NATURE

SATURDAY, APRIL 21, 1934

No. 3364 Vol. 133

CONTENTS

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number: WHITEHALL 8831
Telegraphic Address: PHUSIS, LESQUARE, LONDON

Professional Organisations and Modern Industry

IN a survey of modern industry from any point of view, four tendencies are easily discerned as characteristic of conditions to-day in contrast with those of a couple of decades ago. The first of these tendencies is the growing scale of industrial enterprise and particularly the growth in size of the industrial unit. It is true that the number of small firms in British industry remains surprisingly large, but the growth in size of the leading firms is unmistakable, particularly in chemical industry. Although chemists are employed in such an immense range of industries, those employed by really large firms represent a very considerable proportion of the numbers of the profession who are engaged in industry.

The second tendency is the growing complexity of modern industry. Not only is competition, whether in national or international markets, generally more severe, but also the complexity of manufacturing problems has increased. The range of products produced by an individual firm will frequently be found to have multiplied several fold and the reactions involved in the displacement of old by new products frequently present those responsible for the direction of industry with some of their most difficult problems.

Both the growing scale of modern industry and the increasing complexity of its operations have made the wise direction of industrial enterprise one of the outstanding needs of our time. The importance of technical factors in administration has increased at the very time when the consequences of a mistake in administration have also increased their power. Society can no longer afford to allow large-scale enterprise to be directed by the *entrepreneur*, and is already beginning to realise that our industrial prosperity largely depends on the direction of industry being based so far as possible on definitely ascertained facts and not on 'experience'.

Closer consideration of this question of scientific management brings to light the third factor which characterises industry to-day. The increase in the average size of the industrial unit has been accompanied by a growth in the importance of the duties which fall to those occupying the higher salaried positions. There is already a pronounced tendency for salaried business administrators to be professional men, and for those at the head of large concerns and bearing the responsibility of

ultimate decisions to be drawn either from professional men or from those who, like the accountants, are tending to come under professional influence. There is less and less place in positions which carry powers of ultimate direction for men lacking professional technique and that kind of training and experience out of which a technique is now being evolved. It is probably true, as Prof. Carr Saunders has suggested, that under a system of large-scale commercial and industrial organisation, all those who occupy the important positions will come within professional associations or at least under professional influences. It is certain that the incompatibility of profit-making with professionalism is no longer an obstacle to the spread of professionalism through industry.

Closely related to this is a fourth factor—the extent to which the spirit of service is taking hold of industry. This may be seen on one hand in the way in which co-operation between the manufacturer of a product and the users is facilitating the development of products giving better service. It is equally seen in the growing degree to which men of high personal character and cultural vision are finding in management a sphere of social service. One of the fundamental characteristics of the professional outlook is its emphasis on service; and to the extent to which the control of industry passes into professional hands we may expect to see the spirit of service increasingly influence its conduct. Apart from this, there is a marked and growing tendency in public opinion to judge large-scale industry by the fidelity with which it serves the public weal rather than by its success in amassing huge profits.

These four tendencies are of fundamental importance in considering the position of professional organisations in relation to industry. When in the early years of the British Association of Chemists there were formed within that organisation groups of chemists engaged in specific industries, such as the Guild of Textile Chemists, or the Guild of Dyestuffs Chemists, it was thought that one of their functions might have been to assist in the growth of industrial co-operation, either in such matters as industrial safety or in representations to the Government on matters of public policy. During the last ten years, apart from the growth in size of firms in chemical industry, such associations as the Association of British Chemical Manufacturers or the Federation of British Industries have grown up, which are giving regular attention to such matters and through which corporate representations to Government are naturally and readily made by accredited representatives of industry. Such associations obviously already have within them the germ of the 'councils of industry' advocated by Mr. Harold Macmillan and others as a basis for an industrial parliament.

The function of professional organisation in industry from this point of view must obviously be somewhat narrower. To admit this is not to deny the value and imperative necessity of defence associations. To be effective, representations to the State from a body of industrial professional workers must obviously be confined to matters of definite professional importance, such as conditions of employment, training and so on. In this field, however, very useful work remains to be done. The increase in the size of the industrial unit, so far as the chemist is concerned, has probably tended to increase his security, conditions of service and remuneration. The experience of the British Association of Chemists, however, indicates that there is still a great deal of work to be done in protecting the interests of chemists employed in less organised industries and by smaller firms. Probably the risk of undercutting in the profession of chemistry is less to-day than in the past, but it is to the credit of the profession that such a relatively large proportion of those holding senior or secure positions in industrial work are members of their professional defence association.

Education is a matter in which professional associations have always been more or less interested. Under modern industrial conditions their active concern is more than ever required. The task of planning educational policy, not merely qualitatively but also quantitatively in relation to the recruitment capacity of industry, can scarcely be solved without co-operation from the professional organisations, worthy of the best efforts of even the Institute of Chemistry's fine record.

One effect of the increase in size of the industrial unit has been to diminish the mobility of the professional workers in industry. This has some bearing on both professional and industrial efficiency. It increases the risk of grooviness and militates against the influx of personnel, less familiar indeed with the detail or technique of an industry, but more receptive of new ideas and better able to exercise a detached critical view. This is a matter of sufficient importance to research to merit the attention of professional associations.

It should not be impossible to suggest some system of exchange or interchange which would be of immense value to all concerned.

The question of industrial safety itself is by no means outside the legitimate sphere of work of professional associations. In the main it is true their most effective work will be done through the maintenance of a high spirit of public service among their members, but recent events suggest that on occasion something more may be required. It is at least open to discussion whether when a firm, for good or bad reasons, declines to accept the protection of the patent law and operates a secret process, the liability to disclose the full details in the event of any accident or loss of health or life should not be one of the risks incurred. It is inconsistent with the ideal of a profession to permit the concealment of information which may have a vital bearing in health and safety in other quarters of industry.

The second and third characteristics of modern industry, its growing complexity and the growth in importance of the duties which fall to the lot of the professional worker occupying the higher positions in industry, more than balance, however, any loss of influence of his professional organisations. Professional influence in industry is now, and to an increasing extent will be, exerted largely through the individual members of the profession occupying important posts in which professional ideals influence industrial decisions and policy. This factor alone makes it essential that professional organisations themselves should corporately not only be alive to these possibilities but also animated by the very highest professional traditions. Professional workers, individually or collectively, are interested in doing a job well, in industrial and professional efficiency; only professional association can secure them the independence in which the finest professional ideals flourish and are practised.

There is probably nothing more needed to heal the ills of our industrial and social world to-day, whether regarded from a national or from an international point of view, than the spread of just that spirit of service which is the quintessence of the professional spirit. The extent to which that spirit has already found a foothold in industry, and to which it is already expected of industry, should embolden all scientific workers to address themselves individually and collectively to the task of relating knowledge and power in the service of society and industry.

About Birds

(1) *Northward Ho!—for Birds: from Wild Moorlands of England to Moorlands and Marshes of Scotland and Shetland, Öland and Lapland.* By Ralph Chislett. Pp. xvi+188+44 plates. (London: *Country Life*, Ltd., 1933.) 15*s.* net.

(2) *Birds from the Hide.* Described and photographed by Ian M. Thomson. Pp. xi+108+63 plates. (London: A. and C. Black, Ltd., 1933.) 12*s.* 6*d.* net.

(3) *Evolution of Habit in Birds.* By Edmund Selous. Pp. 296. (London: Constable and Co., Ltd., 1933.) 10*s.* net.

(4) *Monographie des mésanges d'Europe.* Par Marcel Legendre. (Encyclopédie ornithologique, Vol. 6.) Pp. 124+5 plates. (Paris: Paul Lechevalier et fils, 1932.) 36 francs.

(5) *Australian Finches: in Bush and Aviary.* By Neville W. Cayley. Pp. xix+256+21 plates. (Sydney: Angus and Robertson, Ltd.; London: Australian Book Co., 1932.) 12*s.* 6*d.* net.

(6) *The Nidification of Birds of the Indian Empire.* By E. C. Stuart Baker. Vol. 2: *Turdidæ—Sturnidæ.* Pp. vii+564+6 plates. (London: Taylor and Francis, 1933.) 30*s.*

THERE is no branch of zoological science which offers so wide an appeal to human interests and so many avenues for the acquisition of new knowledge as the study of birds; and so it is with books about birds. At one end of the scale are the systematic, cataloguing, dry tomes devised for the use of the specialist and no other—matter without much life; at the opposite end are those volumes which place all their eggs in one basket, the photographs meant to catch the eye and the pence of a Nature-loving public—life without much matter.

It is very noticeable that during recent years a change has been coming over both extremes. Perhaps the stress of competition of numberless bird books, perhaps the demands of the reading public for more intelligent guidance, perhaps the re-awakening of a new interest in natural history, have one or all helped to raise the standard of the modern bird book. In any event, it is seldom nowadays that, on one hand, the systematic treatise or regional fauna does not allot a large proportion of its space to the habits of birds, and, on the other, that the one-time picture book does not contain observations upon the objects of its photographs which are of real scientific value. So the two extremes tend to approach each other on

the common ground of natural history, and the science of bird-lore gains by the change in mood.

From a long series of books about birds received at the office of NATURE, we have made a selection of examples illustrating the most outstanding types of bird-books, and each is excellent of its kind.

(1) "Northward Ho!" belongs to the new type of picture-book; that is to say, its photographs are of first quality, and its text is well written, readable and observant. Its specialty is that it avoids the commoner species, and in Scotland makes for such as the crested tit, greenshank, red- and black-throated divers, great and arctic skuas, whimbrel; and in Scandinavia for such as the turnstone, fieldfare, redwing, blue-throat, wood-sandpiper, jack snipe—most of them familiar enough to us in their winter garb, but to most of us unknown in their breeding haunts.

(2) Ian M. Thomson has found the greater part of his quarry in Shetland and on the Norfolk Broads. The plates, unusual in form since the picture fills the page to the edge, are the most striking bird photographs the reviewer has seen. The text is relatively short, but it is good; some interesting observations, picked at random from many, are: the carrying of chicks in its beak by a water-rail; the contrast between the defence of a young bittern which strikes with its bill, and of a young Montagu's harrier which strikes with its claws; the action of the latter bird and of a water-rail, both of which played with extraneous objects while brooding. In the description of Plate 15, "beak" should be "back", as in the text.

(3) Mr. Edmund Selous, whose death we regret to see announced, has produced quite a different type of bird-book: a serious effort to elucidate the evolution of habit by the interpretation of laborious observations made in the field. Whatever habit he touches upon, Mr. Selous deals with it suggestively: the replacement of the fight in earnest by make-believe 'scrapping'; the origin of simple nests like the lapwing's through movements associated with sex impulses, and so to more complicated nests; the beginning of courtship displays in sex posturing; the swallowing of the fæces of the young in the nest, as a possible addition to nutriment; the regular and extensive storing of acorns by Californian woodpeckers as a product of the simple habit of placing spruce cones in a bark-crevice for convenience of pecking. The author considers that the territorial proprietorship of birds is not "consciously real", but he is in error in assuming that "territory" begins with the nest, and may not be associated with feeding, for American observations suggest the presence of winter feeding territories in some species. Too much space is wasted on ill-judged attacks against other scientific workers, and the pleasure of reading is destroyed by the cumbersome and involved style of expression.

(4) This systematic account of the tits of Europe describes 15 species and 80 different races, but it is more than a descriptive catalogue, for it tells much about distribution and about habits, especially of nesting. Where the opportunity was so good we should have liked to have seen more attempt made at mapping the ranges and analysing the relationships between the numerous geographical races.

(5) For nearly a century and a half, the brilliantly coloured weaver-finches of Australia have been kept in captivity, and many species have become quite domesticated. The bird-lover, whether he loves birds in cages, or prefers simply knowledge about birds, will find this a compendium of almost everything that is known about the natural habits and cage-breeding of, as the coloured plates show, perhaps the most variously beautiful of cage-birds.

(6) Mr. Stuart Baker continues his valuable accounts of Indian birds in a second volume upon nesting, practically a supplement to the Fauna of India series. The nidification of 403 species and races belonging to some of the most familiar families is described. Of 62 forms nothing of the nesting habits has been recorded, and often the descriptions are simply of the completed nest and its clutch of eggs, so that much has still to be learned about nest-building, incubation, feeding and growth of the young, and so on. If this work encourages observation of nesting habits at the expense of egg-collecting, it will add to its great value to science. In one of the most interesting nests in the world, and one of the most common in India, that of the tailor-bird, the author states that the way in which the bird knots the thread with which it sews together the edges of a leaf or leaves, is unknown, and what possibilities of observational results are suggested by the record of peculiar and identical clutches of the Burmese race, obtained from the same creeper upon the porch of a cottage at an interval of eighteen years! Does it mean long life, or detailed hereditary transmission of egg characters? J. R.

Egyptian Astronomy

L'Astronomie égyptienne : depuis les temps les plus reculés jusqu'a la fin de l'époque Alexandrine. Par E.-M. Antoniadi. Pp. xi+157+7 plates. (Paris : Gauthier-Villars et Cie, 1934.) 40 francs.

THE author of this work explains in his preface that, in view of the non-existence up to the present of any book treating of the different branches of the ancient Egyptian astronomy in detail, his object is to make good the deficiency. A special feature is an attempt to give the whole of the evidence on the subject which is to be found in Greek writers ; to this end M. Antoniadi has copied and translated all the most important passages from those authors that he has been able to find in the Bibliothèque Nationale at Paris. Accordingly, we are given multitudes of passages translated from Herodotus, Plato, Aristotle, Ptolemy, Strabo, Diodorus Siculus, Lucian, Dion Cassius, Diogenes Laërtius, Hippolytus, Clement of Alexandria, Eusebius, the Emperor Julian, Porphyry, Simplicius, Proclus, Horapollon, Hermes Trismegistus, Stobaeus, to say nothing of Latin authors, Cicero, Pliny, Seneca, Macrobius and Censorinus.

There are seven chapters. The first consists of 'generalities'—the beginnings of the ancient Egyptian astronomy, presumed to have come originally from Ethiopia, the Egyptian priest-astronomers, the temples as observatories, with a digression on Egyptian mathematics (arithmetic, algebra and geometry), after which come some references to astrology and an account of various astronomical appliances known to have been in use in Egypt (the gnomon, sundials, waterclocks, graduated circles, meridian instruments, and so on). The second chapter begins with the relations which the Greek philosophers who visited Egypt (Solon, Thales, Pythagoras, Œnopides, Democritus, Plato and Eudoxus) had with the Egyptian priests and what they may be presumed to have learnt from them. After this a short sketch is given of the great discoveries in astronomy due to the Greeks themselves, including the deposition by the Pythagoreans of the earth from its assumed place in the centre of the universe, and the anticipation of the Copernican hypothesis, partly by Heraclides of Pontus so far as the axial rotation of the earth and the revolution of the planets Mercury and Venus about the sun are concerned, and completely by Aristarchus of Samos.

The statement on pages 28 and 29 of the debt of the Greeks to the Egyptians will no doubt be found by most experts to be decidedly exaggerated. It is well known how ready the doxographers and other Greek writers were to attribute to the Egyptians the invention of every sort of thing ; and M. Antoniadi seems to take their testimony at its face value, sometimes even going further, as when, from a passage of Seneca to the effect that "The courses of the five planets were not determined ; Eudoxus was the first to bring this theory from Egypt to Greece", he concludes that the reference is to the theory of epicycles, and that the Greeks owed this to Egypt. Those conversant with the limitations of Egyptian geometry as it appears in the surviving documents will not be likely to credit the Egyptians' capacity to deal with a theory like that of epicycles ; rather it required for its discovery a genius such as that of Apollonius of Perga, the "great geometer" ; moreover, Eudoxus is not connected by any authority with the hypothesis of epicycles.

The same chapter has, however, an interesting suggestion about the Pythagoreans' non-geocentric system in which the earth, with the sun, the moon, and the five planets, revolved in circles round the "central fire", namely, that the "central fire" was really the sun all the time, but that Philolaus felt constrained to resort to camouflage for fear of a fate such as very nearly overtook Anaxagoras for declaring that the sun was a red-hot stone. M. Antoniadi (who has also developed his suggestion in some separate papers) relies, first, on a comparison of the descriptions by Simplicius, Stobaeus and others of the "central fire" of the Pythagoreans as containing the creative and governing principle in the universe, with passages of Plato, Aristotle, Cleomedes and others speaking of the sun in very similar terms ; secondly, on the odd tradition that Philolaus said that there were *two* suns, the sun which we see being a sort of mirror receiving and concentrating the reflection of the "fire in the universe" and transmitting it to us, this statement again being held to be part of Philolaus' deliberate camouflage disguising his real meaning.

The end of the chapter is on Copernicus, and maintains that Copernicus owed far more to the Greeks than he would admit ; the author quotes a score of passages from Copernicus, whom he likes to call "the Canon of Frauenburg", side by side with as many closely similar passages from Greek authors (Plato, Aristotle, Ptolemy, Cleomedes, Plutarch and Aëtius), suggesting that

"le chanoine de Frauenburg oubliait bien souvent la source de son inspiration".

To return to Egyptian astronomy. Chap. iii is on the Egyptians' astronomical divinities and their ideas on the universe, Chap. iv on the Egyptian constellations, their names and their situations on the circular star-map from the Temple at Denderah now in the Louvre (as early as the second millennium B.C. the Egyptians knew at least forty-three constellations). Chap. v is on the sun, moon and planets (the Egyptians had of course distinguished the zodiac as the circle in which they move), with their names and respective representations; chap. vi is on the earth and the Egyptian calendar (the Egyptians had arrived at a year of $365\frac{1}{4}$ days). The final chapter (chap. vii) is on the astronomy of the great pyramids. It consists of forty pages and gives a mass of details about them, their dimensions, their exact orientation and their supposed astronomical significance, with special emphasis on the sloping entrance-passages which, being almost exactly in the plane of the meridian, were adapted to serve as "colossal meridian instruments, by far the largest ever constructed", in the observation of the circumpolar stars.

The attraction of the book is much enhanced by the highly interesting plates and illustrations.

T. L. H.

A Panorama of Physics

The Development of Physical Thought: a Survey Course of Modern Physics. By Prof. Leonard B. Loeb and Prof. Arthur S. Adams. Pp. xv + 648. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1933.) 23*s.* net.

WITH the increasing complexity and development of science, the tendency becomes more evident for textbooks to appear, not only on the different sub-divisions of any particular branch of science, but also on each of the various aspects and further sub-divisions of these branches. The number of works essaying to give a historical survey of physics as a whole and correlating the various sections, with due consideration of the philosophical basis, being distinctly limited, one approaches the present volume with more than ordinary interest, even though it was intended to meet the needs of a certain type of college course, rather than those of the general reader.

The authors have attempted to compile a general fifteen-weeks' course open to all students of arts and science irrespective of previous exposure to 'high-school' physics, and comprehensible to a majority having only an elementary knowledge of mathematics. The authors further state that it was therefore decided to "organise the subject in terms of the development of human ideas and concepts of the physical world", to give the manner of their evolution into modern physical science, and "at no place to introduce equations, laws, or phenomena without establishing their origin and their relation to other portions of the subject", the latter being "in every case shown to be the result of a controlled experiment or observation, or else a relation derived from such facts". It is not to be wondered at that the task is admitted to have proved exceedingly difficult, and one marvels at the range of matter covered in a text which copes with such extremes as giving (in a footnote) an explanation of the sine of an angle and, later, the Lorentz transformation formulæ, the Planck equation and the Einstein specific heat expression, or expounding why the formula of water is H_2O and not HO and giving, seven pages farther on, the Wöhler synthesis of urea, and in due course a detailed table of the extra-nuclear electronic configurations.

Every imaginable topic seems to be included, from the phlogiston theory to the Heisenberg uncertainty principle. The theme of historical development is adhered to throughout, while in the whole treatment mathematics is subsidiary and assumes little more than a knowledge of elementary algebra, although in one or two places the language of the calculus is introduced without any adequate explanation.

The book opens with a historical survey of fifty pages dealing with science and philosophy under the Greeks and Romans, as well as much general history covering scholasticism, feudalism and the Church. The foundation and work of the Royal Society receive due consideration.

The first of the five main divisions of the book covers mechanics from the inclined plane to the theory of relativity; in the second part, heat and structure of matter, we go from thermometers and elementary heat to the laws of thermodynamics, entropy (which is vaguely discussed, but not defined), following which the rise of chemistry, gases, mean free path, Brownian movement, Van der Waals' equation, atomic field forces and quantum theory pass kaleidoscopically before the reader. The next section, devoted to

electricity and magnetism, covers Maxwell's laws and the magneton, and is succeeded by light, where, unlike in the case of the other subjects, elementary matter is omitted, but which in twenty-seven pages manages to range from Newton's spectrum, over the wave and corpuscular theories, to the ether, the interferometer and the Michelson-Morley experiment. The final section, on the electrical structure of matter, and the new physics, is perhaps the most ambitious in its comprehensiveness, for here the ramifications of the quantum theory are enlarged upon, with the addition, among others, of paragraphs on the Zeeman and Compton effects, artificial transmutation, neutrons, cosmic rays and wave mechanics and its developments. A complete enumeration would, in fact cover almost every field of modern physical research. A detailed bibliography of works for subsequent reading is appended. Apart from some Wilson cloud-track photographs, and in particular, excellent ones in connexion with the most recent work on disintegration and the neutron, the book is illustrated only by a sparse selection of conventional line diagrams.

It is undeniable that the authors have accomplished a remarkable undertaking. The text is thoroughly up-to-date, and readable in style, while the absence of heavy mathematics must commend the book to a wide circle. On the other hand, of course, the immense range attempted has necessarily restricted to a minimum the information on any given topic. The difficulty is to estimate the probable effect of a study of a work of this class on any particular type of reader. The person who wanted to know "a little about everything" would undoubtedly feel he was ideally served; the lay reader would probably be unequal to the task of orientating his mind to get a true perspective of modern science, although he could not fail to gain much useful information; the general scientific man might feel that he had been provided with a readily digestible refresher course, and the expert that the complex picture of contemporary science had been considerably clarified. N. M. BLIGH.

Short Reviews

Handbuch der Biochemie des Menschen und der Tiere. Herausgegeben von Prof. Dr. Carl Oppenheimer, Zweite Auflage. Ergänzungswerk. Band 1, Halbband 1. Pp. xv+598. Band 1, Halbband 2. Pp. xv+601–1154. (Jena: Gustav Fischer, 1933.) 74 gold marks.

THESE volumes are of the kind that fill the user with awe-inspired gratitude and the reviewer with awe-inspired terror. That is to say, they are compilations exemplifying to the highest degree German thoroughness in surveying and abstracting literature.

The two volumes before us actually constitute two half volumes of a single volume; they run to 1154 pages altogether, of which the last 24 are devoted to a subject index. The double volume constitutes a supplementary volume to volumes 1, 2 and 3 of the second edition of the "Handbuch", published some eight to ten years ago. Presumably volumes 4–10 of the "Handbuch" will require at least another two supplementary double volumes also.

Even those who have some conception of the rapid strides made in biochemistry during the last decade must be astonished at the extent of the work done, as indicated by the scope of these supplementary volumes. A list of those who have collaborated in their production with Dr. Carl Oppenheimer, the editor, is sufficient guarantee of their adequacy in carrying out his ambitious purpose, which is to bring the original "Handbuch" so far as possible up to date at the end of 1932. The names of Profs. Abderhalden, Baudisch, Butenandt, Hoppe-Seyler, Krebs, Pringsheim, to take a half-dozen at random, make further recommendation supererogatory. It should be sufficient to say that the three original volumes of the work, to which these two volumes are supplementary, cover the building materials of animal tissues, the biochemistry of the cell, and the field of general immunological chemistry. This supplementary volume is indispensable to those who possess the main work, and will also be of great value to those who are not so lucky. A. L. B.

The Romance of Research. By L. V. Redman and A. V. H. Mory. (A Century of Progress Series.) Pp. x+149. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1933.) 5*s*.

THIS book depicts, in concise yet lucid and felicitous terms, "the viewpoint of research and something of its methods, its developments, and its achievements". The man of science and the technologist, no less than the thinking layman, will find much that will interest them; but to no one will it make a stronger appeal than the research student, especially the young investigator who is on the threshold of an industrial career.

Notwithstanding the small compass of the book, the authors have succeeded in presenting a delightful sketch of the progress of research in many branches of biological and physical science, in showing how the community has benefited from

"the patient researches of those who sought no personal reward", and in illustrating and explaining the major problems which must be solved before a laboratory discovery can be successfully translated to a large-scale process. As director and associate director of research to the Bakelite Corporation, the authors have had ample opportunity of realising the advantages which result from sustained investigations, so they do not hesitate to preach research to those who are more interested in its exploitation than in its promotion. It is a stimulating book, and deserves to be widely read. W. H. B.

Modern Coffee Planting. By E. G. Windle. Pp. xi+232. (London: John Bale, Sons and Danielsson, Ltd., n.d.) 10*s.* 6*d.* net.

The author of this book is a planter of more than fifty years' experience in the coffee districts of South India. His experience thus dates from the days when coffee was grown without shade, before the disease *Hemileia vastatrix* levied such a heavy toll on this industry in the East. The book is addressed to planters and is based on personal experience and observation. It is seldom that one has the privilege of reading a book on a particular crop written by one who has made it his life study and has at the same time earned his livelihood from it. Though written primarily for the coffee districts of South India, where coffee has been grown since the seventeenth century, the book should prove of great value to other coffee-growing countries, especially those where the industry is comparatively young. Local conditions vary from one country to another, but knowledge of a particular crop which has been acquired by experience will always prove useful elsewhere to anyone who makes an intelligent study of it.

The dedication of this book to His Highness the Maharaja of Mysore "in grateful acknowledgment of the benefit to the Coffee Industry resulting from the establishment of the Coffee Experiment Station at Balehonnur" is welcome evidence that the author has put into practice the results of research to his own benefit.

Constitution and Health. By Prof. Raymond Pearl. (Psyche Miniatures: General Series, No. 60.) Pp. 97+5 plates. (London: Kegan Paul and Co., Ltd., 1933.) 2*s.* 6*d.* net.

This little book is an expansion of a lecture given at the Army Medical Centre, Washington. It discusses the problems of the human constitution with the author's usual lucidity of style, taking the view that the constitution of an individual is determined not only by his genetic inheritance but also by the exigencies of his lifetime, such as the infections to which his body may have reacted, producing immunity. The constitution of an individual is therefore subject to change throughout his history, and statistical treatments are necessary to determine the inter-relationships involved in the series of complex variables, anatomical, physiological, psychological and pathological, which characterise a human being. The asthenic and pycnic types are regarded as merely extremes in a continuous series. Dysplastic or asymmetrical types also occur, having, for example, legs of one somatological type and trunk of another. Such may be regarded as a coarse form of mosaic inheritance. All the general modern biological interpretations are touched upon.

Islands of the West. By Seton Gordon. Pp. xv+211+47 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1933.) 15*s.* net.

Descriptive books on Scotland, even of the west of Scotland, have appeared in unusual numbers during the last few years, most pitching their appeal to the alien tourist. The book before us is not a guide book to the western isles, but a series of essays dealing with one and another aspect of the islands and their life, human and animal, from Skye and the St. Kilda group to Ailsa Craig, and wandering beyond these bounds to Scilly and Connemara. Yet we doubt if any other book can convey so vividly to the mind of the reader the loneliness and pathos, as well as the *camaraderie*, of existence upon these outliers of civilisation. The result is partly due to the fine word-pictures of the islands and their people, but also to the way in which myth and tradition have been interpolated to illustrate a mental outlook which belongs to the past; and, as one would expect, there is much said about the wild life of the places the author has taken such pains to visit. The book is illustrated by striking and beautiful photographs.

Die Faden-Elektrometer. Von Theodor Wulf. Pp. 147. (Berlin und Bonn: Ferd. Dümmler, 1933.) 6 gold marks.

It is useful to have such a complete account of the string electrometers. Although the theory relates to electrometers in general, the greater part of the book deals with string electrometers. Their construction, use and calibration are described in great detail. The double-string electrometer is treated first and the single-string second. In the latter case is a first account of the attainment of enhanced sensitiveness by using such potentials and distances between plates that the string is approaching an unstable condition. The measurement and effect of the capacity of the instrument are described at length.

Cours de mécanique rationnelle. (Cours de la Faculté des Sciences de Paris.) Par Jean Chazy. Tome 2: *Dynamique des systèmes matériels.* Pp. vi+460. (Paris: Gauthier-Villars et Cie, 1933.) 80 francs.

This volume takes the reader through the mechanics of systems, following the work of the earlier volume on the dynamics of point bodies. The two volumes together form a course which will supply the university student's need up to the stage required for the degree in mathematics.

The Giorgi (M.K.S.Ω) System of Units

SEVERAL years ago, Prof. Giovanni Giorgi, professor of mathematical physics in the University of Palermo, proposed a new system of electrical units. At a meeting of a section of the Advisory Committee on Nomenclature of the International Electrochemical Commission in October last, a resolution was passed inviting national committees to express their opinions on the extension of the series of practical units at present employed in electrotechnics in the direction of Prof. Giorgi's system.

In this system there are four fundamental units; namely, the metre, kilogram, second and ohm.

Dealing first with mechanical units and their relation to the C.G.S. system, the changes are simple. We then have:

Length :	1 metre	=	10^2 C.G.S. units
Mass :	1 kilogram	=	10^3 ,, ,,
Time :	1 second	=	1 ,, ,,
Velocity :	1 m. per sec.	=	10^2 ,, ,,
Momentum :	1 kgm. at a vel. of 1 m. per sec.	=	10^5 ,, ,,
Force :	1 vis*	=	10^5 dynes
Energy :	1 vis acting through 1 metre	=	10^7 C.G.S. units
		=	1 Joule
Power :	= 10^7 C.G.S.	=	1 watt

When, however, we pass to electromagnetic questions, we are met with a difficulty. Maxwell attempted to express the measures of the various quantities occurring in terms of the three fundamental variables of mechanics—length, mass and time; and found that, without further assumptions, this was impossible.

The fundamental electrical quantities are four in number, and other quantities occurring can be expressed in terms of these†. We have the strength of an electric charge, ε, the strength of a magnetic pole, m, the permissivity of air, or a vacuum, K_0, the permeability of air, or a vacuum, μ_0. The measurements we make connecting these four quantities with our three mechanical units are three in number: namely, the force between two charges, the force between two poles, the force between a current element and a pole, or alternatively, the force between a current circuit and a magnet. Thus we have insufficient experimental results to express our four fundamental electrical quantities in terms of our mechanical units.

We are left, as is well known, with the result that the dimensions of $\sqrt{\mu_0 K_0}$ are those of the reciprocal of a velocity, and we can proceed no further without some additional assumption. We cannot say what are the dimensions of μ_0 and K_0 in terms of mass, length and time. We know, of course, that the velocity is that of the propagation of electromagnetic waves, but that does not add to our knowledge of the dimensions of μ_0 and K_0. An additional fundamental unit is required.

Maxwell's systems are based on one or other of two alternative assumptions: one—the electrostatic system—that K_0 is unity and therefore $\mu_0 = 1/V^2$, where V is the velocity of wave propagation; the other—the electromagnetic system—that μ_0 is unity and K_0 therefore equal to $1/V^2$. In the first, $K_0 = 1$ gives us the fourth fundamental quantity, while in the second $\mu_0 = 1$ takes its place as such.

These are not, however, the only possible assumptions. Any one of the quantities we wish to define might be assumed as a fundamental unit. It might, for example, be a quantity of electricity measured by its electrochemical effects, or in some other way independent of that already employed when measuring the force between two charges—this has been developed by Prof. W. Cramp in a letter to NATURE[1]—or a current of electricity measured in a similar manner. This was Prof. Giorgi's suggestion in some of his earlier papers.

In his later papers, he adopts the resistance of a certain bar of metal, and thus we have his M.K.S.R. system. Any suitable bar of metal might be taken; for example, the resistance between the ends of the standard metre. But it is universally agreed that any system of practical units must be the volt, ampere, ohm system, and this fixes the unit of resistance as 1 ohm. Prof. Giorgi therefore takes as his fourth fundamental unit a material bar having a resistance of 1 ohm, or more exactly 1 international ohm, and fixes on a column of mercury at a temperature of 0° C., 106·300 cm. in length, having a mass of 14·4521 gm. Thus, except for the 4π question, we arrive at the M.K.S.Ω. system.

The C.G.S. system is based on Coulomb's law of force between two electric charges written in the form

$$\text{Force} = \varepsilon\varepsilon^1/K_0 r^2$$

Prof. Giorgi prefers to use Heaviside's form

$$\text{Force} = \varepsilon\varepsilon^1/4\pi K_0 r^2$$

and thus eliminates the 4π in the expression for magnetomotive force.

On the C.G.S. system we have magnetomotive force = 4π ampere-turns and the unit of magnetomotive force is $1/4\pi$ ampere-turn, whereas on the Heaviside system the unit is the ampere-turn.

The effect of this is to throw the 4π into the value of K_0. Thus we know that, in air, on the electrostatic system, when $r = 1$ cm. $= 10^{-2}$ metre and $\varepsilon = \varepsilon^1 = 1$ C.G.S. unit $= 10$ coulombs, then the force of repulsion is 1 dyne $= 10^{-5}$ vis.

$$\text{Hence } 10^{-5} = \frac{1}{4\pi K_0} \times \frac{10^2}{10^{-4}}$$

$$\text{and } K_0 = \frac{1}{4\pi} \times 10^{11};$$

* Vis is the name given by Prof. Giorgi in one of his papers to the unit of force.

† We might take other four quantities as fundamental, but this would not affect the argument.

or as Prof. Giorgi writes it

$$K_0 = \frac{1}{4\pi} \times 10^9 L,$$

where L stands for the unit of length, the metre.

In the above, for the sake of simplicity, Coulomb's laws have been assumed as the basis of the theory on which the system rests. This, however, is by no means necessary. In a very interesting article in the "Enciclopedia Italiana—Elettricita, Theoria della", to which Prof. Giorgi very kindly referred the present writer in reply to a request for information on some points of theory, he has in the most lucid manner "developed the three fundamental schemes, pre-Maxwellian, Maxwellian and electronic". Any of these can be taken as the starting point.

As Prof. Giorgi stated in a paper read before the Electrical Congress at St. Louis in 1904, neither the C.G.S. electrostatic nor the C.G.S. electromagnetic system is touched. Scientific workers will be free to use any one of these systems without modification, or substitute for them his absolute practical system.

To sum up, quoting again from the same paper: "In order to derive electric and magnetic units from mechanical units, a fourth fundamental unit is necessary. In the C.G.S. electrostatic and the C.G.S. electromagnetic systems, the fourth unit assumed is respectively the electrostatic or the electromagnetic constant of free ether, but this has many disadvantages. For the absolute practical system the fourth unit is the ohm." It would be more accurate to say the "international ohm, defined as the resistance of a certain column of mercury".

It should be noted, of course, that the two changes from the C.G.S. system suggested by Prof. Giorgi are quite independent.

Heaviside's suggestion as to the 4π could be introduced without adopting Prof. Giorgi's proposal to take the international ohm as the fourth independent unit. R. T. G.

[1] NATURE, **130**, 368, Sept. 3, 1932.

The Inheritance of Acquired Habits

By PROF. E. W. MACBRIDE, F.R.S.

FOR the last five years, experiments to test the heritability of acquired habit have been in progress in the Zoological Laboratory of the Imperial College of Science under my supervision; and an account of the work may be of interest to readers of NATURE.

The first part of the results of these experiments has been published by the Royal Society: the second part is almost ready for publication. Miss Sladden, who carried out the work, began by rearing the young of *Salamandra maculosa* and the eggs of *Alytes obstetricans*, thus endeavouring to repeat Kammerer's work. It became evident, however, that we did not possess the equipment necessary to provide the conditions which would induce these animals to breed. We succeeded in confirming some of Kammerer's statements about the effect of the environment on the habits of one generation. Thus it is quite possible to induce *Alytes*, normally a land animal, to adopt an aquatic life; and in regard to *Salamandra* we were enabled to explain Herbst's failure to obtain Kammerer's results.

There are two distinct races of *Salamandra maculosa*, an eastern and a western. In the latter, which inhabits the Jura and the Vosges, the yellow pigment is arranged in two longitudinal bands on the back, over a general body colour of black. Miss Sladden has reared animals of this race from birth to an age of three years in boxes painted inside with bright yellow and also in boxes painted deep black inside. In neither case could we detect any alteration in the amount of yellow pigment as a result of the colour of the background. In the eastern race, however, which formed the subject of Kammerer's researches, the yellow pigment is arranged as a series of spots over a black background; and by experiments conducted by Mr. E. Boulenger, then curator of reptiles in the Zoological Gardens, and by myself, during the years 1919–1924, we were able to show that animals of this race exposed for long periods to a black environment do show definite reduction of the yellow pigment. But even if Miss Sladden had been successful in getting her animals to breed, the length of time involved would have been prohibitive, since the adult condition is only attained after four years' growth. Therefore we sought for a convenient experimental animal in which the generations succeeded each other more rapidly.

Some years ago (1912–1915), in conjunction with another pupil (Miss Jackson, afterwards Mrs. Meinertzhagen), I conducted experiments on breeding the stick-insect, *Carausius morosus*, and I found that this insect, whose normal food in England is privet, could be forced by starvation to feed upon ivy. I therefore suggested to Miss Sladden that she should test the development of this ivy-feeding habit. This insect offers great advantages when used as an experimental animal. It is parthenogenetic: males only appear in small numbers every five or six generations and when they do appear they are at once recognisable by their smaller size and different coloration. The parthenogenetic insect produces about 150 eggs a year which take about three months to develop: there is no metamorphosis and as there are no wings the nymph is morphologically similar to the adult.

The plan adopted was to isolate the just hatched young, keeping each one in a separate box. These boxes were made of metal: they were circular and had glass covers. In each box was placed a small piece of ivy leaf. At the end of two days

about ten per cent of the insects had begun to eat ivy, the rest had not touched it. If we had reared from these insects alone we should have been accused of selection: but we adopted a different plan (suggested by my colleague, Mr. Hewer). The ninety per cent which refused ivy were given a bit of privet leaf to eat and so rescued from starvation. Then after one day the privet was removed and the insect was again provided with ivy. This second provision of ivy was called the 'second presentation'. If after two days more the insect still refused ivy, it was again given privet for a day. The majority of the insects accepted ivy at the second presentation, but some held out until the third, fourth, or even fifth, presentation, and one recalcitrant held out until the tenth presentation.

We started the experiments with 125 females. All the young which accepted ivy at the same presentation, to whatever mother they belonged, were classed together, and when they in turn became adult the eggs of each class were mixed together. From each mixture 100 eggs were selected in order to rear the next generation. In the second generation, in place of ten per cent no less than eighty per cent of the insects accepted ivy when first presented, that is, at the first presentation: in all, 800 insects were tested. In the third generation ninety-five per cent accepted ivy at the first opportunity and 2,000 insects were tested.

Thus with these insects, we reached exactly the same conclusions as those arrived at by Prof. McDougall with regard to induced habits in rats, namely, that when members of one generation are compelled to adopt a new habit, a residual effect of this habit is carried over to the next generation, so that the young insects adopt the new habit more quickly than did their parents. We claim, however, that the stick-insect gives more conclusive results than the rat, because although we think that Prof. McDougall has overcome all his difficulties, yet there were very serious objections to be faced with rats, such as possible mass-suggestion, parental training, etc., which are obviously inapplicable to insects.

What many people fail to realise, however, is that this transference of a residual effect of habit is the central principle of Lamarckism, clearly and unequivocally expressed by Lamarck himself. He said that "the environment produces no direct effect on the animal", but by making new needs (for example, the necessity of eating ivy or starving) it forces the animal to make new efforts to satisfy them, and "if these needs *continue for a long time* then the animal's efforts become habits" and habits by causing the use of some organs more and others less bring about the enlargement of the former and the diminution in size of the latter; and these changes are preserved by reproduction.

This article is written in the hope that other investigators will take up this question and repeat the experiments using other animals, especially other insects, as subjects; for only by such experiments can this fundamental principle be settled. Indeed, experiments with the larvæ of moths were begun some years ago by Dr. Thorpe, of Cambridge. The attractive feature about such experiments is that the percentage of mortality is very low, so that the agency of 'chance' or 'natural selection' is excluded. Prof. Woltereck, whose great book "Grundzüge einer allgemeinen Biologie" was reviewed in NATURE of December 17, 1932, removed Cladoceran Crustacea from northern lakes to Lake Nemi in Italy. When he examined the transported stock after twenty years he found them much altered in shape: when he again re-transferred some of this stock to the post-glacial lakes of their ancestry they reverted to their original shape—but only *gradually during the course of several generations.*

The Linnean Society recently had the privilege of hearing Prof. Woltereck deliver an address on the fauna of recent lakes in many lands. Summing up the evidence, Prof. Woltereck concludes that the time since the recession of the ice of the last phase of the glacial age, that is, about 10,000 years, has only sufficed for the production of new races: for the production of new species we must go back to pre-glacial times possibly 500,000 years ago. As I remarked in my comments on the lecture it would be hard lines on the experimenter if he had to live and experiment for 10,000 years, before he could hope to produce a new heritable *structure*, but heritable changes of *habit* in small rapidly breeding animals may be observed after experiments lasting from five to ten years.

Students of mutation, that is, 'geneticists', will naturally inquire what is the relation between these changes of habit and mutations. That is a question for future study; here only certain tentative suggestions can be offered. From the study of the few cases in which mutations have been experimentally produced by such agencies as X-rays and heat, it may be concluded that they are due to some damage to the developmental machinery of the nucleus in the germ cells. They, and not the Lamarckian changes, are the results of the "direct action of the environment". So long as malign conditions surrounding early development persist, the mutations are faithfully inherited, but if the organism can be replaced in its natural environment, then in a limited number of generations they pass off and the original constitution reasserts itself. In 1790 Capt. Cook introduced the English domestic pig into New Zealand in order to induce the Maoris to abstain from cannibalism. The animals escaped into the woods, and by 1840 had increased to herds of at least 40,000 in number and had assumed all the characters of the ancestral wild boar, including the fierce tusks—although in New Zealand there were no enemies which required such weapons to drive them off. Mutations seemingly are more surface phenomena than racial habits: they are indeed what Johanssen the inventor of the word 'gene' called them, "superficial disturbances of the chromosomes", but racial habits belong to the inmost core of the heritable constitution.

The British Postgraduate Medical School

LONDON has a supply of clinical material—that is, cases of sickness and disease—almost unique in amount and variety, which should be available for teaching and research. Some of this material is utilised by the medical schools in their attached hospitals for the training of their undergraduate students, whom they must in the main serve, and their facilities for the additional training of the postgraduate student are necessarily limited. In fact, London has hitherto lacked an organisation for postgraduation study comparable to the continental centres, such as Vienna. London's wealth of clinical material should be available for the provision of courses of advanced instruction for qualified doctors resident in Great Britain, in the Empire beyond the seas, and abroad, who wish to refresh or extend their knowledge, or to obtain the latest information on new developments in medicine, surgery and obstetrics.

Attempts have been made in the past to institute courses of postgraduation study. In the closing years of last century, the Medical Graduates College and Polyclinic, organised in the main by Sir Jonathan Hutchinson, gave courses of systematic lectures in various branches of medicine, in association with classes and clinics in certain special hospitals and medical schools, but it could not provide that regular attendance at in- and out-patient departments which is one of the principal requirements of the general practitioner and of the specialised postgraduate student. Postgraduate courses of instruction have also been organised by some of London's hospitals which have no medical school attached, for example, the West London, Hammersmith, the Prince of Wales, Tottenham, and the Seamen's Hospital, Greenwich.

Another organisation which has done, and is doing, much good work in the direction of postgraduation study, is the Fellowship of Medicine and Post-graduate Medical Association, with which the name of the late Sir William Osler should be remembered. But its scope is limited much in the same way as in the Polyclinic.

The serious consideration of the problem of a postgraduate medical college dates back to 1921, when Dr. Addison, then Minister of Health, at the suggestion of the University Grants Committee, formed a Committee under the chairmanship of the Earl of Athlone to consider, among other matters, the provision in London of a school with hospital attached to be devoted to postgraduate instruction in medicine, and of an institute for instruction in public health subjects. Largely by the aid of a very generous grant from the Rockefeller Foundation, the last-named institution was the first to be established, and the buildings of the London School of Hygiene and Tropical Medicine were opened in July, 1929.

The other objective of the Athlone Committee still remained to be secured, but the post-War depression had already begun and the scheme remained in abeyance for a time. Then Mr. Neville Chamberlain set up another committee, the terms of reference of which were "to draw up a practicable scheme of postgraduate medical education centred in London". This Committee surveyed the situation, and came to the conclusion that it was impracticable to establish a new school with hospital attached, or to associate the new school with any existing teaching hospital. But fortunately, by the passing of the Local Government Act of March, 1929, between twenty and thirty municipal general hospitals, formerly under the Poor Law, came under the control of the London County Council, and a scheme of associating the proposed postgraduate medical school with one of these institutions was then explored. With the full co-operation of the London County Council, the unanimous conclusion was finally reached that the conversion of the hospital in Ducane Road, Hammersmith, was the best solution of the problem. Here there were 400 beds housed in a building no part of which was more than twenty-five years old, and which had been described as "exceptionally good and well designed for the purposes of a hospital dealing with the acutely sick".

In April, 1930, Mr. Greenwood, then Minister of Health, announced the Government's acceptance of the Committee's recommendations, and its willingness to contribute a sum up to £250,000 for building and equipping the School, together with annual grants for maintenance through the University of London. Following the recommendations of another Committee over which Lord Chelmsford presided, a Royal Charter was granted to the School on July 10, 1931. Unfortunately, shortly afterwards the financial crisis developed and jeopardised the whole scheme, but after serious consideration the Government of the day decided that it was against the public interest to postpone the scheme indefinitely, and offered to make a grant not exceeding £100,000, and the L.C.C. agreed to expend a similar sum towards adaptation of the existing Hospital for the purposes of the School.

Financial reasons again delayed the commencement of building, but the foundation stone was laid by Mr. Neville Chamberlain in July last year, and substantial progress has since been made in the adaptation of the existing buildings and provision of the new ones required.

The L.C.C. is providing, on the hospital side, new blocks for midwifery cases, for out-patients, and for casualty departments, while the School buildings will consist mainly of laboratories, lecture theatres, and accommodation (non-residential) for the teachers and students. The Dean of the School, Dr. MacKeith, has recently issued a circular descriptive of the general plan of the buildings and of the accommodation provided.

The University of London has also recently 'recognised' the new institution as a 'school' of the University, and four chairs have now been advertised, in medicine, surgery, obstetrics and gynæcology, and pathology. Presumably, assistants will also be needed for each unit, and it may be anticipated that courses will also be delivered from time to time by eminent physicians, surgeons and others not permanently attached to the School. In addition, the courses in present postgraduate centres will still be made use of so far as possible.

Thus, after many vicissitudes, a postgraduate medical school worthy of the great Metropolis has come into being, which it may be anticipated will in the future raise the standard of professional skill among the great body of medical practitioners, and will advance the progress of medical science by research carried out within its walls.

Obituary

Prof. Camille Matignon

ARTHÈME CAMILLE MATIGNON, president of the French Chemical Society, who died suddenly in Paris on March 18, was a leading figure in pure chemistry and a great exponent of chemical technology. Matignon was born at Saint Maurice-aux-Riches-Hommes, Yonne, on January 3, 1867, and entered the Ecole Normale, Paris, in 1886; three years later he became assistant to Berthelot at the Collège de France and commenced a long series of original contributions to our knowledge of thermochemistry. After spending five years at the University of Lille as lecturer and professor, he was appointed as a temporary professor at the Collège de France in 1902, a supplementary professor in 1903 and, on the death of Berthelot, became professor of inorganic chemistry in 1908, holding this post until his death.

Matignon early concerned himself with the great problem of the fixation of atmospheric nitrogen and the synthetic production of ammonia; he studied the direct combination of many of the metals with nitrogen, showing that zinc dust always contains zinc nitride, and preparing the nitrides of a number of the rare earth metals. Certain of the nitrides, such as those of silicon and aluminium, were probably formed during the cooling of the earth and, by the action of water vapour, gave ammonia, the first form in which nitrogen became available for assimilation by plant life. Matignon maintained that the increased use of artificial nitrogenous fertilisers was essential to the development of French agriculture; he followed up the advocacy of this principle by working out methods for the economic production of phosphates and potassium salts for use as manures.

With the aid of the calorimetric bomb, Matignon determined the heats of combustion of a long series of substances and, since many of these were closely related organic compounds, he was able to deduce a number of interesting generalities from the heats of formation. His more extended studies of the part played by heat in chemical reactions led him to the statement of an empirical law of thermodynamics which Nernst termed the 'Le Chatelier-Matignon rule'. This states that for gaseous equilibria in which one gaseous and one or more solid phases are concerned (sublimation of solids, dissociation of calcium carbonate, etc.), the relation $Q/T = 32$ holds approximately in all cases, Q being the heat evolved at constant pressure and T the absolute temperature at which the gaseous pressure attains one atmosphere. This empirical law is an extension to chemical dissociation of Trouton's law concerning heats of vaporisation. The Le Chatelier-Matignon rule can be stated in several ways and may be used to foretell whether certain reactions can take place and whether they are reversible. Thus, it was foreseen that hydrogen sulphide should react with potassium carbonate, but not with sodium carbonate at the ordinary temperature; these deductions were verified by experiment. Matignon's achievements in these and many other fields were recognised by his election to the Institut de France in 1926.

Matignon was an eloquent speaker and wrote in a lucid, convincing style. He assumed the editorship of the *Journal* of the French Society of Industrial Chemistry at its inception in 1918, and the editorial which he wrote each month until the end of his life was read with interest by the whole chemical world; the last of these articles—on the fiftieth anniversary of the death of Dumas—appears in the March number of *Chimie et Industrie* which was published a few days ago. Matignon's striking personality and his gay, vivacious enthusiasm made him a notable figure. He did much to promote the re-establishment of those normal relations between scientific men throughout the world which had been so rudely shattered by the War; he had many friends far outside his own country who will remember him with respect and affection.

W. J. Pope.

Mr. E. G. B. Meade-Waldo

It is with great regret that we have to record the death of Mr. Edmund Gustavus Bloomfield Meade-Waldo, of Stonewall Park, Chiddingstone, Kent, who died on February 24, aged seventy-nine years. Only son of Mr. Edmund Waldo Meade-Waldo, of Hever Castle and Stonewall Park, he was born at Holly Brook, Co. Cork, on February 8, 1855, and educated at Eton and Magdalene College, Cambridge. His room at Eton was a menagerie of wild animals, and rumour has it that, while at Eton, his overpowering ambition was to kill one of the red-deer in Windsor forest, and that this ambition was fulfilled. In 1880 he married Ada Coralie, a daughter of the

late Lord Justice Baggallay, and he and his wife went to live for some time at Rope Hill in the New Forest. The New Forest, as was only natural, brought out all that passionate love of Nature and animal life which had already begun to show itself at Eton.

Like his life-long friend, Herbert St. Quintin, of Scampston Hall, Yorkshire, who died a year ago, Meade-Waldo was a born naturalist, and both were fortunate in having leisure to develop more and more their powers of observation in all branches of natural history. It is said that they corresponded almost every day of their lives and, needless to say, the subject of this correspondence formed an almost daily diary of what they had observed in the field of Nature. If the many facts comprised in these remarkable series of letters could be gathered up, it is probably no exaggeration to say that they would vie with those contained in White's "Natural History of Selbourne".

Both these friends were ardent hawkers and, in this fascinating pursuit, such other well-known hawkers and naturalists as Lord Lilford, Aubyn Trevor-Battye, W. R. Ogilvie-Grant, the Hon. Gerald Lascelles, Col. H. Barclay and the Rev. Gage Freeman and others, were very closely associated. Meade-Waldo's diaries contain many records of famous hawks and their prowess in the chase.

Meade-Waldo's life represents a page in the history of ornithology which is not likely to be rewritten. Another of his intimate friends was the late Henry Elwes, a man passionately fond of God's open spaces in many countries, a naturalist in every sense of the word, the author of one of the finest books on trees ever written. Lord Grey of Fallodon was another friend after his own heart, and Herbert St. Quintin, Meade-Waldo and Grey forgathered every year at Fallodon. All three have died in the last year and to those in sympathy with the point of view they represented, their passing will inevitably represent a lost link with the ornithology of the past.

But Meade-Waldo's activities in the realms of Nature were not confined to his own broad acres or those of his friends. He studied birds in Spain, as also in Morocco, where during a long residence he explored the Atlas Mountains in days when travel in that country was not the easy matter it is now. He was also intimately acquainted with the birds of the Canary Islands, and was one of the late Lord Crawford's guests on his voyage to Madagascar and the Comoro Group, in his famous yacht, the *Valhalla*.

Meade-Waldo was also an ardent supporter of the various societies for the protection of bird life, the fauna of the Empire, and the establishment of nature reserves, while he took the deepest interest in the welfare of the Zoological Society of London, of which he was a vice-president and a member of the Council. He was indefatigable in his attendance at the many meetings which such work involved.

Mr. John Power

By the death on January 27, at Rosebank, near Cape Town, of Mr. John Power, one of the few remaining direct links with the Royal Observatory, Greenwich, under the administration of Sir George Airy, has been broken.

John Power was born in Waterford, Ireland, on July 14, 1860. He entered the Greenwich Observatory in 1875, six years before the retirement of Airy. In 1891 he left to take up the appointment of secretary and librarian to the Cape Observatory, under Sir David Gill. In 1895 he was appointed a junior assistant, being succeeded as secretary, after a short interval, by the late Dr. R. T. A. Innes, who afterwards became the first Union Astronomer. In 1905 Power was promoted to the rank of assistant. From 1897 until his retirement in 1920 he was in charge of the miscellaneous computing department. In that capacity he was responsible for the preparation and proof reading of the following catalogues (the dates of publication are in brackets) :—Cape General Catalogue for 1890 (1898) ; the Cape General Catalogue for 1865 (1899) ; the Cape Astrographic Standard Star Catalogue (1906) ; the Cape Catalogues of Special Stars for 1900 (1906) ; the Cape Catalogue (Boss's Stars South of $-36°$) (1907) ; the First Cape Fundamental Catalogue for 1900 (1915) ; the Second Cape Fundamental Catalogue for 1900 (1920) ; and the Cape Zone Catalogue of 20,843 stars for 1900 (1923). He showed remarkable industry and devotion in this work, spared no efforts to ensure accuracy in all details and was very skilled in marshalling large masses of numerical data. He rendered also very valuable services in connexion with the revision and control of the co-ordinates of the plates for the Cape zones of the Carte-du-Ciel work and in their preparation for press. For many years he was a regular and active observer with the transit circle.

Power was much interested in local and municipal affairs. He was largely responsible for the inception of a public library in Observatory (the suburb adjacent to and named after the Cape Observatory) of which he was chairman for many years preceding his death. He was also for many years a member of the Cape School Board, of which he became successively vice-chairman and chairman. After his retirement, he devoted a great deal of his time to the work of this body, on which he will be greatly missed. Financial approval for carrying out the programme of the Board was often difficult to obtain, but Power's Irish extraction showed itself in his love of a fight and he was at his best in defending his policy and attacking his opponents. The cause of elementary education at the Cape owes a great deal to his efforts.

Mr. Power was a widower and his only son, who had had a brilliant career at Oxford as a Rhodes scholar, was killed in action in East Africa.

Prof. J. R. Ainsworth-Davis

Prof. Ainsworth-Davis was born at Bristol in 1861, the son of the Rev. James Davis. He studied under Profs. Huxley and Judd at the Royal School of Mines, London, and afterwards at Trinity College, Cambridge, where he gained a first in both parts of the Natural Science Tripos. Shortly afterwards appointed lecturer at the University College of Wales, Aberystwyth, he threw himself into the work of that institution and was elected professor of zoology and geology. He was a teacher of marked power and strong personality with an unusual gift for epigrammatic statement, and he sought to understand and help his students outside as well as inside the class-room. His home was always open to students and colleagues, and his versatility showed itself in amateur acting, verse writing, organising and commanding the college O.T.C., campaigning for the hall of residence for women students—one of the earliest of these institutions—as well as in scientific writing. In the latter field he wrote papers, some in collaboration with his students, on molluscan morphology, but his chief interest was in teaching, and his textbook of biology, his "Natural History of Animals" and other works have been widely used.

In 1908 Ainsworth-Davis became principal of the Royal Agricultural College, Cirencester, and from 1914 on he served as army instructor with the rank of major, acting at one time as chairman of the Central Civilian Advisory Board at G.H.Q. After demobilisation, he lectured in biology at Middlesex Hospital Medical School and then gave his services as writer and lecturer to the Empire Marketing Board.

His was a life of varied activity, the outcome of a keen mind deeply interested in the life of his time. He is survived by his wife, daughter of the late Mr. James Coutts, of Edinburgh, and by his son, Dr. J. C. Ainsworth-Davis, who has been a distinguished athlete.

We regret to announce the following deaths :

Herr Oskar von Miller, founder and, until 1933, president of the Deutsches Museum at Munich, and formerly a chairman of the World Power Conference, aged seventy-eight years.

Prof. Augustus Trowbridge, professor of physics and, since 1928, dean of the Graduate School of Princeton University, an authority on explosive mixtures, on March 14, aged sixty-four years.

Prof. F. P. Venable, emeritus professor of chemistry in the University of North Carolina, and president of the University in 1900–14, on March 18, aged seventy-eight years.

News and Views

The Hon. John Collier

The death of the Hon. John Collier on April 11 at the great age of eighty-four years recalls his signal services to men of science in the art of portraiture. The National Portrait Gallery possesses the popular and appealing canvas of Darwin, standing, clad in a cloak, holding his hat in the left hand, and looking straight towards the spectator. Here, too, may be seen Collier's representations of Huxley, Sir Michael Foster, Sir William Huggins, and W. K. Clifford, mathematician, physicist and philosopher. The Royal Society is especially fortunate in examples of Collier's faithful portrayal of a select circle of men of science. In its gallery are portraits of James P. Joule, William Spottiswoode, Sir Joseph Hooker and Sir William Huggins, while Sir Michael Foster is included, in replica. A portrait of the late Prof. S. H. Vines hangs in the rooms of the Linnean Society.

Mr. Richard Inwards

Very hearty congratulations are extended to Mr. Richard Inwards, who will reach the age of ninety-four years this week (whilst yet, happily, in good health), having been born on April 22, 1840. Elected into the Royal Astronomical Society so far back as 1861, he is, we believe, the oldest member of that body; also of the Royal Meteorological Society, whose ranks he joined a year later. Early in life, Mr. Inwards became a mine manager in Bolivia, and afterwards he acted in a like capacity in Spain for the Manganese Company. Later on, mining projects and enterprises led him to widely divergent places—to Norway, Austria, South America, Mexico. Settling in England, meteorological studies became his prime interest, and he was for nearly twenty years joint editor of the *Quarterly Journal of the Royal Meteorological Society*, becoming, in 1894, president of the Society, serving the customary period. Exactly forty years ago, corresponding with the present month, Mr. Inwards read a paper entitled "On Some Phenomena of the Upper Air". A contribution (1907), "The Metric System in Meteorology", survived criticism, at any rate, for publication in the *Quarterly Journal*; some will, perhaps, recall the discussion. Mr. Inwards is the author of "Weather Lore" and "The Temple of the Andes"; also, he published (1911) an interesting reminiscent biography of W. Ford Stanley, F.R.A.S., in memory of that gifted mechanician, responsible for many developments in the designs for mathematical drawing, surveying and levelling instruments.

A Broadcast from the Antarctic

The B.B.C. included in its programme on the evening of April 14, an interesting item which took the form of a short broadcast from Admiral Byrd's Antarctic expedition, the main base of which is at Little America, Bay of Whales, in latitude 78° S. The transmission was effected through the

agency of the Columbia Broadcasting System of America, which has a representative with the expedition giving regular talks to listeners in the United States. The signals from the expedition's transmitting station at the Bay of Whales were received in South America, relayed to New York and thence to England and several other European countries. In addition to announcements by the representative mentioned above, members of the party gave a brief account of the prevailing meteorological conditions and of the scientific work being carried out by the expedition. The average daily temperature was stated to have been between −20° and −60° C., while a thirteen days' blizzard had been experienced recently. Admiral Byrd's advance party is located at about 123 miles nearer the South Pole than the main base at Little America. The brief programme included a musical item by members of the expedition and concluded with the singing of the British national anthem. Although reception was marred to some extent by distortion and a fairly high noise level, this broadcasting achievement showed in an interesting manner the possibilities of modern radio communication, and demonstrated that the isolation of polar expeditions is a thing of the past.

Broadcasting over Wires

At a meeting of the Wireless Section of the Institution of Electrical Engineers on April 11, a paper entitled "Principles of Audio-Frequency Wire Broadcasting" was read by Mr. P. P. Eckersley. It is well-known that too few wave-lengths are available for the purposes of wireless broadcasting, a limitation which makes it impossible to give all listeners both a variety of choice of programme and good quality reproduction. These limitations have stimulated an interest in alternative methods of distributing programmes to listeners, and broadcasting over wires has certain basic technical and economic advantages over wireless broadcasting. Wire-broadcasting technique has been extensively applied in Holland, where 50 per cent of the Dutch listeners have their programme service laid on to the house by a wire connexion. Relatively slight developments of the same nature have taken place so far in Great Britain, although a number of companies are in operation for the re-diffusion of the ordinary wireless programmes.

The commonest form of such re-diffusion takes place at audio-frequencies; the ordinary wireless broadcasting programmes are picked up by a receiver located where reception conditions are favourable, and the audio-frequency output of this receiver is of sufficient strength to energise at once a thousand or more loud-speakers connected to it by a line network. It is usual to connect each subscriber by two lines to this network so that a choice of two programmes is provided. Mr. Eckersley's paper dealt with the technical problems encountered in the design and construction of such a network in order to give a good quality service. An analysis was made of the effects set up by the interaction of the reactances and resistances composing the network and the loud-speakers, and it was shown that the received level, particularly towards the ends of the lines, varies with loading and frequency. Certain generalised rules have been evolved to indicate how the distortions incidental to this form of wire-broadcasting may be minimised or even eliminated.

Commercial Production of Heavy Water

The recently discovered 'heavy water', which has created so much interest in popular as well as scientific circles, is to be produced commercially in England. Plant has been developed at the Billingham works of Imperial Chemical Industries, Ltd., which is capable of producing a continuous supply of heavy water of approximately 30 per cent purity at the rate of 5 gm. per day, while approximately pure 'heavy water' will be produced at a somewhat later date. I.C.I. anticipate that they will be able to meet any commercial demand that may arise. Urey and Washburn, in the United States, discovered that the residual water in old electrolytic cells contained a larger proportion of heavy hydrogen than the normal. It was further found that by continued electrolysis, the concentration of the 'heavy water' was enriched, ordinary light hydrogen being given off preferentially, and 'heavy water' accumulating. This gave the key to a successful method of preparing 'heavy water' in quantity, and the electrolytic method is the one in use at Billingham. Large-scale production of 'heavy water' is only possible where exceptional resources of power and raw materials exist together. At Billingham, not only ordinary hydrogen in large quantities, but also residues in which 'heavy water' has accumulated, are readily available. These resources, together with cheap power and convenient research facilities, make Billingham a logical centre for the large-scale production of the new compound. Since its discovery in the United States, its probable uses are becoming more evident, and it is eloquent testimony to the vitality of British chemical technique that in so short a space of time it should have been translated from a scientific curiosity to a marketable commodity.

The 24-Hour Time System

The British Broadcasting Corporation will adopt the 24-hour system of expressing time from April 22, when 'summer-time' commences in Great Britain. The system will be used in all announcements over the microphone, in the journals published by the Corporation and in correspondence. No statement has been made as to the duration of the trial of the system, but it will doubtless be sufficiently long for the public to become thoroughly familiar with the system and for the extent of public approval or disapproval of the system to be gauged. As already announced in Nature, the Postmaster-General will await the result of this experiment before coming to a decision on the question of the adoption of the system in the Post Office. It is proposed by the B.B.C. that a time such as 17 h. 15 m. shall be announced as 'Seventeen-fifteen hours'. This terminology would be inaccurate and undesirable, and it is

to be hoped that such a designation will not be used; otherwise this phraseology may soon become stereotyped. The expression 'seventeen hours fifteen minutes' is accurate but long: 'seventeen hours fifteen' is a contraction analogous to 'seventeen pounds fifteen' for £17 15s. 0d. But 'seventeen fifteen' (analogous to the present 5.15 p.m., but with the now unnecessary p.m. dropped) should be quite sufficient. At the exact hour, 17 hours can be used as simpler than 17.00.

Origin of Tektites

THE suggestion first made in NATURE (131, 117; 1933) by Dr. L. J. Spencer that tektites have been formed by the fusion of terrestrial rocks by the fall of very large meteorites has given rise to an interesting discussion, but, being unexpectedly novel, it has not met with general acceptance. Prof. F. E. Suess of Vienna, in whose classical paper of 1900 the name tektite was introduced and the meteoritic theory first proposed, has returned to the subject and he gives a recent review in *Die Naturwissenschaften* (21, 857, Dec. 8, 1933). Here, and in a private letter, he admits that the Darwin glass of Tasmania may have been formed by the fusion of terrestrial material. Some of the silica-glass from the meteorite craters at Wabar in Arabia is, in fact, exactly like Darwin glass in every respect, and at both places the material is present in thousands of tons. But from Tasmania no meteoric iron or craters have been recorded. For other tektites (australites, billitonites, moldavites and 'indochinites'), Prof. Suess still holds to the meteoritic theory. He points out that they have a much wider distribution than the silica-glass found around meteorite craters, and also that they usually bear no relation in chemical composition to the underlying rocks. The same arguments are also put forward in a letter to the Editor from Mr. T. Hodge-Smith, of the Australian Museum, Sydney, who has given an account of the tektites recently found in the Philippine Islands. These arguments, however, overlook the fact that tektites are usually found in alluvial deposits and that they are often water-worn and corroded, indicating that they have been transported from their place of origin. In the case of australites found scattered on the surface of the ground over wide areas, it is conceivable that they have been transported by the natives.

The 200 inch Reflector

IT was reported in the *Times* of March 27 that an accident had occurred during the pouring of the twenty tons of glass into the mould of the two hundred inch mirror for the new reflector for the California Institute of Technology. Part of the mould came loose and floated to the top of the molten glass. As soon as the pouring was completed, the cores were fished out of the molten mass. According to a message issued by Science Service, Dr. Hostetter, who was in charge of the operations, said that this mishap would not affect the success of the mirror, which has now been set aside to cool very slowly. After the months of cooling have elapsed, it will take several years to grind the surface of the mirror. Our readers will join with us in expressing the hope that it will be found that the incident of the break-up of the mould will not have spoilt the present pouring of glass.

Refrigeration Exhibition at the Science Museum

SIXTY years ago mechanical refrigeration was just coming into existence, and yet to-day it is an essential part of everyday life, not only in its well-known application to the transport and storage (including domestic storage) of perishable foodstuffs, but also in many of the industries upon which Great Britain depends. Of its lesser-known uses mention may be made of the manufacture of bread, biscuits, chocolate, margarine, artificial silk stockings and cinematograph films, the brewing of beer, the curing of bacon, the refining of oil and the sinking of mine shafts and wells. These are a few of about three hundred industries in which its use is either essential or in which it improves the quality of the product. With the object of illustrating the part played by refrigeration, and of showing the public the principles on which the several types of machines operate, a special exhibition has been arranged at the Science Museum, South Kensington, and will remain open until the end of August. It consists mainly of models, working exhibits and demonstrations. The exhibits have been supplied by the manufacturers and users of refrigerating machinery and the Museum has had the wholehearted co-operation of the British Association of Refrigeration, the National Physical Laboratory and the Low Temperature Research Station. A small Handbook has been prepared and will be on sale at the price of 6*d*. (by post 7*d*.): copies may also be obtained from H.M. Stationery Office. Anyone who is interested in the subject may obtain from this Handbook in a concise form an idea of the modern science and practice of mechanical refrigeration: the handbook also contains a brief outline of its historical development. In addition, a bibliography on refrigeration has been prepared in the Science Museum Library and will also be on sale.

Models of Tidal Estuaries

AT the Friday evening discourse held at the Royal Institution on April 13, Prof. A. H. Gibson discussed "Tidal Estuaries: Forecasting by Model Experiments". During recent years much work has been done on models reproducing the flow of water over weirs, through sluice gates, etc., and it has been found that, if suitable precautions are taken, the model results give a reliable indication of the behaviour of the original. River flow models are now being extensively used to investigate the erosion and deposition of bed materials and the effect of works designed to improve the navigable channel. The technique of such investigations is not yet fully developed, different methods being used in different laboratories. Chronologically, models of tidal estuaries were used before those of uni-flow rivers, the first tidal models (of the Mersey Estuary) having been constructed by Osborne Reynolds in 1885.

In 1926 the Severn Barrage Committee of the Department of Civil Research decided to carry out investigations on a working model of the Severn Estuary, with the view of determining the probable effect on the physical and hydrodynamical features of the estuary, of the introduction of a barrage for generating tidal power at the English Stones, between Beachley and Avonmouth. This model was constructed and operated in Prof. Gibson's laboratory.

PROF. GIBSON dealt with the problems involved in the construction and operation of such models, and with a comparison of the results obtained from the Severn model with those observed in the estuary. The successful use of a model depends largely on its being of a suitable scale, and on the possibility of being able to reproduce with reasonable accuracy the physical conditions tending to produce movement of the bed materials. This is more easily accomplished in an estuary having well-defined physical characteristics, with a large tidal range in which the action of the ebb and flood currents are all important. In such a case experience shows that the behaviour of the model reproduces closely that of the estuary. In other types of estuary having comparatively small tidal ranges, and especially if very exposed to gales, the results are mainly likely to be of value in so far as they enable the effect of any training works on the set and velocity of the currents and on the tidal range and period to be determined.

Close of Excavations at Ur

WITHIN a few days of the publication by the British Museum of the volume reporting on the excavation of the Royal Tombs at Ur, Dr. C. Leonard Woolley in the *Times* of April 13 announces the close of the brief season's work, and with it the end of the joint expedition of the British Museum and the Museum of the University of Pennsylvania to Mesopotamia. For twelve years this expedition has been engaged in an excavation which has produced results comparable in their far-reaching effect on archæological studies with the epoch-making discoveries of Sir Arthur Evans in Crete. The results reported by Dr. Woolley in what all will regret to know is his final dispatch in the long series he has contributed to the *Times* since 1922, form a fitting and impressive climax to what has preceded. The main objective of the season was the discovery of a cemetery of the early Jemdet Nasr period, for which the search, in default of guiding indications, was in the nature of an act of faith. It was abundantly justified by the discovery, after prolonged and strenuous digging, of a stratum of 10 ft. containing burials, in the upper levels of which the characteristically flexed human skeletons were surrounded by large numbers of stone jars in a variety of forms and material. One grave alone contained thirty-three vases. In the upper range the stone vase had entirely ousted that of clay. As Dr. Woolley remarks, it "was a luxury that had become a commonplace". As Ur stands in a stoneless land and the material had to be brought from either the north of Mesopotamia or from the area of the Persian Gulf, it would be difficult to find a more impressive testimony than this closing discovery to the early accession of Ur to wealth and importance, of which Dr. Woolley's excavations have afforded cumulative evidence year by year.

SINCE the trial excavations made by Dr. R. Campbell-Thompson at the end of the War for the purpose of a report to the British Museum, and the more or less tentative expedition of the late Dr. H. R. Hall to Ur and Al 'Ubaid before Dr. Woolley began systematic excavations in 1922, the archæology of the Middle East has advanced far and fast. Stimulated by Dr. Woolley's results, expeditions have worked at Kish, Nineveh, Arpachiyah, Tell Asmar and elsewhere, each site helping in the work of amplifying and elucidating material which in the long run, it is not unfair to say, gains its full significance by reference to the evidence from Ur and the outline of early Mesopotamian history which that site has afforded. It will be some time, perhaps years, before the place of Ur in archæological studies will have attained its final adjustment. Possibly from this point of view it may be no bad thing that further discovery here has ceased for the time being, affording an opportunity for comparison and reflection. Results must be weighed and pondered; they must be brought into closer relation with what has been done on the fringes of this great archæological province. It may then appear that by no means the least important outcome of the broader view now taken of the archæological field, of which Ur has been made the centre, has been its bearing on the discovery of the prehistoric civilisation of the Indus Valley. This discovery would never, in almost any circumstances, have been passed over as unimportant, but the systematic examination of the site and its interpretation would have been far different, and certainly less fruitful, had it been made before, instead of after, the early excavations at Ur. Archæologists, indeed, owe a deep debt of gratitude to those who have taken part in the work of the expedition, with Dr. Woolley at their head, and to the institutions by which the joint expedition has been supported.

Jubilee of the Society for the Study of Inebriety

THE fiftieth anniversary of the foundation of the Society for the Study of Inebriety and Drug Addiction, and the centenary of the birth of its founder, Dr. Norman Kerr, who died in 1899, were celebrated on April 10 by a luncheon held at the Langham Hotel, at which the Minister of Health, Lord D'Abernon, the Bishop of Norwich, Sir Thomas Barlow, the presidents of the Royal College of Surgeons and of the Royal Society of Medicine, and Sir Josiah Stamp were the principal guests. The luncheon was followed by a commemoration address delivered by the president, Sir Humphry Rolleston, who gave a sketch of the life of the founder and the activities of the Society. Norman Kerr, who was the author of numerous works on various aspects of the alcohol problem, regarded inebriety as a disease

essentially allied to insanity and insisted that it should be treated medically and not as if it were a crime. It was mainly due to him that the Habitual Drunkards Act of 1888 and the Inebriates Act of 1898 were amended. During the fifty years of its existence, the subjects discussed by the Society have included the influence of heredity on alcoholism, alcoholism and child welfare, alcoholism and venereal disease, the use of alcohol in medicine, drug addiction as an international problem, ether-drinking and the cigarette habit. The Society, which consists of medical members and lay associates, aims at a scientific study of alcoholism and drug addiction, and has not a policy of total abstinence.

Society of Dyers and Colourists

ARRANGEMENTS for the jubilee celebrations of the Society of Dyers and Colourists, to be held at Bradford at Whitsuntide, are in active progress. Inaugurated at a meeting in Bradford on May 14, 1884, the Society is the oldest of its kind in Great Britain. Special interest in the celebrations will be attached to the issue early next month of a jubilee number of the Society's *Journal*, containing original articles by eminent authorities on the processes of dyeing and their development in the course of the past fifty years. In these, invention, scientific research and records of practical applications will receive full attention. It may be recalled here that the Society allots the Perkin Gold Medal at intervals, for conspicuous service to the tinctorial industries. By means of its award the synthesis of indigo, the discovery of viscose, of primuline, and of alizarine blue have been severally recognised.

Geistige Arbeit

THE object of a new periodical of this title which appears twice monthly (25 pfennigs per copy) is to give brief reviews of the progress and tendencies of modern scientific research. The subjects considered cover a wide field, including anthropology, political economy, agriculture, sociology and all the pure and applied sciences. There are articles on peasants and nomads, problems of German sociology, new concepts of natural science, methods of counting for statistical purposes, Paracelsus (a sketch), and many others. The contributors are chosen from the ranks of those who have done original work in their respective fields. In the article by Möglich dealing with the foundations of present-day physics, we find due acknowledgment paid to the epoch-making ideas of Planck and Heisenberg, but there are important omissions which detract from the value of the account. In highly compressed articles of this type, it is of primary importance that the authors should have not only a deep insight into their subjects but also a proper sense of values, if the services of a discriminating censor are not to be invoked. Goethe has said: "Die Vernunft ist auf das Werdende, der Verstand auf das Gewordene angewiesen". This remark applies particularly aptly to the present journal, which bears the sub-title "Zentralblatt für die gelehrte Welt". The article on Theophrastus Bombastus von Hohenheim, commonly called Paracelsus, is of interest as his name has recently come into prominence again as one of the first great experimenters in medical science—one hears of a Paracelsus Renaissance in Germany—in spite of a certain notoriety as a vagabond miracle-worker which he probably only partly deserved. His ideas, if not actual results obtained, undoubtedly exerted a considerable influence on later workers. The journal is published by Walter de Gruyter and Co., Berlin W.10, Genthinerstr. 38.

Philosophy of Science

THE welcome co-operation between science and philosophy, which has become a distinctive feature of our time, is further illustrated by the appearance of a new quarterly, *Philosophy of Science*, which is published by the Philosophy of Science Association in the United States (Baltimore: Williams and Wilkins Co.; London: Baillière, Tindall and Cox. 6*s*. 9*d*.). This interesting publication sets itself the useful task of giving an organised expression to the growing interest among philosophers and scientific workers in classifying, and perhaps unifying, the programmes, methods and results of the disciplines of philosophy and of science. With this object in view, the editor, Prof. W. M. Malisoff, proposes as a research programme, the analysis of meaning, symbolism, definition, axioms and postulates, the study of the nature and formulation of theoretical principles, and questions of method and of the structure and hierarchy of the sciences. The first issue of the new journal contains a remarkable series of papers; among the contributors are Prof. J. B. S. Haldane on "Quantum Mechanics as a Basis for Philosophy", D. J. Struik on "The Foundations of the Theory of Probabilities", Rudolf Carnap on "The Character of Philosophic Problems". The excellent presentation of the journal and the eminence of its contributors give an added value to its object and method which, no doubt, will appeal equally to scientific workers and to philosophers.

Research in the Solomon Islands

A REPORT on the work of the Templeton-Crocker Expedition to the Solomon Islands, 1933, has recently been sent to NATURE by the Director of the Bernice P. Bishop Museum, Honolulu. The expedition left San Francisco on March 2, 1933, in Mr. Templeton-Crocker's auxiliary schooner *Vaca* and returned on September 15 after conducting a preliminary ethnographical and medical survey of a number of islands in the Solomon group. The principal objective was the Rennell and Bellona islands, but before arriving there the expedition collected data bearing on tuberculosis and tropical diseases, as well as ethnographical material, at Sikiana, Tulalagi, Guadalcanar and Malaita. Advantage was taken of conditions on Rennell and Bellona, where bird and insect life are undisturbed and the inhabitants virtually unaffected by European contacts, to make extensive collections of birds, plants and insects and to record particulars relating to native life and customs, which appear to

have suffered little change since the Polynesian ancestors of the inhabitants first arrived there twenty generations ago. It was also possible to arrange for an intensive study of the disease and general health of the population of one district. Blood samples for filaria tests and blood groups were obtained. On Bellona the party was fortunate enough to obtain cinematograph record of the annual first-fruits ceremony. A medical and health survey was also made on the islands of San Cristobal, Santa Anna and Santa Catalina. As a result of the expedition's work, 3,200 artefacts have been added to the collections of the museum in Honolulu, as well as a large number of entomological and botanical specimens. Other collections are to be distributed among scientific institutions in America and Europe, while the material relating to canoes will be submitted to Dr. A. C. Haddon in Cambridge.

Regulations Concerning Chemicals

Acts of Parliament and Statutory Rules and Orders affecting the chemical industry are sufficiently numerous and complex to require documentation in a convenient and easily accessible form. That task has been undertaken by the Association of British Chemical Manufacturers, which in January 1931 published an index of such information. The third supplement, covering acts, rules and orders which have come to the notice of the Association during 1933 has recently been issued (Heffer, Cambridge ; 6*d*. post free). New regulations regarding the packing and stowing of dangerous goods in ships have been made, and a revised edition of the summary of the principal regulations made under the Explosives Act has been issued. Reference is made to the Spirits Act, 1880, and the Still Licence Act, 1849. All plant capable of being used as a still is subject to licence, but exemptions are granted in respect of alkali works, coal gas, tar distillation, solvent recovery, chemical experiments, professional chemists, etc. Water stills of more than 1 gallon capacity require a licence ; otherwise exemption may be granted on application. The supplementary index also refers, *inter alia*, to the Dyestuffs (Import Regulation) Act, the Import Duties Act, the Ottawa Agreements Act, the Poisons and Pharmacy Act, and the Safeguarding of Industries Act.

Graph Papers

We have received from Messrs. Wightman Mountain, Ltd., of Artillery House, Victoria Street, Westminster, some samples of graph paper. These are of considerable interest as exhibiting the great range and variety of papers now produced in England. Of squared papers alone, Messrs. Wightman Mountain list more than 250 sizes and styles, some with ruled and others with engraved lines. A wide range of logarithmic papers includes, for example, sheets covering the ranges 7–400 and 1–10,000. Profile paper is specially ruled for making longitudinal sections of railways, roads, etc. Other varieties of graph paper include permille paper (arithmetic probability), square-law, polar, isocandle, triangular and isometric papers. A new paper is one ruled in tenths of an inch one way and in inches and twelfths the other. The increasing demand for the graphical presentation of commercial data has led to the publication of a number of data sheets, including daily, weekly and monthly progress sheets. Even a holiday chart is not lacking. To furnish some idea of the papers available, the firm is offering for half a crown a special sample packet of 58 different data sheets.

International Agricultural Congress in Budapest

The International Congress of Agriculture is meeting this year in Budapest on June 13–20. The Congress is held every two years in a different European capital and is attended by delegates from some thirty countries who represent every side of agricultural life. The work of the Congress is divided into eight sections. The first deals with economics and agrarian policy, world prices, the organisation of markets and the economic consequences of mechanisation. Two other sections, those on co-operation and agricultural industries, occupy parts of the same field, and the section dealing with viticulture will this year be economic rather than technical. Two sections treat respectively of animal and vegetable production from the scientific side. Modern horse-breeding, the influence of pasture on the quality of milk, contagious abortion, the production of forage crops under semi-desert conditions, plant selection, the classification of wheats and the improvement of alkaline soils are the principal subjects for discussion at Budapest. The remaining sections are to some extent social in scope, dealing with agricultural instruction and the position of women in rural communities. The Congress will be accompanied by social functions and followed by excursions, which will enable delegates to see something of educational and scientific work in connexion with Hungarian agriculture, as well as of Hungarian farming and peasant life. It is expected that a party of British delegates, connected either with agricultural science or with bodies such as the National Federation of Women's Institutes, will take part. Further information can be obtained from the secretary of the British Corresponding Committee, International Congress of Agriculture, 10 Doughty Street, London, W.C.1.

Announcements

Prof. J. C. McLennan will deliver the twenty-fifth Kelvin Lecture before the Institution of Electrical Engineers on April 26, taking as his subject "Electrical Phenomena at Extremely Low Temperatures". Before the lecture, the Faraday Medal of the Institution will be presented to Sir Frank Smith.

Dr. C. E. Kenneth Mees, director of research to the Eastman Kodak Co., Rochester, U.S.A., will deliver the Sir Henry Trueman Wood Memorial Lecture before the Royal Society of Arts on May 16. The subject of Dr. Mees's lecture will be "Some Photographic Aspects of Sound Recording".

A DINNER in honour of Prof. Karl Pearson will be held at University College, London, on April 23, when a portrait plaque in bronze of Prof. Pearson will be presented to the College on behalf of subscribers to the Karl Pearson Commemoration Fund. A Brunsviga calculating-machine has already been handed over to Prof. Pearson and a duplicate of the plaque will be given to him at the dinner.

THE Gold Medal of the Institution of Mining and Metallurgy, the highest distinction in its power to confer, has been awarded to Mr. John A. Agnew, in recognition of his services in the development of the mineral resources of the Empire, and to the mining industry. The following awards have also been made by the Council of the Institution: The Consolidated Gold Fields of South Africa Ltd. Gold Medal and premium of forty guineas to Dr. W. R. Jones, for his researches on the incidence of silicosis, and for his published papers on the subject; William Frecheville Student's Prize of ten guineas to Mr. D. J. Rogers, for his "Notes on a Tunnel driven at Stan Trg Mine, Yugoslavia"; two grants from the Post-graduate Grants Fund to enable the recipients to pursue their geological studies in Spain.

MR. K. E. TOMS, late assistant superintendent of plantations, East African Agricultural Research Station, Amani, has been appointed by the Secretary of State for the Colonies to be agricultural and forestry officer, St. Helena.

AT the stratosphere conference, which closed in Leningrad a few days ago, it was decided to call a world conference for the study of the stratosphere in the U.S.S.R. in 1936. The time of the conference is to coincide with the eclipse of the sun on June 19 of that year.

THE applications of photography to map-making are steadily widening. The fourth International Congress of Photogrammetry will be held in Paris on November 16–December 2 this year. There will be an exhibition of materials and apparatus relevant to the Congress at the same time. Inquiries should be addressed to M. le President, Commission 2, Congrès International de Photogrammetrie, 4 Rue Galilée, Paris 16 e.

THE Rome correspondent of the *Times* reports that Commendatore Rinato Donati on April 11 at the airport of Montecelio broke the world's altitude record for aeroplanes of any type when he reached a height of 14,500 metres. Signor Donati was flying a specially constructed Caproni 114 h.p. biplane.

AT the meeting of the London Mathematical Society to be held on Thursday, April 26, at 5 p.m. in the rooms of the Royal Astronomical Society, Burlington House, W.1, there will be discussion on "Integral Functions". Prof. E. C. Titchmarsh will introduce the subject, Dr. E. C. Collingwood will speak on "Properties of Exceptional Values of Integral and Meromorphic Functions", Miss M. L. Cartwright on "Directions of Borel of Integral Functions and their Relation to the Singularities of Power Series", and Prof. J. M. Whittaker on "Difference Properties of Integral and Meromorphic Functions".

WE have received a volume of Abridged Scientific Publications from the Kodak Research Laboratories, vol. 15, 1931–32, published by the Eastman Kodak Company, Rochester, New York. This volume comprises abridgments of 61 papers, most of which are accounts of original researches on subjects related to photography.

THE Ministry of Agriculture has recently issued a portfolio of "Leaflets on Insect Pests of Farm and Garden Crops" which is intended to replace sectional vol. 11 on the same subject. The advantage of the present portfolio over the bound sectional volume is that it enables all new and revised leaflets to be inserted and the portfolio is thus kept up to date. The portfolio of leaflets is obtainable, price 1*s.* 6*d.* net, through any bookseller. Readers who wish to receive copies of new or revised leaflets may do so on payment of a nominal registration fee: full particulars of this scheme may be obtained by writing to the Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A technical officer (Grade II) in the Directorate of Technical Development, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (April 23). A lecturer in educational psychology at the Maria Grey Training College, Salusbury Road, London, N.W.6—The Principal (April 24). Three male junior assistants (temporary) at the Experimental Research Station, Porton, Wiltshire—The Chief Superintendent, Chemical Defence Research Department, 14, Grosvenor Gardens, S.W.1 (April 28). A demonstrator in biochemistry in the School of Biochemistry, University of Cambridge—Sir F. G. Hopkins, Sir William Dunn Institute, Tennis Court Road, Cambridge (May 2). A temporary technical assistant in farm economics in the Department of Agriculture for Scotland—The Establishment Officer, Queen Street, Edinburgh, 2 (May 5). An assistant master to teach mathematics, mechanics and physics at the Polytechnic, Regent Street, London, W.1—The Director of Education (May 7). An assistant lecturer in botany at the University of Manchester—The Registrar (May 7). A chief inspector of explosives in India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (May 10). An assistant lecturer in zoology at the University of Bristol—The Registrar (May 11). A lecturer in zoology at Bedford College for Women, Regent's Park, N.W.1—The Secretary (May 22). A fuel technologist in the Public Service Board of New South Wales—The Official Representative of the Government of New South Wales, Wellington House, 125, Strand, London, W.C.2 (May 31). A member of the vocational guidance staff at the National Institute of Industrial Psychology, Aldwych House, London, W.C.2—The Secretary.

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.*]

Co-ordination of State Scientific Services

THE editorial article on "Co-ordination of the State Scientific Services" in NATURE of February 10 comments upon various statements made in "Patriotism Ltd."

For example, the article states that since the War period, the D.S.I.R. and the M.R.C. have not undertaken or financed any work for "purely warlike purposes" and implies that "purely industrial or medical motives" have been the primary aim in all their investigations. Furthermore, the article states :—

"It would be equally indefensible if work undertaken at the instigations of the fighting services, but not specially paid for by contributions from their vote, were not published and made available for use in industry."

In the case of the following three investigations carried out by the Medical Research Council, reports were sent only to departments of the fighting services and were not published.

(1) The Council investigated a problem of direct importance to chemical warfare ; namely, the limiting of the visual field for different types of respirators. This investigation was carried out at the request of the Chemical Defence Research Department and the results were reported to that Department only.

(2) The Industrial Health Research Board investigated "the personal factors in proficiency for naval gunnery". Is it seriously maintained that this has an industrial application ?

(3) The same Board, at the request of the Admiralty, investigated the psychological factors in deep sea diving and sent its report to the Admiralty.

In all these cases the investigations appear to have been financed by the M.R.C., yet the reports are not recorded as having been published.

The M.R.C. investigations into rifle-shooting were reported to the War Office and no report seems to have been given to the general public. It is incorrect to suggest that the Council has drawn on the special acoustical knowledge of the fighting services primarily to assist in the alleviation of deafness, since it undertook "at the request of the War Office" investigations into the selection and training of anti-aircraft listeners. These investigations were reported as being continued in the M.R.C. Annual Report for 1931–32, but all reference to them is omitted from the Report for 1932–33.

In view of these facts and of many similar ones published in "Patriotism Ltd.", we must conclude that a considerable amount of assistance has been given to the fighting services by these committees. We agree that in practically all branches of science, under the control of these committees, new knowledge is adaptable to the purposes of military science. It seems, however, to be indisputable that such adaptation is the proper function of the soldier and of his scientist servants. It is known that there have been certain resignations and a protest against this employment for warlike purposes of presumably neutral scientists' time and energy.

The statement made by the president of the Royal Society that scientific men "are now in real control of scientific policy in Great Britain" greatly clarifies the position. As you valuably state, further militarisation of these research committees can take place only with the scientists' "connivance and responsibility".

DOROTHY WOODMAN.

Union of Democratic Control,
34, Victoria Street,
London, S.W.1.
March 15.

"PATRIOTISM LTD. : an Exposure of the War Machine" is published by the Union of Democratic Control ; and Chap. 5, entitled "The Science of Murder", is intended to show how such organisations as the Department of Scientific and Industrial Research, the various industrial research associations, the Medical Research Council and the Industrial Health Research Board, "are perverted to the uses of death". The main contention is that research is carried out for the fighting services by these bodies though their financial resources are budgeted for in the civil estimates. After an inquiry into the facts, these and related allegations were dealt with in the article in NATURE to which Miss Woodman refers. When the article appeared, we received a long communication in which an attempt was made to justify the statements in "Patriotism Ltd.", but we could not possibly find space for it, and therefore we asked Miss Woodman to limit herself to specific examples of the diversion of financial provision for civil research to work for the fighting services. The above letter is the result ; and the very triviality of the cases cited is almost enough to condemn the main thesis.

It is scarcely worth while to traverse the arguments again, but in any government department concerned with scientific research it may be taken for granted that : (1) Its financial resources will not be available for work which should be paid for by another department. (2) If work is done at the suggestion of another department, or with facilities given by it, a report is usually transmitted to the department. (3) If the results are not published, this is not because of any seal of secrecy but because they are incomplete or not of sufficient scientific value to be published.

As to the particular investigations mentioned by Miss Woodman, we suggest that if the Union of Democratic Control had desired to know the truth concerning them, it would have communicated with the Medical Research Council instead of construing for itself isolated sentences in reports. We have inquired into these cases, and have satisfied ourselves that the facts are as follows :

1. The Physiology of Vision Committee of the M.R.C. was consulted on the effect of respirators on the visual field. The only work done on the subject was undertaken by a member of the Committee who is an officer of the R.A.M.C., as stated in the Annual Report of the M.R.C., and as he was giving whole-time service to the War Office, the M.R.C. was not involved in any expenditure. Any knowledge gained by the committee remains, however, available when advice is asked as regards respirators used in dangerous industries, mine rescue work and the like.

2. It is certainly maintained that the investigation of the personal factors in proficiency for naval gunnery has an industrial application. It formed part of a larger investigation into the general problem of vocational selection. Many of the opportunities

for this work have been found in the Services, where it is possible to examine a controlled personnel and to obtain at a later date reliable records of their after-histories. Few of the results have yet been published, but all are available for publication eventually when enough evidence has been accumulated.

3. The main part of the work on deep diving done by the M.R.C. was on the fundamental question of the saturation of the tissues with gaseous nitrogen. The report on this work forwarded to the Admiralty consisted of three sections, each of which has since appeared in the *Quarterly Journal of Experimental Physiology*. The work done on the psychological side occupied only a very small fraction of the time; and as nothing of importance emerged from it, no report has yet been published, though the knowledge gained is available to anyone inquiring about deep diving from a civilian point of view.

4. The investigation of rifle shooting was not undertaken at the request of the military authorities, but at the instance of an academic psychologist who happened to see in the operation an interesting combination of manual, visual and psychological factors. The results have not been published, but they are being prepared for publication. The War Office was sent a report as a matter of courtesy.

5. In the matter of the selection and training of anti-aircraft listeners, the actual investigations made by the M.R.C. have taken the form of fundamental research into questions of aural localisation; and the results have been, or are being, published.

We need scarcely say that no further space can be afforded in these columns for a discussion of the questions raised by the Union of Democratic Control as to the use made by the fighting services of civil research organisations.

EDITOR OF "NATURE".

Proportion of Heavy Water in Natural Water

IT has been suggested that the proportion of heavy water in natural waters may vary according to their source. It is, however, unlikely that any considerable variations occur.

Consider, for example, the Dead Sea. We may suppose that the rate of influx of water into the Dead Sea is equal to the rate of loss by evaporation. In a case like this a steady state will eventually be reached—and in the case of the Dead Sea, presumably has been reached—such that the proportion of heavy water in it remains constant with time. At the steady state, the composition of the inflowing water is the same as that of the water vapour evaporating away. So the Dead Sea is in equilibrium with water vapour of the same composition as the inflowing water; and, in consequence, it contains but a very slightly greater concentration of heavy water than the inflowing water. In fact, the excess is no more than would be gained by a single distillation at a pressure equal to the vapour pressure of the Dead Sea—a negligibly small amount.

This argument assumes that the inflowing water is at once distributed evenly throughout the whole of the Dead Sea. Imperfect mixing will permit of a greater concentration of heavy water; but it is unlikely even then that there is any remarkable concentration of heavy water in water from any natural source. We may take it, then, that natural waters contain a sensibly constant concentration of heavy water; or, to speak more cautiously, that the processes of evaporation and condensation in Nature are unlikely to produce any considerable separation of the two kinds of water.

H. A. C. MCKAY.

33, New Road,
Croxley Green,
Herts.
March 27.

IN connexion with the foregoing letter, some results may be quoted of an examination of Dead Sea water carried out in this laboratory by Dr. A. E. Martin.

The Dead Sea water was obtained by the kindness of Palestine Potash, Ltd., and consisted of samples taken from near the surface and at a depth of 53 metres below the surface.

These samples were distilled and, in addition, the salts remaining after ordinary distillation were reduced to dryness by the application of heat, but none of the distillates was found to be heavier than ordinary pure distilled water prepared in the laboratory.

To determine the density, a spherical mass of silica attached to the beam of the balance by a fine silica fibre was weighed in the various samples of water and the greatest difference in density between distilled water and distilled Dead Sea water was 0·00003, the uncertainty of measurement being about 0·00002.

It does not appear, therefore, that there is any notable proportion of heavy water in the Dead Sea.

R. ROBERTSON.

Government Laboratory,
Clement's Inn Passage,
Strand, London, W.C.2.
March 29.

Spectrum of the HD- and D_2-Molecules

WE have photographed the molecular spectrum of hydrogen under high dispersion and obtained a series of photographs of samples with increasing amounts of the heavy isotope ranging from pure H_2 to practically pure D_2. We are indebted to Prof. H. S. Taylor, of Princeton, for the heavy hydrogen. In this way it was possible to decide unambiguously whether a line is due to H_2, HD or D_2. It is well known that a considerable part of the H_2-spectrum was analysed chiefly through the efforts of O. W. Richardson and his co-workers, but there remains a great number of problems concerned with the analysis and interpretation of this complicated spectrum. The main purpose of the present investigation is to obtain additional material which can be used for a further analysis of the molecular spectrum of hydrogen and to help to clear up doubtful points in its interpretation. We are confident that in this way our knowledge of the structure of the hydrogen molecule can be greatly increased.

The comparison of the three spectra gives indeed a vast amount of interesting information for which we must, however, refer to the full account of the work which is to appear elsewhere. We wish to give here only some of the results of the analysis of the bands of HD and D_2 which are analogous to the Fulcher bands of H_2. These bands have a relatively simple structure and do not show markedly the decoupling effects which are so characteristic of most

other hydrogen bands. Therefore most of the results of the analysis can be summarised by a table of the band constants.

	1	2	3	Ratio		ρ_{12}^n	ρ_{13}^n	n
	H_2	HD	D_2	1 : 2	1 : 3			
ω'	2373·18	2055·52	1678·70	0·866 15	0·707 37	0·866 17	0·707 44	1
ω''	2665·34	2308·39	1885·80	0·866 08	0·707 53			
$\omega x'$	66·32	49·68	32·90	0·7490	0·4960	0·7502	0·5005	2
$\omega x''$	72·09	53·73	35·93	0·7454	0·4985			
B''	34·216	25·685	17·109	0·7507	0·5000			
α''	1·671	1·099	0·606	0·658	0·363	0·650	0·354	3
D''	0·0216	0·0128	0·0055	0·59	0·25	0·563	0·250	4

In this table the chief constants which occur in the expression

$$W/hc = \omega v - \omega x v^2 + \ldots + B(1 - \alpha v)J(J+1) - DJ^2(J+1)^2 + \ldots$$

($v = \frac{1}{2}, 1\frac{1}{2}, \ldots$; $J = 0, 1, 2, \ldots$) for the vibrational and rotational energy are given for the upper and lower states of the three different hydrogen molecules. The values for H_2 are taken from the work of Richardson and Das[1]. The columns marked '*Ratio*' give the ratio of the constants of HD and D_2 to the corresponding values for H_2. The next two columns give the theoretical values to which these ratios should be equal. These are found from the known[2] values of the reduced masses μ_i by the relations $\rho_{ij}^2 = \frac{\mu_i}{\mu_j}$.

It is seen that the agreement between the theoretical and experimental ratios is very satisfactory. We are confident that the remaining discrepancies are entirely due to experimental errors which arise chiefly from the fact that an inadequate formula is used for the calculation of the constants. (We included terms up to the fourth power in v and to the sixth power in J.) The agreement can be materially improved by an adjustment of the constants without impairing the accuracy with which the observed wave numbers are represented by the formulæ. We prefer, however, to give here the constants which were calculated without bias in the usual way for each molecule separately. The table then shows to what accuracy the calculated values for band constants of this type in general can be expected to agree with the theoretical values. The fact that a given formula represents well the experimental data is very often insufficient to judge this point.

We find that there is a discrepancy of about 2·6 cm.$^{-1}$ between the values of the electronic frequencies. This seems too large to be attributed entirely to experimental errors. We wish to suspend our judgment about this, however, until all the constants have been recalculated in a way which takes more rigorously into account all the various relations between them.

The component of the initial $^3\Pi$ state which gives the P- and R-branches shows perturbations for all three molecules. The type of perturbation is the same, and is most easily recognised by the anomalous values of the Λ-doubling. The details, however, differ considerably. While, for example, in H_2 the state with $v' = 1$ is most strongly affected, it is quite regular for HD, but for this molecule the $v' = 0$ level is very irregular. This behaviour can be understood from the fact that the relative positions of the perturbing and the perturbed vibrational levels are slightly shifted in the three different molecules due to the anharmonic character of the binding.

Richardson and Das noticed that in H_2 all P- and R-branches are absent for $v' \geqslant 4$. This is also true for HD, but in D_2 the P- and R-branches are normal for $v' = 4$ whereas they are absent for $v' \geqslant 5$. We can understand this behaviour if we attribute the disappearance of these branches to predissociation. The predissociation limit, which is determined entirely by the shape of the potential curves, is independent of the nuclear masses, and while it is surpassed by four vibrational quanta of H_2 and HD, four of the smaller vibrational quanta of D_2 will fall below it, but five will also surpass it for this molecule. From these observed facts we can derive that the predissociation limit must lie between 0·93 and 1·02 volts above the electronic frequency of the $^3\Pi$ state.

G. H. Dieke.
R. W. Blue.

Johns Hopkins University,
Baltimore.
March 7.

[1] *Proc. Roy. Soc.*, A, **122**, 688; 1929.
[2] Bainbridge, *Phys. Rev.*, **44**, 57; 1933.

Activities of Life and the Second Law of Thermodynamics

I am anxious to treat Prof. Donnan's views with all courtesy, but think his last letter, written in conjunction with Prof. Guggenheim, is entirely invalidated, like his previous letter, by a technical error in thermodynamics.

The ordinary formula for the positional entropy of a large number of particles is

$$-k \iiint \nu \log \nu \, dx \, dy \, dz$$

where ν is the number of particles per unit volume. Thus moving N particles from a place of density ν to one of higher density ν' decreases the entropy by

$$kN(\log \nu' - \log \nu).$$

Surely Profs. Donnan and Guggenheim have overlooked the factor N. Owing to its presence, moving a single molecule does not, as they contend, have the same effect as moving a truckload of N molecules, but only $1/N$th of this effect. The same error, I think, invalidates their second paragraph.

It is difficult to discuss views based on arguments which seem to me so entirely fallacious, so I can only repeat that I think the writers are in error by more than mere technical mistakes. They seem to me to be comparing two things that do not enter into relation with one another at all—like the number of calories in a man's dinner, and the number of ergs needed to carry it in from the kitchen to the dining-room.

As they ask for a physiological reference, may I (although no physiologist) refer them to Carnegie Institution Publication, No. 446 ("Mental Effort", by F. G. and C. G. Benedict, 1934)?

J. H. Jeans.

Cleveland Lodge,
Dorking.

Periodic Structure in Ice

A CONCAVE metal vessel, 5 cm. × 3·75 cm. × 1·2 cm. at its deepest point, resting in natural contact (that is, at greatest convexity of its convex surface) with a stone pavement, became filled with rain water or melted sleet. It remained overnight, and held next morning a plano-convex lens of ice, which exhibited a beautiful periodic structure.

The periodic structure consisted of about a dozen very distinct colourless concentric circles, 0·5–1 mm. radial variation, the least, central, one about 1 cm. diameter, with transparent ice between the rings. The structure persisted through the depth of the lens, the largest circle being, of course, of least depth. A small piece of black foreign matter (perhaps a smut) which may, or may not, have had something to do with the formation of the structure, was frozen into the centre of the smallest circle.

In reporting a previous observation of periodic structures in carbon films due to oil drops[1], the absence of colloids, chemical action and dissolution was stressed. But in this present observation, which also is probably original, one chemical substance alone appears to be concerned. There is, of course, the possibility of 'heavy' water and of two phases—solid and liquid—being concerned, though the ring structures seemed as solid as the clear ice. The original liquid might also have contained a slight amount of dissolved impurity, if only condensation nuclei. Attempts will be made, artificially, to reproduce such periodic structures in ice.

S. C. BLACKTIN.

20 Denton Avenue,
Leeds, 8.
March 15.

NATURE, **129**, 401, March 12, 1932.

Loss of Mass in Binary Systems

SOME years ago, Sir James Jeans[1] considered the problem of the variation in the orbital elements of a binary star in which one or both of the components is losing mass by radiation. He concluded that, in these circumstances, the orbital eccentricity will remain constant, whereas the semi-axis major varies inversely as the sum of the masses of the components.

Shortly after, Prof. E. W. Brown[2] discussed the same problem from a different point of view, arriving at the conclusion that the orbital eccentricity varies inversely as the sum of the masses, while the semi-axis increases at a still higher rate. His paper was criticised by Jeans[3], but the cause of their fundamental disagreement was not then, nor has since, been cleared up.

An investigation which has recently been completed throws light on this difficulty. Starting from the equations of motion in Cartesian form as given by Jeans, the differential equation of the orbit is deduced, and its general solution obtained. It is found that Jeans's result is justified, and the source of Brown's error is explained.

The main result of the investigation is that the loss of mass through radiation leads to the relation : *semi-axis major is inversely proportional to the mass of the system*, which holds throughout the life of the binary ; or alternatively,

$$P/a^2 = \text{constant},$$

that is, $\log P - 2 \log a'' + 2 \log \pi'' = \text{constant}$ in the usual notation.

A statistical study of all the available material for the visual binaries has shown that not only does this relation hold throughout the life of any one star, but also it holds statistically at the present epoch for all visual binaries in the form

$$\log P - 2 \log a'' + 2 \log \pi'' = -0{\cdot}826 \pm 0{\cdot}098.$$

This result shows that all such binaries apparently originate with nearly equal values of the quantity P/a^2, the degree of scatter of individual values from the mean being given by the probable error 0·098 of the constant 0·826.

This relation leads to a form of hypothetical parallax which we may call the mass-radiation parallax, and which has been computed for 123 binaries the orbital data of which can be taken as well determined. The computed values are found to agree very well with those found on the basis of other methods.

The above relation does not appear to hold for the eclipsing or the short period spectroscopic binaries. The reason for this difference between the short and the long period binaries is probably bound up with the difference in origin of these two groups, but as yet no adequate explanation of the observations has been forthcoming.

A. E. H. BLEKSLEY.

University of the Witwatersrand,
Johannesburg,
South Africa.
Feb. 18.

[1] *Mon. Not. Roy. Ast. Soc.*, **85**, 2 ; 1924.
[2] *Proc. Nat. Acad. Sci.*, **11**, 274 ; 1925.
[3] *Mon. Not. Roy. Ast. Soc.*, **85**, 912 ; 1925.

Calcium Isotope with Mass 41 and the Radioactive Half-period of Potassium

THE values given in a previous note[1] for the radioactive half-period of the potassium isotope with mass 41, as derived from the abnormality in the atomic weight of calcium extracted from Rhiconich and Portsoy pegmatites, stand in need of correction.

In the first place, it has been learned through the kindness of Prof. Arthur Holmes, of the University of Durham, to whom a sample of the Rhiconich rock had been sent, that the Geological Survey analysis of this pegmatite[2] was not applicable to the material actually used, which had not been hand-picked. Independent analysis conducted by Dr. Winifred Guthrie in this laboratory and by Dr. A. W. Groves of the Royal College of Science agreed in assigning to this material a CaO content of 0·55 per cent (instead of 0·27) and K_2O content of 8·0 per cent (instead of 9·35).

The Portsoy pegmatite, which had been hand-picked, gave analyses much closer to the Geological Survey figures, namely, CaO 0·28 per cent (exact agreement) and K_2O 8·0 per cent (instead of 8·9). The age of 600 million years assumed for this rock in our previous note, however, is decidedly higher than geological evidence warrants, and a value of 400 million years may be regarded as more reasonable.

While the necessary recalculations were being made in the light of the above changes, it transpired that an unsuspected constant error had entered into our earlier calculations and that the life-periods arrived at were accordingly all too high. The final values for the half-period of the potassium isotope with mass 41 now obtained are :

(*a*) under the assumption that all the calcium with mass 41 was extracted, $1 \cdot 6 \times 10^{11}$ years.

(*b*) under the assumption that only one third was extracted, $0 \cdot 5 \times 10^{11}$ years.

The Rhiconich and Portsoy rocks give identical figures, and the value indicated is of the order 1×10^{11} years, which is in accordance with the revised results of Holmes and Lawson, *not* with the more recent work of Mühlhoff[3].

James Kendall.
William W. Smith.
Thomas Tait.

Chemistry Department,
University, Edinburgh.
April 4.

[1] Nature, **131**, 688, May 13, 1933.
[2] Geological Survey, Summary of Progress for 1919, pp. 43–4.
[3] *Ann. Rep. Chem. Soc.*, **27**, 310–11; 1930.

The Helmholtz Resonance Theory of Hearing

Direct evidence in favour of the view that the vibrating elements of the cochlea are differentially tuned for frequency has been adduced in the following way:

The cochlea of the cat is exposed under Nembutal anæsthesia. Viewing the preparation through a dissecting microscope, and using a dental burr, small excavations are now made in the bone, one proximal to the round window, the other towards the apex of the cochlea; the floor of these concavities may be made so thin that the cochlear fluids seep through, a state of affairs which may be easily seen through the microscope. At this juncture, small beads of mercury are placed in the depressions, using a micro-pipette; in this way, further loss of fluid is prevented, and a good electrical contact with the fluids of the inner ear established, by the insertion of platinum electrodes into the mercury droplets.

In response to sound stimuli, potentials are engendered between these electrodes and an indifferent electrode placed beneath the mylo-hyoid muscle (Wever and Bray effect), and these may be recorded by means of an amplifier and oscillograph.

The amplitude of the potentials in response to a note of 250 cycles has been found to be three or more times as great at the apex as at the base; while a note of 2,050 cycles gives rise to potentials of amplitude some four times greater at the base than at the apex.

C. S. Hallpike.
A. F. Rawdon Smith.

Ferens Institute of Otology,
Middlesex Hospital Annexe,
Cleveland Street, W.1.
March 27.

The Attitude of the German Government towards Science

In spite of my letter in Nature of February 24, there still seems to exist in English scientific circles a misunderstanding of the attitude of the new Government in Germany towards science and of the reasons why Jewish scientists have left the country. May I be allowed therefore to point out the following facts?

It must be emphasised once more that it is far from the thought of the National Socialist Government to make an attack on the freedom of scientific investigation; rather is it anxious to give scientific persons every possible help for their work. I have myself on many occasions been asked by the National Socialist Ministers to join them in assisting individual scientific persons and institutes.

The National Socialist Government has not subjected Jewish scientists to exceptional treatment, or forced them to emigrate: it has passed a law for the reform of the Civil Service which applies to all kinds of officials, not only to those concerned with science. According to this law, non-Aryan officials were obliged to leave their positions if they were not appointed before 1914, or if they had not fought at the front in the War, or had not lost fathers or sons in the War. No Government can be denied the right to make such rules in the interests of its own people, and no group of officials, for example, scientific ones, can be made an exception to such a general law. As a matter of fact, however, in a number of individual cases an exception was made to the advantage of Jewish scientists.

Various Jewish scientists, without being forced to do so, have given up their professorships and moved to other countries. This they have done, as some of them have declared openly, out of sympathy with their Jewish kinsfolk who were affected by the law. This attitude can be understood and appreciated. One should not, however, set them up outside Germany as martyrs of unjust treatment by National Socialist Germany, nor quote them as signs of the denial of intellectual freedom in Germany. This would be a misunderstanding of the actual position.

The withholding of criticism of the new regime in Germany, or at least a conscientious regard for the truth in scientific circles, will be to the advantage not only of international co-operation but also of the Jewish scientists themselves.

With regard to the assertions and opinions of my respected colleague, Prof. A. V. Hill, on the above-mentioned matter, I should like to invite him to visit Germany and as a scientific investigator to get acquainted with the actual facts by means of his own observation and collection of evidence.

J. Stark
(President).

Physikalisch-Technische Reichanstalt,
Berlin.

Ancient Houses of North Rona

In a short notice of a book on Ronay[1], the reviewer refers to the curious remains of dwelling houses on North Rona and likens them (from the description) to the dolmen of Locmariaquer and Carnac. In the latter part of October 1928, in the course of making a census of the grey seals of Scotland during the breeding season, on behalf of the Scottish Office, W. L. Calderwood and I landed on this island, seldom visited by naturalists or archæologists. The salient characteristics of the houses, which seem to have been inhabited in recent historic times, are that they are half-sunk in the ground, have a low wall of dry-stone construction rising above the surface, which probably carried a wooden roof made water-tight by turves, and were entered not directly, but through a low and generally curved, roofed passage, along which the entrant had to crawl.

So far as I know, no suggestion has been made, other than the reviewer's, as to the origin of such a construction, and I write to direct attention to the

possibility that they may indicate Eskimo influence or perhaps even a former Eskimo habitation of the island. During excavations which revealed ancient Eskimo culture on the long-since deserted island of Punuk, off St. Lawrence in north-western Alaska, Henry B. Collins, of the U.S. National Museum, discovered ruined houses of the historic period which bear close resemblance to the houses of North Rona. There is the same subterranean construction, low walls, carrying a low roof, and an entrance by way of a long narrow tunnel. The chief difference is in the building material, for the Punuk houses are constructed of a framework of driftwood logs and the bones of whales, apparently jaw bones and ribs[2].

There is no reason why North Rona, lying forty miles north of the Scottish mainland, might not at some early period have been colonised by Eskimos. But there is the other possibility that the peculiar conditions of exposed, wind-swept islands, lacking protective vegetation, may have led to the independent development of this curious type of hut in these distant places. Something of the same kind has been revealed in the excavations supervised by Prof. Gordon Childe at Skara-brae in the Orkney Isles.

JAMES RITCHIE.

Natural History Department,
University of Aberdeen.

[1] NATURE, **133**, 399, March 17, 1934.
[2] Explorations and Field-work of the Smithsonian Institution in 1928, Washington 1929, p. 148.

Chromosome Differences in Mice Susceptible and Resistant to Cancer

COUNTS of chiasma frequency made at early, mid and late diaphase of spermatogenesis have revealed a significant difference between two strains of mice, one highly susceptible to spontaneous development of mammary carcinoma, the other highly resistant. The strains are respectively *A* and *CBA* obtained from Dr. C. C. Little, Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Maine.

The mean number of chiasmata per cell is 28·44 in strain *A*, and 33·12 in strain *CBA*. The difference between them is 4·68 (with a standard error of 0·707); the necessary difference for $P=0{\cdot}01$ is only 1·909 (Fisher, "Statistical Methods for Research Workers", 3rd ed.). The test for significance of the difference in distribution gave $\chi^2=54{\cdot}93$, as shown in the accompanying table; the requirement for $P=0{\cdot}01$ is only 11·341.

	Number of bivalents				
Number of chiasmata per bivalent	1	2	3	4	Total bivalents
Strain *A* (susceptible)	304	181	15	0	500
Strain *CBA* (resistant)	247	185	61	7	500
Total bivalents	551	366	76	7	1,000
χ^2/m	13·15	0·09	34·69	7·00	χ^2 = 54·93

The data have been obtained from two distinct studies in which different fixatives and slightly different methods of staining were used. Twenty-eight complete nuclei were analysed in the first test and twenty-two in the second. In each case these comprised equal numbers of nuclei at the same stages of meiosis from each strain. They were from seven mice of comparable ages. The results from the two studies were in complete agreement.

These observations were made as a first test of a series of simple related working hypotheses on the mechanism of heritable susceptibility to cancer. The hypotheses are based primarily on the somatic cell mutation theory of cancer, and the discovery of genes and chromosome deficiencies affecting the mechanism of mitosis or meiosis[1]. This first test of chiasma frequency is, of course, entirely indirect in its possible application to the cancer problem; it hinges on the relationship of meiosis to mitosis[2]. Though indirect, the chiasma frequency test is, on the hypotheses formulated, of particular value since it provides a relatively precise *quantitative* measure of differences between sets of chromosomes; other tests are in progress. Until they are completed anp other strains of mice tested for chiasma frequency, it would be premature to discuss the possible significance of these data for the cancer problem. They are in striking accord with expectation on the basis of the particular hypothesis they were designed to test, but the possibility of an unknown factor other than cancer susceptibility being involved has not yet been eliminated.

Apart altogether from the cancer problem, the results obviously have general cytogenetic significance.

C. LEONARD HUSKINS.
E. MARIE HEARNE.

McGill University, Montreal.
March 3.

[1] Huskins, C. L., and Hearne, E. M., *J. Roy. Micro. Soc.*, **53**, 109 1933.
[2] Huskins, C. L., NATURE, **132**, 62, July 8, 1933.

International Status and Obligations of Science

IN NATURE of February 24 were published letters from Prof. Stark and myself referring to dismissed German scholars and scientists. I could not neglect the opportunity of saying that the Academic Assistance Council (Burlington House, W.1) urgently needs funds. Whether it was Prof. Stark's eloquence or mine I am not sure (perhaps a little of each), but an unknown friend in America has written me referring to this correspondence and enclosing five cheques from members of his family to the amount of 230 dollars, "to be used for furthering this assistance". He hopes to send "a little more".

His generous action will provide for one of our colleagues for several months, but—will Prof. Stark allow me to say ?—many still need help, and there is next year and the year after before a limit to the problem can be seen: and who can tell what may happen elsewhere ? This gift represents 0·2 per cent of what is still required for the next two years. Will other readers of NATURE help with the remainder ?

A. V. HILL.

University College,
Gower Street,
London, W.C.1.
March 23.

Research Items

Bronze Age Cephalotaphy in Wiltshire. Mr. J. F. S. Stone records in *Man* for March the discovery of a separate burial of a skull in the course of excavations of Beaker Folk dwelling-pits surrounding the cluster of flint-mine shafts on Easton Downs, Wilts. Authenticated instances of the ancient burial rite of cephalotaphy are rare in England. The barrow in which the discovery was made is small and low, being 23 ft. in diameter and 2 ft. high. The body of the barrow was composed entirely of chalk rubble which had been extracted from the surrounding ditch. The ditch was square in section, 2 ft. 3 in. wide and cut in the chalk to a depth of 16 in. A shell-filled band of humus containing numbers of well-patinated flints to a depth of 8 inches overlay the primary chalk silting. Very slightly north of central was found a comparatively large stone cist, 5 ft. 6 in. long, by 3 ft. 2 in. wide, cut into the chalk twelve inches below the original surface. The total depth was 3 ft. 8 in. In the south-west corner was an almost perfect skull, twelve inches from the west wall and seven from the south. It lay on the left parietal and faced south, the skull base, therefore, being toward the west wall and thus precluding the possibility of any body having been attached to it at the time of burial. The skull had been pillowed on six inches of chalk dust. The atlas and axis were articulated in their normal position; but the lower jaw had been moved by rabbits to a distance two feet away. The vertebræ fell away on the skull being removed, proving that it had not been moved since the flesh rotted away. Propped against the vault of the skull, and erect on its broader end, was a roughly chipped bar of flint 9½ in. long, 3½ in. wide at the broader end, and averaging 2 in. thick. No dateable object was found, but various considerations suggest the Early Bronze Age. Miss M. L. Tildesley reports on the skull, her conclusion being "Early Bronze Age very probable; La Tène or Romano-British possible; Anglo-Saxon improbable".

Clan and Moiety. Mr. Ronald L. Olson has made a study of the derivation of social organisations among the American Indians, which is published under the title "Clan and Moiety in Native America" (*Univ. California Pub. Amer. Archæol. and Ethnol.*, vol. 33, No. 4). Except among the Eskimo and in Patagonia, clans and moieties are found in every culture area in the two Americas. In all these, except on the north-west coast and in the California Great Basin, both maternal and paternal descent occur, while the dual grouping and the multiple type are also found, sometimes singly, sometimes co-existing. Probably three fourths of the area of the Americas was occupied by tribes organised into unilateral social groups. It is believed that a sufficient number of extrinsic, arbitrary factors are shown to underlie these institutions in their several areas to support the view of the unitary origin of native American unilateral groupings, contrary to the current opinion of American anthropologists, who hold that they represent from two to upwards of six independent growths. If the hypothesis of the unity of origin of all the unilateral institutions of native America be accepted, their widespread distribution points to a very respectable antiquity. The clan organisation bulks large in every area from which we have data, except in the southern part of the North Pacific coast. Unilateral institutions may be assigned to the 'archaic' period of American culture along with shamanism, crisis ceremonies, and so on, while the derivation of American clans from the Old World as a concomitant of the migrations makes it unnecessary to posit their special creation in the New World. The Old World distribution of unilateral institutions falls into line, being practically universal in Siberia, except among some of the Palæo-Siberians. There is the strongest evidence for them in Old China and for their antiquity over the greater part of the Old World.

Maximum Yield of Ceylon Pearl Oysters. In the September number of the *Ceylon Journal of Science* (Section C. Fisheries. Vol. 4. 1933) there are two very interesting papers connected with pearl oysters, "The Maximum Pearl-Yield of a Pearl Oyster Bed" by Joseph Pearson, and "Further Observations on the Age and Growth-rate of the Ceylon Pearl Oyster, *Margaritifera vulgaris*, with Special Reference to Oysters of Donnan's Muttuvarattu Paar" by A. H. Malpas. The first discusses the theoretical aspects of the problem of deciding the optimum for fishing a mixed bed of pearl oysters. In the second, some practical aspects of the same problem are indicated and an account is given of the different phases in the life-history of a bed of oysters on one important paar. Dr. Pearson deals with his subject on mathematical principles, basing his work on the two main considerations affecting the problem: (1) that the normal rate of mortality of an oyster bed is very high, and (2) that the pearl-yield of the oyster increases with age. Oysters older than 5 years are very rare, and the best age for fishing is probably between 3½ and 4 years. Having due regard for the age-limit of the oyster, the longer the fishery is postponed the fewer the oysters but the greater the average pearl yield. The question is how to strike the balance and find the time when the bed may be expected to attain its greatest value. At present, purely practical methods are used for estimating the numbers and computing the approximate pearl-value of a bed, but the author suggests that a valuable research could be followed in the immediate future on the lines laid down in his paper for determining the optimum of a bed of mixed oysters.

Plankton in the Java Sea. Dr. H. C. Delsman in his paper "Over het Productievermogen der Tropische Zeeën" (Delsman en Hardenberg. De Indische Zeevisschen en Zeevischereij ter perse bij. Visser and Co., Batavia C. 1933) deals with quantitative plankton investigations in the Java Sea and phosphate determinations. As was to be expected in a shallow tropical sea, he finds much less plankton in these regions than in the North Sea, where he has made similar observations at the *Haaks* Lightship. The phytoplankton is restricted to a relatively narrow belt along the coast, the life farther out being predominantly animal. In Sunda Strait, which has strong tidal currents, there was much more plankton, especially on and near the border of the continental flat. Copepods were more than five times as numerous as in the Java Sea. Five large species of copepods are predominant in the plankton—*Euchaeta concinna*, *Undinula* (*Calanus*) *vulgaris* forma *minor*, *Eucalanus subcrassus*, *Candacea bradyi* and *Labidocera acuta*, the largest being *Undinula*. There are also many smaller

species. The diatoms are mostly well-known and widely distributed species which occur also in northern seas. The copepods are very important as they are the chief fish food. It is interesting to find that the structure of the gill rakers is finer in those plankton-eating fishes which feed on the fine coastal plankton than in those which feed on the larger plankton farther out.

Deposition of Fat in the Animal Body. The mechanism of the penetration of fat into the cells of adipose tissue during fattening and its issue from the cells during fasting is a physiological problem which, despite much investigation, still remains unsolved. In a paper published in the *Memoirs of the Royal Italian Academy*, 4, 1933, Dr. Gaetano Quagliariello summarises the present state of knowledge of this question and gives a brief account of his own experiments. His results indicate the existence, in the cells of adipose tissue, of a lipase capable of attacking glycerides of the higher fatty acids and of an enzyme which is able to dehydrogenate the higher fatty acids but not their esters. It was found, moreover, that lipolysis and also oxidation phenomena which must be, at least partly, dehydrogenating in character, are detectable in adipose tissue detached from the organism. In experiments on dogs it was observed that, during fasting, the degree of unsaturation of the fatty acids, both of the adipose tissue and of the blood, underwent appreciable increase. On these data is based the hypothesis that, prior to its mobilisation, fat is hydrolysed and the resulting fatty acids are rendered sufficiently unsaturated to make them diffusible. It is considered probable also that, under normal conditions of nutrition at any rate, penetration of fat into adipose cells is effected by a similar mechanism.

Action of Growth Substance in Plants. It has long been recognised that the terminal bud of a stem inhibits the development of lateral buds, causing them to remain dormant, but the mechanism of this action has not been understood. Messrs. Thimann and Skoog (*Proc. Roy. Soc.*, B, 114, 317) put forward an interesting hypothesis based on numerous experiments with young plants of *Vicia Faba*. The work of Went and others has shown that the coleoptile of *Avena* produces a growth substance (auxin). The present authors conclude that the same substance, diffusing from the terminal bud, acts as an inhibitor of growth in the buds below. By placing the terminal bud on a small block of agar into which the auxin diffused, and then placing the agar block on an *Avena* coleoptile, they were able to get a measure of the amount of growth substance produced by the terminal bud. It was also found that the lateral buds produce no auxin while dormant, but begin to produce it when their growth begins. The growth substance was also produced by the leaves, especially when young. Application of growth substance to a decapitated stem similarly suppresses the development of the lateral buds in accordance with the amount applied. It was further shown that the growth substance causes elongation of the stem, both in intact plants and in isolated portions of stem, the stimulus being to cell elongation and not to cell division. The amount necessary to produce elongation is much less than that required for bud inhibition. The stem was found to show a greater response to auxin in the dark, but the production of this substance takes place only in the light. It thus appears that the same substance which promotes cell elongation in the stem inhibits the development of lateral buds.

Leaf Stripe of Oats. A severe disease of oats known as leaf stripe is caused by the fungus *Helminthosporium avenæ*. It can be controlled readily by means of disinfectant dusts applied to the grain, but several new facts about the life-history of the fungus are published in a recent paper ("Studies in the Morphology and Biology of *Helminthosporium avenæ*", by R. W. G. Dennis, *Trans. Brit. Mycol. Soc.*, 18, part 3, 223–237, Dec. 1933). Primary symptoms occur on the seedlings, the coleoptile being infected from spores on the grain each year. Then spores are produced, which infect the more mature parts of the plant, giving secondary symptoms. The fungus produces sclerotia and spores within pycnidia, and grows best at a temperature of 20° C. Secondary infection is largely dependent on a high relative humidity in the crop. The paper under review is the result of fifteen years' investigation of the causal fungus.

Propagation of Plum Rootstocks. The necessity for the vegetative propagation of rootstocks for fruit trees is now generally realised, and has stimulated the investigation of various methods of multiplication. Layering and stem cuttings are used in Great Britain, though on the Continent root cuttings are employed to some extent. A great deal of information is given in a recent paper by Messrs. T. N. Hoblyn and R. C. Palmer (*J. Pom. and Hort. Sci.*, 12, No. 1, March 1934). The variety Pershore Egg proved entirely unsuitable for propagation by root cuttings, whilst the Common Mussel plum rooted with ease. October, December, January and February seem to be good months for the preparation and planting of cuttings, which are recommended to be 9 in. long, and not less than ¼ in. in diameter. The yield of cuttings from even a 3-year old tree is low, and the method would seem to be applicable commercially only when roots can be trimmed from general nursery stock. Great interest is attached to the method of experiment, which departs from the usual plan of controlling the variables, and combines them in a complete variety of ways, thus giving combinations some of which are successful.

Sodium Chlorate as a Weed-Killer. Dr. M. A. H. Tincker has prepared a useful digest of our present knowledge of sodium chlorate as a weed-killer ("Tests of Sodium Chlorate as a Garden Weed Killer", *J. Roy. Hort. Soc.*, 59, 107, Feb. 1934). The paper begins with an account of experiments conducted at the Society's gardens at Wisley on the destructive action of sodium chlorate on various weeds. It is shown that it is quite effective, and it ceases to have any action after about seven months from the time of application. There are thus no harmful after-effects as with arsenical weed-killers. From other literature, it appears that a 10 per cent solution (1 lb. per gallon of water) is required for the eradication of large grasses and docks, a 5 per cent solution for herbaceous weeds and small grasses, whilst small annual weeds are destroyed by a 2½ per cent solution. The liquid is applied at the rate of 1 gallon per 10 square yards. Dry sodium chlorate must be handled with care, but the chances of any grazing animal taking a harmful dose seem very remote. Costs of treatment are low, and one may imagine a time when a dressing of sodium chlorate may replace the exorbitant incubus of a bare summer fallow.

Temperature of the Atmosphere in Northern India. In *Gerlands Beiträge zur Geophysik*, **39**, 121, 1933, there is a paper by Barkat Ali of the Meteorological Office, Poona, entitled "High Lapse Rates of Temperature and their Diurnal Variation in the Surface Layers of the Atmosphere over Northern India". The observations were made at Agra (lat. 27° N.) in March 1925 with sounding balloons carrying a temperature-recording apparatus of greater sensitivity than those usually used in work with sounding balloons, and protected from solar radiation by a polished aluminium shield. They showed a surprisingly rapid decrease in the amplitude of the diurnal variation of temperature with height, the change being from an average of about 25° C. near the surface to about 2° C. between heights of 300 and 400 metres above the surface. The relationship between the amplitude of the diurnal range and the height was such as to suggest that the amplitude would probably be negligible at a height of 1,000 metres at Agra. The lapse rate of temperature was generally greater than the dry adiabatic rate (9·9° C. per 1,000 metres) near the surface during the middle of the day and at times even exceeded the lapse rate corresponding with a constant air density in the vertical (34·2° C. per 1,000 metres). These inversions of temperature generally extended to a height of 300 or 400 metres, and occasionally temperature was 16° C. higher at the top of the inversion than 1·2 metres above the ground, though generally the difference was between 4° C. and 6° C.

Secondary γ-Rays of Nuclear Origin. Gray and Tarrant, Chao, and other workers have found a secondary γ-radiation when several elements are exposed to the penetrating γ-rays from thorium C″. Gray and Tarrant have now examined this radiation in more detail (*Proc. Roy. Soc.*, A, Feb.). The absorption curve of the radiation in lead has been very carefully determined, using alternative primary sources of radium C and thorium C. All the elements studied give a soft secondary radiation of quantum energy about $0{\cdot}5 \times 10^6$ volts when irradiated by thorium C″. With lead (and to a lesser extent with elements of lower atomic number), a harder radiation of energy about $1{\cdot}1 \times 10^6$ volts is also emitted. When radium C rays were used, a similar phenomenon was observed, but the soft radiation had an energy which the authors think is significantly less than $0{\cdot}5 \times 10^6$ volts. This is extremely puzzling, since this difference seems to exclude the possibility that the radiation is a characteristic radiation of the secondary emitter and that the primary radiation serves simply to excite it. Special experiments with a Wilson chamber and with a hydrogen-filled ionisation chamber showed that the radiation was really γ-rays and not a neutron emission. The emission seems to be isotropic and to correspond with the whole of the 'anomalous' nuclear absorption of γ-rays. The authors examine the question of the relation of the radiation to the production and annihilation of positive electrons—an explanation on these lines is very attractive for the thorium rays but seems to leave the phenomena with radium rays unexplained.

A New Diode for Electronic Oscillations. Reference was made in a letter to Nature of May 13, 1933, p. 691, to the construction of a novel and simple type of two-electrode valve for the generation of very high-frequency electronic oscillators. The same contributor, Mr. J. S. McPetrie, has now published in the *Wireless Engineer* of March 1934 further details of this diode and some experiments carried out with it at the National Physical Laboratory. The valve differs from the conventional type in that the central electrode is the anode, consisting of a tungsten rod 1 mm. in diameter, around which as axis four tungsten filaments are arranged on a ring 12·5 mm. in diameter. When these filaments are heated and the anode potential is raised to about 360 volts, oscillations are obtained either in an aerial connected to the anode or in a Lecher wire system suitably connected between anode and filament. These oscillations are presumed to arise from the periodic motion of the electrons past the anode, along diameters of the cylindrical cathode which the four filaments virtually comprise. The wave-length of the oscillations under the above conditions was about 1·5 metres and was mainly dependent upon the adjustments of the external circuit. With an anode potential of 600 volts, the wave-length could be varied from 0·94 metre to 1·2 metres by adjusting the length of the circuit. The intensity of the oscillations obtained passes through a maximum value as the filament current is varied; but their production was shown to be independent of the application of an external electrostatic or magnetic field to the valve.

Action of Papain on Ovalbumin. Svedberg and Eriksson (*J. Amer. Chem. Soc.*, **56**, 409; 1934) have made a number of determinations by the ultra-centrifuge method of the sedimentation constant and molecular weight of products obtained by digesting pure crystalline ovalbumin with activated and unactivated papain at 40°. Attempts were made to separate the products by fractional dialysis and fractional precipitation with ammonium sulphate, the fractions being ultra-centrifuged. Unactivated papain produced no influence on the sedimentation constant of ovalbumin and no non-centrifugible products were formed. Activated papain gave rise to three kinds of disintegration products. One was a non-centrifugible substance which probably contained lower polypeptides and aminoacids. The second was a centrifugible substance of a sedimentation constant of about $0{\cdot}6 \times 10^{-13}$, which with regard to molecular weight is of the same order as the protomines. The third product had the same molecular weight as ovalbumin, with a sedimentation constant of $2{\cdot}7 \times 10^{-13}$, and was probably formed by the loosening of some of the bonds within the ovalbumin molecule, thus causing it to assume a highly dissymmetrical shape. This may represent the first step towards the breaking up of the molecule into individual parts. The third substance was found to be practically homogeneous with regard to molecular weight. Papain has its maximum activity within the stability range near the isoelectric point of the protein.

Superheated Water. Mr. J. Small, of the James Watt Engineering Laboratories, University of Glasgow, has sent us an account of an experiment in which a drop of de-aerated water was heated in a glass tube of 1/16 in. bore open at one end. The temperature of the oil bath in which the tube was heated was taken to 304° F. before the drop was explosively expelled. The degree of superheat was 90° F., whilst previous experimenters, it is stated, attained only 16° F. of superheat.

Conservation of Tropical Forests

THREE articles which have appeared in the *Empire Forestry Journal* (vol. 12, No. 1, 1933) display the difficulties which exist in conserving and putting to their fullest utilisation the tropical forests of the Empire. To take the second case first, Sir Ralph Pearson, formerly director of the Forest Products Laboratory at Princes Risborough, discusses the problem of creating and developing markets for Empire hardwood timbers at home.

Sir Ralph briefly reviews the reasons why well-known timbers have not found favour amongst markets in Great Britain, ascribing some of the causes to the fact that the consignments sent over were often not carefully chosen; nor, with the facilities available in the forests, was there much chance of their being so chosen when the short-handed and over-worked forest officer was himself responsible for their dispatch. Sir Ralph deprecates trying to push too many new timbers upon the markets at the same time, and points out the way in which chosen timbers should be forwarded and tested.

A second article, by Mr. J. B. Clements, conservator of forests in Nyasaland, treats of the cultivation of finger millet (*Eleusine coracana*) and its relation to shifting cultivation in Nyasaland. This article, and the practice dealt with, is typical of one of the chief sources of the disappearance of valuable forests in tropical countries, the difficulties facing the administration, not always convinced of the increasing injury supervening, in weaning the people from so wasteful a form of primitive agriculture; and finally, of the troubles of a forestry department well aware of the evils resulting from the practice.

"It is therefore clear that shifting cultivation in Nyasaland is accelerated to a very considerable extent by the growing of *Eleusine coracana* under prevalent methods. Compared with the growing of other crops, the requisites of the millet make extravagant demands as regards the use of land, and systematic burning of the top soil combined with flat cultivation when carried out on any large scale leads to widespread loss and impoverishment of the soil, particularly in hilly country. Rapid deforestation inevitably takes place in any wooded country where the millet is grown, as conditions are there ideal for providing both new soil for each crop and fuel for heating the soil."

The third article, by N. V. Brasnett, conservator of forests, Uganda, discusses the formation of State forests, and forest rights and privileges of local inhabitants in Uganda. After briefly reviewing the position of the colony from the day, in 1890, when Capt. (now Lord) Lugard signed a treaty on behalf of the British East Africa Co. with the King of Buganda, the declaration of the British protectorate in 1894, and Sir Harry Johnston's arrival in 1899 and subsequent organisation of the administration of the country, the author concentrates upon the various arrangements, regulations and ordinances for the management of the forest areas of the country.

It is impossible to deal with the varying policies to which succeeding administrations subjected the forests after the first and promising lines were laid down. But a perusal furnishes evidence that one of the past flaws in colonial administration has been the refusal or inability of those responsible for the future welfare of their charges to lay down a definite forest policy, based on wide views, and to adhere to it.

Mr. Brasnett ends his summary of the present position of the forests in Uganda with the sentence: "When formation is completed it is estimated that the State forests of Uganda will constitute just about 2% of the total land area of the Protectorate, and the total forest area, including private woodlands and the valuable savannah, just over 3%, so that it is obviously essential to preserve the whole of this small percentage." Many conversant with the tropical forest and the importance it plays in countries where it exists would consider the percentage dangerously low.

Band Spectrum of PN and its Significance

OF the diatomic emitters of band spectra, few have been more extensively studied than the 14-electron molecules N_2 and CO, which are responsible for many observed band systems and, unlike most emitters, are well known as stable molecules rather than as intermediate products in chemical reactions or equilibrium products at high temperatures. Emitters which are chemically or spectroscopically analogous to these two have, as would be expected, also received considerable attention, the best known examples being the 30-electron molecule P_2 and the 22-electron molecules SiO and CS.

To the latter category the PN molecule becomes an interesting addition as the result of the recent discovery and analysis, by J. Curry, L. Herzberg and G. Herzberg[1], of an ultra-violet band system which is produced by an electrical discharge through a mixture of phosphorus vapour and pure nitrogen. With a heavy discharge (about 6000 v. and $\frac{1}{3}$ amp.) in a water-cooled tube, this PN system has been photographed in the first and second orders of a 3-m. grating, and both the vibrational and rotational structures analysed.

The new bands extend from λ2375 to λ2992, are degraded towards the red and have a fine structure characteristic of the electronic transition designated as $^1\Pi \rightarrow {}^1\Sigma$. The system is therefore similar to those of the iso-electronic molecules CS and SiO in the same spectral region and to the well-known fourth position system of CO and the Lyman system of N_2.[2] The P_2 ultra-violet system is not analogous to these as it is due to a $^1\Sigma \rightarrow {}^1\Sigma$ transition[3]; other and less refrangible P_2 bands are known, some of which may, when analysed, prove to belong to the expected $^1\Pi \rightarrow {}^1\Sigma$ system.

From the accompanying table of the more important numerical constants for the electronic states concerned, it is clear that the three 22-electron molecules are similar to one another and intermediate to the 14-electron and the 30-electron molecules in respect of the vibrational coefficients ω_e and $x_e\omega_e$, the rotational coefficient B_0 and the equilibrium inter-

nuclear distance r_e. With CO, N_2, SiO and P_2, the band systems under discussion have been observed in absorption as well as in emission, and the lower ($^1\Sigma$) states are therefore stable ground states. The same is expected, though not yet observed, to be true of CS and PN; that is to say, each of these should be capable of existence as gaseous substances in the absence of an electric discharge; J. Curry and L. and G. Herzberg are further investigating the PN system from this point of view.

Molecule	$^1\Pi \rightarrow {}^1\Sigma$ ν_0 (0, 0) cm.$^{-1}$	Upper State, $^1\Pi$				Lower State, $^1\Sigma$			
		ω_e cm.$^{-1}$	$x_e\omega_e$ cm.$^{-1}$	B_0 cm.$^{-1}$	r_e A.U.	ω_e cm.$^{-1}$	$x_e\omega_e$ cm.$^{-1}$	B_0 cm.$^{-1}$	r_e A.U.
(14) CO	64765	1516·7	17·24	1·600	1·232	2167·4	12·70	1·85	(1·15)
(14) N_2	68962·7	1692·28	13·318	(1·52)	(1·26)	2359·60	14·445	1·992	1·094
(22) SiO	42690·0	851·51	6·143	0·6270	1·62	1242·03	6·047	0·7238	1·51
(22) CS	38796·3	1072·2	10·05	0·74	1·61	1282·5	6·00	0·79	1·56
(22) PN	39688·5	1103·09	7·222	0·7274	1·542	1337·24	6·983	0·7834	1·487
(30) P_2						780·43	2·812	0·3133	1·856

The heat of dissociation of the $^1\Sigma$ state of PN is estimated as 7·8 volts from a Birge-Sponer linear extrapolation of vibrational energies, and as 6·3 volts from a consideration of probable products of dissociation. It is thus somewhat less than that of N_2 (recently given as about 7·9 volts[4] rather than the hitherto accepted value of about 9·0 volts[2]) and greater than that of P_2 (5·0 volts[3]). Similarly the heats of dissociation of CS and SiO (each roughly 8 volts) are less than that of CO (about 10 volts).

The molecules discussed here are all composed of nitrogen, phosphorus and their immediate neighbours in the periodic table. From the atoms preceding and following these we have other 22-electron molecules about which, however, nothing can yet be stated, namely BCl (bands observed in the same spectral region but not systematised[5]) and AlF (expected band system not yet recorded).

W. Jevons.

[1] *J. Chem. Phys.*, **1**, 749; 1933 (preliminary report). *Z. Phys.*, **86**, 348; 1933.

[2] Particulars of these band-systems and of the notation used in the PN paper and in the present article are given in the writer's "Report on Band Spectra of Diatomic Molecules" (*Phys. Soc.*, 1932). The more recent analysis of SiO bands is by Saper (*Phys. Rev.*, **42**, 498; 1932) and that of CS bands is by Crawford and Shurcliff (*Phys. Rev.*, **43**, 766; 1933).

[3] G. Herzberg, *Ann. Phys.*, **15**, 677; 1932.

[4] Lozier, *Phys. Rev.*, **44**, 575; 1933.

[5] Lochte-Holtgreven and van der Vleugel, *Z. Phys.*, **70**, 188; 1931.

Biology of Heavy Water

In *Science* of February 16, 1934, Prof. Gilbert N. Lewis summarises the results of certain sporadic attempts to observe the effect of water containing heavy hydrogen, H^2, upon living organisms. Experiments have necessarily been confined to small organisms, though some preliminary observations on mice are included. The first experiments were upon tobacco seeds, the germination of which was completely retarded by pure H_2^2O and slowed up some 50 per cent by water containing 50 per cent H_2^2O. Seeds transferred to normal water after three weeks in pure H_2^2O sprouted in about half the cases but gave unhealthy seedlings. Yeast cultures in an appropriate nutrient medium dissolved in pure heavy water failed to grow, and Pacsu has also shown that the evolution of carbon dioxide by yeast from sugar solution made up with heavy water is much diminished.

In an experiment that was expensive if preparatory in nature, a mouse was supplied in three doses with some 0·66 gm. of pure H_2^2O. The mouse survived, though during the experiment it showed "marked signs of intoxication". The symptoms of distress seemed more marked after each dose but not cumulative, which led Prof. Lewis to conclude that the heavy water was being voided, but no preparation had been made to test this point. Prof. Lewis concludes that H^2 is not toxic in any high degree but that its complete substitution for H^1 leads probably to a complete inhibition of growth, an effect which is to be traced to "the greatly reduced rate of all physico-chemical processes when H^2 is substituted for H^1."

Mr. S. L. Meyer of the Vanderbilt University Biology Department describes in *Science* of March 2 culture experiments with a blue mould, in which those grown on media made up with one out of every 214 hydrogen atoms H^2 gave sixteen times the yield of fungus as those grown on control solutions free from H^2.

The late Dr. Edward W. Washburn and Dr. Edgar R. Smith have been carrying on experiments at the Bureau of Standards at Washington in which they have studied the proportion of H^2 atoms present in the tissues after plants have grown in normal soil solutions. So far as could be judged, rooted willow cuttings absorbed H^1 and H^2 in the proportions in which they were present in the original water supply, but apparently the heavy hydrogen was selectively accumulated in the tissues as the expressed sap contained water 2·8 parts per million heavier than normal water, whilst the water obtained from the destructive distillation of the willows was 5·4 parts per million heavier than the normal supply. Dr. Washburn died suddenly on February 6; his report with Dr. Smith has been published since, in *Science* of February 23.

Universe and Atom

The issue of *Die Naturwissenschaften* of March 9 contains the address on this subject which Prof. Wehl of Göttingen gave at the opening of the holiday course on mathematical sciences given at Göttingen in July 1933. His object was to put before his audience only such conclusions as are at the present time reasonably certain and to avoid any fantastic speculations.

By representing space in the space time continuum as the abscissa and time as the ordinate of a point on a curved surface, Prof. Wehl shows how the Einstein continuum with its mass distribution is represented by a cylindrical surface with its axis vertical and its radius determined by the density of distribution of mass. Stars at rest are represented by generating lines and the movement of light

through the universe by spirals the pitch of which is equal to the time the light takes to go round the universe. The stars are thus represented at different epochs separated by æons.

De Sitter's massless continuum is, on the other hand, represented by a hyperboloid of one sheet with its time axis vertical, and lines of shortest length now represent the stars while the movement of light through the universe is represented by a straight line generator in which a tangent plane to the asymptotic cone cuts the surface. As this cannot intersect a geodesic a second time, there is no repetition of the representation, and as the geodesics themselves change their distances apart as they travel over the surface, the universe must be either expanding or contracting.

Neither the gravitational universe of Einstein nor the non-gravitational one of De Sitter corresponds sufficiently closely with the facts, but the later one of Friedman and Lemaître, according to which space is spherically bounded and the boundary expands with time, is much more satisfactory. The radius of space is about 10^{27} cm. and the total mass it contains is about 10^{27} that of the earth, possibly due to 10^{80} particles.

In the atom the electrical forces between its constituents are about 10^{40} times the gravitational, a ratio which may have some connexion with the square root of the number of particles in the universe. The wave-length associated in wave mechanics with the electron, when multiplied by the constant known as the fine structure constant (1/137), gives the radius of the electron and when divided by it the radius of the atom. The product of the wave-length of the electron wave by the square root of the number of particles gives the radius of the universe and when divided by it the gravitational radius of the electron.

Although in this theory the appearance of the square root of the number of particles in the universe can be understood, there still remains considerable obscurity with regard to the wave-length of the electron wave and the fine structure constant.

Science News a Century Ago

John Phillips at King's College

When Lyell in 1833 resigned the chair of geology at King's College, London, he was succeeded by John Phillips (1800–74), the nephew of William Smith. Phillips began his courses of lectures on April 21, 1834. The science of geology, he said, was of but recent growth and it was necessary that students should be cautious as to the reception of theories; many of the theories which had been introduced were the results of imagination rather than the deduction of actual observation. Nothing was to be received as truth but what was warranted by actual observation and diligent research. If the science were pursued with strict attention to these preliminary principles, the benefits which would arise to those who pursued it would be commensurate with their desire of truth. In the course of his remarks, he described the primary, secondary and tertiary deposits and explained the position of the various strata of rock. He directed attention to the incontrovertible fact that in the various strata fossils had been discovered including many thousands of species of animals and vegetables which were no longer found in the animal and vegetable kingdoms by which the surface of the earth was covered, and deduced from this fact that it was obvious that the system of Nature had in the revolution of ages undergone many changes. He reminded the students of the high eminence to which their fellow countrymen had exalted the science and begged them to remember that the philosophers of the Continent had their eyes upon their proceedings and success.

Honours for Men of Science

Shortly after the first meeting of the British Association, William IV conferred the Guelphic order of knighthood upon David Brewster, Charles Bell, John Leslie, John Herschel and other men of science. In the spring of 1834, the subject of honorary distinctions for eminent scientific persons was discussed in the House of Commons, the discussion leading "Vindex" on April 22, 1834, to address a letter to the editor of the *Times* mentioning one or two points which he considered had been overlooked. In the first place, he said, the Guelphic order of Hanover, the only one conferred so far, was one of the lowest on the Continent. The title of knight could not be assumed until the recipient had been to court, and as this could not be done under an expense of nearly £200, several persons whom it had been intended should be honoured had been unable to stand this expenditure. Secondly, the order was a 'foreign' one and after the death of King William it could not again be granted and the knighthoods already conferred would lapse. "It surely," said Vindex, "would be more becoming in the Sovereign and more worthy of the nation either to make a new order or enlarge one of the present ones so as to embrace such persons as are distinguished in art or science."

Progress in Lighthouse Illumination

In the *Mechanics Magazine* of April 26, 1834, a correspondent described a visit he had made to the National Gallery in Adelaide Street, London, where an exhibition was being held illustrating the various methods of illumination in use for lighthouses and for geodetical operations. So late as 1811, the writer said, the Eddystone lighthouse was illuminated by wax candles, while in 1812 a coal fire was still in use at the Lizard. By 1834 the general method adopted in British lighthouses included the use of oil-burning Argand lamps in conjunction with parabolic mirrors of silvered-copper. This type of illumination was stated to be due to Mr. Ezekial Walker of Lynn, who had fitted up the Hunston light on the Norfolk coast in 1778. Many kinds of vegetable and animal oils had been tried with Argand lamps, but spermaceti had been found to be the most suitable. Coal gas had been tried in some foreign lighthouses, that at Dantzig having been lit by gas in 1819.

After referring to the introduction by Arago and Fresnel of the plano-convex lens in French lighthouses and to the Cordovan lighthouse at the mouth of the Garonne, then the finest in the world, the writer said that, as lenses of more than 15 inches diameter were not easily made, the lens system would not have found the favour it had but for "the discovery of our distinguished countryman Sir David Brewster that by surrounding any lens with a series of glass rings of a particular curve, it might have its effect magnified to any given extent". Other methods of illumination shown included a primitive form of arc light and the hydro-oxygen limelight of Lieut. Drummond, which gave a light "only inferior to the sun itself".

Botanic Garden, Oxford

"It is much to be regretted that the city of Oxford has not a botanic garden suited to the rank which it holds as a British university. Were a small sum contributed by each of the colleges yearly, even the present garden might be rendered doubly efficient: more especially if the adjoining ground at present occupied by Mr. Penson, were added to it, and a part, or the whole of the meadows of Christ Church. But the situation is altogether bad; and, for a botanic garden worthy of Oxford, a dry, open, ample, airy piece of ground should be selected outside of the town; say, somewhere about Jeffery's Nursery. The present botanic garden might still be continued as such, on a smaller scale, so as to suit the income destined for its support. Till lately there has been a great want of botanical taste among the Oxford professors; but hope that a taste for botany, as well as a taste for geology, is now dawning upon them; and, whenever it does, they will soon produce a botanic garden worthy of themselves. After a botanic garden is established, a zoological garden will follow; and, perhaps, ultimately, a public ornamental garden surrounding the whole city as a breathing zone." (J. C. Loudon, *Gardener's Magazine*, April, 1834.)

Societies and Academies

London

Physical Society, March 2. A. O. Rankine: A simple method of demonstrating the paramagnetism and diamagnetism of substances in magnetic fields of low intensity (see Nature, 133, 150, Jan. 27, 1934). A. M. Ferasah: Anomalous changes in temperature due to thermionic emission in the filaments of valves. In some valves the steady filament temperature is lower when the anode is positive, as would be expected, but in other valves it is higher. This anomalous increase in temperature is due to radiation from the anode and is larger for valves which have a high anode dissipation and an anode which closely surrounds the filament. After correction for this effect has been applied, the work-function can be approximately calculated from measurements made on an ordinary valve. T. Smith: Change of variables in Laplace's and other second-order differential equations. Transformations of variables are expressed as matrix products, the effect of transposition being particularly considered, and the results are applied to the transformation of the general second-order differential expression. Mary Taylor: The Appleton-Hartree formula and dispersion curves for the propagation of electromagnetic waves through an ionised medium in the presence of an external magnetic field. (2) Curves with collisional friction. Four typical frequencies have been chosen for the calculations, one from each of the classes into which the frequencies fall when collisional friction is absent, as described in part 1. The corresponding wavelengths are 80, 240, 400 and 1,000 metres. The various stages in the effect of increasing collisional friction have been found to be usefully represented by collisional frequencies of 10^5, 10^6, 10^7 c./sec. and curves are given showing the indices of refraction κ_r $(r=a, b)$, and the real part and imaginary part of M_r^2 or $(\mu_r - i\kappa_r c/p)^2$, together with the polarisations of the basic modes as functions of the electronic density for each of the four frequencies and collision frequencies named. The process of evaluation of M_r and of the polarisation is described. The attenuation and absorption are found to be, in general, greater for the right-handed component than for the left-handed component, with the direction of magnetic field appropriate for down-coming waves in the northern hemisphere. The use of the dispersion curves in the interpretation of propagation phenomena is discussed. J. McGarva Bruckshaw: An instrument for electrical prospecting by the inductive method. In the Bieler-Watson method of geophysical surveying, in general, the horizontal field is not in quadrature with the vertical field. An instrument has been designed which will allow the horizontal field to be compared completely with the vertical field, an important feature being that the horizontal components in phase and in quadrature with the vertical field are obtained directly from the instrument readings. The apparatus has been tested on elliptically polarised fields and has given satisfactory results.

Paris

Academy of Sciences, February 26 (*C.R.*, **198**, 777–860). C. Matignon and A. de Passillé. The ammonium arsenates. An account of the preparation of anhydrous triammonium arsenate, of the dissociation of this and the diammonium arsenate. The properties of a new ammonium metarsenate are also described. Marin Molliard and Robert Echevin: The ovarian fluid of rust (*Agrostemma Githago*) and its relations with the seminal tegument. R. de Montessus de Ballore: The determination of the median in the binomial function. Paul Lévy: The generalisation of the differential space of N. Wiener. René Lagrange: A class of congruences of circles. S. K. Zaremba: The course of the integral curves of the equation $Y(x,y)dx - X(x,y)dy = 0$ in the neighbourhood of an isolated singular point. A. Kovanko: The structure of almost periodic generalised functions. Jean Grégoire: Certain shock phenomena produced in differentials. R. Swyngedauw: The friction couple of ball bearings. Loève: The integration of Dirac's equations. Y. Rocard: The quantic absorption of sound in gases. Arcadius Piekara and Bruno Piekara: The thermal hysteresis of the specific inductive capacity and of the conductivity of aqueous solutions of gelatine. J. Thibaud and F. Dupré la Tour: The diffusion and absorption of positive electrons traversing matter. Experiments based on photographic methods, using the Chalenge-Lambert recording microphotometer, lead to the conclusion that positive electrons behave like negative electrons; they undergo multiple diffusions near the charged atomic centres, with progressive deceleration. G. A. Boutry and J. Orcel: Remarks on the comparison of the properties of vacuum (photoelectric) cells with those containing a gaseous atmosphere. Criticism of work on the same subject by L. Capdecomme. Alb. Perrier and Mlle. T. Kousmine: The longitudinal magneto-thermoelectric effects in nickel and iron. The experimental laws. From experiments with an iron-nickel couple it is concluded that, with the magnetisation parallel to the temperature gradient, the thermoelectric power is increased: normal magnetisation, on the contrary, lowers it. O. Miller and J. Lecomte: The infra-red absorption spectra of the stereoisomeric orthodimethyl-cyclohexanes. Since the molecular structure of these two stereoisomers is not the same, different infra-red absorption spectra would be expected, and this is shown by experiment to be the case. The Raman spectra of the

same compounds are also given. A. KASTLER : The amount of polarisation of the fluorescence of mercury vapour in the presence of nitrogen. JEAN GENARD : The magnetic extinction of the fluorescence of the diatomic molecules of tellurium. Repetition of the work of Smoluchowski, utilising the large Bellevue electromagnet, which gives stronger fields. MME. BRANCA-EDMÉE MARQUES : The distribution of the radium in crystals of radiferous barium bromide. EDMOND BANDERET : The formation of Liesegang rings by electrolysis. Utilising the method of producing very clear rings described in an earlier note, Veil's relation, $\sqrt{\delta}=an+b$, where n is the order of ring and δ the distances between the rings, was verified ; a was also found to be inversely proportional to the voltage applied. MLLE. LUCIA DE BROUCKERE : The adsorption of electrolytes by crystalline surfaces. The influence of the sign of the electric charge of the adsorbant. A. MICHEL-LÉVY and H. MURAOUR : The possibility of utilising the microscope in the study of the phenomena of detonation. Results obtained by detonation of lead azide, in quantities of the order of 0·5 mgm., and subsequent examination of the lead deposits under the microscope. P. JOB : The constitution of hydrobromic solutions of salts of copper and cobalt. A. TRAVERS and PIERRE LEDUC : A reaction differentiating various hydrated calcium aluminates. P. BASTIEN : The existence of three allotropic varieties of calcium. Differential thermal analysis, differential thermoelectric power, expansion and hardness all indicate allotropic changes at 260° C. and about 430° C., thus proving the existence of three allotropic varieties of calcium. M. CHÂTELET and MME. P. M. CHÂTELET : Some reactions of divalent chromium acetate. Descriptions of the preparation of dry chromous acetate and its reactions with dry hydrogen chloride, pyridine and ammonia. MAURICE LOURY : An acid alcohol containing the acetylene linkage : phenyl-phenyl ethinylglycollic acid, $C_{16}H_{12}O_3$. MARCEL GODCHOT and MAX MOUSSERON : The resolution of 1.2.trans-cycloheptanediol into its optical antipodes. MME. E. JÉRÉMINE : Some rocks from Kenya Colony. J. CHAZE : The mode of formation of the aleurone grains in the Gramineæ and the production in the latter of oxyflavonic and anthocyanic compounds. RENÉ VANDENDRIES : The haploid and diploid conidian cycle in the Basidiomycetes. R. KÜHNER : The utilisation of cresyl blue in systematic mycology. G. GUITTONNEAU and A. LEROY : Opotherapic feeding in milch cows. The system of feeding suggested by G. Monnot has been tested on a herd of 35 cows with negative results. MLLE. A. DUSSEAU : A new durelloid hybrid strain resulting from the crossing of two *Triticum vulgare*. PIERRE GAVAUDAN : The diffuse vital staining of flagella and the chemical affinities of the cytoplasm and of its various constituents. A. GIROUD, C. P. LEBLOND and M. GIROUX : Vitamin C in the ovary and the yellow body. Results of histological studies based on the reaction of ascorbic acid with silver nitrate. P. PORTIER and MLLE. A. RAFFY : The mechanism of the death of birds the plumage of which is impregnated with hydrocarbons. In the normal state the plumage of birds acts as a screen against losses of heat even in a prolonged dive under water near 0° C. These heat-insulating properties are lost when the feathers are covered with oil and this is the cause of death. MLLE. G. COUSIN : The normal fecundity and characters of the hybrids resulting from crossing two species of grasshoppers, *Achœta campestris* and *A. bimaculata*. G. DELAMARE : Numerical variations of some primary sinusoids of the body of the Spirochetidæ.

MELBOURNE

Royal Society of Victoria, December 14. W. J. HARRIS : The eastern boundary of the Bendigo goldfield. A number of traverses across the eastern portion of the Bendigo goldfield show that the Lower Ordovician rocks (mostly Lancefieldian) near the east of the Bendigo city area, end abruptly and are succeeded farther to the east by beds which are uniformly much younger (Darriwilian). The break in the normal succession has been traced for a distance of about fourteen miles and is attributed to a fault named the Whitelaw fault, which runs almost parallel to the strike of the bed-rock N. 15° W. The presence of the Darriwilian non-auriferous beds accounts for the absence of profitable gold-mining east of the line indicated. F. A. SINGLETON and NELLY HOOPER WOODS : On the occurrence of the pelecypod genus *Miltha* in the Australian Tertiary. The Tertiary pelecypod, *Dosinia grandis*, Hooper Woods, from a boring near Adelaide, South Australia, is redescribed, refigured and transferred to *Miltha* (*Milthoidea*) in the family Lucinidæ. A new subspecies, *flindersensis*, is described and figured from a boring on Flinders Island, Tasmania. B. J. GRIEVE : The isolation of the organism causing crown gall on almond trees in Victoria. The galls have been shown to be related to the presence of bacteria. The causal organism has been isolated in pure culture and has been shown to be identical with *Bacterium tumefaciens*, Sm. and T. R. B. WITHERS and R. A. KEBLE : The Palæozoic star-fishes of Victoria. This contribution comprises the Palæozoic star-fishes of Victoria and nearly all those of Australia ; they are wholly of Silurian age. Ten new species have been described. Several of the genera represented are new to Victoria ; one of the most interesting is *Hudsonaster*, which is regarded as a somewhat primitive type and is only recorded from Ordovician beds elsewhere.

VIENNA

Academy of Sciences, December 7. HERBERT HABERLANDT, BERTA KARLIK and KARL PRZIBRAM : Synthesis of the blue fluorescence of fluorite. Examination of a number of mixtures of fluorite with small proportions of other substances shows that the fluorescence exhibits blue bands only when a rare earth metal, most probably europium, is present. After being heated and exposed to radium radiation, calcium fluoride, either pure or containing 0·1 per cent of cerium, praseodymium, neodymium or samarium, gives no blue bands, which, however, appear when either impure samarium (containing europium) or pure europium is added (see also NATURE, **133**, 99, Jan. 20, 1934). ALEXANDER KÖHLER and HERBERT HABERLANDT : Luminescence of apatite and other phosphates. As with fluorite, so also with many apatites, either in the natural state or after heating, the occurrence of lines in the fluorescence spectrum affords a sensitive means of detecting rare earths. Certain other phosphates may be examined similarly. GEORG STETTER : (1) Process of charging in the ionisation chamber. (2) Choice of the grid resistance for a highly sensitive amplifier. GUSTAV ORTNER and GEORG STETTER : (1) Choice of the coupling element in making an amplifier with low time constant. (2) Experiments on atom-disintegration with radium B+C as source of radiation (1). By

the procedure described, processes of nuclei transformation occurring when RaB+C is used as source of radiation may, in spite of the presence of β- and γ-rays, be recorded electrically with the same reliability as when polonium is used. GEORG KOLLER and ADOLF KLEIN: Saxatilic acid. On the basis of the known chemical behaviour, together with new data, a structural formula for this acid is proposed. KASIMIR GRAFF: (1) Colorimetric and photometric observations on δ-Cephei and η-Aquilæ. The spectral changes of these two stars show also in the visual colour and are readily detectable with a colorimeter. The colour curve of δ-Cephei is very similar to, but not quite synchronous with, the light curve. With η-Aquilæ, however, larger deviations occur. (2) Regularities in the change in colour of stars on the horizon. The excess colour of stars on the horizon, observed in Majorca, is related linearly to the path of the rays in the homogeneous atmosphere. RUDOLF GRILL: Oligocene and miocene in the Gallneukirchen basin east of Linz on the Danube and the neighbouring regions. WOLFGANG HOLZER: Action of rapid electrical vibrations on electrolyte solutions in relation to biological effects of short waves.

December 14. STEFAN PELZ: Crystal photo-effect in coloured rock salt. A. SKRABAL: Unstable intermediate products and classical chemical mechanics. In investigations on chemical kinetics, it is often necessary to decide, from a given scheme of reactions in which unstable reactants take part, the actual gross reactions occurring and their velocity equations. A method of solving this problem, based on classical chemical mechanics, is now given. K. W. F. KOHLRAUSCH and A. PONGRATZ: Studies on the Raman effect (31). Raman spectrum of organic substances (polysubstituted benzenes). Each of the four spectra for the molecular types C_6H_5X and $CH_3.C_6H_4X$ (X in the ortho-, meta-, or para-position) is analysed for the cases where X is NH_2, OH, F, CH_3, CN, Cl, Br, or I.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, April 23

VICTORIA INSTITUTE, at 4.30.—Sir Charles Marston: "Bible and Spade".

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—"Life in Hungary" (film).

Tuesday, April 24

ROYAL SOCIETY OF ARTS, at 4.30.—C. F. Strickland: "The Co-operative Movement among African Races".

Thursday, April 26

ROYAL SOCIETY, at 4.30.—F. W. P. Götz, A. R. Meetham and Dr. G. M. B. Dobson: "The Vertical Distribution of Ozone in the Atmosphere".

Dr. F. P. Bowden and Dr. C. P. Snow: "Physico-Chemical Studies of Complex Organic Molecules" (1).

Dr. F. P. Bowden and S. D. D. Morris: "Physico-Chemical Studies of Complex Organic Molecules" (2).

LONDON MATHEMATICAL SOCIETY, at 5—(at Burlington House, W.1).—Discussion on: "Integral Functions". Speakers: Prof. E. C. Titchmarsh, Dr. E. F. Collingwood, Dr. M. L. Cartwright, Prof. J. M. Whittaker, A. J. Macintyre, Prof. J. E. Littlewood.

WORSHIPFUL COMPANY OF ARMOURERS AND BRASIERS, at 5.30—(in the Metallurgy Lecture Theatre, Royal School of Mines, Prince Consort Road, South Kensington).—Prof. J. H. Andrew: "Alloy Steels" (succeeding lectures on May 3 and 10).*

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Prof. J. C. M'Lennan: "Electrical Phenomena at Extremely Low Temperatures". (Twenty-fifth Kelvin Lecture.)

Friday, April 27

ROYAL INSTITUTION, at 9.—J. M. Stagg: "The British Polar Year Expedition to Fort Rae, N.W. Canada, 1932–33".

Official Publications Received

GREAT BRITAIN AND IRELAND

City and County of Bristol: Bristol Museum and Art Gallery. Report of the Museum and Art Gallery Committee for the Year ending 31 December 1933. Pp. 26+4 plates. (Bristol.)

Report of the Rugby School Natural History Society for the Year 1933. (Sixty-seventh Issue.) Pp. 44. (Rugby: George Over (Rugby), Ltd.)

Annual Report of the Council of the Yorkshire Philosophical Society for the Year 1933; The Yorkshire Museum, York—Report of the Museum Committee for the Year 1933. Pp. 47. (York.)

The London School of Economics and Political Science (University of London). Register, 1895–1932. Edited by the Registrar of the School. Pp. xix+266. (London.) 3*s.* 6*d.* net.

Thirty-third Report of the Felsted School Scientific Society, 1932–1933. Pp. 54+4 plates. (Felsted.)

University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1932–33. Pp. 26. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 3, No. 34: Geology of the Outer Hebrides, Part 5: North Harris and Lewis. By Prof. T. J. Jehu and Dr. R. M. Craig. Pp. 839–874+5 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 6*s.* 6*d.*

OTHER COUNTRIES

The Indian Lac Research Institute. Annual Report for the Year 1932–33. Pp. 39+6 plates. (Nankum.)

Columbia University. Bulletin of Information, Thirty-fourth Series, No. 24: Announcement of Professional Courses in Optometry for the Winter and Spring Sessions, 1934–1935. Pp. 31. (New York: Columbia University Press.)

Summary Proceedings of the Twenty-seventh Meeting of the Indian Central Cotton Committee, Bombay, held on the 29th and 30th August 1933. Pp. 40. The Indian Central Cotton Committee: its Objects, Activities and Achievements, with Special Reference to the Punjab, Sind, the United Provinces and Central India. Pp. 32. Annual Report of the Indian Central Cotton Committee, Bombay, for the Year ending 31st August 1933. Pp. ii+155. 2 rupees. (Bombay.)

Proceedings of the American Academy of Arts and Sciences. Vol. 69, No. 5: Studies on Histomoniasis or "Blackhead" Infection in the Chicken and the Turkey. By Ernest Edward Tyzzer. Pp. 189–264+6 plates. 1.25 dollars. Vol. 69, No. 6: Critical Examination of Physical Anthropometry on the Living. By C. B. Davenport, Morris Steggerda and William Drager. Pp. 265–284. 45 cents. (Boston, Mass.).

Sulphur, an Essential to Industry and Agriculture: a Treatise on the Properties and Applications of Sulphur. Pp. vi+45. (New York: Texas Gulf Sulphur Co.). Free.

Southern Rhodesia: Geological Survey. Short Report No. 29: Geological Observations in the Nata Native Reserve, Bulalima-Mangwe District. By J. C. Ferguson. Pp. 8. (Salisbury.)

Records of the Survey of India. Vol. 24: Riverain Surveys in the Punjab, 1901 to 1929. Pp. v+33+2 plates. (Dehra Dun.) 1.8 rupees; 2*s.* 6*d.*

Journal of the Faculty of Science, Hokkaido Imperial University. Series 2, Physics, Vol. 1, No. 5: Physical Investigations on Snow, Part 1: Snow Crystals observed in 1933 at Sapporo and some Relations with Meteorological Conditions. By Ukitirô Nakaya and Tuneo Iizima. Pp. 149–162+4 plates. (Sapporo: Hokkaido Imperial University.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 26: Further Researches into the Possibility of Long-range Forecasting in Netherlands India. By Dr. H. P. Berlage, Jr. Pp. 31+6 plates. Verhandelingen No. 27: Daily Forecast of Windforce on Java. By Prof. Dr. J. Boerema. Pp. 8+1 plate. (Batavia.)

CATALOGUES

Nephelo- and Absorptiometers for White and Monochromatic Light. (Ex 34.) Pp. 2. A.C. Standard Cell. (Normal 34.) Pp. 2. Moll Recording Microphotometers. (Review 34.) Pp. 4. Mill Thermopiles. (Ther 34.) Pp. 2. (Delft: P. J. Kipp en Zonen.)

The Applications of Marmite (Yeast Extract) in Medicine and Dietetics. Pp. 23. (London: The Marmite Food Extract Co., Ltd.)

B.D.H. Vitamin Products. Pp. 4. (London: The British Drug Houses, Ltd.)

The "Glamat" Lamp Protector. Pp. 8. (London: The Glamat Co.)