. Henri Villat. (Chaire de mécanique des fluides et applications, Fondation du sous-secrétariat d'État de l'aéronautique.) Pp. viii + 296. (Paris: Gauthier-Villars et Cie, 1929.) 50 francs.

(3) *Hydro- und Aeromechanik nach Vorlesungen von L. Prandtl.* Von Dr. O. Tietjens. Band 1: *Gleichgewicht und reibungslose Bewegung.* Pp. viii + 238. (Berlin: Julius Springer, 1929.) 15 gold marks.

(1) THESE three books all deal with hydrodynamics, but differ widely in scope, and appeal almost to different types of mind. Prof. Lichtenstein, well known for his elegant investigations of some special problems, here undertakes a systematic survey of the science from a strictly logical point of view, incorporating an account of the researches on the existence-theorems of the subject on which he has been engaged for a number of years. He submits to a rigorous scrutiny the various conceptions which lie at the base of the science, as well as the assumptions which have been made implicitly in its development. This task is here essayed for the first time in the present connexion. The classical writers and their followers have been accustomed to pass lightly over such matters and to be guided (often unconsciously) by physical intuitions rather than logical deductions. In this they were entirely justified, for it is hard to see how they could otherwise have got on with their own primary business, to construct a mathematical scheme which should represent as well as might be the processes of natural phenomena. But at length the pure mathematician comes into the field. He is attracted by the interest and beauty of the mathematical structure which the classical writers have by degrees built up, but his keen logical eye detects flaws here and there; he is impelled to strive after precision where he finds vagueness in fundamental conceptions, and to supply *lacunæ* in the logical processes.

This is the task to which Prof. Lichtenstein has set himself in this book, which, he tells us, is the outcome of some six years' meditation. It may be said at once that the result is worthy of the pains

bestowed. The work is admirably arranged and lucidly written. The arguments are of course highly technical and intricate, and not always easy to follow by a reader inexpert in the more abstruse departments of modern mathematics. The easy-going 'intuitional' mathematician may be dismayed at the outset by a recital of definitions from the 'Mengenlehre', and may be astonished to find what a number of unsuspected assumptions he is in the habit of making when he talks lightly of a 'curve' or a 'surface', or even of a 'space'. When he proceeds further he will find that the statements of theorems which have become familiar and almost obvious to himself are hedged about with a multitude of tedious limitations and restrictions. But all this is no new phenomenon in the development of science, and is indeed of the nature of the case.

One or two examples may be given of the kind of question here discussed. Thus, suppose we have an unlimited mass of frictionless incompressible fluid, not necessarily homogeneous, at rest at infinity, and that it is in a prescribed state of continuous motion at a given instant t_0. The question is, Do the differential equations of hydrodynamics, without any appeal to experience, logically determine a definite and continuous state of motion for any subsequent instant t? The intuitionist has no hesitation about the answer; he is by nature a determinist, and is confident that his equations are adequate and consistent. But it must be confessed that his faith rests on physical prepossessions rather than on strict deduction. If he turns to the final chapter of the book, which is devoted to existence-theorems of this and other more complicated types, he will find what a long and intricate process of reasoning is needed to establish the conclusion.

Again, suppose that the mathematical equations involve some parameter which admits of continuous variation. Does the motion which is governed by these equations vary in a continuous manner with the parameter? This question is raised, but not discussed in detail. The author, indeed, states frankly that many questions still remain to be examined from the point of view of his treatise. The case of compressible fluids, where mathematical discoveries of interest to the physicist are not impossible, is left aside. The problems suggested by the theory of viscosity are in like case.

Enough has perhaps been said to indicate the special character of the book. But it should be added that the expositions of classical theory which are given incidentally as a text are extremely elegant, and are worthy of some attention from readers who may not wish to embark on the study of the intricate commentary.

(2) The treatise of M. Villat is based on a course of lectures given at the Sorbonne. It deals with the various efforts which have been made to construct a strictly mathematical theory of the resistance which a fluid opposes to the motion of bodies through it. The first to be considered is the two-dimensional theory of discontinuous motions originated by Helmholtz and developed by Kirchhoff, Rayleigh, and others. The author discusses in detail the case of the flat lamina, following a method due to Levi-Cività, and obtains of course the well-known result of Rayleigh. The theory in question had at one time a great fascination for mathematicians, on account of the power and elegance of its methods. It will always retain a place in mathematical expositions, but its practical deficiencies have long been recognised. It does not give the actual distribution of pressure over the faces of the lamina, and fails altogether to account for the suction in the rear to which most of the resistance is due.

The rest of the work is devoted to an exposition of the interesting theory of Oseen. This is a theory of slow motions, and only takes partial account of the inertia of the fluid. On the other hand, viscosity is not ignored, though it is assumed to be infinitesimal. More precisely, the investigation seeks to determine a priori the form which a solution of a particular problem might be expected to assume in the limit when $\mu \to 0$. Two special cases due to M. Zeilon are here worked out, namely, the case of a hemisphere advancing with its flat, or with its curved surface in advance. Here also there is a sharp discrepancy between the theory and experiment.

M. Villat's exposition is exceedingly clear, and is adapted to students who come to the subject with no great previous knowledge beyond the range of ordinary pure mathematics. The various ancillary theories are discussed as occasion arises. Thus we find a preliminary sketch of the theory of complex functions and conformal representation. When Oseen's theory is approached we find a chapter on the theory of the potential. M. Zeilon's problems of the hemisphere, again, are prefaced by a brief account of zonal harmonics. The book is thus logically complete, but it remains, alas, true that the student who wishes to get a physical insight into the mechanism of fluid resistance must have recourse to the experimental literature of the subject, with at present only imperfect guidance from pure theory.

(3) In the third book on our list we come in contact with reality. It is based on lectures given at Göttingen by Prof. Prandtl, and is issued under his supervision and with his occasional collaboration. It is expressly designed to form an elementary introduction to the classical hydrodynamics so far as this bears on practical questions. The student is led on by easy stages from the fundamental conceptions to the final mathematical scheme. The explanations are full and lucid, and illuminated by occasional touches which betray the master hand. A word must be said in praise of the abundant diagrams, which though small in scale are exquisitely clear. The volume is to be followed by another dealing more particularly with technical applications, including (it is to be presumed) the problems of aviation. Already in the present volume a number of technical questions are touched upon by way of illustration. Thus in the section on hydrostatics there is an interesting account of the statics of the atmosphere, the influence of moisture, the formation of clouds, and the behaviour of a balloon under various conditions. At a later stage we have discussions on the efflux of gases, the flow round an aerofoil, and the trail of vortices shed by a screw-propeller.

The matter and style of the book are to be warmly commended, and not least to students whose approach to the subject has been hitherto mainly from the analytical side.

HORACE LAMB.

From Thales to Einstein.

Two Thousand Years of Science: the Wonders of Nature and their Discoverers. By Prof. R. J. Harvey-Gibson. Pp. vii + 362. (London: A. and C. Black, Ltd., 1929.) 12*s*. 6*d*. net.

THE lack of scientific knowledge among the general public is universally recognised and deplored in the world of science. We may hope that the defect will be remedied in the next few generations, since science is now a part of all secondary school education and will doubtless permeate the elementary schools before many years are past. At the moment, however, there is a very real need for books which will give the layman some acquaintance with science and its development without entering too deeply into points of technical detail. Prof. Harvey-Gibson's book is a valiant effort to give a popular résumé of the history of science from the earliest times to the present day, and as such commands at least our admiration for its courage, even if we cannot unreservedly award it our full approval on all points.

It is a melancholy task to review a book the author of which never lived to see it published. Prof. Harvey-Gibson, after a life whole-heartedly devoted to the pursuit of science and the propagation of scientific knowledge, unhappily died while the present volume was still in the early stages of its passage through the press. Mr. A. W. Titherley, however, upon whom fell the duty of bringing it into final shape, has striven to follow the spirit and intention of the author, and there is small likelihood that Prof. Harvey-Gibson would have made any extensive alterations.

In his preface, the author says that he has tried to write a book of reasonable size which will give the general reader a sketch of the growth of science from early times, and in which he will also find an explanation, written in popular terms, of some of the principal subjects at present occupying the minds of scientific men. It is an ambitious project, and the two aims are fulfilled with varying degrees of success. To write a history of science in the small compass of three hundred and fifty pages is an undertaking before which the boldest might hesitate, and in point of fact Prof. Harvey-Gibson has not accomplished it. What he has done is to give a brief account of some outstanding figures of science up to the eighteenth century, followed by a description of subsequent advances in physics, chemistry, biology, geology, and astronomy. There is consequently a lack of balance about the book as a whole, the earlier sections being too short and disjointed to have any great value. Thus Greek science is dismissed in twelve pages, while Roman science is omitted completely except for three incidental references to Pliny. Arabian science is described in four short paragraphs, and even these contain such surprising errors as that the introduction of Arabic numerals was due to 'Ben Musa', presumably Al-Khwarizmi.

The first seventy pages of the book, dealing with science up to the eighteenth century, fall far short of the standard of the remainder. They might profitably have been replaced by a general essay on classical and medieval science, which would have formed a much better introduction to the later periods than the somewhat staccato effect of the treatment adopted. It is, indeed, abundantly clear that Prof. Harvey-Gibson did not feel at home in the earlier ages of science, but was anxious to arrive as quickly as possible to the more familiar and more fruitful later centuries. With this transition, the level of the book rises steeply; the

material is selected with care and sound judgement, and the story runs smoothly and well. Particularly clearly in the biological sections, but adequately in all, the author brings out the essential features and shows the gradual unfolding of the flowers of science.

The twin aims of the book are never overlooked; Prof. Harvey-Gibson was determined that the reader should not merely know about a discovery, but that he should actually understand the discovery. In some cases the explanation is necessarily compressed so much that the non-scientific reader will find the going hard, but, on the whole, the author has successfully anticipated and provided for the difficulties that inevitably arise. Any intelligent layman should be able to follow the arguments without undue mental strain, and it was for him that the book was written. Men of science may be expected to know something of the history of science in general and of their own branches of it, but if they wish to supplement their knowledge without devoting too much attention to minutiæ, they will find Prof. Harvey-Gibson an entertaining and well-informed guide. It remains to be said that the book is well printed, but that the illustrations might have been more numerous and of better quality. E. J. H.

Photochemistry.

Photo-Processes in Gaseous and Liquid Systems. By Dr. R. O. Griffith and Dr. A. McKeown. (Text-books of Physical Chemistry.) Pp. viii + 691. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 25*s.* net.

IT has been stated, possibly with truth, that any investigations performed by chemists which prove to be of more than passing interest are rapidly assimilated by and incorporated in physics. This stage appears to have been reached in the subject of photochemistry, ably dealt with by Drs. R. O. Griffith and A. McKeown in "Photo-Processes in Gaseous and Liquid Systems", published in the well-known Longmans Green series of text-books on physical chemistry, edited for so long by the late Sir William Ramsay, and now under the genial direction of Prof. F. G. Donnan.

It is clear that, in order to gain an insight into the reasons why absorbed light causes an atom or molecule to become chemically reactive, it is necessary to find out what is the fate of the absorbed energy and what changes in the molecular electronic, vibrational or rotational energies take place as a result of such absorption, and in what manner these may be interdependent, before one can state definitely that chemical reactivity is imparted by such and such a change in the molecular system. This the authors have clearly recognised, for they have devoted no less than half the volume, which contains six hundred and eighty pages, to such considerations. This section of the book is conveniently divided into five chapters, commencing with a classification of spectra, the Bohr theory of spectral lines, the spectra of atoms including transition probabilities and lives of excited and metastable atoms.

Chapter iv. is devoted to the more complex case of molecular spectra, which introduces naturally the subject of fluorescence. It is only natural that in such a rapidly growing subject any book written will be 'dated' at the time of publication. Whilst the authors have kept well abreast of the times in many sections of the subject matter in this portion of the volume, in others information anticipated in a volume published in 1929 is not to be found. Thus the section on rotational and vibrational molecular spectra might well have been amplified. The statement (p. 33) that "the infra-red bands of carbon monoxide and of carbon dioxide are not capable of complete resolution" must certainly be regarded as somewhat sweeping. Whilst on page 54 some space is devoted to the Compton effect as evidence for the existence of the light quant or photon, it is somewhat curious that the analogous effect discovered by Raman, which has proved of such value in the determination of infra-red molecular spectra, is not even mentioned, although it is now common practice to employ the Raman effect for the identification of lines in the infra-red molecular spectrum.

In discussing the optical convergence limits for the diatomic gases such as nitrogen, oxygen, and the halogens, with the object of determining the heats of dissociation, it is somewhat unfortunate, on account of the frequency with which they are used in thermochemical calculation, that in both nitrogen and oxygen figures more recent than 1926 have not been employed; the values given are certainly much too high. The chapters on fluorescence and chemiluminescence are full of interesting information; in the latter the oxidation of dye-stuffs such as safranin by ozone might have been included just for the sake of its beauty and suitability for lecture demonstration purposes.

In the second portion of the book, two chapters are devoted to the Stark-Einstein law of photochemical equivalence, the experimental confirmation of which was commenced by Warburg; one

to the still mysterious chlorine-hydrogen and chlorine-carbon monoxide reactions, and one to the important phenomenon of photosensitisation. The last chapter includes a discussion on the temperature coefficient of photochemical reactions and phenomena resulting from the intrusion of catalysts in photochemical reactions. It is interesting to note (p. 556) that the authors do not favour the concept of an excited chlorine atom as being the link in the atom chain mechanism so long sought for in the hydrogen-chlorine combination, although recent work from Semenoff's laboratory lends additional support to this view. The treatment, however, in this portion of the book is very fair to the diverse views which have been expressed, and the criticism which is presented from time to time by the authors is both pertinent and stimulating. The authors are to be congratulated on writing what may well be considered the standard text-book in this growing subject.

ERIC K. RIDEAL.

Our Bookshelf.

The Glorious Oyster: his History in Rome and in Britain, his Anatomy and Reproduction, how to cook him, and what various Writers and Poets have written in his Praise; collected together as an Acknowledgment of the Supreme Pleasure he has given to all Persons of Taste since Roman Times. By Hector Bolitho. With certain Chapters edited by Maurice Burton. Pp. x + 203. (London and New York: Alfred A. Knopf, 1929.) 6*s*.

THIS small book is "written merely as a record of those stories of the oyster of which the author has read, brought together as a tribute to *his* (the oyster's) importance", and in fulfilment of a long-standing vow to write such a book. The author's confessions provide a key to the product. In historical quotations on the oyster in Rome and Britain (many culled from Philpots, "Oysters and All About Them"), in references to curious habits and an anthology, the author finds a congenial topic, and has collected within a small compass a number of stories and references likely to be of interest to those readers who browse, to some who read lightly, certainly to those who have an affection for the oyster, or who want to find one of the less well-known stories. The subject, however, is not treated exhaustively or seriously. In an interesting quotation dated 1859 (occupying thirteen pages, and from "All the Year Round", edited by Charles Dickens) it is recorded that 800 oysters were taken in one dredge haul off Whitstable, where an equivalent catch of all sizes nowadays would probably be a good one if twenty were taken.

The author is, unfortunately, not successful in his treatment of reproduction, enemies, and cultivation, in spite of the fact that contributions to these subjects were made by Mr. Burton. It is apparently a very difficult matter for a (presumed) layman to write on a scientific subject even when provided with the subject matter. For example, he writes: "As time proceeds, each of the embryos constituting the black spat develops a crown of protoplasmic hairs or cilia . . . and becomes known technically as a 'trochosphere' larva". The author is amusingly unaware that he is describing the development of the oyster backwards. The fall of spat is stated to occur usually in May! A single oyster is quoted as producing from 300,000 to 60,000,000 eggs in a sentence sandwiched between two others referring to the European oyster. It is stated that 'hockling' is a prevalent and familiar disease; that the mantle is a tough fleshy plate of tissue; that oysters cannot live in water which contains less than three per cent of salt; while a native oyster is still believed to be "one which is or has been bred on or near the Thames Estuary". After quoting Goldsmith on oysters, the author states: "This quotation illustrates the ignorance concerning oysters existing as recently as when Goldsmith was alive". J. H. O.

Thermodynamik: die Lehre von den Kreisprozessen der physikalischen und chemischen Veränderungen und Gleichgewichten; eine Hinführung zu den thermodynamischen Problemen unserer Kraft- und Stoffwirtschaft. Von Prof. Dr. W. Schottky. In Gemeinschaft mit Dr. H. Ulich und Dr. C. Wagner. Pp. xxv + 619. (Berlin: Julius Springer, 1929.) 56 gold marks.

THIS is an interesting and important book, of which at least parts will be of use to all teachers of thermodynamics. The fundamental principles of the subject are dealt with at considerable length, and difficulties are not glossed over but fully discussed.

An important aim of the book is to retain the advantages of the analytical method of Clausius–Gibbs–Planck while avoiding the possible obscurity of the characteristic functions, and to retain the close touch with experimentally measured quantities of the cycle method of Helmholtz–van 't Hoff–Nernst while avoiding its clumsiness. New coefficients, called heat and work coefficients, are introduced which have a close and obvious connexion with the measured quantities of heat and work. At the same time, these coefficients are shown to depend only on the state of the system and their relation to the older characteristic functions is worked out. Although at a first reading the new notation is rather confusing, it is an advantage where possible to have experimentally measured quantities in the equations. In this connexion reference must be made to the large amount of information concerning the relations between experimental quantities that, with the new notation, is compressed into the two small tables on pp. 77 and 78. Whether the new method will appeal to students more than the old can only be found by trial.

Another important point is the development of the ideas of Gibbs on the components of a system in a natural and helpful way by the introduction of the conception of resistant groups. The appli-

cations of thermodynamics to homogeneous and heterogeneous chemical systems are considered at length.

From the point of view of the teacher who decides to use the new method, it would have been better to arrange the book so that the possibilities of classical thermodynamics were more fully exploited before the introduction of the Nernst heat theorem. Also the eighteen numerical applications would be better in the main text, and considerably increased.

The History of British Civilization. By Dr. Esmé Wingfield-Stratford. Second edition, revised. Pp. xix + 1332. (London: George Routledge and Sons, Ltd., 1930.) 15*s.* net.

IT is very satisfactory to see that Dr. Wingfield-Stratford's work, reviewed in NATURE of June 8, 1929, p. 863, has already reached a second edition in one volume. The price of the first edition in two volumes was the only obstacle to the wide popularity of the book; the price of the second removes that difficulty, for no one can 'boggle' at 15*s.* for 1300 large and well-printed pages.

The book is certainly a godsend, for repeated trials on the average intelligent person have convinced us that it has just the elements needed for success—a very wide reading on the part of the author, a generous and impartial spirit, a lively style, a strong personal interest, and a burning enthusiasm for his country. It is not an elementary history for schools, it is not a scientific history, based on documents and adding to our knowledge, but it is a real book, adding to our interest and bringing together, from a new and personal point of view, a multitude of facts and personalities of which most people have some vague and often disconnected knowledge.

When one considers the vast importance of the subject and its growing complexity, this is great service to the public, and one should be duly grateful to Dr. Wingfield-Stratford for having done it so zealously. It may be confidently expected that this book will attain to late editions, and, if so, he may find opportunities to make good some of the defects we pointed out in an earlier notice. This edition is practically a reprint of the first. F. S. M.

Hindu Exogamy. By S. V. Karandikar. (University of Bombay Publication.) Pp. xv + 308. (Bombay: D. B. Taraporevala, Sons and Co., 1929.) 6 rupees.

IN attempting to formulate a theory of Hindu exogamy, Mr. Karandikar has attacked a subject of considerable intricacy, and if his book is difficult the fault is not to be attributed to the author. He seeks to extract the evidence for exogamy from the earliest Sanskrit literature and to trace its history and development through the later documents, while at the same time comparing or contrasting it with the practice in Indian culture. Owing to the general dissociation of the study of Sanskrit literature from anthropological studies, the subject is not one which hitherto has been attacked on these lines. It would appear that among the Aryan invaders, exogamy was not practised. Indeed, the union of close kin was encouraged. The present exogamy of the Indo-Aryans is derived from the *gotra*—sept or clan—a word which occurs a few times only in the Rig-Veda. On the other hand, there appears to have been a form of *sapinda* exogamy based upon the generations on both the father's and the mother's side. Mr. Karandikar has traced the development of these forms of exogamy from early times and shows how, by a process of admixture and borrowing as between Aryan and Dravidian stocks, the forms of exogamy as at present practised in India have come about. He concludes with some considerations of the eugenic aspect of the practice on the population of India.

Bandenspektren auf experimenteller Grundlage. Von Dr. Richard Ruedy. (Sammlung Vieweg, Hefte 101-102.) Pp. vi + 124. (Braunschweig: Friedr. Vieweg und Sohn A.-G., 1930.) 9·60 gold marks.

THIS famous series of monographs has now added to its number an excellent little volume on band spectra by Dr. Richard Ruedy of Toronto. This appears at a time when rapid progress is being made both on the theoretical side by Hund, Mulliken, and others, and on the experimental side by a large number of workers in many countries. The foundations of the subject are, however, sufficiently well established to justify a volume of this scope, and it should prove a trustworthy and valuable introduction to the whole subject of electronic band spectra, especially for those who have not previously had any specialised acquaintance with the subject.

This book to some extent covers the same ground as Mecke's article in the "Handbuch der Physik", vol. 21, but there is ample scope for several presentations of the subject by men who can write authoritatively. Dr. Ruedy has managed to compress into moderate space a very lucid and attractively arranged account of the basis of this difficult subject.

Physikalische Beiträge zur Radium-emanationstherapie. Von Heinrich Mache und Stefan Meyer. (Abhandlungen aus dem Gesamtgebiete der Hygiene, herausgegeben von Prof. Dr. R. Grassberger, Heft 5.) Pp. 32. (Leipzig und Wien: Franz Deuticke, 1929.) 2·40 gold marks.

IT is commonly supposed that thermal waters possessing radioactive emanations exert therapeutic action due to the emanations, but definite data concerning this are difficult to find. The authors of the two papers contained in this memoir give the results of investigations on the entrance into the body of the radioactive emanations of the Gastein thermal waters by bathing, by drinking, and by breathing air containing them. By drinking and by breathing, the emanations rapidly enter the blood, but are quickly eliminated, though it is questionable if the emanations can enter through the skin by bathing. Quantitative data are given of the amount of the emanations found in the blood and of the rates of accumulation and elimination of the emanations.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Curling.

WE should like to direct attention to the question of what can be learnt about ice friction from the well-known behaviour of a curling stone.

A stone laid tee high has a run of 42 yards. It has spin (called handle), which remains almost constant until near the end of the run. The total lateral divergence of the stone, from the straight line on which it is laid by the player, is called the borrow. Clockwise spin (in handle) causes divergence to the right; the opposite spin (out handle) causes divergence to the left. Spin is necessary, because a stone laid without spin is at the mercy of any slight irregularity in the ice which may catch one side of it. Ordinarily, the spin is between 3 and 5 complete turns in the run of 42 yards. Between these limits the borrow is not much affected by the amount of the spin; probably it is affected a little, increasing slightly with increased spin. But a substantial increase of the spin beyond this range decreases the borrow; and

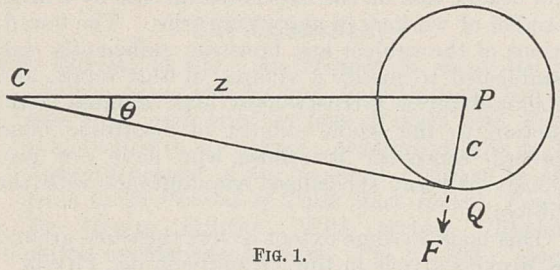


FIG. 1.

by giving a very heavy spin a nearly straight path can be obtained. Sweeping in front of a stone, which on good dry ice reduces friction, at the same time delays or reduces the bending of the path.

Sir Gilbert Walker has remarked that the direction of the borrow requires that the friction at the back edge of the cup, on which the stone runs, should be greater than at the front edge; and that, in consequence of retardation, the pressure between the stone and the ice is greater in front than behind. But we have not been able to hear of any attempt to consider the borrow quantitatively. The following calculation for a simple case will show the way in which we have attacked the problem.

Suppose the total friction to be constant, and applied in the way most favourable to curvature of the path; and let us deal only with the first 40 yards of the run. By the omission of the last two yards we avoid complications introduced at the very end of the run; and this is found, in our calculation, to be sufficient to provide that we are dealing with a portion of the run in which the angles involved are small angles the squares of which are negligible.

Let P be any point in the first 40 yards of the path of the centre of a stone laid tee high. Let C be the instantaneous centre of the motion, and Q the point of contact of a tangent drawn from C to the cup. Then PCQ is a small angle, θ. We assume that the friction at any point acts in the direction opposite to that in which the point is moving; but we do not know how it is distributed round the cup. Let us take the extreme case in which it is concentrated into a single force, F, at Q, in the direction of PQ. We will assume this force to be constant. We write F for $F\cos\theta$, and the force along the normal to the path is $F\sin\theta$, or $F\frac{c}{z}$, where c is the radius of the cup, and z is written for CP. Let M be the mass of the stone, τ the whole time of the run, and l the whole length, s the length of the path measured backwards from the tee up to P, ψ the inclination of the tangent at P to the line on which the stone was laid, y the distance of P from this line, ρ the radius of curvature, v the velocity of the centre of the stone, f the tangential component of the retardation, and ω the angular velocity, which must be constant within our range. Then the following equations seem to be nearly correct:

$$Mf=F,\quad l=\tfrac{1}{2}f\tau^2,\quad v^2=2fs,\quad \frac{v^2}{\rho}=f\frac{c}{z},\quad v=z\omega,$$

$$\frac{1}{\rho}=-\frac{d\psi}{ds},\qquad -\frac{dy}{ds}=\sin\psi.$$

Thus we get

$$-\frac{d\psi}{ds}=\frac{fc\omega}{v^3}=\tfrac{1}{4}c\omega\tau l^{-\frac{1}{2}}s^{-\frac{3}{2}},$$

and, by integration,

$$\psi=\tfrac{1}{2}c\omega\tau l^{-\frac{1}{2}}(s^{-\frac{1}{2}}-l^{-\frac{1}{2}}),$$

and writing $\sin\psi$, or $-\frac{dy}{ds}$, for the small angle ψ, and integrating again,

$$y=\tfrac{1}{2}c\omega\tau l^{-1}(l^{\frac{1}{2}}-s^{\frac{1}{2}})^2.$$

With a cup of $4\frac{1}{2}$ inches diameter, and a spin of 5 turns in the length of the run, the value of $\frac{1}{2}c\omega\tau l^{-1}$ is about 0·025. Thus the value of y at a point 2 yards short of the tee is 1 ft. 11 in. (At this point θ and ψ are about 0·1.)

This is a disconcerting result. No reasonable correction of the point from which s and l are taken to be measured alters the general character of it. The calculated borrow might perhaps be accepted for average conditions, but it is much too small to admit allowance for variation of the data. To account for the facts, it seems to be necessary to suppose that increased spin tends (in some way not explained) to equalise the friction in front and behind, and thus counteract the effect of the increased value of ω. But by putting all the friction behind, with a spin of 5 turns, we have not left room for this; nor for the occasional occurrence of borrow of exceptional magnitude.

There remains the question whether it is approximately correct to take the total friction to be constant during the run. We know its average value; the question is whether it increases to a value substantially above the average as the velocity decreases. In several successive years, so far as we have had occasional opportunities, we have tried to test this. But our results have not shown this variation; indeed, our records have a slight tendency to show a little decrease of friction at the point at which increase is most wanted. We began by using stop-watches; but eventually we had a suitable electric chronograph, and stretched threads across the ice, the slightest twitch of which made an electric contact. Thus we have some fairly accurate records.

We have also used a dynamometer to test the relation between total friction and pressure. For various reasons this could not be used so as to give very accurate results; but it showed that if a stone was loaded so as to increase the pressure by varying amounts up to 40 per cent, the total friction was nearly constant. Doubled pressure gave a considerable increase of friction. A consistent variation of

10 per cent would not have escaped notice. The friction thus measured, when a stone was towed at a foot's pace, agreed roughly with that shown in an ordinary run of a stone.

It seems clear that we have failed to take account of some important feature of the motion. What is it ?

W. H. MACAULAY.

King's College, Cambridge.

G. E. SMITH.

Cherry Tree Lane, Woodbridge,
Feb. 18.

Gaseous Combustion.

I AM greatly indebted to Prof. Bone for the very clear exposition of his views in the issue of NATURE for Feb. 22. I think, however, that a serious misunderstanding has arisen which I should like to try to make clear.

In the letter in NATURE for Jan. 25 from Mr. Davies and myself, it was stated that our new experiments suggested the analysis of the overall process of combustion into two broad stages :

(1) The combination (and of course the main) stage, resulting in the formation of molecules of carbon dioxide and water of abnormal structure, during which the energy released is $H - x$, where H is the heat of combustion.

(2) The passage of these molecules of abnormal structure into normal molecules during which energy x is released. (While x cannot be a large proportion of H, the platinum wire experiments mentioned in our letter suggest that it is of appreciable magnitude.)

The misunderstanding mainly arises, I think, in the matter of time scale. The second stage—if the suggested analysis is to explain our experiments—must be regarded as being one of extraordinarily long duration when combustion takes place in the gaseous phase. As indicated in our letter, we appear to have traced its existence for so long as 14 seconds after maximum pressure in an explosion, and we have little doubt that we could trace it for a much longer time with new apparatus.

Assuming the correctness of this view, it will be clear that in ordinary explosion experiments, in which measurements are rarely, if ever, made later than one second after maximum pressure, this stage, so very slowly does it progress, may for many purposes be disregarded and the explosion regarded as one in which energy amounting to $H - x$ approximately is released. It is, for example, disregarded in this manner in the coal-gas explosion experiments mentioned by Prof. Bone, from which I estimated that about 10 per cent of the gas is unburnt at maximum pressure, for the method adopted was roughly that of comparing the energy at the moment of maximum temperature in a weak mixture explosion with that remaining in an exploded strong mixture after it had cooled to the maximum temperature of the weak mixture, and the cooling to this temperature took only about $\frac{1}{4}$ sec. Thus the estimate of 10 per cent unburnt gas (which should now be amended to the slightly different value 10 $H/(H - x)$ per cent) derived from these experiments refers only to incompleteness of the first stage. The experiments further appear to indicate that burning in the weak mixture is also complete in this sense in about $\frac{1}{4}$ sec. after maximum pressure (*Proc. Roy. Soc.*, vol. 98, p. 313).

While Prof. Bone is somewhat doubtful as to the duration of what we have termed the second stage in the overall process of combustion, I think I am right in my interpretation of his letter in assuming that the main difference of opinion between us is in regard to the way in which this 10 per cent (or rather 10 $H/(H - x)$ per cent) is to be accounted for. My view in regard to this is unchanged ; I believe that it is to be accounted for in terms of uncombined gas. Prof. Bone believes that it is to be explained in terms of excess energy concentrated in the vibratory and rotational degrees of freedom of the freshly formed molecules. I fully admit that, in the absence of chemical analysis, my view must remain a hypothesis, but I prefer it to his view for the reason he mentions, namely, that I think partitioning at explosion temperatures must be very rapid, and also because my experiments indicate that the radiation at the maximum temperature in a weak or medium mixture is very little greater than that from a strong mixture when it has cooled to this temperature. Such small difference as there is may be readily explained in terms of the greater temperature variation in exploded gases at the moment of maximum temperature than some time later, and also of the higher transparency of the gases at that time (*Phil. Trans.*, A, vol. 211, pp. 386 and 398 ; and *Proc. Roy. Soc.*, A, vol. 98, pp. 189 and 195). Furthermore, I find less difficulty than ever in believing in the reality of incomplete combination at maximum pressure in ordinary explosions since Prof. Bone has published his analyses of the cold products of dry carbon monoxide mixture explosions. He shows that in these very stubborn mixtures there is a large proportion of carbon monoxide in the products after explosion, although the flame during the explosion period had completely traversed the mixtures and the time interval during which combination could take place was very much longer than the interval from ignition to maximum pressure in ordinary explosions.

The main object of our letter published in NATURE for Jan. 25 was to suggest that what we have called the long-drawn-out second stage in the overall process of combustion is a possible explanation of our luminosity and platinum wire measurements. As already stated, we found that in a large explosion vessel (18-inch sphere) silver plated so as to arrange for as slow cooling as possible, the luminosity in a 30 per cent moist carbon monoxide–air mixture at 3 atmospheres density remained visible to the eye for at least 14 sec. after maximum pressure, that is, until the temperature had fallen to about 300° C. I believe Prof. Bone has a high pressure explosion vessel fitted with a quartz window, and it would be of great interest if he could indicate the duration of luminosity after maximum pressure in a high pressure explosion and also give an estimate of the temperature at which luminosity disappears. If, as seems reasonable to suppose, the second stage is speeded up in a high density mixture, the temperature at which luminosity ceases to be visible to the eye should be higher than 300° C.

If the second stage can be shown conclusively to exist, it is of interest to note that an internal combustion engine exhausts the working fluid with its carbon dioxide and water molecules in the abnormal condition, and, if x is appreciable, an appreciable amount of energy is thereby wasted. A window fitted to the exhaust pipe of a gas engine shows that the exhaust gases (temp. 500° C.-600° C.) are luminous, though chemical analysis fails to detect uncombined gas.

Exceedingly interesting information can be collected from the literature of the internal-combustion engine in this connexion. For example, Hopkinson, by means of an exhaust gas calorimeter, found in the exhaust gases actually more heat that he deduced from the temperature (as inferred from the pressure) of the working fluid in the cylinder at the end of the explosion-expansion stroke, in spite of the fact that the opinion is firmly held that as much as 10 per cent of the heat of combustion of the charge is lost to the cylinder

walls and the exhaust valve during the exhaust stroke, and has therefore been extracted from the working fluid before it reaches the calorimeter (Scientific Papers, pp. 272 and 288).

This would, of course, yield a very high value for x—much higher than I should have thought possible. It is right, however, to add that although Hopkinson's experiments relate to the same engine and are given in the same paper, he does not appear to have correlated the two sets of figures. But even so, after making large allowance for possible experimental error, we are still left with a value for x which suggests its very real practical importance.

W. T. DAVID.

Engineering Department,
The University, Leeds,
Feb. 24.

Australian Origin of Red Rain in New Zealand.

WE have recently had two striking examples of the manner in which the influence of a continent may extend, in ways which might easily be overlooked, to enormous distances round about it. It is well known that in dry years large quantities of smoke from bush fires in Australia are carried by the south-east monsoon over the East Indian Archipelago. On Oct. 25 and 26, 1929, however, dense haze, which can have had none other than an Australian origin, was seen at the Island of Niue in lat. 19° S., long. 170° W., 2300 miles distant from Australia. The meteorological observer, Mr. J. P. McMahon-Box, reports that "A strange smoky haze enveloped the whole Island on the 25th and 26th. It came up about midnight on the 24th to 25th, apparently from the south-west, in which direction it was densest. Visibility was very poor indeed. . . . It disappeared during the night of the 26th to 27th. . . . We experienced a couple of thunderstorms during the period of the haze."

On reference to the weather charts, it is found that on the morning of Oct. 22 a rather intense anticyclone was centred just west of Tasmania, while a deep cyclone had developed in the Tasman Sea. Strong south-west or southerly winds were blowing over eastern Australia, where there had been little rain. It is probable that dense masses of bush-fire smoke mixed with fine dust started on the journey to Niue on that day. During the following days the cyclone moved eastward, its track curving round to the north of New Zealand. At 9 A.M. (New Zealand time) on Oct. 24 its centre was in about 32° S. and 178° E., the pressure being below 29·10 inches. The strong west to south winds in the north-west quadrant of the cyclone made conditions ideal for the transport of dust and smoke from Australia to the Pacific Islands. It is worth noting that thunderstorms were reported near the centre of the cyclone on both Oct. 22 and 24, when vessels happened to be favourably situated.

The second phenomenon was recorded in New Zealand on Nov. 27, when copious deposits of red dust, such as is found in the interior of Australia, were brought down by rain over a wide area covering the Marlborough, Nelson, and Taranaki Provinces, and the portion of the Wellington Province lying to the west of the mountain ranges. Flowers, washing, motor-cars, etc., were stained a pale chocolate colour. Many observers noted that the clouds had a reddish-brown appearance and some severe thunderstorms occurred. Several samples of the dust were sent to the Meteorological Office. Another interesting sample was forwarded by Mr. A. C. Jones, the second officer of the M.S. *Taranaki*. This was found adhering to damp structures on the vessel when 190 miles from the Australian coast on Nov. 23. The vessel was in dust haze when between the following positions, 39° 43′ S., 151° 4′ E., and 39° 56′ S., 152° 43′ E.

On this occasion again the dust was brought to New Zealand by the winds in the north-west quadrant of a complicated depression which moved across the Tasman Sea between Nov. 23 and 28. This depression was at first of the inverted-V type, but afterwards two cyclonic centres developed in the northern portion. One of these disappeared, and by Nov. 27 a deep cyclone was centred off the south-west coast of the Dominion.

At Reefton, in the Nelson Province, a slight sediment was left by the rain on Sept. 4, 1929.

The most notable deposit of dust from Australia on New Zealand occurred, however, on Oct. 6–10, 1928, and is described in papers by Dr. P. Marshall and myself in the *New Zealand Journal of Science and Technology*, vol. 10, No. 5, pp. 291-99; 1929. Following on that occurrence the snow for many miles, probably 200 to 300, along the main ranges of the South Island, was for months stained a pale chocolate colour. On Ben Lomond, near Queenstown, in Otago, at the end of October, I found the snow impregnated with the dust in a layer about five inches thick. From the amount of snow I was able to carry away in a handkerchief, more than 4 grams of deposit were collected. 200,000 tons is a conservative estimate for the weight of the total deposit on New Zealand in this fall. On this occasion, also, thunderstorms were numerous and very violent, and it seems certain that the suspended dust is, in part at least, responsible for their development.

It will be seen that dust storms of the nature described may, in the course of time, be responsible for a red sediment of no inconsiderable thickness on the floors of the Tasman Sea and the Pacific Ocean.

EDWARD KIDSON.

Meteorological Office, Wellington,
Dec. 27, 1929.

THE sample of red rain dust collected at Ben Lomond, near Queenstown in southern New Zealand, by Dr. Kidson, which the Editor has kindly sent me for inspection, agrees in its microscopic characters with falls previously described. It contains some coarse quartz grains, doubtless of local origin, but the bulk is a fine clay and silt such as is common on the dry lake beds of the interior of Australia; it contains some diatoms and shreds of algæ, which look like those that grow in the pools in such localities.

The red rain that falls in Victoria acts as an indelible stain on fresh paint, and that which fell on Feb. 14, 1903, was proved by F. Chapman and H. J. Grayson (*Vict. Naturalist*, vol. 20, pp. 17-32, pl. i, ii; 1903) from the diatoms to be derived "from the swamps and salt-lakes which fringe the River Murray and its tributaries" and from other rivers in South Australia. These authors proved the same origin for some material which I obtained in southern New Zealand, which must have travelled in the air for more than 1000 miles; this record was given in my "Geography of Victoria", p. 264.

I cannot determine the diatoms in Dr. Kidson's sample; but the character of the material is strikingly like that of the lake plains of Lakes Eyre, Callabonna, etc., in South Australia, and fully supports Mr. Kidson's conclusions. This record is of interest not only as of another occurrence of his widespread dust distribution, but also from his estimates of its quantity.

This red dust no doubt contributes to the red clay of the deep sea; but that material covers so vast an area, and often lies so far from any likely source of desert supply, that the abysmal red clay is probably

in the main derived from other sources. The red clay of the Tasman Sea may be largely composed of this desert dust, and its comparison with that from the central Pacific would be of interest.

I have not yet had the opportunity of seeing the recent paper in the *N.Z. Journal of Science and Technology* referred to by Dr. Kidson.

Black snow and black rain fall in the south-west of Scotland, but when some of this was sent to Glasgow, it was determined by Mr. B. K. N. Wyllie as due to particles of slag from the Cumberland iron works (*Scottish Ski-Club Magaz.*, January 1912, pp. 153-5).

J. W. GREGORY.

The Present Status of *Drosophila melanogaster*.

DURING more than two decades *Drosophila melanogaster* has occupied a prominent position in connexion with developments in biological theory. Its extreme variability was noted in 1906 by Castle, and its peculiarities in this respect were later exploited by Morgan and his associates in a long series of publications. On account of the great ease with which this fly can be maintained in cultures and of the short life cycle, it has proved most convenient for genetical investigations. Apparently, experimental work excites a disproportionate degree of credence at the present time in connexion with biological theories. Experimental work, from the evolutionary point of view at any rate, by itself alone, appears to have a definitely restricted value.

It has been known ever since Rosenberg's truly epoch-making investigations on the cytology of the hybrid between *Drosera rotundifolia* and *D. longifolia* that there are certain cytological characteristics which are of fundamental importance in connexion with the study of hybrids between species. Starting with his work on the hybrid between these two species, commonly known as *D. obovata*, Rosenberg was led to extend his observations to variable species in Nature, notably the genus *Rosa* as represented by the dog roses of Europe. Similar observations have been carried out in my laboratories on other genera of the Rosaceæ, namely, the extremely variable and exceedingly numerous American species of the genus *Cratægus* and of the equally variable American blackberries. Further observations carried on in the southern hemisphere in the case of the huge and variable genera *Eucalyptus*, *Acacia*, and *Veronica*, show that this condition is not confined in any way geographically, but is a feature commonly exemplified by large genera. This state of variability in large genera was prophetically pointed out, many years ago, by Charles Darwin in the "Origin of Species".

Those species which are the favourite material of genetical experimenters at the present time are species which have all the variability of hybrids. This condition has long been recognised in the case of the species of the genus *Œnothera*, which was brought into prominence more than two decades ago by De Vries. There are now scarcely any students of the genus who do not admit that its species are very largely contaminated by hybridisation. On the botanical side the idea of widespread hybridism in Nature is more and more hospitably received. On the zoological side we find, however, a much less degree of cordiality towards this idea. It is strongly maintained by many geneticists, for example, that *D. melanogaster* is a good species, and one of the pieces of evidence cited in this connexion is that it does not readily cross with other species of the genus. This turns out to be an untrustworthy criterion, however, because cases are known on the botanical side of experimentally produced hybrids which will not back-cross even to their own parents.

In 1925 the present writer, in collaboration with Prof. G. C. Hicks, published [1, 2, 3] a number of observations on the meiotic or maturation division in the male gonads of *D. melanogaster*. These observations were rendered possible by the development of methods which made it feasible to examine a huge amount of material with a minimum amount of effort. The investigations showed clearly that the reduction division in *D. melanogaster* presents all the peculiarities of those found in natural or experimentally produced hybrids. In 1928, Belar [4] published some photomicrographs which, according to his view, showed the inaccuracy of the observations made by the present writer and Prof. Hicks. Belar's figures of the division of the primary spermatocytes, however, show a distinct lagging of the chromosomes in the maturation division, which is recognisable by all who are familiar with the cytology of hybrids as a distinct criterion of hybrid origin. Very recently Zuitin has published in the *Bulletins* of the Bureau of Genetics of Leningrad (vol. 7, 1929) an account of the reduction division in this species. His results confirm the accuracy of the observations made by Prof. Hicks and the writer, inasmuch as he figures the abnormalities described in our papers published in 1925. He reaches the conclusion, further, that *D. melanogaster*, as he puts it, has the cytological abnormalities of "special [obviously the meaning is interspecific] hybrids".

It will be obvious to the reader that *D. melanogaster* as an object of genetical investigation must be subject to all the reservations which should be made in the case of the study of hybrids. Probably the reluctance of geneticists in general to admit the hybrid origin of *D. melanogaster* arises out of the fear lest either the Mendelian hypothesis or the chromosome theory of heredity should be thereby compromised. It is also important to note that not only breeding experiments with *D. melanogaster* are open to such criticisms as would arise from the hybrid character of the material, but also the investigation of this and other variable species by means of radiations is likewise open to grave question. Another prominent weakness of actinic experimentation in connexion with theories of the origin of species is the fact that there is no reason to suppose that such radiations have any important influence in moulding species in Nature.

E. C. JEFFREY.

Botanical Laboratories,
Harvard University, Cambridge,
Massachusetts.

[1] Jeffrey, E. C. "*Drosophila* and the Mutation Hypothesis." *Science*, vol. 62, No. 1592; 1925.
[2] Jeffrey, E. C., and Hicks, G. C. "The Reduction Division in Relation to Mutation in Plants and Animals." *American Naturalist*, vol. 59; 1925.
[3] Jeffrey, E. C., and Hicks, G. C. "Evidence as to the Cause of So-Called Mutations in *Drosophila*." *Genetica*, 7, 1925.
[4] Belar, "Die cytologischen Grundlagen der Vererbung". Handbuch der Vererbungswissenschaft, Berlin; 1928.

The Water Balance of Plants as a Factor in their Resistance to Insect Pests.

As a result of a review of the available evidence with regard to the effect of climatic and soil conditions on the distribution of the *Dysdercus* sp., the hypothesis was put forward by one of us (E. P. M.) in 1925–26 that a disturbed water content, from whatever cause, rendered the cotton plant more susceptible to the attack of sap-feeding insect pests, such as various species of thrips. Later it was found that this hypothesis appeared also to hold true in the case of certain sap-feeding insect pests of sugar-cane, notably the

froghopper *Tomaspis saccharina* Dist. So far as cotton is concerned, the hypothesis has since been confirmed by observations made in the field in California.

In the autumn of 1926 several extensive tours were made into the cotton-growing regions of California, which included not only the well-known Sacramento, San Joaquin, and Imperial Valleys, but also the lesser known Ferris, Coachella, Palo Verde, and Barde Valleys. At that time more than 160,000 acres of cotton were growing in California proper, an additional 130,000 acres occurring in Lower California. It was then found that thrips (*Heliothrips fasciatus* Perg.) attack on Acala cotton invariably followed faulty irrigation practice. Thrips were never found in large numbers on plants receiving an optimum water supply. It seemed that plants suffering from water shortage were definitely more attractive to the attacking thrips.

W. B. Camp, of the U.S. Bureau of Plant Industry, working in collaboration with the Department of Agriculture, has been carrying out a series of experiments on these lines for a number of years, and we have reason to believe that this hypothesis is supported and extended by the results of his researches. It also receives support from Bedford's observations on thrips (*Heliothrips indicus* Bagnall) attack on Egyptian cotton in the Sudan (*Wellcome Trop. Res. Lab., Khartoum, Ent. Sec. Bul.*, **18**, 1921), though in some respects it would appear to be contradicted by Wardle's observations on *Thrips tabaci* Lind. attack on cotton in a Manchester greenhouse (*Ann. App. Biol.*, **14**, 482; 1927. Compare also MacGill, *ibid.*, **16**, 288; 1929).

With regard to the sugar-cane froghopper (*Tomaspis saccharina* Dist.), the hypothesis has also received striking confirmation in practical experiments by Withycombe (*Ann. App. Biol.*, **13**, 64; 1926. *Proc. Agric. Soc. Trinidad and Tobago*, **26**, No. 6, 294; 1926) and other workers in the West Indies. Increasingly we are led to believe that the hypothesis holds true for a large number, but not all, species of thrips, red spider, etc., as pests of a wide range of food plants. Several cases are cited by Lees (*Ann. App. Biol.*, **13**, 506; 1926) in which heavy irrigation and heavy rainfall resulted in increased susceptibility to insect attack, but it is not improbable that, in a number of cases, conditions of physiological drought were present as a result of deficient soil aeration.

It seems also that the nitrogen content of the sap is an important factor with regard to susceptibility to attack. This has been referred to by Davidson (*Ann. App. Biol.*, **10**, 35; 1923) and by Lees (loc. cit.). Experiments carried out by one of us (E. P. M.) on the curly-top disease of the sugar-beet in California, transmitted by the leafhopper *Eutettix tenellus* Bak. (results to be published shortly in *Annals of Applied Biology*), point in a similar direction. There is, indeed, much evidence available which indicates that a highly nitrogenous diet stimulates reproduction. The two factors, water content and the nitrogen content of the sap, are interdependent, but it would form an interesting problem in nutrition to find which of the two is of the greater importance in any particular case.

The specific rôle of water in the metabolism of plant and insect is not mentioned by Uvarov in his recent memoir and review of the literature on insect nutrition and metabolism (*Trans. Ent. Soc., London*, Pt. 2; December 1928), although considerable attention is paid to the related subjects of the food of insects and the influence of diet on growth and reproduction. There is also no reference in "Filterable Viruses" (Ed. by T. M. Rivers; Baillière, Tindall and Cox, 1929) to the water relationships in plants susceptible to virus diseases, but it is a frequent observation that plants so infected have, in general, poorly developed root systems.

In order to understand these diseases more fully, much further work will be necessary on insect nutrition and metabolism, their habits, host-plants, and rates of reproduction, and in particular on the specific biological relationships which appear to exist in many cases between the insect and the disease it transmits. In this connexion it seemed desirable again to direct attention to the water balance of plants as a factor in their resistance to insect pests.

E. PHILPOTT MUMFORD.
Pacific Entomological Survey,
Marquesas Islands.

D. HOLROYDE HEY.
The University,
Manchester, Feb. 14.

Starch Envelopes of Pyrenoids.

THE pyrenoids are colourless masses of protein associated with the chromatophores in several classes of the Protophyta. They have been most studied in the Isokontæ (Boubier, *Bull. Herb. Boissier*, **7**, p. 451; 1899; Bourquin, *Bot. Gaz.*, **64**, 426; 1917), where they are embedded in the substance of the chloroplast and are covered with an envelope consisting of small starch grains which are the last to disappear under starvation conditions. The pyrenoids are generally regarded as reserve protein stores. During the formation of reproductive cells they disappear more or less completely.

Starch formation and accumulation does not seem to be confined to the neighbourhood of the pyrenoids. According to Timberlake (*Ann. of Bot.*, **15**, 624; 1901), however, in the case of *Hydrodictyon*, and to Carter (*ibid.*, **33**, 475; 1919) in the case of *Cladophora*, all the starch is derived from the pyrenoids.

If we regard the pyrenoids as storehouses of reserve protein, the exact conditions and the mechanism by which this reserve is utilised are not yet fully established. Steinecke and Ziegenspeck (*Ber. Deutsch. Bot. Ges.*, **46**, 678-681; 24/1) are of the opinion that the pyrenoids function as a storehouse for a prophase of a starch-building ferment, a view which has been adversely criticised by Czurda (*ibid.*, **47**, 181-185, 25/4).

The observations of Timberlake and Carter indicate that a reaction as shown by the equation:

Protein $\longrightarrow$ Carbohydrate + Protein Fission Product

is possible.

The reaction might in fact be considered as reversible; thus, Protein $\leftrightharpoons$ Carbohydrate + Protein Fission Product.

In a preliminary series of experiments on the action of ultra-violet light on protein solutions, results have been obtained which may throw some light on this question of protein-carbohydrate metabolism in plants. A 0·50 per cent solution of recrystallised ovalbumin at any reaction increases in hydrogen ion concentration on irradiation. In the case of ovalbumin, when the reaction is near that of the isoelectric point, the protein is partly or completely denatured. Thus with an initial *p*H value of 5·92, four hours' irradiation partly denatured the protein and caused the reaction to drop to *p*H 5·33. The coagulum was soluble in alkali and not soluble in acid and was probably an acid-metaprotein. The most striking feature of the experiments was that formaldehyde was distinctly recognisable by its odour in several instances of prolonged irradiation.

Irradiation in presence of chlorauric acid produced a splendid gold sol, but only if the solution was acidic in reaction. The gold sol increased in depth of colour

when the solution was afterwards heated. An irradiated solution of ovalbumin with a perceptible odour of formaldehyde gave on distillation an aqueous distillate neutral in reaction, and whilst not responding to the pyrogallol and nitroprusside-phenylhydrazine tests for formaldehyde, it produced a brown coloration with ammoniacal silver nitrate on boiling.

The conclusion is that formaldehyde (or some substance resembling formaldehyde) is produced on irradiation of ovalbumin by ultra-violet light. The increased acidity is probably due to conversion of amino groups to methylene derivatives by the aldehyde (Henriques and Sørensen, *Zeit. physiol. Chem.*, **64**, 120; 1909). An alkaline reaction evidently favours such a combination, with the result that no reducing action (as, for example, on gold chloride) can take place.

That formaldehyde functions as a precursor of hexoses and starches is generally accepted, and hence it is conceivable that the protein of the pyrenoids can give rise to the carbohydrate of their envelopes.

The action of ultra-violet light on proteins is being further investigated.

F. O. HOWITT.

University College,
Nottingham, Feb. 3.

Globular Lightning.

PROF. MARCHANT'S account of a case of globular lightning inside a room, in NATURE of Jan. 25, leads me to think that the publication of the details of two somewhat similar instances which occurred in the dining-room of the Faulhorn Hotel, near Grindelwald, are worth putting on record.

I did not witness either occurrence myself, but I questioned Fräulein Suzanne Iacci, the manageress of the hotel, on the subject on Aug. 2, 1925; her answers are given in inverted commas.

It seems probable that both induction and stationary waves are concerned with the phenomena.

"About 5 P.M. of a hot fine July afternoon in 1921, I was in the dining-room of the hotel, with my sister Margaret and six other guests. A dark cloud was noticed approaching from the east, but neither rain, hail, nor snow fell before the occurrence of the fire-balls, and only distant lightning had been observed. Suddenly from the air inlet of the large stove, in which a small wood fire was burning, came, practically simultaneously, a large number of very bright round balls of various colours, the largest perhaps nearly as large as my head. Almost at the same moment, a dreadful deafening explosion occurred, and the balls had all vanished. The room was full of a grey smoke —perhaps disturbed dust—and a strong peculiar odour was observed. I opened the doors to clear the air, and then examined the room. I could find no signs of scorching on the curtains, flowers, or the unenclosed stuffed birds and animals in the room. The fire had not been disturbed, and none of the fuel was ejected. The guests who were nearest the stove momentarily experienced a slight electric shock, but no one was injured. I myself was farther away, and did not feel any shock.

"In July 1914 my sister Louise and Madame Bohren, the wife of the proprietor, were in this same room during a hailstorm, and they had a similar experience. On this occasion the stove was not alight. No damage was done on this occasion either.

"During thunderstorms I always warn people not to stand too close to the stove, as they sometimes receive nasty electric sparks. There is no record of any serious injury here since the hotel was built in 1830."

I afterwards interviewed the sister (Margaret) and Mme Bohren in Grindelwald. Their account nearly agreed with the above, though to the latter the incandescent spheres of 1914 appeared of the same colour and size—"reddish and of about the size of my two hands". I should add that this hotel stands in a very exposed position only a few feet from the summit of the Faulhorn (8800 feet). It is surrounded by a series of lightning conductors. The closed cylindrical stove was 5 feet 4 inches high and 2 feet 2 inches diameter. It stood just away from the wall of the room on a wooden plank. The air inlet referred to above was rhomboidal in shape—the sides being 1·7 cm. and 4·3 cm. in length. The iron flue at the top was 11 cm. in diameter. For warming purposes this flue passes horizontally through several bedrooms on the floor above the dining-room before issuing through the roof some 20 feet above the stove. I have a small photograph of this stove and will lend it to anyone interested in it.

Since the last occurrence the stove has been 'earthed', and a lightning conductor has been fixed above the chimney.

WILLIAM COLEBROOK REYNOLDS.

"Wharfedale", Upminster,
Essex, Feb. 4.

Improvements in the Peel-Method of Preparing Sections of Fossil Plants.

THE peel-method of preparing sections of fossil plants was briefly described by me in NATURE of Oct. 13, 1928, p. 571. The use of cellulose esters was recommended for preparing peel-sections. Since writing that letter, I have performed experiments on the use of gelatine instead of cellulose esters, and have obtained results which fully justify the adoption of gelatine on many occasions in which this type of section is required. For small sections the cellulose ester solutions are more easily applicable, but for large sections, for example, those exceeding 2 sq. decimetres in area, gelatine is preferable.

Gelatine peel-sections are non-inflammable and involve in their preparation none of the unpleasant smelling and sometimes actually noxious solvents necessary when using cellulose esters. There is very little difference in translucency; cellulose pell-sections are perhaps a little clearer than gelatine, but this advantage amounts to little.

The surface of the petrifaction is prepared and etched with acid in the manner described before, washed, and then, *before* the surface is allowed to dry, a hot solution of jelly containing a certain quantity of glycerine and formalin is poured on to the surface. The quantities and proportions used must be determined by experiment. To cover a surface 1 sq. decimetre in area it is necessary to use about 2 grams of fairly pure gelatine such as that used in making bacteriological cultures, 50 c.c. water, 0·5 c.c. glycerine, and 0·5 c.c. formalin (40 per cent). The surface must be surrounded before the etching process with a rim of plasticene or some other substance and should be levelled by means of a spirit-level. The water and glycerine are mixed, heated, and the jelly stirred until dissolved. The heating is continued until the mixture is at a temperature of about 60° to 80° C. The formalin is then stirred in quickly and the solution is immediately poured over the surface of the petrifaction. The jelly is allowed to set, and then the specimen under treatment may be removed with its adhering layer of jelly to a warm, well-aired place to dry. Dust must not be allowed to settle on the jelly. When the jelly has become dry it may be peeled off. As it is always more brittle than cellulose

there is more difficulty in starting the peeling process, but on the other hand when once a satisfactory start is made it peels off more readily.

Large sections have been prepared (about 20 sq. decimetres in area) with scarcely a detectable flaw and with the cellular details of the fossil-plants perfectly represented. Gelatine peels may be cleared in zylol and mounted in Canada balsam solutions.

JOHN WALTON.

Botanical Department,
The University, Manchester, Feb. 6.

Matthew Island.

ON May 7, 1928, when on the s.s. *Suva*, I passed close to Matthew Island, in the South Pacific, but was unable to land. It is about 200 miles from the nearest of the Loyalty Islands, and about 170 from the southernmost of the New Hebrides. It is known to be inhabited by numerous sea-birds, and it is possible to see green vegetation on the sides of the central mass. I could not see any coconut palms. From the heavy surf dashing against the shore, it appeared that landing would be difficult, but I was told that the island was used for target practice by British gunners during the War. Owing to the position of the island, and the many interesting problems connected with the fauna and flora of the New Caledonia and New Hebrides groups, any endemic terrestrial animals or plants found upon it would be of extraordinary interest. It may be that none will be found, but I think the chances for discovery are good enough to justify a careful search, especially in view of the richness of Norfolk Island and Lord Howe Island. Perhaps there are some records, but I have not heard of any, and believe that no careful investigation has ever been made.

Matthew Island was discovered in 1788 by Capt. Gilbert on the *Charlotte*. It is said to be 465 feet high, of volcanic formation, composed principally of basaltic rock. The outline is roughly triangular, each side about a third of a mile long. It may perhaps be regarded as the southernmost point of the New Hebridean chain, although the nearest relatively shallow water is that of the New Caledonian group.

The Middleton Reef, north of Lord Howe Island, has a fair-sized rock above the sea, but this is undoubtedly devoid of terrestrial life other than sea-birds.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado, Feb. 12.

The Moment of the Bromine Nucleus.

THE following interpretation has been given by Kiess and de Bruin (U.S. Bureau of Standards *Journal*, in print) of the strong bromine arc lines:

Int.	λ	Combination.
15	6631·64	$5s\ {}^4P_{5/2} - 5p\ {}^2D_{5/2}$
12	6559·81	$5s\ {}^4P_{5/2} - 5p\ {}^4S_{3/2}$
20	6350·74	$5s\ {}^4P_{5/2} - 5p\ {}^2P_{3/2}$
12	6148·62	$5s\ {}^4P_{5/2} - 5p\ {}^2D_{3/2}$

These lines have thus the same end-level ${}^4P_{5/2}$ originating in the coupling of a 5*s*-electron.

The hyper-fine structure of bromine lines has been investigated by Kimura (*Mem. Coll. Sci., Kyoto*, **4**, p. 133; 1920) and by Hori (*Mem. Coll. Sci., Kyoto*, **9**, p. 312; 1926). The above-mentioned lines are quadruplets consisting of a series of components of decreasing spacing and intensities. The distances between the components are in all cases practically the same: $\Delta\nu = 0{\cdot}19$, $0{\cdot}13$, and $0{\cdot}08$.

In combining the value $i = 3/2$ with the value $j = 5/2$, one finds the right number of hyperfine structure levels, namely, four. Further, one should expect on the basis of the interval rule for the ratio between the hyperfine structure levels 4 : 3 : 2, which is in good agreement with the observed values 4 : 2·7 : 1·7. It seems, therefore, probable that the moment of the bromine nucleus is $i = 3/2$.

The Zeeman effect of these hyperfine structures will be investigated.

T. L. DE BRUIN.

Laboratory 'Physica' of the University
of Amsterdam, Feb. 6.

Zoological Nomenclature: Acarine or Insect?

IN answer to Dr. C. W. Stiles's letter in NATURE of Feb. 9, 1929, p. 207, in which he states "that application for suspension of the rules has been made in the case of *Nycteribia* Latreille, 1796, monotype *Pediculus vespertilionis* Linn., 1758. The Commission is requested to set aside the monotype designated in 1796 and to validate *Nycteribia pedicularia* 1805 as type of *Nycteribia*", I desire to point out that as Latreille's description is based on an insect, and as the so-called monotype is an acarid, it follows that the name Nycteribia cannot supplant *Spinturnix* for the genus in which *Pediculus* [Scopoli used *Acarus*.—Ed. NATURE] *vespertilionis* Scopoli 1763 is now placed.

1. *Pediculus vespertilionis* Linné 1758 is a *Nycteribia* from his diagnosis, therefore no emendation is necessary.

2. *N. pedicularia* Latreille 1805 is the same species.

3. *N. vespertilionis* cannot be an acarid as suggested by the pretext for alteration.

ANTHONY MUSGRAVE
(Entomologist).

The Australian Museum,
Sydney, Dec. 13, 1929.

THE foregoing letter from Dr. Musgrave, one of the world's best-known authors on the *Pupipara* (in which *Nycteribia* is classified), presents one angle of the triangular problem upon which the International Commission on Zoological Nomenclature has been requested to render an opinion: (1) From 1763 to 1796, *Pediculus vespertilionis* Linn., 1758, was interpreted as an acarine on basis of Frisch's (1728) figure cited by Linnæus in 1758. (2) From 1796 to 1900 it was interpreted as an insect on basis of Latreille's description. From 1900 to date it has been interpreted by some authors as an acarine, by others as an insect. (3) If Linné's diagnosis be compared with the description by Frisch, the probability is seen to be present that Linné's *P. vespertilionis* was a composite species consisting of an acarine plus an insect.

In the communication printed in NATURE of Feb. 9, 1929, p. 207, the Commission complied with the routine prescribed by the International Zoological Congress, that is when (as in this case) it may become necessary 'to suspend the rules' and to act under its 'Plenary Power', in order to settle certain cases of controversial nature, the Commission is required to give public notice of at least one year of its possible action, to enable every side to the controversy to submit its point of view.

We are forwarding Dr. Musgrave's argument to Mr. Frederick Chapman, the Australian member of the International Commission, and to the Secretary of the Commission.—EDITOR.

Diving.*

By Prof. LEONARD HILL, F.R.S.

THE new submarine escape dresses designed by Mr. R. H. Davis have been successfully used at a depth of 130 ft. at Loch Long and have since been adopted by the Admiralty. Every man in the submarine service will have to have one, just as the soldier has his gas mask. In case of accidental sinking of a submarine, each man will at once put on the dress and partly fill the breathing bag from the small oxygen cylinder which is fixed below the bag, and then breathe in and out of the bag through a cartridge of soda lime which is put inside to absorb the exhaled carbon dioxide. Then the submarine will be flooded so as to equalise the air and the water pressure, and allow a hatch to be opened through which the men will float up one by one and reach the surface; the breathing bag, acting as a balloon, will take them there. There is an escape valve provided for preventing over-distension of the bag.

In using the submarine escape dress, men must be trained to fill the bag only partially with oxygen, so as to allow expansion of the gas on coming up. There is no risk of bubbles of nitrogen forming in the body fluids through coming up quickly, even from a depth of 300 feet, because oxygen has been breathed from the time the air pressure was increased by flooding the submarine.

In case of prolonged difficulty in effecting escape from a submarine, surplus apparatus to afford fresh soda-lime cartridges and oxygen will be required. If the water has entered the submarine so that the air is under pressure, the bag should be filled with expired air two-thirds full and only enough oxygen added to keep it comfortably full—this to prevent oxygen poisoning. In this case, just before coming out, the bag must be squeezed empty and then filled with pure oxygen and this breathed for a few minutes so as to prevent bubbling off of nitrogen in the body.

The new self-contained diving dress allows a diver to get an air supply from a cylinder containing a mixture of air and oxygen, an injector device being used to draw the air in the helmet through a canister of soda lime. The diver is free from hose-pipe and air-pump, and merely carries a life-line with connexion for the telephone in his helmet. Arrangement is made so that he can detach this line and leave it fast outside while proceeding into a wreck, using a distance line to find his way out by.

The use of this apparatus is limited to a certain depth by the percentage of oxygen which it is safe to breathe. If 50 per cent oxygen is supplied in the cylinder, the diver can safely do two or three hours' work in shallow water, but he should not exceed half an hour at a depth of 100 feet. For greater depths, air with smaller percentages of oxygen must be used, and experience is required to work out the most suitable method of supply. If the air is kept pure by absorption of carbon dioxide by means of a soda-lime cartridge, then a small oxygen cylinder will suffice to keep the percentage in the helmet at, say, 10 per cent, for deep work. The reducing valve can be set to give that amount of oxygen which the diver uses per minute, but there is a risk of too little oxygen arising through extra hard work on the part of the diver, and we must bear in mind that want of oxygen does not give warning before a man loses full use of his senses. An additional cylinder of air with 10 per cent of oxygen in it will have to be carried for altering the buoyancy of the dress as needed. Probably the ordinary method of ventilating the helmet by a hose-pipe will be used for deep work, a tank containing compressed air with 10 per cent oxygen being used as the supply. A ready method of partially deoxygenating air will have to be installed on the diving ship.

The new submersible decompression chamber, also designed by Mr. R. H. Davis, was used with great success at trials conducted by the Admiralty at Loch Long last summer. An attendant goes down in this cylindrical chamber, which is fitted with a door top and bottom, and waits to receive the diver at a depth of 66 feet. The lower door is open and water kept out of the chamber by compressed air pumped into it. The chamber is lit with an electric lamp. The shot rope of the diver passes through rings attached to the outside of the chamber. After doing his job on the bottom he ascends rapidly to the chamber, and climbing up by a small ladder thrusts his helmet up in the chamber, so far that the attendant can cast off hose-pipe and life-line and take off the helmet. The diver then comes right in and the lower door is shut. A telephone message is then sent and the chamber is raised to deck level and decompression carried out there. From the time the diver leaves the bottom, all these operations take only seven or eight minutes to carry out; the diving ship can, if need be, then proceed to harbour. This is a great improvement on the old method of the diver hanging on the shot rope in the cold and dark while decompression in stages is carried out. Moreover, when in the chamber the diver can breathe oxygen by means of a small apparatus, and by this means shorten the decompression time by at least one-half.

There are three dangers from which the diver has to be protected. First, he may be poisoned by too much carbon dioxide through insufficient ventilation. If one air-pump suffices to ventilate the helmet at one atmosphere, an extra pump is required for each atmosphere in addition, as pointed out by Dr. J. S. Haldane, so at 300 feet ten pumps are required. Many divers have been made less efficient while at work and damaged in health by insufficient ventilation. In place of so many pumps, a canister of soda lime can be arranged to purify the air in the helmet, and this is an improve-

* From the Friday evening address delivered at the Royal Institution on Feb. 7.

ment which will, I think, be adopted for deep diving. Secondly, at considerable depths the diver is exposed to high tensions of oxygen; for example, at 300 feet, to 10 atmospheres of air, which is equivalent to 2 atmospheres of oxygen; and oxygen at any tension a little greater than 70 per cent of an atmosphere acts as a poison when breathed for more than a certain time, the time becoming shorter as the tension is raised. While exposure for some days to a tension of oxygen greater than 70 per cent of an atmosphere produces pneumonia, experience has shown that the breathing of pure oxygen at a pressure of one atmosphere for a few hours, as in the use of mine-rescue apparatus, has no ill-effect.

Experiments have shown that animals can safely breathe 2 atmospheres of oxygen for 2 hours, but during this period both the use of oxygen by the body and the output of carbonic acid diminish, the body temperature drops and the animals become drowsy. If the exposure is more prolonged, or in shorter times if the oxygen tension is higher, the animals fall into a comatose condition and finally have convulsions and die. Some very important experiments were made by Bornstein at the Elbe tunnel works. He breathed oxygen at 3 atmospheres (+30 lb.) for 48 minutes, and two of the engineers (at the Elbe tunnels) for 30 minutes without harm. He considered periods such as these set the limits to safety.

In diving experiments in the United States of America in connexion with the practice of an American submarine escape apparatus, oxygen has been used without detriment for short periods up to a pressure of about twelve atmospheres, equivalent to 357 feet of water.

Argyll Campbell has shown that normally when breathing air the tension of oxygen in the tissues equals 37 mm. of mercury. The blood in the veins coming from the tissues is normally about 75 per cent saturated with oxygen and carries $2\frac{1}{2}$ to 3 volumes per cent more carbon dioxide than the arterial blood, which is 95 per cent saturated with oxygen. Under high oxygen tensions in the inspired air, the tissue oxygen tensions rise, for example, from 84 mm. to 430 mm. of mercury, and the venous blood, being almost fully saturated with oxygen, can carry very little more carbon dioxide than arterial blood. Moreover, when the tissues are in danger of oxygen poisoning, the circulation may be reduced. Thus carbon dioxide is held back in the tissues and the tension may rise to poisonous heights, as was found to be the case by Argyll Campbell.

It is clear, then, that for deep diving the ventilation of the helmet must be kept adequate enough to prevent even a small rise of carbon dioxide in the air breathed. It must be kept in mind that, at 10 atmospheres, 0·1 per cent of carbon dioxide in the air breathed produces a tension of carbon dioxide of 1 per cent of an atmosphere, and 1 per cent produces a tension of 10 per cent. The poisonous effect depends on the tension, and 10 per cent is enough to anæsthetise a man. If there is difficulty in carbon dioxide being carried from the tissues owing to high oxygen tension, this difficulty must not be accentuated in the least degree by ill-ventilation of the helmet, otherwise the diver may become drowsy, and even comatose.

To avoid any poisonous effect of oxygen for deep dives the percentage in the air supplied to the helmet can be halved. Mr. R. H. Davis has contrived apparatus for effecting this, that is, for supplying less oxygen during compression, and more during decompression; for diving to greater depths, air with still less oxygen in it will have to be used. As pure oxygen is going to be used in the submersible decompression chamber, it is obviously best to prevent any excess of oxygen while at work on the bottom. At 10 atmospheres, 2 per cent of oxygen in the air would give a diver the natural amount of oxygen. Suppose, for safety sake, that 10 per cent of oxygen is used at 10 atmospheres, the nitrogen will be increased by one atmosphere, and this will have to be allowed for in reckoning the decompression period.

The effect of breathing oxygen in washing out nitrogen can be shown. If diuresis is established by drinking two or three pints of water, the secretion of the kidneys can be used as a measure of the nitrogen dissolved in the blood. The bladder can be emptied every few minutes and samples of the urine collected with precaution to exclude contact with air. The dissolved gas can be extracted by a vacuum pump, and the amount of nitrogen estimated. At ordinary atmospheric pressure, there is approximately 1 per cent of dissolved nitrogen gas, at 2 atmospheres 2 per cent, at 3 atmospheres 3 per cent, and so on. The effect of breathing oxygen for nine minutes during exposure of the body to a pressure of 3 atmospheres (+ 30 lb.) was to lower the percentage of nitrogen in the urine then secreted to 2·1, and in the next six minutes to 0·9. Urine secreted during decompression after being at + 30 lb. pressure, this time with no breathing of oxygen, contained 2·86 per cent of dissolved nitrogen, more than three times as much. It is clear, then, that the breathing of oxygen quickly washes out nitrogen dissolved in the blood and tissues of the kidneys.

The washing out of nitrogen from the body by breathing oxygen has been shown in another way, by Argyll Campbell and myself. After taking three or four deep inspirations from a bag full of oxygen and expiring into the air so as to wash most of the nitrogen out of the lungs, a deep expiration is made and a sample of alveolar air collected, the subject then breathing through a soda-lime cartridge in and out of a spirometer containing a few litres of pure oxygen. A sample is drawn from the spirometer for analysis at 3 min. and 6 min., in each case at the end of a deep expiration, and the volume of gas in the spirometer being on each occasion measured. At the end of the deep expiration a sample of alveolar air is also collected from the tube leading to the spirometer. The volume of the residual air in the lungs can be calculated, and so, too, the use of oxygen in metabolism by the subject during the period.

It is estimated that there are about 960 c.c. of

nitrogen dissolved in the body of a man under ordinary atmospheric pressure, say 30 c.c. in the blood, 510 c.c. in the fat, which dissolves about five times as much water, and 420 c.c. in the other tissues. Our experiments show that about 30 c.c. of nitrogen per minute are washed out in the first few minutes from a man at rest, and about 50 c.c. from one doing stepping exercise. It seems clear, then, that by breathing oxygen, and exercise, the washing out of half of the nitrogen, probably that amount which causes bubbling and severe symptoms on decompression, takes place in about 10 minutes. It is safe for a diver to breathe oxygen during the time required for decompression in the submersible chamber from 3 atmospheres absolute pressure (66 feet approx. depth) if the oxygen breathing allows the times of the Admiralty table set for the safe decompression of divers to be halved.

Further research on animals is now being carried out to settle the point whether the formation of bubbles can be prevented by plus two atmospheres of pressure (66 ft. depth) when a diver is quickly decompressed from 300 ft. to that pressure after a prolonged stay on the bottom. Possibly a stage will have to be given at 99 ft. If the diver is supplied with, say, 5 per cent of oxygen at the great depths, he can safely begin to increase the oxygen in his helmet as he climbs up from the bottom, using a small cylinder of pure oxygen for this purpose, and then arriving at the submersible decompression chamber be ready to breathe pure oxygen at plus two atmospheres and during the decompression from that pressure. When a bottle of champagne is opened in a chamber at plus two atmospheres, it appears flat, as this pressure stops the formation of bubbles and the gas escapes quietly. In the trials at Loch Long, divers came up quickly from 300 ft. to 66 ft. and suffered no harm. It is important that the deep sea divers go down fasting with the least gas in his alimentary canal. Gas formed therein mechanically obstructs the circulation by expanding during decompression and enhances the danger of bubbles forming in the blood. Out of twenty-four well-fed guinea-pigs compressed for 1 hour to plus 100 lb. and decompressed in five minutes, nineteen died; out of twenty-four fasting guinea-pigs only eleven died. None died when oxygen was given during the period of decompression.

The U.S. Navy is experimenting with helium and oxygen; helium has less solubility and greater diffusivity than nitrogen, and good results are reported. We have no available helium.

There are certain other dangers to which the diver is exposed, as were evidenced by the salving of the *S 51* submarine by the U.S. Navy. The inlet valve may become blocked by ice due to freezing of water condensed out of the air pumped down the hose pipe in wintry weather when the salt water at the bottom of the sea is below freezing point. One diver was drawn up just in time, half suffocated; another was far inside the submarine when this happened, but managed to knock his valve free of ice by striking the outside with a spanner. The air-supply after that had to be freed from water vapour for such wintry diving. It is astonishing that the divers can work with their hands exposed to such cold water even when gloved. A thick, knitted wool glove containing air in its meshes with a rubber glove outside is, of course, the best protection against cold.

Another danger is the outlet valve becoming jammed through sand getting into it when lying down and tunnelling as those American divers did through clay, using a fire hose and high pressure water to cut out the clay. If the outlet valve closes, a diver may have his dress blown out and be spread-eagled before he can shut off his air supply or open his spit cock and use that as an air outlet. If his telephonic message to cut off the air be not heard his dress will be burst. This actually happened to Eddy, a famous diver, but another diver witnessed the accident and, telephoning the news, Eddy was drawn up in time, put in the recompression chamber, and saved. To be blown up is dangerous, first, because of the rapid decompression, and secondly because of the risk of the helmet hitting the bottom of the attendant ship. If a diver be blown up to the surface, he must be at once sent down again after letting out excess of air, or have his helmet taken off and be rushed into the recompression chamber.

The courage and presence of mind of divers is shown by the story of a diver named Smith who, when tunnelling out the clay and getting near the keel of the submarine *S 51*, had the clay walls of the tunnel fall in upon him. He telephoned for help, but managed to turn round the nozzle between his legs and force out the clay and so escape; then, telephoning he was all right, he went back again into the tunnel and completed the job, and this down in the dark at a depth of 130 feet.

The oxyhydrogen flame has been adapted for use under water, and large thicknesses of metal were quickly burnt through by this means in the salving of *S 51*, by Commander Ellsburgh.

The 'iron man' designed in Germany and used in wrecks by Italian divers is an observation chamber with jointed limbs which allow a certain amount of awkward movement. The joints have ball bearings. The diver, shut inside, is at ordinary atmospheric pressure and breathes oxygen, having the exhaled carbon dioxide absorbed by soda lime. He can use the oxygen supply also to alter the buoyancy of the iron man. There are glass discs for observation, and in dark water a powerful electric lamp has to be lowered down for him to see by. At a depth of 100 feet the sunlight appears as moonlight, and at 200 feet as starlight. Tools are affixed to the end of the 'iron man's' arm, and the diver works these by scissor-like handles inside. The diver in the 'iron man' cannot use his sense of touch, and prolonged training and good lighting are necessary for effecting any skilled work. After a dozen trials in it, one diver failed to shackle a rope on to a buoy. The diver in the 'iron man' can guide a charge of guncotton, or a grab for seizing hold of wreckage, but is not capable of very skilled work.

Mineralogy at Cambridge.

THE report of a syndicate appointed by the Council of the Senate of the University of Cambridge to consider the position of mineralogy in the studies of the University was the subject of a lengthy discussion in the Senate House on Jan. 28. The recommendations contained in this report were summarised in a leading article in NATURE of July 13, 1929. They have since been reported on by the University Boards concerned and by the Committee of the Natural Sciences Tripos.

The proposals for the creation of two departments —one of mineralogy and petrology, and one of crystallography—met with approval in principle, but the Financial Board had already indicated that no money was forthcoming to meet the additional expenditure involved except "at the expense of existing University activities". No definite opinion is expressed on the proposal to make 'half-subjects' in the examination of crystallography and of mineralogy and petrology, as this involves problems of some difficulty. It is, however, suggested that the regulations for the Natural Sciences Tripos should receive general reconsideration.

The Syndicate included distinguished representatives of every science bordering on mineralogy, and it was perhaps natural that its report (which was unanimous) should have dealt mainly with the relations of mineralogy to other sciences. The discussion, however, was left entirely to mineralogists and geologists, among whom the report has aroused very considerable interest and some controversy. That this interest is not confined to resident members of the University is indicated by the fact that speakers in the discussion included two professors of geology in London, the professor of geology in Edinburgh, and four of the curators of the two great collections of minerals and rocks in London (the Natural History Museum and the Museum of Practical Geology). The resident members of the University participating in the discussion (which occupies twelve pages in the *Cambridge University Reporter*, Feb. 11) were the professors of geology and mineralogy, the chairman and secretary of the Syndicate, the reader and the lecturer in petrology, the lecturer in structural crystallography, and two other members of the staff of the Department of Mineralogy.

The speeches of the professor of mineralogy and of the lecturers in petrology and in structural crystallography outlined the possible scope and the present difficulties affecting teaching and research in their subjects.

The lecturer in structural crystallography spoke whole-heartedly in favour of a separate Department of Crystallography, and with this recommendation of the Syndicate the other speakers (with two exceptions) seemed disposed to agree. The professor of mineralogy regretted that the Syndicate had not considered the possibility of housing crystallography, mineralogy, and petrology under one roof, and quoted the examples of Zurich and Göttingen. Mr. Hallimond felt that any Department of Mineralogy had a reason for having an X-ray department on the crystallographic side, while many parts of the X-ray researches, involving some of the most advanced theories of modern physics, really belonged to that Department. Additional point was given to this suggestion by the remarks of the lecturer in structural crystallography, who seemed to envisage a department for the X-ray study of the solid state, and foretold a remodelled teaching of crystallography which evidently gave some of the mineralogists seriously to doubt whether "the teaching of such crystallography and crystal physics as is required by students of mineralogy and petrology" would be provided by the new department. Another speaker made it clear, however, that the need in X-ray research of a sound knowledge of geometrical 'surface' crystallography was fully realised.

On the recommendation to bring mineralogy and petrology into one department and to house them in a new building adjacent to the Sedgwick Museum, the speakers were almost all in agreement. The only important difference of opinion revealed is on the extent to which the study of advanced petrology should be restricted to students of geology, and whether the association of the newly constituted department should be quite so close as that provided for in the recommendations for the reorganisation of the Tripos.

Non-residents with experience in other universities spoke highly of the teaching of both mineralogy and petrology in Cambridge, and emphasised the need for maintaining its schools in these subjects in the pre-eminent positions which they have occupied in the past. On the other hand, it is evident that many speakers considered that the progress of both studies was seriously hampered, if not actually stopped, for want of adequate accommodation and facilities for research along modern lines. Particular stress was laid on the urgent need for a laboratory for research in experimental petrology on the lines so successfully followed at the Geophysical Laboratory of the Carnegie Institution of Washington.

The lecturer in petrology made a good point when he remarked that research and Part II work in mineralogy was spasmodic, and therefore unsatisfactory, because of the few openings available for men trained in mineralogy alone. The union with petrology (and geology) would, he thought, induce a steady flow of students to take up Part II work and research in the two subjects. Prof. Watts spoke strongly in the same sense of the extensive increase in the possibility of research which would be offered by the united departments. He also reminded his hearers that a proposal to establish a laboratory in Cambridge on the lines of that of the Carnegie Institution of Washington had been before the Conjoint Board of Scientific Societies several years ago and had been abandoned only because of expense.

Following publication of the report of this discussion, notice was given of a Grace approving in principle the policy of dividing mineralogy and petrology for the purposes of teaching and research into crystallography on one hand and mineralogy and petrology on the other. The Grace was passed unopposed on Mar. 8. This is the first part of the Syndicate's report, which received almost unanimous support in the discussion: the second was the desirability of housing mineralogy and petrology in a new building, thus making room for crystallography in the old. It is to be hoped that the means will speedily be found to build and equip the new laboratories and thus to make possible in Cambridge the kind of teaching and research on the need for which there seems such unanimity of opinion among competent judges. It may be remarked that every branch of research mentioned in the discussion, both in X-ray work on crystal structure, and in the study of ores, of rocks, and of silicate-melts, has its direct application in industry.

Obituary.

PROF. F. M. EXNER.

FELIX M. EXNER, professor of geophysics in the University of Vienna, director of the Zentralanstalt für Meteorologie und Geodynamik, Vienna, and joint editor with Süring of the *Meteorologische Zeitschrift*, died in Vienna on Feb. 7. Exner, who was a son of the physiologist Sigmund Exner, was born in Vienna on Aug. 23, 1876. He was educated at the University of Vienna, where he graduated as Ph.D. in 1900. After ten years as assistant at the Zentralanstalt, he became professor of cosmical physics at the University of Innsbruck in 1910, returning to Vienna in 1917 to take up the post of director of the Zentralanstalt and professor of geophysics.

Exner was a very active research worker in meteorology and allied sciences, and published a large number of papers in the proceedings of the Vienna Academy of Sciences, the *Meteorologische Zeitschrift*, the *Annalen der Hydrographie*, and various other journals. These papers cover a wide field. He was particularly interested in the mechanism of changes of pressure, and in the earlier years, in the correlation between meteorological factors over different regions of the globe. He treated the latter question at great length in a paper in the proceedings of the Vienna Academy of Sciences, vol. 122, the work having been largely carried out during a visit to the United States.

Exner was an industrious and sound, rather than a brilliant worker, and he will be remembered for his treatise "Dynamische Meteorologie", rather than for his original work. This book, which gives a very clear exposition of the outlook of the Austrian school of meteorologists, stands alone to-day as the only available exposition of the mathematical aspects of meteorology. Its preparation, which must have involved years of unremitting labour, was doubtless facilitated by his appointment to the professorship of cosmical physics at Innsbruck. The Austrians are fortunate in having this professorship, to which they can appoint a young man to enable him to carry on research work or authorship unimpeded by official duties, and this professorship has usually been the avenue of approach to the post of director of their meteorological service.

There is no text-book in the English language which is strictly comparable with Exner's. The dynamical methods followed by Exner, Margules, and others of the Austrian school of meteorologists have not been very widely used in England or the United States, and as a result, English text-books are either descriptive or physical, rather than mathematical. Thus Exner's book has met a widely felt need among meteorologists, and is one of the few books of which we can say with complete honesty that it is indispensable to any serious student.

Exner was also the author of an article on dynamical meteorology in the "Enzyklopädie der mathematischen Wissenschaften", but a more outstanding service to science was the publication in 1922 of a revision of Pernter's classic text-book on meteorological optics. He also prepared the European portion of "World's Weather Records", published by the Smithsonian Institution.

As director of the Austrian meteorological service, Exner was a member of the International Meteorological Conference. His pleasing personality won him the respect and liking of his international colleagues, and his death will be regretted by meteorologists throughout the world. D. B.

DR. G. G. CHISHOLM.

GEORGE GOUDIE CHISHOLM, who was the first lecturer (1908) and later the first reader (1921) in geography at the University of Edinburgh, and acted also as secretary of the Royal Scottish Geographical Society from 1910 to 1925, died very suddenly in Edinburgh on Feb. 9. Born on May 1, 1850, he was thus on the eve of completing his eightieth year, though few of his associates realised the fact; his mental vigour being unimpaired to the end, while even physically there were few signs of age.

A native of Edinburgh, Dr. Chisholm attended the Royal High School there and took the degrees of M.A. and B.Sc. at the University, which after his retirement in 1923 bestowed upon him the LL.D. He spent his earlier life in Scotland, going to London in 1895. There, until the date of his Edinburgh appointment, he was engaged in lecturing and literary work, and soon became a prominent figure at the annual meetings of the British Association, being president of Section E (Geography) in 1907. Of his writings, those through which his influence was most felt were his "Handbook of Commercial Geography", first published in 1889, of which an eleventh edition appeared in 1928,

and "Longmans' Gazetteer of the World", of which he was editor, which first appeared in 1895 and has been often reissued. Both works show that rigorous accuracy in detail, based upon profound and wide research into original sources, and that sober and balanced judgment which were his outstanding characteristics.

Dr. Chisholm may, indeed, be said to have been one of the founders of scientific geography, particularly from the economic side, within Great Britain. Not only did he show that it demanded as exact scholarship, as wide knowledge as the subjects which had been recognised earlier as worthy of academic rank, but also at a time when, with the apparently sudden recognition of its interest and wide ramifications there was grave risk of hasty generalisation, he insisted upon the need for precise and, if possible, statistical proof of fundamentals. Rigidly conscientious himself, and with a passion for accuracy and completeness of statement, he was peculiarly impatient of slovenliness, whether in speech or thought, and if modern geography in Great Britain may seem to have developed relatively slowly, it is to Dr. Chisholm largely that we owe the fact that its foundations have been well and truly laid.

Dr. Chisholm's influence also extended far beyond the limits of his own country. His "Handbook of Commercial Geography" had the rare distinction of being translated into Arabic, and he carried on an extensive correspondence with geographers, economists, and others throughout large parts of the world. It was characteristic that his handwriting was clear and precise to the end and that he would give to letters, even on trifling matters, the same care and attention as to his own special work. His help and advice were, in consequence, constantly asked for, and so freely given as to bring him into contact with a wide circle. Though never in much sympathy with the narrowly nationalist Scottish point of view, he was a Scot of the best type, upright, honourable to the last degree, fair-minded, indifferent to worldly advancement, but profoundly concerned with the deeper problems of man's destiny, and too clear-sighted to be content with easy solutions. Even apart from his influence on economic geography and history, which was both wide and deep, the example he set of a life devoted to the search after knowledge was an inspiration to all who knew him.

We regret to announce the following deaths:

The Hon. Edward Gerald Strutt, C.H., past president of the Surveyors' Institution and agricultural adviser to the Board of Agriculture during the War, on Mar. 8, aged seventy-five years.

Prof. Eugenio Rignano, professor of theoretical philosophy at the University of Milan and editor of *Scientia*, on Feb. 9.

News and Views.

Sincere regret will be felt throughout the world of science at the destruction by fire of a large part of Lord Rayleigh's laboratory at Terling Place, Chelmsford, Essex, on Mar. 7. After taking his degree at Cambridge in 1865, the late Lord Rayleigh found great difficulties in getting opportunities for experimental research or instruction in laboratory work. Three years later he started experiments on his own account at Terling Place, and from there produced a number of papers which at once secured for him a position as a leader in physical science. When he resigned from the chair of experimental physics at Cambridge in 1884, he continued his researches in his private laboratory, and it was there that he carried out the precise determinations of the density of nitrogen which led to the discovery of argon. The simplicity of the apparatus used by the late Lord Rayleigh is well known, and most visitors to the laboratory were astonished that results of prime significance could be obtained with such modest equipments. We are glad to know that most of this historic apparatus has been saved as well as all books and papers belonging to the late Lord Rayleigh.

The upper storey of the laboratory at Terling Place—originally a stall loft—has been burnt out; it was here that the main work on argon was done. Among the pieces of historic apparatus which have been destroyed are the original Rayleigh refractometer and the manometer used for adjusting the pressures of gases to an accurate standard in the weighings of nitrogen, hydrogen, and oxygen. Most of the present Lord Rayleigh's chief working instruments have also been destroyed and much preparatory work for experiments in progress is gone. The apparatus thus lost includes several valuable spectrographs, quartz apparatus and lenses for investigating the optical properties of mercury vapour, air pumps, equipment for measuring the light of the night sky by photo-electric cells, and other instruments used in recent or current researches. It is distressing to have to record a disaster of this kind, and we ask Lord Rayleigh to accept the sincere sympathy of scientific workers everywhere at the losses he has suffered and the consequent interference with his research work.

The Department of Scientific and Industrial Research has, since the inception of research associations, always emphasised that the associations, to be eligible for grant from the Department, must secure adequate financial contributions from industry itself. While the securing of this support from the great industries has not been an easy matter, it is gratifying to find that in several of the most important industries of Great Britain a general levy is made in order to provide funds for particular research associations. The report of the council of the British Research Association for the Woollen and Worsted Industries for 1929–1930 indicates that this Association is about to complete an arrangement under which the wool textile industry will submit to a voluntary levy on imported wool, mohair, and so on, as well as to a levy on those processing sections of the industry which do not pay the levy on the raw material. The income which will

thus become available, together with the generous assistance which is being given by the Empire Marketing Board, the Ministry of Agriculture, and by the Dominions of South Africa, Australia, and New Zealand, should ensure that the future work of this important Research Association shall be conducted on a scale which the importance of the industry to the Empire as a whole properly demands.

THE British Research Association for the Woollen and Worsted Industries has continued to devote its attention to fundamental problems of research into the properties of individual hairs and fibres, as well as to technical and more practical problems of the trade itself. The determination of Young's modulus for the wool fibre appears to indicate that plastic flow occurs in the fibre after the initial rapid change of length due to change of load. If the measurements are made quickly, the extension of fibre appears to be proportional to the load over small ranges of change of load, and it exhibits negligible hysteresis. The examination of the cultivation of skin and hair by tissue culture methods, and of the effect of diet on the characteristics of the fleeces, is being continued. The result of the examination of samples of wool for mean fineness has indicated the extraordinary variability which occurs over very small areas. This condition constitutes, of course, an important problem for the wool sorter, and, as such, is of sufficient practical importance to justify the most exhaustive experimental examination. An important practical application from the chemical work of the Association may arise as the result of an investigation which appears to indicate that low quality and waste woollen materials may be dissolved and spun in the manner which has now become familiar in the production of artificial silk yarns. Yarn has already been produced from a mixture of wool and cellulose, and solvents have been found which may make possible the production of a similar all-wool yarn.

FROM time to time references have been made in NATURE and elsewhere to the need for authoritative portrayal and dissemination of the scientific point of view. It is, of course, neither useful nor possible that everyone should be trained to elucidate scientific facts or substantially to understand the implications of properties and behaviour, nor even is it reasonable that he should with much labour and exclusion of other important affairs acquire that foundation of special knowledge which would enable him to do so. On the other hand, it is clearly desirable to show the general public that science does not depend for its advance on the intuition and 'formulæ' of a few 'brilliant inventors' so much as on ordered, if sometimes laborious, experiment and deduction. It needs to be constantly advertised that chemistry, for example, progresses because chemists make use of strategy and tactics which they have been able to develop by applying scientific methods of thought and by consistently employing the results of scientific inquiry.

IF the problems of chemistry can be solved thus, so also, by similar appropriate methods, can those of other factors in the life of the individual or his community. In a recent issue of *The Listener*, Prof. Arthur Smithells made a noteworthy contribution to the education of the general public in this particular. Confining himself to simple, fundamental facts and to the study of their relationships, he succeeded in exposing in a pleasant, conversational manner something of the working of the experimenter's mind and something of the way in which our knowledge concerning combustion was acquired. The B.B.C. is wise to include in its publication devoted to raising the general standard of culture such an article as that contributed by Prof. Smithells. Whether the B.B.C. can assist would-be students of chemistry in their actual studies is, of course, entirely another matter. When telephony and television are joined by radio-olfaction, who knows what it may not be possible to broadcast?

AT the annual general meeting of the Institute of Chemistry, Prof. Arthur Smithells, the president, in moving the adoption of the report of council, made some observations on the question of chemical training, urging in particular that the burden now put upon the student is excessive and too apt to result in undigested knowledge of what are regarded as the higher things of chemistry, with accompanying neglect of what is more simple and basic. He thinks that the courses have become congested and the pace too rapid, though he acknowledges the great improvement that has taken place in schools of chemistry in Great Britain. It is now no longer necessary to go abroad for the latest or the best in any division of the science: we are, in a way, doing too much rather than too little. He alluded at some length to the ways of teaching and work which prevailed in Bunsen's laboratory at Heidelberg as illustrating the kind of conditions under which, he believed, the early training of the chemist might be more satisfactorily conducted. Prof. Smithells said he had only touched on one part of a very large question and was concerned to arouse interest in it rather than to lay down any law; the education of the professional chemist is really an important question of the day and calls for the most careful consideration. The report of council shows that the roll of the Institute has increased by 156 members and 20 students, that the Institute is in a sound position financially, and that the committees of the council and local sections have been actively engaged in the interests of the profession of chemistry. The Meldola Medal was awarded to Dr. R. A. Morton, of Liverpool, and the Sir Edward Frankland Medal and Prize to Mr. B. W. Bradford. The officers and members of Council for the ensuing year were elected, Dr. G. C. Clayton being elected president in succession to Prof. Smithells, who has occupied the chair during the past three years.

AS a result of heavy and long-continued rains at the end of February and the beginning of March, disastrous floods have occurred in southern France, entailing enormous damage to property and the loss of several hundred lives. The floods reached their greatest intensity in the valley of the Garonne and

its tributaries, especially the Tarn, which originate in the southern Auvergne Mountains. Few details are yet available, but it appears from the *Bulletin Quotidien d'Études*, published by the French Meteorological Service, that the heavy rain was associated with a persistent strong south-easterly wind blowing from the Mediterranean. Even on the low ground of the coast and of the Rhone valley, falls of two or three inches in a day were reported from several stations on Feb. 28 and Mar. 1, and where the moist wind struck the higher ground one would expect the rain to be very much heavier. The rivers flowing westward from the Auvergne Mountains occupy deep narrow valleys which offer no opportunity for the floods to dissipate, and the water appears to have risen with such rapidity that the inhabitants of the valley towns were caught almost unawares. Where the swollen streams debouched on the low ground of the main Garonne valley conditions were even worse, and the greatest disaster of the week occurred at Moissac, near the junction of the Tarn and Garonne. The report says that the Tarn burst its banks, and the town was almost entirely destroyed.

IN his Huxley lecture to the University of Birmingham, delivered on Mar. 6, Sir William B. Hardy dealt with "The Physical Basis of Life", which was the subject of one of Huxley's essays in 1868. He asked if we could still be as sure of the soundness of Dujardin's postulate of the one common physical basis of life, protoplasm, as Huxley was? And are we right in ascribing to this protoplasm the contradictory attributes of extreme stability and extreme instability? The view to-day is that protoplasm *is* the physical basis of life; but there are as many distinct varieties as there are species of living organisms, the differences in the chemistry of their proteins giving rise to such varied forms as a whale or a gnat, a mushroom or a man. All forms of organisms from the whale to the smallest bacillus are built up on this fundamental basis; but the gap between the smallest bacillus and the properties of the half-dozen kinds of atoms of which it is made is immense. This gap has perhaps been partly bridged by the discovery of the viruses. The virus is only known by its effects; it is exceedingly potent in producing disease and yet is so small that it passes through the pores of unglazed porcelain; its dimensions may be compared with those of a sphere of 0·000025 mm. diameter. It possesses great power of multiplication. A small drop of fluid from a dog with distemper may be diluted ten million times, and yet when a drop of this is injected into another dog, the virus may multiply to such an extent that in three days it has invaded every tissue; and if the rest of the dog could be removed, leaving the virus, the latter would form a good model of the dog. These viruses possess individuality and are not interchangeable. Are they to be regarded as protoplasm? We can scarcely regard so small an aggregation of molecules, 400 or 500 say, as the basis of life. Perhaps they are 'first attempts' at protoplasm, parasitic on more advanced forms.

IN his Friday evening discourse, delivered at the Royal Institution on Mar. 7, Dr. C. Tate Regan spoke on "Angler Fishes". In off-shoots of the perch tribe the spinous dorsal fin is variously modified; in the angler fishes its spines have become slender and flexible, and the first is placed on the head, and serves as a line and bait. Anglers that lie on the bottom have a coloration that harmonises with their surroundings and tends to conceal them; their bait or lure is a flap or a tassel at the end of the line, and is used to entice other fishes near enough to be caught. The anglers that float about in the middle depths of the ocean, where there is little or no light, are uniform in colour, generally blackish, and possess a luminous lure. Oceanic anglers generally have a large mouth, strong sharp teeth, and a very distensible stomach; such fishes are able to swallow others many times their own size. An interesting group of these oceanic anglers includes little fishes that have lost the line and lure, live at lesser depths and seek small prey by smell and sight; they have a small mouth and feeble teeth, but large nostrils and olfactory organs; one has the eyes directed forwards, and the snout is shortened in relation to stereoscopic vision. All the free-swimming oceanic anglers are females, and the only males known are dwarfs parasitic on the females, to which they are completely united. The males, as soon as they are hatched, when they are relatively numerous, seek the females; if they find one they hold on by the mouth; then the lips and tongue unite with the skin of the female, and the husband becomes an insignificant appendage of his wife, degenerate in structure, and nourished by the continuity of his blood system with hers. The evolution of the dwarfed and parasite males is difficult to explain unless it be assumed that the actions and reactions of the fishes themselves produce modifications that become hereditary.

ON Mar. 6 a public lecture on "Twenty-five Years Study of the Polar Aurora" was delivered at Oxford by Prof. C. Størmer of Oslo. A large series of photographs, taken during the last twenty years, was exhibited. Base lines starting from Oslo and going in several directions were employed for taking these photographs, and by means of the parallax thus shown, the height of the lower border of each aurora had been calculated. This was found to be usually in the neighbourhood of 100 km. above the surface of the earth, though in some instances a height of 600-800 km. was reached. The height was greater in the morning and evening than at night. Many of the phenomena could be explained, said Prof. Størmer, by attacking the problem in a simplified form, such factors as gravitation, repulsion, etc., being omitted. He attributed the aurora to a stream of negative electric corpuscles passing from the sun through the magnetic field surrounding the earth's magnetic axis. This view was illustrated by a number of photographs of ingenious models. In moving a vote of thanks to Prof. Størmer, Prof. Lindemann observed that he hoped that the omitted factors would eventually be taken into account. He thought that Prof. Størmer's explanation of the 'echo' phenomenon was perhaps the most interesting feature of the whole research.

SWITZERLAND is to have a 'regional' broadcasting system, somewhat similar to that which is being instituted by the British Broadcasting Corporation, with three high-power stations—in the German, French, and Italian speaking sections of the country respectively—and smaller relay stations where required in the principal towns. The most powerful of the new stations, a Marconi Type 'P.B.' 60-kilowatt broadcasting transmitter, is to be erected at Münster, about twelve miles to the north-west of Lucerne, and will constitute the main 'regional' station for German-speaking Switzerland. It will be allotted the wavelength of 459 metres. To provide for 'crystal listeners' in the towns, Marconi broadcasting stations of ½ kilowatt aerial power are to be erected at Berne and Basle. The new station at Berne will replace the present Marconi 1 kw. 'Q' broadcasting station, which was erected in 1925 and will later be modernised and re-erected elsewhere to play a part in the 'regional' plan. At Basle the new station will be this town's first full-time broadcasting station, the broadcasting service having previously been carried out by the Marconi transmitter at the Basle aerodrome, which is primarily employed for wireless telephony with aircraft. The reorganisation of the Swiss broadcasting service on the 'regional' basis is expected to be completed in 1931.

IN connexion with the Physical and Chemical Survey of the National Coal Resources, which is one of the important aspects of the Fuel Research work of the Department of Scientific and Industrial Research, the Department has recently appointed a committee to deal with the West Yorkshire Coal Area. Among the members are: Prof. J. W. Cobb, Leeds; Prof. J. A. S. Ritson, Leeds; Mr. C. E. N. Bromehead, Geological Survey of Great Britain; Dr. C. H. Lander, Director of Fuel Research; and Dr. F. S. Sinnatt, Superintendent of the Coal Survey. The object of the Survey is to investigate the characteristics of the various coal seams in Great Britain with the view of their utilisation to the best advantage. Local laboratories are established in each area for the examination of samples, and, when necessary, large-scale investigations are carried out at the Fuel Research Station (East Greenwich) or elsewhere. The Survey is now in active operation in most of the coalfields of Great Britain.

THE recent award of the Roozeboom gold medal to Prof. J. J. van Laar was made at a special meeting of the Royal Academy of Sciences at Amsterdam by Prof. Schreinemakers. This is the third time since Roozeboom's early death in 1907 that such an award has been made, the other recipients being Profs. Schreinemakers and Tamman. From the *Chemiker-Zeitung* we learn the following particulars of van Laar's career, as outlined by Prof. Schreinemakers. Born in 1860 at The Hague, van Laar first adopted the career of a naval officer, and in that capacity he travelled over the whole world. In 1881 he began to study at the University of Amsterdam, where he came directly under the inspiring influence of van 't Hoff and van der Waals. In 1898 he was appointed lecturer in mathematical physics and chemistry, and in 1907 he was appointed successor to Prof. Bakhuis Roozeboom, but he resigned his chair five years later for reasons of health. From 1892 onwards there appeared under his name a constant stream of scientific papers, amounting to more than two hundred and covering almost every branch of physical chemistry.

PROF. VAN LAAR devoted much attention to the melting-point and freezing-point curves and vapour-pressures of binary mixtures, to van der Waals' equation of state, to the formulæ and theories used in electrochemistry, and to the calculation of potentials of liquids, which are now used in physiological investigations. He was also the author of several books on thermochemistry, electrochemistry, the equation of state, and a well-known volume entitled "Six Lectures on Thermodynamic Potentials". His work has perhaps not received everywhere the attention which it merits. This may be due to some extent to the extreme intricacy of the problems with which he has dealt. But although his mathematical investigations of binary and ternary mixtures may not be easy to follow, the results are often relatively simple. Van Laar indeed rendered a great service by his masterly application of strict thermodynamical principles and the equation of state to the problem of co-ordinating mathematical theory with experimental results. As might be expected, his work provoked a good deal of criticism, and he frequently came into conflict with those who attempted to adapt to concentrated mixtures laws which are only applicable to dilute solutions. His investigations upon the borderline between the solid and liquid states under very high pressures will undoubtedly have an important bearing on the solution of some geochemical problems.

THE seventh annual number of *Brighter Biochemistry*, the journal of the Cambridge Biochemical Laboratory, is up to the standard of its predecessors. The identity of the various contributors is but thinly veiled under the initials appended to each item. For matter, the authors have cast their net wide and caught a number of well-known scientific workers whose habitat is not in this laboratory. The number could scarcely have been considered complete without references to the Nobel prizemen for 1929. It is probable that for a true appreciation of many of the points a personal acquaintance with the victims and their biographers is a necessary precedent, but even without this knowledge many of the rhymes can be understood by those with some idea of modern biochemical literature. For an hour's quiet fun, the number can be recommended to all biochemists and physiologists as a method of retreat from scientific problems.

THE successor to the ninth annual report of the Tidal Institute of the University of Liverpool is the Annual Report (1929) of the Liverpool Observatory and Tidal Institute, which now form a single institution governed by a joint committee of the Mersey Docks and Harbour Board, and the University of Liverpool. The scientific staff numbers Prof. J. Proudman and Dr. A. T. Doodson, as director and

associate director, with six assistants. About half the income of the institution is derived from grants by the Board, the University, and the Liverpool Steam Ship Owners' Association, the remainder being obtained as payment for services rendered by the institution to outside bodies; these services consist mainly of the analysis and prediction of tides, but also of the supply of meteorological information and the testing of chronometers, sextants, and other instruments. The institution has acquired the business, and the tide-predicting machine, of Messrs. E. Roberts and Sons, Broadstairs, tidal and astronomical computers; the first machine owned by the institution was being worked almost to its full capacity. The detailed account of the year's activities shows that the institution continues its valuable and highly successful combined work of practical analysis and prediction of tides, with theoretical research on tidal currents and the meteorological and other influences which affect them.

IT has long been known that the currents in the mains of electric traction systems interfere, sometimes most seriously, with delicate electrical measurements carried out in laboratories and observatories. It has now been proved that similar interference from electric tramways has been affecting the quality of the reception in broadcast receiving sets. Some results obtained by C. O. Horn of the Post Office are published in *Engineering* for Feb. 21. Generally, in electric tramways in Great Britain, a trolley wheel is pressed against the trolley wire. At every suspension 'ear', the trolley usually gives a jump, the ensuing arc burning by a minute amount the wheel and the wire. Similarly, at the section insulators which occur at every half-mile, there is an arc when the wheel passes from one section to the next. Radio receiving sets in the neighbourhood hear a click every time an arc is formed. Tests made at Blackpool prove that if the trolley wheel be replaced by a Fischer plate similar to those usually employed on the continent, much of the noise is eliminated. Tests were made at Birmingham with another type of collector, but the results were not so good as those obtained by the Fischer plate. It was apparent that most of the interference was due to causes outside the collecting system. Satisfactory results were obtained by transposing the coils of the traction motor so that they came between the trolley wire and the armature instead of between the armature and the rails. In the new position, the coils act as a high frequency choking coil and so prevent the formation of oscillatory currents.

THE nineteenth report of the Development Commissioners for the year ending Mar. 31, 1929, has recently been published by H.M. Stationery Office. It is arranged in four sections, the first two of which are concerned with advances in agriculture, rural economy, fisheries, and harbours. The third part relates to action taken in connexion with the compulsory acquisition of land for road improvement, while the fourth deals with the financial position of the Development Fund. The successful establishment of the eight new Imperial agricultural bureaux was one of the chief features of the year, their object being to act as central agencies for the collection and dissemination of information on the various branches of agricultural research. An important step in determining the practicability of extending electrification into rural areas has been taken in a trial scheme started in Bedfordshire, from which it is hoped to calculate the probabilities of success in other areas. With regard to research and education, each of the institutes and advisory centres is dealt with in turn and an account of the investigations in progress given in some detail. In the rural economy section, the work of the community councils and their organisation for the development of rural industries seems to be giving encouraging results. Reports are also supplied of the work at the various marine biological institutions and of the special investigations 'directed' by the fishery departments of the Ministry. The grants and loans made during the year are quoted in detail, and the report concludes with three appendices, in which a list of all work published by members of the staffs of institutions receiving financial support from the fund is given.

THE honorary membership of the Academia Scientiarum Fennica, Helsingfors, has been conferred on Sir J. C. Bose for his contributions in advancement of knowledge of life-reactions in plants.

THE G. J. Symons memorial lecture of the Royal Meteorological Society will be delivered on Mar. 19 by Dr. Herbert Lapworth, who will take as his subject, "Meteorology and Water Supply."

THE following appointments in the Colonial Agricultural Services have recently been made by the Secretary of State for the Colonies: Dr. W. Youngman to be director of agriculture, Ceylon; Mr. E. J. Wortley, director of agriculture, Nyasaland, to be director of agriculture, Trinidad; Mr. F. Burnett, divisional agricultural officer, Ceylon, to be deputy director of agriculture, British Guiana; Dr. F. J. Martin, agricultural chemist, Sierra Leone, to be assistant director of agriculture, Sierra Leone; and Mr. R. W. Donkin to be produce inspector, Nigeria.

THE governors of the Scottish Woollen Technical College, Galashiels, have elected Dr. A. W. Stevenson, of the British Research Association for the Woollen and Worsted Industries, as colleague and successor to Dr. Thos. Oliver, who wishes to retire from the principalship in 1931. Under Dr. Oliver, wool textile education in Galashiels has grown from a local evening class to a well-equipped mono-technical institution controlled by and serving the whole Scottish woollen industry. He was also a pioneer in wool textile research, that being the subject of his degree thesis more than twenty years ago. Since the war, Dr. Stevenson's principal work has been connected with problems in worsted spinning. The high standard of this work was recognised by the University of Edinburgh in 1928, when the degree of Doctor of Science was awarded to him on a comprehensive thesis embodying the main points of his investigations.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A senior secretary in the Matriculation and School Examinations Department of the University of London—The

Principal, University of London, South Kensington, S.W.7 (Mar. 22). Examiners in the following subjects for the Matriculation Examination of the University of London for 1931: Chemistry, French, Geography, German, Latin, Modern History, Physics, Spanish—The Secretary of the Matriculation and School Examinations Council, University of London, South Kensington, S.W.7 (Mar. 27). A professor of pathology and bacteriology at the Calcutta School of Tropical Medicine—The Secretary to the High Commissioner for India, Education Department, India House, Aldwych, W.C.2 (Mar. 27). A chief sanitary officer for the Asansal Mining Settlement under the Asansal Mines Board of Health, Burdwan District, Bengal—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Mar. 29). An assistant horticultural instructor at the Hertfordshire Agricultural Institute, Oaklands, near St. Albans—The Clerk of the County Council, 28 Castle Street, Hertford (Mar. 29). A woman lecturer in biology at the Avery Hill Training College, Eltham—The Education Officer (H.2/1), County Hall, Westminster Bridge, S.E.1 (Mar. 31). A Bernard Baron research student in the Ferens Institute of Otolaryngology of Middlesex Hospital—The Secretary, Middlesex Hospital Medical School, W.1 (April 7). A professor of physiology at Bedford College for Women—The Academic Registrar, University of London, South Kensington, S.W.7 (April 15). A lecturer in the chemistry of cellulose at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (April 21). A woman assistant lecturer and demonstrator in botany at the Royal Holloway College—The Principal, Royal Holloway College, Englefield Green, Surrey (April 24). A whole-time medical registrar for the Society of Apothecaries of London—The Clerk, Apothecaries Hall, Water Lane, Blackfriars, E.C. (April 30). A director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India and Rajputana—The Secretary to the Board of Governors, Institute of Plant Industry, Indore, India (Aug. 31). An assistant master (a graduate in engineering with emphasis on electrical engineering) in the Junior Technical School of the Maidstone Technical Institute, and for evening classes—The Principal, Technical Institute, Maidstone. An assistant secretary of the British Association for the Advancement of Science—The Secretary, British Association, Burlington House, W.1.

Our Astronomical Column.

Comets.—*Popular Astronomy* for February contains a photograph by Prof. G. van Biesbroeck of Wilk's comet taken on Dec. 31, 1929. The tail extends as a narrow ribbon to the edge of the plate 1° 36′ from the nucleus. There are fainter tails, about 40′ long, on each side of it. There is a bright circular coma, some 4′ in diameter, with a fainter border. On Jan. 22 the tail lagged 5° or 6° behind the prolongation of the line from the sun to the comet.

Prof. van Biesbroeck is still observing two other faint comets, 1927 IV, Stearns, the magnitude of which is now 16, and 1925 II, Schwassmann-Wachmann (1). A photograph on Dec. 28 showed it as a circular nebulosity 1′ in diameter with a brighter central condensation 20″ in diameter. Its magnitude was 15. A visual observation with the 40-inch refractor on Dec. 30 gave a diameter of 25″, the faint outer border being invisible to the eye.

Saturn.—*L'Astronomie* for January contains an illustrated article on Saturn by M. E. M. Antoniadi. Most of the drawings were made by him with the great Meudon refractor between 1927 and 1929, but a few older ones are reproduced. Stress is laid on the dusky polar caps; the author concludes that the irradiation produced by the brighter regions between the poles and the temperate zones causes them to appear to bulge out beyond the elliptical outline and so produce the 'square-shouldered aspect' noted by Sir William Herschel and by many later observers. Drawings made in July and August 1927 show some spots, both bright and dusky, breaking the regularity of the belts; some of these look definite enough to use for obtaining values of the rotation period, of which there are not very many determinations; this question is not, however, discussed in the article. It is noted that these markings are much less permanent than on Jupiter, where the Great Red Spot has now persisted more or less visible for half a century.

Plans for the 200-Inch Telescope.—The *Scientific Monthly* for January contains an article by Dr. Elihu Thomson on the plans and experiments that are now in progress with regard to this proposed gigantic telescope. The use of glass for the great mirror is considered impracticable; hopes are entertained that fused quartz will prove suitable; one great advantage is the much smaller coefficient of expansion. Dr. Thomson describes some experiments on a small scale in which mirrors of glass and quartz were compared; the image of an artificial star was almost instantly shattered on applying heat to the back of the glass mirror; the quartz one reached a much higher temperature before the image was much distorted. The main body of the proposed great mirror would be formed by fusing a great mass of quartz sand in an electric furnace at a temperature of 1700°-1800° C. This would contain bubbles on cooling, but it is not considered that these would do much harm. On this block a surface of clear glass-like fused quartz, or silica glass, would be deposited. A method of doing this has been arrived at; a quantity of finely powdered crystal quartz is poured through a very hot oxy-hydrogen jet, which melts it. It falls in this state on the face of the mirror, where it solidifies in a transparent deposit. The process is compared to the deposit of clear ice on objects during a sleet storm. Small mirrors have already been successfully made, and some of these may be of use as the subsidiary mirrors which will be required in the proposed telescope. It is thought that at least three years will be necessary for the production of the great mirror, even before the figuring begins. There will be the advantage in the figuring that the heat produced by friction will not distort the figure so much as in the case of glass; in that case, frequent pauses have to be made to allow the glass to cool. Dr. Thomson states that the General Electric Company at West Lynn has offered to make the mirror merely at the cost of the labour and material.

Research Items.

Cultural Areas in Africa.—In *Africa* for January, Dr. Melville J. Herskovits applies to the ethnological problems of Africa the American method of 'cultural areas'. He suggests nine cultural areas: (1) Hottentot: essentially a herding culture but differing from the Bantu, in that there is no agriculture, and the women have much to do with the herds. The cattle are given as gifts in marriage, but for the wedding feast, not as a dower. The language, with that of the Bushmen, is differentiated by the 'click'. (2) The Bushman: with poor material culture, but high artistic and literary (folklore) ability. The dog is the only domesticated animal, and hunting is brought to a high degree of skill. (3) The East African cattle area: cattle determine a man's position and prestige, and are utilised in all the important ceremonials of life; but they do not furnish food, excepting milk, or when eaten as a ceremonial offering or after they have died. Food is obtained from the produce of the fields, and is the work of the women, to whom the care of the cattle is forbidden. Polygamy prevails, being based on the number of cattle a man commands. (4) The Congo: predominantly agricultural. The people live in rectangular houses, make bark cloth, use masks, practice cicatrisation, and carve human representations. The secret society is important. (5) The East Horn: not sharply differentiated, but shades off from East Africa. The camel and horse slowly take the place of cattle—a marginal area. (6) The eastern Sudan: a nomadic culture organised around live stock. Living in a hard desert area, their first care is the feeding and watering of their animals. The religion is Mahommedanism and the social order is strongly paternal. Clothing is of cloth and the people live in tents. (7) The western Sudan: a marginal area, in which great kingdoms—Benin, Bornu, Haussa—have risen. The economic life is basically herding, agriculture, and trade. (8) Desert: a nomadic area dependent upon trade, camel and horse breeding. (9) Egypt: an area distinct from the rest of Africa, of which the influence on other African culture must have been profound.

Preservation of Fruit and Vegetables.—One of the difficulties in the fruit and vegetable trade is the tendency for periods of scarcity to alternate with seasons of plenty when the market may be glutted with perishable produce, which must be sold at once or thrown away. In such a case the preservation of the surplus for future sale prevents instability of the market and presents the consumer with a constant source of supply of perfectly satisfactory foods, containing all the food values of the fresh materials and often many of the vitamins as well. At the request of the Ministry of Agriculture and Fisheries, the workers at the University of Bristol Research Station, Campden, have compiled a short monograph on the subject of the domestic preservation of fruit and vegetables (Ministry of Agriculture and Fisheries. Miscellaneous Publications, No. 69, "Domestic Preservation of Fruit and Vegetables". London: H.M. Stationery Office, 1929. 1*s*. net). After a short chapter on the theory of preservation, practical details, including numerous recipes, are given for fruit canning and fruit bottling, for jam making, for the preparation of fruit jellies and syrups, and of candied, crystallised, and glacé fruits, for the preservation of vegetables, the drying of fruit and vegetables, and the preparation of chutneys and pickles. Many of the recipes given are based on those which have been in use in domestic households for many generations. The methods described can be used by the housewife or by the manufacturer.

Artificial Ripening of Bananas.—Bananas for export are gathered unripe and their proper maturation afterwards is an important commercial problem, investigations upon which have been undertaken by the Australian Council for Scientific and Industrial Research (*Jour. for Sci. and Indust. Res.*, Commonwealth of Australia, vol. 2, 1929, p. 219). It is recommended that at first the store should not be ventilated, though its air should be kept in motion by a fan, and a temperature of 68° F. and a relative humidity of 85-90 per cent maintained. An addition of coal gas night and morning, in the proportion of one part to 2000 parts of air, is found to accelerate the ripening and to produce more uniform ripening throughout the bunch, probably by means of its ethylene content.

Methods of Tagging Fishes and Crustacea.—With the view of tracing the migratory habits of commercial fishes and the Cape crawfish (*Jasus lalandii*), Dr. Cecil von Bonde (*Fisheries and Marine Biological Survey*. Report No. 6. For the Year 1927–1928. Special Report No. 2. Pp. 1-7 and No. 3. Pp. 1-5) has made use of aluminium tags fixed to the upper lobe of the caudal fin, covering the base of the caudal rays, and finds that these function quite effectively. They are fixed to the fish by means of a pair of tongs, which are figured. He also suggests that there is reason to suspect the spawning ground of the South African eels to be in the deep waters of the Indian Ocean. The difficulty of marking Crustacea, which undergo periodic ecdysis, is overcome by attaching aluminium tags through the ventral flexor muscles lateral to the mid-ventral line, thus avoiding the nerve cord and the blood-vessels. Preliminary tests of this method have been successful.

Pycnogonida of South Africa.—Prof. Thomson Flynn has described the important forms obtained from South African waters (Fisheries and Marine Biological Survey. Report No. 6. For the Year 1927–28. Special Report No. 1. Pp. 1-36. The Government Printing and Stationery Office, Pretoria, 1928). Of nineteen species examined, only nine had been described previously. The new species *Nymphon bipunctatum*, *N. natalense*, *N. comes*, *Parapalenne calmani*, *Pallenopsis intermedia*, *Pseudopallene gilchristi*, *Anoplodactylus pelagicus*, *Phoxichilidium capense*, *Pycnogonum forte*, and *Tanystylum ornatum* are figured and described. It is interesting to note that as many as thirty-five specimens comprising four species have been captured by a tow-net off Port Natal and that "all the species are of slender fragile type with long limbs, such as may be expected to be good swimmers". *Pallenopsis ovalis*, which has been recorded by Loman from the East Indies, by Calman from the Andamans and from Ceylon, and *Parapallene nierstraszi* by Loman from the East Indies, were obtained from the west and south-west coasts, thus suggesting an obvious relationship between the Pycnogonid fauna of South Africa and the East Indies. This is probably due to the course of the equatorial current, which also exists on the east coast of Australia.

Earth Evolution.—The *Journal* of the Washington Academy of Sciences, vol. 20, pp. 17-25, Jan. 18, 1930, contains an interesting article by B. Gutenberg on "Hypotheses on the Development of the Earth". The ideas involved are to be more fully explained and developed in a future volume (3) of the "Handbuch der Geophysik". He accepts Darwin's theory of the evolution of the moon by fissure from the earth, and supposes that whereas, before this event, the earth's

crust was nearly in hydrostatic equilibrium, afterwards the outer sialic shell was absent from the part whence the moon was removed, so that the hydrostatic equilibrium was completely disturbed. In the Carboniferous epoch, some degree of quiet seems to have been restored, but at this time nearly the whole complex of continents was a single block situated in the southern hemisphere. Under the action of hydrostatic forces, this block separated into pieces which began to drift apart, and do so even to-day; at the same time, the *Polflucht* forces tended to move the whole mass so that about equal parts lay on the two sides of the equator. This having been accomplished, no further large movement of this block as a whole is to be expected, though the continents will continue to spread out and the surface of the extending regions will tend to sink, as is perhaps exemplified in the sinking of the western coast of Europe.

Collisions between Very Slow Electrons and Molecules.—In two recent papers in the *Annalen der Physik* (vol. 3, p. 536, and vol. 4, p. 91) C. Ramsauer and R. Kollath have given an account of some new work upon the collisions of very slow electrons with gaseous atoms and molecules. Using the original form of apparatus devised by Ramsauer, they have now been able to study the motion of the electrons for speeds equivalent to a fall of potential of only one-sixth of a volt. Their results again show a dissimilarity between the behaviour of different gases. Amongst the inert gases, the effective area of helium changes little with the speed of the incident electron, whilst the area of neon decreases continually with fall in electron velocity. Argon, krypton, and xenon, on the other hand, have a single minimum in the area-velocity curves, a property shared by oxygen and by methane. The curves for nitrogen and the oxides of carbon are more complicated. The maxima and minima on these curves occur in general at potentials which are far below the critical potentials of the gases, the small irregularities on the curve for helium, for example, being at about one volt, whilst its lowest excitation potential is just below twenty volts. The authors suggest that the area-velocity curves for all gases may be found to have a minimum even where this has not already been found, when the great technical difficulties in the way of working with electron speeds less than 0·16 volt can be overcome.

Extreme Ultra-Violet Spectra.—Further details of the important work of B. Edlén and A. Ericson on extreme ultra-violet spark spectra (see NATURE, Nov. 2, 1929, vol. 124, p. 688) are given in the *Zeitschrift für Physik* for Jan. 21. The spectrograph designed for this purpose by Prof. Siegbahn is relatively simple in construction, the spark chamber being a modified Siegbahn metal X-ray tube exhausted from one lead of a pump, the other lead from which evacuated the main chamber of the instrument. The grating used had a radius of curvature of 101 cm., and was ruled over an area of 35×50 mm.^{2}, the ruling being performed at the National Physical Laboratory, Teddington. The plates used for photographing the spectra were Schumann plates with glass only 0·4 mm. in thickness, these being considered preferable to several other types of plates and films that were tested. More reproductions of spectra are given than were shown in NATURE, perhaps the most interesting of which are enlargements of two multiplets at 834 A. and 1175 A. taken in the first order, which show very well the detail which can be recorded, the two lines at 832·75 A. and 832·92 A. being clearly separated. A note added in proof states that it has now been found possible by the use of a more intense spark as source to push the limit of the spectra still farther into the ultra-violet (see NATURE, Feb. 15, 1930, p. 233). The first members of the hydrogen-like spectra of doubly ionised lithium (Li III.) and of trebly ionised beryllium (Be IV.) have been found at 135·02 A. and 75·94 A. respectively, and considerable extensions of the spectra of doubly ionised beryllium (Be III.) and of the third, fourth, and fifth spark spectra of aluminium have also been made in the same region.

Oxides of Nickel.—Measurements of the heats of solution in sulphuric acid of nickel hydroxide and of its various oxidation products, the results of which are given by Giordani and Mattias in the *Rendiconti dell' Accademia delle Scienze Fisiche e Matematiche di Napoli* (1929), indicate the existence, between NiO and Ni_2O, of two intermediate oxides. Of these, the one with the higher content of active oxygen determines the characteristic potential of the anode during the greater part of the discharge of the alkaline accumulator.

Respiration Apparatus.—This assembly of apparatus for indirect calorimetry, designed by Dr. E. Simonson, of Frankfort a. M. and manufactured by Askania-Werke A. G., of Berlin Friedenan (London agent, O. G. Karlowa, Abford House, Victoria, S.W.1), differs but slightly from existing models such as the Douglas-Haldane equipment. A diverting manifold (see Fig. 1 : 8-12) is attached directly to the mouth-

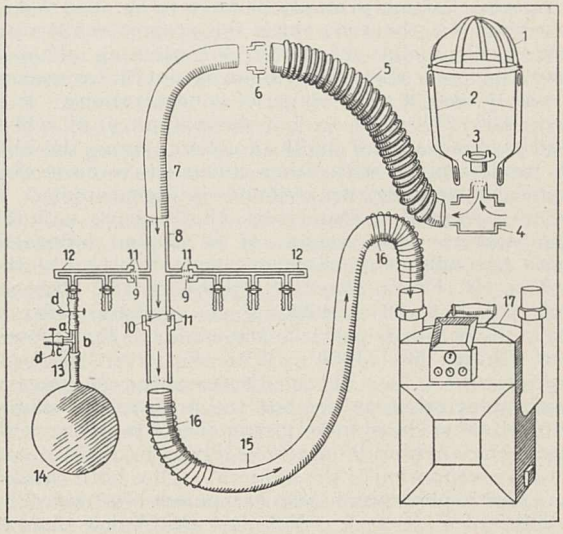


FIG. 1.

piece (4), permitting of the sampling of expired air for analysis in either a rubber or cellophane bag (14), while the volume of expired air is obtained from the dry meter (17). A variety of orifice plates with packing rings (9) are available with capillary metal tubes which can be closed individually, thus enabling the removal of short or continuous samples (about 1 litre) of the expired air in a protracted experiment. The volumes per unit time of these samples, naturally, will depend on the cross-sectional areas of the orifices, which are always predetermined. It thus becomes possible to withdraw samples for analysis at any stage of the experiment and to measure the basal metabolic rate before and after the experiment. The diverting manifold is obtainable in a portable form for strapping on the back and weighs about $2\frac{3}{4}$ lb. The apparatus may find application in experiments of long duration where the more expensive chambers or closed circuit assembly are at present used.

Recent Work on Vitamin A.

DURING the past two years advances have been made in our knowledge of the chemistry and properties of vitamin A and its relationship to certain other compounds, but progress, though steady, has not been so dramatic as in the case of vitamin D. Attention has been directed chiefly to methods of assay, both biological and chemical, to attempts at isolation of the vitamin, and to its formation under natural conditions: less work has been devoted to its physiological functions. In this article certain aspects of the subject will be briefly reviewed.

Assay.

The tediousness and inherent difficulties of the biological test have led investigators to seek some simple chemical reaction or some physical property which could be utilised for the quantitative determination of the vitamin. However, since these methods are not absolutely specific, the final criterion must be the animal test, so that its accuracy has been critically considered and its technique improved, in the hope of obtaining more reliable results.

The arsenic trichloride test of Rosenheim and Drummond (*Biochem. J.*, vol. 19, p. 753; 1925) and the antimony trichloride test of Carr and Price (*ibid.*, vol. 20, p. 497; 1926) have been widely used; more especially the latter, since the blue colour produced lasts somewhat longer than that given by the former reagent. Certain precautions have to be observed in carrying out the test, since the proportionality between the amount of vitamin A containing oil taken and the blue colour developed is not linear except possibly over a small range of concentrations. It is necessary, therefore, to find the amount of oil which will give a standard depth of colour; since the blue is usually mixed with other colours, it is most conveniently measured in Lovibond tintometer units. It is also essential to standardise the reagents and the temperature: the amount of oil present influences both the rate of development and of fading of the colour (N. Evers, *Quart. J. Pharmacy and Pharmacol.*, vol. 2, p. 227; 1929. T. T. Cocking, *ibid.*, p. 310: E. R. Norris and I. S. Danielson, *J. Biol. Chem.*, vol. 83, p. 469; 1929). With cod-liver oil, good agreement has been obtained between the colorimetric and biological methods, but the presence in animal fats of other substances giving the blue colour with antimony trichloride interferes with the direct quantitative estimation of the vitamin. Thus both carotin and xanthophyll give a deep permanent blue under the conditions of the test. Willimott and Wokes (*Lancet*, vol. 2, p. 8; 1927) removed the interfering pigments by adsorption on charcoal, and found good agreement between the two methods of assay in the case of a variety of vegetable and animal foodstuffs. The blue colour can be distinguished also by spectroscopic examination: thus in the case of vitamin A with the $AsCl_3$ reagent, there is a band at 5870 A., with a second band, developing on standing, at 4750 A.; with the $SbCl_3$ reagent the initial band is at 6140 A. and the second at 5300 A.: in both cases the initial bands rapidly fade. Carotin, however, gives a band at 5900 A. and the colour produced is duller and greener (Rosenheim and Drummond, loc. cit.; Wokes, *Biochem. J.*, vol. 22, p. 997; 1928. Moore, *Lancet*, vol. 2, p. 219; 1929). Blue colours are also given by other compounds, but under conditions in which they are not likely to be confused with that given by vitamin A: thus both cholesterol and cholic acid, after treatment with benzoyl chloride in solution in chloroform, give a blue colour with $AsCl_3$ (Rosenheim, *Biochem. J.*, vol. 21, p. 386; 1927. Wokes, *ibid.*, vol. 22, p. 830; 1928). The cholesterol oxidation product has none of the properties of vitamin A, fails to give the colour after solution in oil, and has no stimulating effect on growth.

The absorption spectrum of cod-liver oil shows bands at 3200-3280 A. and 2700-2900 A. Morton and Heilbron (*Biochem. J.*, vol. 22, p. 987; 1928) have found that the intensity of the former band varies with the intensity of the blue colour developed in the $SbCl_3$ test, both in natural oils and concentrates, and also in oils oxidised or irradiated when the band disappears and no blue colour is obtained. Other compounds may show a band near 3200 A.: their presence is disclosed after oxidation of the oil. Although the intensity of this band may, under certain conditions, be used as an estimate of the concentration of vitamin A in the oil, yet it is not absolutely specific for the vitamin, so that it cannot be relied on as sole test, without an accompanying biological assay, in the case of materials from which the presence of interfering substances has not been excluded. Rosenheim and Webster (*ibid.*, vol. 23, p. 633; 1929) have, in fact, shown that dehydroergosterol has an absorption band at 3200-3280 A., but gives no blue colour with $AsCl_3$ or $SbCl_3$, and is inactive in doses up to 1 mgm. per diem when given to rats maintained on the standard deficient diet. The intensity of the band, however, is considerably less than that of the absorbing substance in cod-liver oil.

A number of workers have analysed the responses of their animals, the growth of which had ceased on a vitamin A deficient diet, to various supplements containing the vitamin. It is now agreed that such a diet must contain vitamin D, and that results obtained on diets deficient in both vitamins A and D cannot be relied on to give even a rough idea of the vitamin A activity. One of the difficulties of the usual method of assay is that when growth ceases the rat is frequently suffering from some infection, and that a supply of vitamin A may fail to stimulate growth until the infection has cleared up, or if the dose is too small, the animal may succumb to its infection. Coward and Key (*ibid.*, vol. 22, p. 1019; 1928) find that the responses of depleted animals fall into four groups: there may be no response, on too small a dose; there may be subnormal quantitative growth, with or without premature slackening, on a small dose; or there may be normal growth, with premature slackening or to maturity, according to the size of the dose given. Sometimes a growth response only occurs after a latent period of some weeks. They consider it necessary to use 2-4 animals on each dose with a test period of 8 weeks. Hume and Smith (*ibid.*, vol. 22, p. 504; 1928) report similar results: they are of opinion that it is possible to obtain a qualitative result by this method, and possibly in the first 3-4 weeks of vitamin A feeding after a depletion period, to attain a quantitative assay. They consider that a better method is to give the animals small doses of vitamin from the beginning of the experiment: the growth curves are graded according to the size of the dose, but a result cannot be looked for in under 3 months.

Drummond and Morton (*ibid.*, vol. 23, p. 785; 1929) found the growth responses of different animals on the same doses to vary considerably: up to twelve animals on each dose, with an extensive range of doses, must be used to obtain a distinction between two cod-liver oils differing from each other by less than 100 per cent. Only the growth rates for the first 5-6 weeks following the depletion period should be considered: better results are obtained when doses necessary to give a growth rate of 3 grams per week

are compared than when comparison is made between rates of growth on the same dose. These authors hold, however, that for quantitative estimation of vitamin A in cod-liver oil, the colour test or the determination of the intensity of the absorption band gives more reliable results than the biological assay. Similar analyses have been published by Nelson and Jones, and Sherman and Burtis (*J. Biol. Chem.*, vol. 80, p. 215, and vol. 78, p. 671; 1928). Smedley-Maclean and her co-workers (*Biochem. J.*, vol. 23, p. 634; 1929) suggest that doses of the substance under test which will just sustain life over a certain time, and those which just fail to do so, should be determined, since a better comparison between different samples can be made thus. Furthermore, as a check upon the response of the animal, a dose of cod-liver oil which might be expected to stimulate growth should be given at the end of the experiment.

In connexion with biological assays, some recent work by Coward and her collaborators may be referred to (Coward *et al.*, *Biochem. J.*, vol. 23, pp. 695 and 913; 1929). Rats sometimes fail to grow on an apparently complete synthetic diet; the failure has been traced to the casein employed, since changing the casein permits of normal growth. This work may explain some of the irregular results which are observed at different times in vitamin A (and B) assay.

Chemistry.

Drummond and Baker (*Biochem. J.*, vol. 23, p. 274; 1929) have investigated the chemical nature of vitamin A. Unsaponifiable matter was prepared from the liver oils of the cod, sheep, and Greenland and Japanese sharks. Cholesterol was removed by crystallisation: only small amounts were present in the shark liver oils, the chief constituents being selachyl, batyl, chimyl, and oleyl alcohols, some of which were removed in part by crystallisation from suitable solvents. The residual oils were then submitted to fractional distillation at very low pressures: no satisfactory fractionation was obtained in the case of cod- or sheep-liver oils, and in both cases decomposition occurred: recovery of the vitamin from the fractions was only 2 and 11 per cent respectively, as estimated by the colour test. Distillation of the shark-liver oils yielded only the higher alcohols, but the vitamin recovery was up to 50 per cent in the case of the Japanese shark-liver oil. It is considered that the destruction of the vitamin in the former case is due to the presence of complex alcohols and hydrocarbons of the terpene series, which are only present in small proportions in the shark oils. No fraction consisting exclusively of vitamin A was obtained, nor was it separated by crystallisation. It appears that it is present in Japanese shark-liver oil to the extent of 1 per cent only, or less, of the unsaponifiable matter. The authors are of opinion that it is probably a sterol, from the nature of its colour reactions, and suggest that its chemical composition may be elucidated rather by studying the properties of sterols than by attempting its isolation from a natural source.

In connexion with the destruction occurring on distillation at low pressures, it may be mentioned that Wokes and Willimott (*ibid.*, vol. 21, p. 419; 1927) suggest, as a result of experiments on the effect of heat and oxidation on the vitamin A content of cod-liver oil, that the destruction observed may be due to the presence of volatile organic peroxides.

In the identification of the complex alcohols present in liver oils, it is often necessary to hydrogenate the material and isolate the reduced products. Drummond and Baker (loc. cit.) found that reduction of the oil obtained from the unsaponifiable matter of cod-liver oil, after removal of sterols by digitonin, did not destroy completely the vitamin A content, but the reduction was admittedly incomplete. Nakamiya and Kawakami (*Sci. Papers, Inst. Physical and Chem. Res.*, vol. 7, p. 121; 1927), however, found that hydrogenation of 'Biosterin' led to complete loss of the vitamin activity.

Another line of approach to the chemical nature of vitamin A has been the study of its relationship to certain plant pigments. Xanthophyll has been shown to have no growth-promoting power (Willimott and Moore, *Biochem. J.*, vol. 21, p. 86; 1927: Smedley-Maclean *et al.*, *ibid.*, vol. 23, p. 634; 1929), but several observers (v. Euler, Maclean, Moore) have found that carotin in very small doses can restore normal growth in a rat maintained on a vitamin A deficient diet.

Collison, Hume, Smedley-Maclean, and Smith (*Biochem. J.*, vol. 23, p. 634) have investigated the nature of the vitamin A constituent of certain green leaves.

The material soluble in light petroleum was extracted from green cabbage and saponified: the yield was 0·84 per cent of the dried leaves. The unsaponifiable matter was fractionated by means of solvents: cold alcohol extracted a sterol together with a substance giving the blue colour with antimony trichloride: hot alcohol extracted from the residue nonacosane and di-*n*-tetradecyl ketone: whilst from the final material carotin was obtained by extraction with light petroleum: the carotin had definite growth-promoting power even in a daily dose of 0·003 mgm. From white cabbage little carotin was obtained, and this material contained little vitamin A. Carotin prepared from spinach and carrots was also active, in doses of 0·01 mgm. daily, but it was obtained in a somewhat less pure condition than when cabbage was used as source. The authors consider that possibly more than one substance can function as vitamin A, that, in fact, the growth-promoting power is the property of a special grouping of atoms which may occur in several different molecules: they cite the observations of v. Euler and his co-workers, who have shown that dihydro-α-crocetin is also active. Moreover, the absorption spectra of the blue colours produced by vitamin A and carotin with $SbCl_3$ are different, but no trace of the former appears in that of an active sample of carotin, suggesting that vitamin A is not simply a contaminant of the latter. It is possible that the negative results of Drummond as regards the potency of carotin are due to the fact that his basal diet is free from fat. There is evidence that some constituent of the unsaponifiable fraction of the fat is necessary for carotin to exert its growth-promoting power.

Moore has also found that carotin can exert a vitamin A activity (*Biochem. J.*, vol. 23, p. 803; 1929: *Lancet*, vol. 2, p. 380; 1929). His results confirm those obtained by other workers, who have found carotin active, but his latest experiments have led to a different conclusion. Carotin was fed to rats in daily doses of from 0·0001 to 0·75 mgm.; after 5 weeks the animals were killed, the fat extracted from the liver and analysed for vitamin A by colorimetric and spectroscopic methods. The intensity of the vitamin A blue reaction (absorption band at 6100-6300 A.) indicated that a daily dose of 0·01 mgm. or more of carotin increased the vitamin A content of the liver: at the same time only a very slight increase in the degree of yellow pigmentation of the fat occurred, showing that carotin was stored to only a negligible extent in this organ. Hence, even when a large excess is ingested, carotin appears in the liver only in minute traces; the simplest explanation of the increase in the vitamin A content is that it was actually formed from a portion of the carotin eaten.

In a recent review Drummond points out that the

ordinary standards of chemical purity give insufficient security in biochemical work with substances so highly active as the vitamins (*Chem. and Industry*, vol. 49, p. 1 T; 1930). The difficulties experienced in detecting ergosterol as the impurity in cholesterol which is activated by exposure to ultra-violet light need scarcely be referred to in this connexion. In this case, the doubt is as to the purity of the carotin used by the various investigators who have found it to contain growth-promoting activity. Drummond has obtained carotin of melting point so high as 185°: it showed no vitamin A activity even in relatively large doses. He has also prepared di-hydro-α-crocetin: his specimen failed to restore growth in rats deprived of vitamin A. From the results obtained with liver oils, it may be estimated that the daily dose of the vitamin for a rat is probably less than 0·0001 mgm., an order of activity comparable with that of vitamin D. If this is so, preparations of vitamin A which must be given in larger doses to restore growth must necessarily be impure.

PHYSIOLOGY.

The presence of vitamin A in the diet is essential if it is to be adequate for growth and the maintenance of normal health. E. Mellanby has stressed the latter function: without vitamin A in the food, infections occur regularly among the experimental animals: administration of large quantities to human beings may cure certain infections (see NATURE, vol. 122, p. 750; 1928). It must be assumed that vitamin A is, or is the precursor of, an essential constituent of certain cells of the body: without it they can neither multiply nor maintain their normal structure. In many cases the onset of an infection appears to be facilitated by an alteration in the cells lining an exposed surface when the vitamin is withdrawn from the diet.

Unlike vitamin D, vitamin A is not synthesised in the animal body: hence it is important to see that it is present in the food. Thus the content of cow's milk in this vitamin depends on the food given the animal; it is increased by feeding green food and cod-liver oil. The vitamin D in the milk can be increased by giving it in the food or by irradiating the cow or even the milk itself.

Yeast, a source of many interesting compounds, does not contain vitamin A: previous conclusions to the contrary were the result of using a diet deficient in both vitamins A and D in testing for this vitamin. (Hume, Smith, and Smedley-Maclean, *Biochem. J.*, vol. 22, p. 27; 1928.)

The ultimate source of vitamin A is the green plant: there has been considerable doubt as to whether the presence of light is necessary for its formation or not, partly owing to the difficulty of excluding all light, partly owing to the fact that many tests have been carried out using a basal diet deficient in both vitamins A and D. The most recent work indicates, however, that vitamin A can be formed in the complete absence of light, except the minimum required to feed and handle the animals and collect the etiolated shoots. Moore found that wheat seeds contained no vitamin A, that etiolated shoots fed to rats in a diet containing vitamin D but no A stimulated growth, although given to the animals after dark, and finally that the same result was obtained when no light except red was admitted to the room in which the animals were housed and the shoots grown throughout the experiment (*ibid.*, vol. 21, p. 870; 1927; vol. 22, p. 1097; 1928). It is, however, possible that the brief exposure to the red light may have been the essential factor in the production of the vitamin: it is certain that light can accelerate the synthesis, since green plant tissues are better sources than white.

Education and Science in the Civil Service Estimates.

THE Civil Estimates and Estimates for Revenue Departments (Vote on Account) for the year ending Mar. 31, 1931, have been issued (82. London: H.M. Stationery Office. 3*d.* net). The total of the estimates for the full year is £368,095,208, against a total of £320,190,105 voted for the current year; this latter total, however, includes supplementary estimates.

The items in which readers of NATURE will be most interested occur in Classes IV. and VI., and are as follows:

	Total Estimate for 1930 (Net).	Total Net Estimate for 1929 (adjusted for transfers).
Class IV.		
Board of Education	£45,495,653	£41,685,899
British Museum	297,263	283,559
Scientific Investigation, etc.	232,303	228,278
Universities and Colleges, Great Britain	1,830,000	1,550,000
SCOTLAND:		
Public Education	7,197,422	6,173,485
Class VI.		
Ministry of Agriculture and Fisheries	2,312,310	2,953,863
Beet Sugar Subsidy, Great Britain	5,400,000	4,250,000
Surveys of Great Britain	143,203	140,980
Forestry Commission	837,800	600,000
Development Fund	625,000	300,000
Development Grants	200,000	—
Department of Scientific and Industrial Research	469,278	446,214
SCOTLAND:		
Department of Agriculture	574,918	484,047
Fishery Board	137,442	68,895

The details of Class IV. estimates are now available (83-IV. London: H.M.S.O. 1*s.* 3*d.* net). Under the heading "Scientific Investigation, etc.", there is an increase of £4025 over last year's estimate. The position is shown in the following table:

GRANTS IN AID.	1930.	1929.	Increase.
Royal Society	£10,000	£10,000	—
Royal Geographical Society	1,250	1,250	—
Royal Society of Edinburgh	600	600	—
British School at Athens	500	500	—
British School at Rome	500	500	—
Royal Scottish Geographical Society	200	200	—
National Library of Wales	25,334	25,333	£ 1
National Museum of Wales	28,000	27,000	1,000
Solar Physics Observatory	3,000	3,000	—
North Sea Fisheries Investigation	1,150	1,150	—
Royal Academy of Music	500	500	—
Royal College of Music	500	500	—
Royal Academy of Dramatic Art	500	500	—
British Academy	2,000	2,000	—
Central Library for Students	3,000	—	3,000
Medical Research Council	148,000	148,000	—
OTHER GRANTS.			
Edinburgh Observatory	7,269	7,245	24
	£232,303	228,278	4,025

Under the heading "Universities and Colleges, Great Britain", there is an increase of £280,000, the greater part of which, £243,110, is put down as unallocated grant.

The detailed estimates for Class VI., departments dealing with trade and industry, have also been issued (83-VI. London: H.M.S.O. 3s. net). From these it appears that grants for agricultural education and research are increased on those of the current financial year by £165,410, the largest parts of which are £93,400 for agricultural education and £67,760 for grants for research. The Fisheries Department estimate shows an increase of £87,519; this is largely accounted for by the provision of £80,000 for the construction of a new vessel for deep-sea research and investigation.

The estimates for the Forestry Commission show a net increase of £101,800; a large item here is the increase of £29,840 under the heading of forestry operations, the greater part of which is for the acquisition of land, buildings, and standing timber.

The Department of Scientific and Industrial Research estimate shows a net increase of £23,064 over that for the current year. Grants for investigation and research, distributed on the recommendation of the Advisory Council, are increased by £5250, and a special grant of 100,000 francs (£4000) is to be made to an international fund for the erection and endowment of a scientific station on the Col de la Jungfrau.

The staff of the National Physical Laboratory is to be increased by nine, building research requires ten more officers, chemical research five, food investigation nine, forest products six, fuel research, including physical and chemical surveys, ten, radio research eight.

University and Educational Intelligence.

CAMBRIDGE.—The Appointments Committee of the Faculty of Biology B have appointed Dr. R. Williamson to be University demonstrator in pathology.

The Allen Scholarship of the value of £250 has been awarded to S. Verblumsky, Donaldson Bye Fellow of Magdalene College.

The Appointments Committee of the Faculty of Physics and Chemistry has made the following appointments: Dr. F. G. Mann, of Downing College, to be University lecturer in chemistry; Dr. J. D. Cockcroft, of St. John's College, to be University demonstrator in physics; Dr. F. B. Kipping, of Trinity College, to be University demonstrator in chemistry.

EDINBURGH.—The University Court has received with very great regret intimation from Prof. Baldwin Brown of his desire to retire from the Watson-Gordon chair of fine art at the end of the current academical year. Prof. Baldwin Brown was appointed to this chair, as its first occupant, in June 1880, and so is now about to complete his fiftieth year as professor. The only previous instance of a professor serving in this University for fifty years was that of Robert Jameson, professor of natural history from 1804 to 1854; in his case, however, his lectures were delivered by a deputy during his last year of office.

The Court has accepted from Sir Edward Sharpey Schafer the books, portraits, specimens, and apparatus collected by him in the Department of Physiology. Mrs. Kennedy Fraser has offered and the Court has accepted a collection of 280 phonograph records of Hebridean songs, made by the Isle folk themselves. The collection has been made in the course of Mrs. Kennedy Fraser's research work in the Hebrides during the past twenty-five years.

The late Mr. W. A. Tait, son of the late Prof. P. G. Tait, has bequeathed £50 to the Engineering Library and £100 for apparatus in the Department of Natural Philosophy.

LONDON.—The following doctorates have been conferred: D.Sc. in chemistry on Mr. Bhupendranath Ghosh (University College), for a thesis entitled (1) "The Rôle of Electrokinetic Potential in Colloidal Behaviour", and (2) "Action of Alkali on Stannic Oxide Sol"; D.Sc. in physics on Mr. Leslie Hartshorn (Imperial College—Royal College of Science), for a thesis entitled "Studies in Precision Alternating Current Measurements"; D.Sc. in mathematics on Mr. W. G. Bickley, for a thesis entitled "Two Dimensional Potential Problems concerning a Single Closed Boundary", and other papers; D.Sc. (engineering) on Mr. H. S. Rowell, for a thesis entitled "Suspension of Vehicles and Laminated Springs", and other papers.

OXFORD.—The annual report of the Curators of the Bodleian Library just published contains an account of recent improvements and additions in the Radcliffe (Science) Library, which now takes rank, like the Indian Institute and Rhodes House Libraries, as a Departmental Library in connexion with the Bodleian.

THE Grocers' Company is again offering scholarships, each of the value of £300 a year, plus an allowance for expenses, in furtherance of original research in sanitary science. Applications upon a prescribed form must be received before the end of April by the Clerk to the Grocers' Company, Grocers' Hall, E.C.2.

APPLICATIONS for Beit fellowships for scientific research are invited from candidates under the age of twenty-five years on the date of election. The latest date for the receipt of applications is April 15. Forms of application and particulars as to the fellowships are obtainable from the Rector, Imperial College of Science and Technology, South Kensington, S.W.7.

THE Carnegie Trust for the Universities of Scotland endows post-graduate study and research by means of a scheme designed, to quote from the report of the chairman, Lord Sands, on the administration of the Trust for the year 1928–29, "to discover and if possible to supply within the limits of the Trust Deed the demand for higher study and research throughout Scotland". For the completer fulfilment of this purpose, the trustees have resolved that in future graduate scholarships which carry an annual stipend of £175 for two years may be extended for a third year with a stipend of £200, and that the value of fellowships, tenable for a maximum period of three years, shall be £300 per annum instead of, as at present, £250. It will now be possible for a Scottish graduate to be engaged in research under the auspices of the Trust for a continuous period of six years. Reports on the work of investigators by Prof. Arthur Smithells (physical and chemical), Prof. J. T. Wilson (biological and medical), Sir George Macdonald (historical, economic, and linguistic), and the Superintendent of the Royal College of Physicians, Edinburgh, afford ample evidence of the value of this work. Prof. Smithells notes with gratification an increasing encouragement of beneficiaries to secure the great advantage of some experience in foreign laboratories. During the past year, the actual expenditure for endowment of research was £17,514, grants to universities, etc., amounted to £48,020, and assistance to students in payment of class fees to £56,453. Repayments (voluntary) by former beneficiaries (31 men and 32 women) amounted to £2606, the largest amount ever received in this way in any year, and making with similar repayments in previous years an aggregate of £25,148 from 665 beneficiaries.

Historic Natural Events.

Mar. 17, 1669. Blood Rain at Chatillon-sur-Seine.—The history of the Paris Academy of Sciences says: "There fell in various parts of the city, a sort of rain, or reddish liquid, thick, viscous, and stinking, which resembled a rain of blood. The prints of great drops of it were observed on walls". It is believed that this rain was composed of stagnant muddy water, raised by a whirlwind from some pond in the neighbourhood.

Mar. 17, 1906. Earthquake in Formosa.—This destructive earthquake, by which 1266 persons were killed and 7284 houses were totally destroyed, was chiefly remarkable for the somewhat complex distortion of the ground, along a fault at least 10 miles and possibly 30 miles in length. Throughout the observed length, the north part of the fault was displaced horizontally with respect to the other 2-8 ft. to the east, and in the greater part was depressed by 3-4 ft. At the east end, however, the vertical movement was reversed, and the south side was depressed relatively to the other by as much as 6 ft.

Mar. 18, 1667. Great Cold.—The winter of 1666–67 was known in Germany as "the double winter", because the rivers were frozen twice. January was cold, February was snowy, but the greatest intensity of the frost occurred from Mar. 18 until Mar. 26, with north-easterly winds. The Zuider Zee was full of ice, and waggons were drawn over the rivers. No one remembered such severe weather so late in the season. In England the winter was not especially severe, but the spring was very cold. On Mar. 6, Pepys wrote: "The weather, too, being become most bitter cold, the King saying to-day that it was the coldest day he ever knew in England"; and again on Mar. 7: "This day was reckoned by all the people the coldest day that ever was remembered in England". Evelyn recorded: "Great frosts, snow, and winds prodigious at the vernal equinox; indeed it had been a year of prodigies in this nation, plague, war, fire [the Great Fire of London], tempest, and comet". On April 4 he added: "The cold so intense that there was hardly a leaf on a tree".

Mar. 19, 1719. Great Fireball.—A brilliant apparition was seen from the whole of Great Britain and Ireland, Holland, and from the nearer parts of Germany, France, and Spain. Halley discussed collected observations made of this meteor or fireball in *Phil. Trans.*, p. 978; 1719. In parts of England "within doors the Candles gave no manner of Light"; indeed, "for some few Seconds of Time, in all respects it resembled perfect Day". In London the path of the fireball (timed as at 8.15 P.M.) lay nearly in the direction of the Pleiades and Orion's belt. The moon, it may be noted, was nine days old. The track deduced by Halley was from over Presteigne (height 73 miles), Cardiff, Tiverton (height 69 miles) to Brest. There were two explosions, the first when the fireball was over Tiverton, when the sound of it, accompanied by an air tremor causing windows and doors to rattle, was heard over an area extending from Cornwall to London; the second and greater explosion took place at the extinction of the fireball over Brittany. The diameter of the fireball is stated to have been fully 1½ miles, and its velocity along the visible part of its track nearly 60 miles a second.

Mar. 20, 1784. Mirage at Malta.—At 1 P.M. great excitement was aroused in Malta by the sudden appearance of what seemed to be a new island. Sailors and fishermen hurried out to take possession of it, but it proved to be the top of Mount Etna, and later the hills and buildings of Sicily became visible. The appearance of the mountain top as an island indicates that no rays from such lower parts of the land as were normally visible could reach the observer's eyes, and that the horizon was brought much closer than usual.

Mar. 21, 1920. Sunspots and Aurora.—The date of central meridian passage of an enormous stream of sunspots, visible to the naked eye on this day as a curved streak nearly $\frac{1}{5}$ of the sun's diameter. This region of the sun was active for about six months, and in the previous January contained another large stream but slightly inferior in size to that of March. The length of these streams was of the order of 150,000 miles, the aggregate area of the component spots being about 2500 millions of square miles. On Mar. 22–23 a severe magnetic storm occurred; the ranges in declination at Greenwich and Stonyhurst were 86′ and 160′ respectively, whilst the ranges in horizontal force at both observatories exceeded 700γ. The accompanying auroral display was the finest seen for many years. In parts of Great Britain, objects at several yards' distance could be plainly seen at midnight, and at times even newspaper print could be read. At Eskdalemuir, the 'curtain' extended to within 30° of the southern horizon.

Mar. 22, 1205. End of Long Winter.—Although not especially severe, the winter of 1204–5 was very prolonged in north-west Europe and England, the greatest cold lasting from the middle of January to Mar. 22. It was followed by great mortality among animals in Europe, especially sheep and birds, and this resulted in a famine. In England there was great distress, and Stow records that a "quarter of oats [was sold] for forty pence, that were wont to be sold for fourpence. Also the money was so sore clipped that there was no remedy but to have it renewed."

SUPPLEMENTARY.

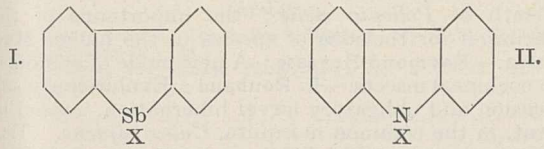
Mar. 9-10, 1891. West of England Blizzard.—During the passage of a deep barometric depression eastwards along the English Channel, heavy snow fell with high winds over southern England, and especially in the south-west. According to Mr. Bonacina's account in the *Meteorological Magazine* for 1927, in Devon and Cornwall the depth of snow averaged two feet with immense drifts. Trains were not only blocked but actually buried in snow, and some of the passengers nearly died of starvation. The 'Zulu Express' which left Paddington at 3 P.M. on Mar. 9 did not reach Plymouth until 8.30 P.M. on Mar. 13. The Devonshire lanes remained blocked until the end of March, and it is said that the snow remained on the higher parts of Dartmoor and Exmoor until June. There were a number of shipwrecks, especially on the south coast of Devon and Cornwall, in which many lives were lost.

Societies and Academies.

LONDON.

Royal Society, Mar. 6.—W. J. Elford: Structure in very permeable collodion gel films and its significance in filtration problems. Optical studies have revealed two definite types of structure: (i) microgel structure of microscopic order, (ii) ultragel structure of ultra-microscopic order. Gelation here is a process of phase transition resulting from the coagulating influence of desolvation. The nature and stability of the gel is a function of the specific characters of the nitrocellulose and solvent, and the variation in free surface forces around the dispersed phase particles with differing degrees of molecular complexity of the system. A complete explanation of the general behaviour of ultra-filter membranes is afforded.—T. W. Wormell:

Vertical electric currents below thunderstorms and showers. This paper describes observations on the discharge of electricity beneath thunderstorms and showers from a raised metal point, 12·3 metres above the ground. In the course of a year, the net effect of the point is to discharge about + 0·13 coulombs into the atmosphere. The majority of the clouds observed were of positive polarity, that is, mean height of positive charge in cloud was greater than mean height of negative charge. In the locality in question, the effective gain of negative electric charge by the earth through the mechanisms of point-discharge currents and lightning discharges is at least as large as the sum of the positive charges brought down by the fine-weather current and by rain. The observations are in agreement with C. T. R. Wilson's hypothesis that downward current in fine-weather regions from upper layers of atmosphere to ground is, on the average, balanced by upward current in regions of cumulo-nimbus from earth through cloud to upper atmosphere. —**G. T. Morgan and G. R. Davies**: Antimony analogues of the carbazole series. A description of the anti-monial analogues I of the carbazole series II. The following structural formulæ represent this analogy, where X is an alkyl or aryl radical.



The starting point in this investigation is commercially available diphenyl.—**R. Fort and C. N. Hinshelwood**: The kinetics of the oxidation of gaseous benzene. The oxidation of gaseous benzene is a predominantly homogeneous reaction. The rate of reaction varies according to a high power of the benzene concentration; and a high ratio of benzene to oxygen favours rapid oxidation. It appears probable that comparatively short reaction chains are propagated, the variation in the length of which gives rise to the abnormal influence of temperature and pressure on the velocity. The chains are propagated more readily when the initial oxygenated product encounters another molecule of hydrocarbon than when oxidised further by oxygen.—**A. Unmack, D. M. Murray-Rust, and Sir Harold Hartley**: The conductivity of thiocyanates in methyl alcohol. At 25° C. the univalent thiocyanates obey the square-root relationship $\Lambda_c = \Lambda_o - x\sqrt{c}$, and the degree of association is slight, but increases with the atomic number of the metal. The divalent thiocyanates fall into two groups: those of barium, strontium, calcium, and magnesium, which show considerable association, and zinc and cadmium thiocyanates, which are weak electrolyges.—**S. J. Wright**: The elasticity of Pintsch crystals of tungsten. The torsional moduli of rigidity of six wires, of which five were single crystals of tungsten of different orientations, while the remaining one consisted of three crystals, were determined by a dynamical method. The results indicated that the variations in elastic properties of tungsten crystals over the whole range of possible orientations would not exceed 1 part in 200. It is concluded that tungsten crystals are isotropic.—**Ramakrishna Rao**: Study of electrolytic dissociation by the Raman effect (1). The Raman line at 4566·8 A. is common to nitric acid and nitrates; it is due to the NO_3 ion, and increases in intensity with increasing dilution of nitric acid. The line at 4620·3 A. is present only in nitric acid, and corresponds to the undissociated HNO_3 molecule. It diminishes rapidly in intensity with increasing dilution, indicating dissociation of nitric acid. Variation of the degree of dissociation is similar to that found from conductivity measurements but different in order of magnitude.

Society of Public Analysts, Feb. 5.—R. L. Andrew: The determination of minute amounts of iodine in soils and waters. A modification of Fellenberg's method has been devised and 60-70 per cent of iodine added to a soil can be recovered. The results obtained by colorimetric methods are more trustworthy than those obtained by titration. Soils from the North Island of New Zealand contained from 10 to 2100 parts of iodine in 10 millions, and the drinking waters from 0·004 to 0·120 part per 10 millions.—**D. W. Kent-Jones and A. J. Amos**: Preliminary studies in the bacteriology of wheat and flour. A satisfactory procedure for enumerating bacteria in wheat and flour has been devised. Freshly and normally milled patent flour contains less than 20,000 blood-heat bacteria, straight-run flour less than 50,000, and lower grade flour up to 300,000 per gm. The cool organism content of any grade is nearly always greater than that for blood-heat organisms. Storage decreases the number of both forms. Organisms of the *B. mesentericus* group are almost universally present in flour and bread.—**H. J. S. Sand**: The separation of metals by 'internal electrolysis'. The metal to be determined is deposited on a platinum cathode, the essential feature of the method being that no electric current is introduced from outside, but, instead, an anode of the baser metal is employed, which is placed in contact with a solution of one of its salts in a compartment separated by a parchment membrane from the solution to be examined.—**Ella M. Collin**: The rapid determination of bismuth and copper in lead bullion by internal electrolysis. The method has been used to separate small quantities of bismuth and copper from large amounts of lead, the less basic metals being displaced from solution by means of lead, without any external E.M.F.—**G. Winthrop Leeper**: Notes on the thiocyanate method of determining iron. Influence of different classes of phosphates. Orthophosphates do not interfere with the thiocyanate reaction provided that the ratio of phosphoric anhydride to iron does not exceed 100·0·02 mgm. When extracting the ashed material with acid, sufficient time must be allowed for any pyrophosphate formed to be reconverted into orthophosphate. Both pyrophosphates and metaphosphates rapidly destroy the colour of ferric thiocyanate.

Physical Society, Feb. 14.—W. E. Summerhays: The diffusion constant of water vapour. Water vapour was allowed to diffuse down a vertical tube about 2 in. in diameter, a steady concentration-gradient being maintained from approximate saturation at the top to approximate dryness at the bottom. The gradient was measured with two katharometers at a definite distance apart and the mass of vapour passing in an observed time was weighed. The result is 0·281 cm.²/sec. at mean temperature 16·1° C.—**M. C. Johnson**: A method of calculating the numerical equation of state for helium below 6° abs., and of estimating the relative importance of gas degeneracy and interatomic forces. Gas 'degeneracy' (the effect of non-Maxwellian distribution of molecular velocities) is distinguished from gas 'imperfection' (the effect of intermolecular forces). A thermodynamic method is used to calculate the sum of degeneracy and imperfection at 4° and 5° abs. for helium.—**F. D. Smith**: The magnetostriction constant for alternating magnetic fields. A magnetostriction constant K for the Joule effect is defined by the equation $p = KH$ where p is the alternating mechanical stress produced by a

small alternating magnetic field H superposed on a steady magnetic field H_0. It is shown that the alternating intensity of magnetisation I produced by an alternating strain $\delta l/l$ is given by the equation $I = K^{\delta l/l}$, K being the same constant in both equations. These equations are used to calculate the motional impedance of a laminated ring toroidally wound and vibrating in its fundamental radial mode.

DUBLIN.

Royal Dublin Society, Jan. 28.—**Henry H. Dixon** and **T. A. Bennet-Clark**: (1) Responses of plant tissues to electric currents. Previous experiments on plant tissues revealed an S-shaped relation between response and voltage. This result might be interpreted as due to the response of cells of modal size in the conducting tissue to a certain voltage, each cell responding on the 'all or none' principle; or it might be that the responses of the individual cells vary in magnitude, and that a modal response is given by these cells to a certain voltage. In the present experiments, the staminal hairs of *Tradescantia* consisting of a single filament of cells were used. The same S-shaped relation was found. Hence it is evident that the component cells gave responses of different magnitudes according to the voltages applied, and that the 'all or none' principle taking the cells as units is not effective. This result was confirmed on other filiform tissues.—(2) Electrical properties of emulsions. Emulsions of water and olive oil containing both sodium and calcium soaps were prepared so that exceedingly slight increase in the [Na]/[Ca] ratio caused the emulsions to change from the water-in-oil state to the oil-in-water state. This change occurred when a sufficient potential difference was applied across the emulsion. The effect was detected most readily by noticing the change in resistance of the emulsions. These were of the order of 10 megohms before the stimulus, and between 1 megohm and 100,000 ohms after. Living protoplasts and water-in-oil emulsions are apparently the only systems of which the electrical conductivity changes in this manner as a result of the application of an electrical stimulus.—**C. O'Sullivan** and **J. Reilly**: Studies in peat (4). Low temperature carbonisation under various conditions.—**H. A. Cummins**: Experiments on the establishment of rice grass (*Spartina Townsendii*) in the estuary of the Lee.

PARIS.

Academy of Sciences, Feb. 3.—**Marcel Brelot**: The equation $\Delta u = cu$, where $c > 0$ admits singular points, and a corresponding Fredholm equation with singular nucleus.—**S. Soboleff**: The analytical solutions of partial differential equations with two independent variables.—**J. S. Lappo-Danilevski**: Observations on the note: "Analytical functions of a single variable substitution".—**T. Takéuchi**: The Brownian movement in a field of thermal radiation.—**E. Darmois** and **J. Martin**: The influence of alkaline molybdates on the rotatory power of glucose. Studies of the rotation of glucose solutions in solutions containing sodium hydroxide and molybdenum trioxide as a function of the time. The results suggest the formation of a compound $NaMoO_3,2C_6H_{12}O_6$.—**E. Sevin**: The emission of spectral lines in an electric field.—**R. Deaglio**: The action of light on thermionic phenomena. When the thermionic current is far from saturation, the increase of the thermoelectronic current produced by light on the filament is almost completely a true photoelectric effect.—**Er. Toporescu**: The potentials of metals in pure liquids. From the study of the potential differences shown by a platinum-zinc couple in various alcohols, it was found that there is no parallelism between the potential differences and the dielectric constants of the liquids.—**S. Schlivitch**: The photochemical transformations of photovoltaic batteries.—**F. Bourion** and **E. Rouyer**: Boiling point study of the molecular equilibria of resorcinol in solutions of barium chloride.—**Ballay**: Electrolytic deposits on aluminium and its alloys. For the preliminary treatment of the aluminium or alloy a hot slightly acid solution of ferric chloride is proposed. After this treatment, nickel can be deposited electrolytically as a strongly adherent film.—**R. Cornubert**: The constitution of the so-called tetrahydropyronic compounds.—**Max** and **Michel Polonovski**: The passage of a tertiary aminoxide into a dialkylhydroxylamine: N-oxynornarceine. — **Pierre Viennot**: The geology of the Rhune massif (Basse-Pyrénées).—**Cazalas**: The evolution of the vacuome of *Chara* in its relations with the movements of the cytoplasm.—**Mlle. Gabrielle Bonne** and **S. Buchet**: A curious case of floral proliferation in *Rosa alpina*.—**G. Dinulescu**: The presence in France of *Gastrophilus inermis*. The larvæ, obtained from horses suffering from the disease caused by this parasite, were transferred to a suitable medium and growth to the final stage completed outside the animal.—**L. Mercier**: The variation of certain pieces of the male genital sheath of *Pollenia rudis*; the importance of this variation for the idea of species in the higher Myodaria.—**Raymond Hovasse**: A new mode of symbiosis in cochineal insects.—**E. Roubaud**: Evolutionary suspension and obligatory larval hibernation, caused by heat, in the common mosquito, *Culex pipiens*. True diapauses and pseudo-diapauses in insects.—**J. Lefèvre** and **A. Auguet**: The influence of the hygrometric state of the air on metabolism. Hypotonus in a moist warm medium. Making use of the calorimetric chamber described in an earlier communication, experiments with sheep proved that for relative humidities less than 85 per cent, the evaporation of the body is not disturbed, but when the humidity exceeds 90 per cent the loss of heat by evaporation falls rapidly and the metabolism is diminished. These results are discussed from the theoretical, hygienic, and practical points of view.—**Pierre Girard** and **J. Parrod**: The formation of hydroxymethyl-4-imidazol, at low temperatures, starting with fructose in a solution of ammoniacal cupric hydroxide. The slow oxidation of lævulose, by shaking with oxygen in ammoniacal copper solution, gave a base, identified through its picrate as hydroxymethyl-4-imidazol.—**A. Paillot**: The cellular and humoral reactions of antimicrobial immunity in the phenomena of symbiosis in *Macrosiphum Jaceæ*.—**Y. Manouélian**: Hereditary syphilis and evolutionary forms of the treponeme.—**J. Alquier**, **Mlle. L. Asselin**, **Mme. M. Kogane** and **Mlle. G. Silvestre de Sacy**: The variations of the mineral composition of the bone tissue in the normal rat, rachitic rat, and the rat cured of experimental rickets. The cure of rickets, controlled both clinically and radiologically, does not necessarily imply that the mineral composition of the bone has returned to the normal.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society. Series A, Vol. 126, No. A802, February 3. Pp. 365-541. (London: Harrison and Sons, Ltd.) 6s.

Proceedings of the Royal Physical Society for the Promotion of Zoology and other Branches of Natural History. Session 1927-28. Vol. 21, Part 5. Pp. 217-268. (Edinburgh: Oliver and Boyd.)

Ceylon Journal of Science. Section C: Fisheries. Bulletins of the Ceylon Fisheries. Vol. 3: The Pearl Fishery of 1925. By Dr. Joseph Pearson, A. H. Malpas and J. C. Kerkham. Pp. 90+12 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

Survey of India. Map Publication and Office Work, from 1st April 1928 to 31st March 1929. Pp. vii+22+5 maps. (Calcutta.) 1 rupee; 1s. 9d.

Proceedings of the Royal Irish Academy. Vol. 39, Section A, No. 4: The Brachistochronic Motion of a Dynamical System. By A. J. McConnell. Pp. 31-48. 1s. Vol. 39, Section B, No. 11: The Collembola of Ireland. By Herbert Womersley. Pp. 160-202. 1s. 6d. Vol. 39, Section B, No. 12: The Vegetation of Southern Connemara. By Gertrude Connolly. Pp. 203-231. 1s. Vol. 39, Section B, No. 13: Mollusca (Pelecypoda, Scaphopoda, Gastropoda, Opisthobranchia) of the Irish Atlantic Slope. By Anne L. Massy. Pp. 232-342. 3s. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

The Engineer Directory and Buyers Guide, 1930. Pp. 256. (London: *The Engineer*.)

FOREIGN.

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 26, Part 4: The Piperaceae of Costa Rica. By William Trelease. Pp. iii+115-226+vii-xii. (Washington, D.C.: Government Printing Office.) 20 cents.

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 7, Part 3, December 1929. Pp. 389-588+plates 32-43. (Tokyo: Iwanami Shoten.) 2.40 yen.

Proceedings of the United States National Museum. Vol. 76, Art. 9: New Lower and Middle Cambrian Crustacea. By Charles E. Resser. (No. 2806.) Pp. 18+7 plates. Vol. 76, Art. 10: Notes on the Species of Myctophine Fishes represented by Type Specimens in the United States National Museum. By Albert Eide Parr. (No. 2807.) Pp. 47. Vol. 76, Art. 19: The Foraminifera of the Ripley Formation on Coon Creek, Tennessee. By Willard Berry and Louis Kelley. (No. 2816.) Pp. 20+3 plates. Vol. 76, Art. 26: A nearly complete Carapace of a Fossil Turtle, *Amyda virginiana* (Clark). By W. Gardner Lynn. (No. 2823.) Pp. 4+2 plates. (Washington, D.C.: Government Printing Office.)

University of California Publications in American Archaeology and Ethnology. Vol. 28, No. 1: Chumash Prehistory. By Ronald L. Olson. Pp. 21. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 30 cents.

CATALOGUES.

The Nickel Bulletin. Vol. 3, No. 2, February. Pp. 41-72. (London: The Mond Nickel Co., Ltd.)

X-Ray News and Clinical Photography. No. 8, March. Pp. 12. (London: Kodak, Ltd.)

Diary of Societies.

FRIDAY, MARCH 14.

BIOCHEMICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry, University College), at 3.—R. A. McCance and K. Madders: The Comparative Rates of Absorption of Certain Sugars from the Human Intestine.—A. Hunter and J. A. Dauphinee: The Rate of Liberation of Arginine in the Tryptic Digestion of Proteins.—Prof. A. Harden and M. G. Macfarlane: Fermentation by Yeast Preparations.—G. F. Marrian and P. F. Marrian: Microdeterminations of Hydroxyl Groups by Grignard's Reagent.—G. F. Marrian: (*a*) Further Observations on the Alcohol Isolated from the Urine of Pregnancy; (*b*) An Improved Method for the Preparation of Œstrin. The Isolation of Active Crystalline Material from Urine.—B. Ahmad and Dr. J. C. Drummond: Observations on the Relation of Carotene to Vitamin A.—L. F. Hewitt: Oxidation-reduction Potentials of Cultures of Hæmolytic Streptococci.—C. A. Ashford: The Phosphorus Distribution in Blood during Hypervitaminosis.—R. A. Morton, I. M. Heilbron, and A. Thompson: Some Further Observations on Vitamin A.—R. A. Morton and I. M. Heilbron: A Note on the Vitamin A of Butter.—T. Moore: The Conversion of Carotene to Vitamin A *in vivo*.—F. Dickens: The Preparation and Properties of an Active Principle from the Urine of Pregnancy.—K. H. Coward, K. M. Key, R. Morgan, and F. J. Dyer: Variation in Vitamin A Assay.

ROYAL SANITARY INSTITUTE (at Council Chamber, Middlesbrough), at 4.—W. S. Walton: Ventilation of Cinemas, etc.—S. E. Burgess: Flooding from Streams at Middlesbrough.

ROYAL ASTRONOMICAL SOCIETY, at 5.—*Papers received*:—H. C. Woods: The Use of a Floating Mirror with the Transit Circle.—N. Goryatscheff: Occultations of Stars by the Moon, 1929.—D. L. Edwards: Spectroscopic Parallaxes of B-Type Stars (Sixth Paper): the Spectral Types and Parallaxes of 175 Stars.—H. Mineur: Some Remarks concerning the Galactic Rotation.—Prof. S. Chapman: On Solar Ultra-Violet Radiation as the Cause of Auroræ and Magnetic Storms.—P. R. Chidambara Aiyar: The Relative Variations in the Extents of Bases and in the Heights of Prominences accompanying Variations in their Areas.—W. M. Smart: On the Derivation of the Elements of a Visual Binary Orbit by Kowalsky's Method.—Royal Observatory, Greenwich: Preliminary Values of the Variation of Latitude at Greenwich in 1929.—R. M. Petrie: On the Calculation of the Relative Temperatures and Pressures existing at the Base of Sun-spots.—Prof. E. A. Milne: Preliminary Note on the Structure of Sun-spots.—Dr. W. J. S. Lockyer: Monochromatic Images of the Orion Nebula.—B. Lindblad: Velocity Ellipsoid, Galactic Rotation, and the Dimensions of the Stellar System.—J. G. Hagen: On W. Herschel's Nebulosity V 34=N.G.C. 1990.—M. A. Blagg: Discussion of Observations on Three Long-Period Variables made by A. N. Brown: No. 2, V Cassiopeiæ, 1909-1929 January.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Guy's Hospital), at 5.—Clinical Meeting.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Frank Colyer: Demonstration of John Hunter's Specimens of the Teeth.

PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.—J. Harvey: A Harmonic Analyser.—R. A. Fereday: A Method of Comparing Small Magnetic Susceptibilities.—Dr. H. T. Flint: The Masses of the Proton and Electron.—Dr. Ezer Griffiths: Exhibition of Lantern Slides in Connexion with his Recent Visit to New Zealand.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 5.30.—J. J. O'Neal: Deep Well Pumps.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.—A. S. Kennard, A. E. Salisbury, and B. B. Woodward: On the Types of Lamarck's Genera of Shells selected by J. G. Children, with Notes.

TOWN PLANNING INSTITUTE (at Caxton Hall), at 6.—Capt. B. S. Townroe: Town Planning and the Man in the Street.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (Annual Business Meeting), at 6.45.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Exhibition of Industrial Kinematograph Films.

MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.—H. C. Armitage: Machine Tools from the Manufacturing Users' Point of View.

NEW EDUCATION FELLOWSHIP (at Livingstone Hall, S.W.1), at 7.30.—G. H. Widdows: Open-Air Schools for all.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—W. A. Sallis: An outline of Siemen's No. 50 Telephone Switching equipment.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—A. G. Lobley: Electric Heat-Treatment Furnaces.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 30 Russell Square), at 7.30.—The Protection of Ironwork on Buildings.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hal, Manchester), at 7.30.—Members' Evening.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. G. Elliot Smith: New Light on Vision.

INSTITUTE OF RUBBER TECHNOLOGISTS (at Manchester Café, Ltd., Manchester).—G. F. Thomson: Colours used in the Rubber Industry.

SATURDAY, MARCH 15.

PHYSIOLOGICAL SOCIETY (Annual General Meeting) (in Department of Physiology and Biochemistry, University College), at 3.—Prof. A. V. Hill: The State of Water in Muscle.—M. G. Eggleton and P. Eggleton: The Creatine Content of Resting and Fatigued Sartorius Muscles of the Frog.—O. Meyerhof and F. Lipmann: Change of *p*H during Activity of Muscle.—F. J. W. Roughton: The Rate of Penetration of Oxygen into the Red Blood Corpuscle.—H. E. Magee and E. Reid: Diffusion of Phosphates through Surviving Intestine.—Margaret Hill and Dr. A. S. Parkes: (*a*) Ovulation Induced in the Hypophysectomised Rabbit by Anterior Lobe Extracts; (*b*) Effects of Anterior Pituitary Preparations on the Anœstrous Ferret.—J. H. Burn and H. W. Ling: Ketonuria on Fat Diet (*a*) after Injections of Pituitary (Anterior Lobe) Extract; (*b*) during Pregnancy.—H. P. Gilding: The Relation of the Central Nervous System to a Local Cutaneous Ischæmia in Animals.—Dr. F. R. Winton: The Effects of Increases of Ureter and Venous Pressures on the Composition of the Urine.—Ruth Verney: The Osmotic Pressure of Plasma Proteins in the Presence of Caffeine.—Marion O. P. Wiltshire: The Effect of Amino-Acids on the Rate of Oxidation of Adrenaline.—R. Granit: Interaction between Distant Areas in the Human Eye.—Demonstrations:—Prof. A. V. Hill: The Measurement of the Depression of Vapour Pressure in an Aqueous Solution.—W. Hartree: (*a*) Rapid Sensitive Muscle Thermopiles: (*b*) Records showing Relaxation Heat.—Dr. A. S. Parkes and Margaret Hill: Experiments on the Relation between the Anterior Pituitary Body and the Gonads.—Dr. D. T. Harris: A Photoelectric Colorimeter.—H. P. Gilding: A Method for Demonstrating the Localised Distribution of Vasoconstrictor Nerves.—R. T. Grant: Arterio-venous Anastomoses in the Rabbit's Ear.—F. R. Miller: A Decerebration Clamp.—W. A. M. Smart, C. G. Wilson, and F. Campbell Smith: A Photoelectric Hæmoglobinometer.—J. H. Shaxby: Simple Methods of Demonstrating Visual Adaptation.—Dr. E. D. Adrian and B. H. C. Matthews: Apparatus for Demonstrating Action Current Records.—E. W. H. Ellis: (*a*) Electric Recording Drum; (*b*) Spiral Recording Drum; (*c*) Improved Gas Smoking Burner: (*d*) Syringe Signal.—Mary Pickford and Dr. E. B. Verney: Exteriorised Ureters in the Dog.—Dr. F. R. Winton: Methods and Models for the Analysis of Tonus in Unstriated Muscle.—L. E. Bayliss and the late A. R. Fee: (*a*) An Automatic Pump-Control, and Flow-Recorder; (*b*) The Rein 'Thermo-Stromuhr'.—P. Eggleton: Micro-chemical Apparatus for Lactic Acid and Nitrogen Determination.—A. V. Horton and P. Eggleton: An Isometric Lever.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Nuclei and their Structure (2).

ROYAL IRISH ACADEMY (Dublin).

MONDAY, MARCH 17.

ROYAL SOCIETY, EDINBURGH, at 4.30.—F. Walker: The Doleritic Isles of the North Minch.—W. J. McCallien and R. B. Anderson: The Carboniferous Sediments of Kintyre.—W. J. McCallien: A Contribution to the Geology of North-Eastern Antrim: being an Introduction to the Correlation of the Dalradian Rocks of Scotland and Ireland.—Lt.-Col. L. M. Davies: The Genus *Dictyoconus* and its Allies: A Review of the Group, together with a Description of Three New Species from the Lower Eocene Beds of Northern Baluchistan.—D. F. Martyn: On a New Method of Measurement of Minute Alternating Currents.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. C. Gardner: How far do the Apologetics of Bacon, Butler, and Paley hold good for Present Use?

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Demonstration of Diverticula.

KING'S COLLEGE ENGINEERING SOCIETY, at 5.15.—W. H. Dormer: Haulage in Coal Mines.

BEDSON CLUB (at Armstrong College, Newcastle-upon-Tyne), at 6.30.—Dr. E. K. Rideal: Some New Properties of Unimolecular Films (Bedson Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—A. F. Harmer and others: Discussion on High-Tension Substation Control Gear.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—W. Taylor: Science in Works Management (Lecture).

INSTITUTION OF AUTOMOBILE ENGINEERS (Glasgow Centre) (at Royal Technical College, Glasgow), at 7.30.—H. R. Ricardo: Combustion in Diesel Engines.

BRADFORD TEXTILE SOCIETY (at Midland Hotel, Bradford), at 7.30.—J. H. C. Hodgson: International Co-operation in the Textile Trade.

HUDDERSFIELD TEXTILE SOCIETY (at Huddersfield Technical College), at 7.30.—G. R. Carter: The Peculiar Economics of the Textile Industry.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.

ROYAL AERONAUTICAL SOCIETY (Halton Branch).—Metal Construction of Aircraft.

TUESDAY, MARCH 18.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. H. Hunter: The Significance to Clinical Medicine of Studies in Calcium and Phosphorus Metabolism (Goulstonian Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. C. Singer: The Passage from Mediæval to Modern Science (2): The Science of the Renaissance.

MINERALOGICAL SOCIETY, at 5.30.—Prof. W. L. Bragg: The Structure of Silicates (Lecture).

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Col. A. E. Hamerton: Report on the Deaths occurring in the Society's Gardens during the Year 1929.—Dr. H. F. Barnes: On some Factors Governing the Emergence of Gall Midges (Cecidomyidæ: Diptera).—G. Dollman: On Mammals obtained by Mr. Shaw Mayer in New Guinea, and presented to the British Museum by Mr. J. Spedan Lewis.—G. E. Hutchinson: Report on *Notonectidæ*, *Pleidæ*, and *Coroxidæ* (Hemiptera-Heteroptera) collected during Mr. Omer-Cooper's Expedition to Abyssinia.—A. Stanley Hirst: On some New Australian Acari (Trombidiidæ, Anystidæ, and Gamasidæ).

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.—D. J. Watkins: Electric Locomotives.

LONDON NATURAL HISTORY SOCIETY (at Winchester House, E.C.), at 6.30.—Dr. A. Thomson: The Pecten of the Bird's Eye.

TELEVISION SOCIETY (Annual General Meeting) (at University College), at 6.30.—Sir Ambrose Fleming: The Relation of Governments to Invention (Presidential Address).

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—H. W. Taylor: Voltage Control of Large Alternators.

ILLUMINATING ENGINEERING SOCIETY, at 7.—The Lighting of a Large Liner.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section—Manchester and District Branch) (at Milton Hall, Manchester), at 7.

INSTITUTE OF METALS (Birmingham Local Section) (at Chamber of Commerce, Birmingham), at 7.—W. R. Barclay: Nickel-Chromium Alloys.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Kinematograph Group—Annual General Meeting), at 7.—A. Kossowsky: Modern Methods of Sound Reproduction in Kinematography.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—Capt. J. S. Irving: Problems Encountered in the Design of the *Golden Arrow*.

INSTITUTE OF METALS (North-East Coast Local Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.30.—Annual General Meeting.

INSTITUTE OF CHEMISTRY (Edinburgh and East of Scotland Section) (jointly with Society of Chemical Industry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 8.—Prof. S. A. Smith: Poisoning and Disease in Industry.

ROYAL SOCIETY OF MEDICINE (Pathology Section), at 8.—Annual General Meeting.

WEDNESDAY, MARCH 19.

SOCIETY OF GLASS TECHNOLOGY (at Talbot Hotel, Stourbridge), at 2.—G. V. Evers: Notes on the Manufacture of Refractory Materials in America.—Dr. J. H. Partridge and H. C. Biggs: Glasshouse Refractories. A Study of Corrosion Resisting Properties.—L. C. Gough: Some Practical Results with Sillimanite for Glasshouse Refractories.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

OVERHEAD LINES ASSOCIATION (at Institution of Electrical Engineers), at 5.30.—Dr. Eckstrom: Comparative Costs of Overhead and Underground Transmission Lines.

INSTITUTION OF AUTOMOBILE ENGINEERS (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.—W. L. Morgan: Organisation of Public-Service Motor Vehicle Repair and Maintenance Systems.

INSTITUTION OF LOCOMOTIVE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.15.—W. Kay: Mineral Oils and Lubrication.

SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.—Dr. H. Levinstein: Some Derivatives of Cellulose and their Industrial Application (Lecture).

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Dr. H. Lapworth: Meteorology and Water Supply (G. J. Symons Memorial Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Mrs. Arundell Esdaile: The Portrait in Later Monumental Sculpture.

FOLK-LORE SOCIETY (at University College), at 8.—Mrs. R. Aitken: Saint Dominic of the Road and the Cock that crowed in the Dish.

ST. PAUL'S ECCLESIOLOGICAL SOCIETY (Annual Meeting) (at Royal Institute of British Architects), at 8.—At 8.30.—H. W. Fincham: Ely.

ROYAL MICROSCOPICAL SOCIETY, at 8.—J. E. Barnard: Resolution and Visibility in Medical Microscopy (postponed Presidential Address).

ROYAL AERONAUTICAL SOCIETY (Yeovil Branch).—Major C. J. Stewart: High Altitude Equipment for Aircraft.

ROYAL AERONAUTICAL SOCIETY (Coventry Branch).—Wing-Comdr. T. R. Cave-Browne-Cave: The New Airships Machinery.

INSTITUTION OF ELECTRICAL ENGINEERS (Sheffield Sub-Centre).

THURSDAY, MARCH 20.

ROYAL SOCIETY, at 4.30.—Discussion on Catalytic Reactions at High Pressures, to be opened by Prof. G. T. Morgan, followed probably by M. P. Applebey, Prof. W. A. Bone, Prof. H. B. Dixon, Prof. F. G. Donnan, Dr. F. A. Freeth, S. J. Green, C. N. Hinshelwood, E. J. Lush, Col. Pollitt, Dr. E. K. Rideal, Dr. R. E. Slade, and Prof. R. V. Wheeler.

LINNEAN SOCIETY, at 5.—Dr. C. Tate Regan: A Ceratioid Fish (*Caulophryne polynema*, sp. n.), Female with Male, from off Madeira.—Lt.-Col. J. Stephenson: An Oligochæte Worm Parasitic in Frogs of the Genus *Phrynomerus*.—Capt. F. Kingdon Ward: Mishmi Hills and Assam.

ROYAL SOCIETY OF MEDICINE (Dermatology and Medicine Sections), at 5.—Discussion on The Therapeutic Value of Gold Compounds, Sanocrysin, etc.

KING'S COLLEGE ENGINEERING SOCIETY, at 5.15.—S. B. Thomas: Motoring: Its Progress in the Last Thirty Years.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. B. S. Haldane: Some Problems of Genetics.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. B. Leggett: The Medical and Surgical Applications of Electricity.

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (Annual Meeting) (at Chamber of Commerce, Birmingham), at 6.30.—At 7.—Dr. W. R. Ormandy: A Wood Distillation Factory in Jugo Slavia.

INSTITUTION OF ELECTRICAL ENGINEERS (Hampshire Sub-Centre) (at University College, Southampton), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.—W. J. Girvan: The Practical Application of the Principles underlying the Equitable and Profitable Sale of Electrical Energy.

CHEMICAL SOCIETY, at 8.—Prof. C. K. Ingold: The Mechanism of and Constitutional Factors Controlling the Hydrolysis of Carboxylic Esters. Part I. The Constitutional Significance of Hydrolytic Stability Maxima.—Miss C. M. Groocock, Prof. C. K. Ingold, and A. Jackson: The Mechanism of and Constitutional Factors Controlling the Hydrolysis of Carboxylic Esters. Part II. Hydrolytic Stability Maxima of some Glyceric Esters.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (Laboratory Meeting) (at Royal Army Medical College, Millbank), at 8.15.—Demonstrations by Dr. S. Adler, Sir Aldo Castellani, Col. A. C. H. Gray, Dr. C. A. Hoare, Lt.-Col. S. P. James, Dr. W. James, C. MacHattie and Major C. R. Chadwick, J. F. Marshall.

BRITISH INSTITUTE OF RADIOLOGY, at 8.30.

FRIDAY, MARCH 21.

BRITISH INSTITUTE OF RADIOLOGY, at 5.—Discussion on Radiology in Chest Diseases.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Frank Colyer: Demonstration of Specimens illustrating Dento-alveolar Abscess and Dental Cyst.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—W. Nithsdale: The Design and Results of a 600 lb. per sq. in. Boiler Installation.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.—Sir Westcott Abell: Direct Flooding Calculations.

INSTITUTE OF MARINE ENGINEERS, at 6.30.—Annual General Meeting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group—Informal Meeting), at 7.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.15.—J. Bennett and O. A. Chrisp: A Survey of Switch and Control Arrangements with Examples of Modern Practice.

JUNIOR INSTITUTION OF ENGINEERS (Informal Meeting), at 7.30.—M. V. Hurst: Surface Combustion.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Seton Gordon: Sea Birds and Seals.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—Short Papers.

SATURDAY, MARCH 22.

MATHEMATICAL ASSOCIATION (London Branch) (at Bedford College), at 3.—C. L. Beaven and others: Discussion: Are we satisfied with the Present Syllabus in Mathematics for the General School Certificate?

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Atomic Nuclei and their Structure.

PUBLIC LECTURES.

SATURDAY, MARCH 15.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—H. N. Milligan: Monsters of the Deep.

MONDAY, MARCH 17.

LONDON SCHOOL OF ECONOMICS, at 5.—Prof. E. Lederer: Social Development in Germany during the last Ten Years. (Succeeding Lectures on Mar. 19 and 20.)

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.—Prof. E. B. Verney: The Reserve Forces of the Kidney (Sydney Ringer Memorial Lecture).

UNIVERSITY OF LEEDS, at 8.—Prof. P. N. Miliukov: The Past in the Present in Russia.

WEDNESDAY, MARCH 19.

KING'S COLLEGE, at 5.30.—Prof. J. Maritain: Science et Philosophie d'après les Principes du Réalisme Critique.

THURSDAY, MARCH 20.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Dr. Margaret Fishenden: The Outlook for Smokeless Heating (Chadwick Lecture).

SATURDAY, MARCH 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—M. A. Phillips: Pond Life.