NATURE

SATURDAY, MARCH 18, 1933

No. 3307 Vol. 131

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

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4
Telephone Number: City 1266

Science and Service in Universities Overseas

IT cannot be gainsaid that the inhabitants of England, and of London in particular, are prone to assume an air of superiority over visiting representatives of the Dominions, even when the latter are themselves engaged in the task of building up new universities at the outposts of the British Empire. Necessarily the Empire must have a centre, which can only be London, but acceptance of this postulate does not preclude first-class work on a particular subject being carried out at a university thousands of miles away. It is only required to mention the names of Rutherford and Soddy in connexion with McGill University to establish this point. Whilst it is desirable and indeed excellent to have a cultural centre for the Empire, it would be disastrous if the advantages of proximity to it had the effect of making the foremost teachers, old and young, reluctant to work at the circumference, where there is much educational work of the highest importance to be done.

Among those who take the view—and there can be few who oppose it—that never was the closest union with the Dominions as a whole more essential to the Mother Country and that indeed her future prosperity largely depends on strengthening the bonds which unite the Empire, there is a keen desire to see the best possible use made of the intellectual ability of the Empire to this end. Apart from those few philosophers who can only work under conditions which are to-day's equivalent of monastic seclusion, it would do all the good in the world to most of the younger scientific workers to spend a year or more out in the Empire making contact with life as it is lived under somewhat different conditions from those which prevail at home, conditions which are claimed by some to be nearer the actualities of life.

The basic ideas we desire to develop are, first, the need for the universities of the Dominions to be able to draw on the best brains in the Empire for their professoriate. The material to be taught there is worthy of the teacher; the problems, both pure and applied, to use the hackneyed terms, are there in plenty. Secondly, those who accept such posts should be placed at no disadvantage in their future professional career. As this is at the moment perhaps the crux of the matter, it may be considered in more detail. At the end of the nineteenth century and for a decade in the twentieth it was usual for the enterprising sons of large families to cross the

seas to find work under conditions of greater freedom than at home : for all classes the opportunities were greater than at home, and the rising man of science gained a professorship at a substantial salary years before he could have achieved this in Britain. To-day things have changed : the working man no longer emigrates, for a variety of reasons which do not concern us here ; the young scientific worker finds sufficient opportunities, including some measure of financial security, to keep him at home and he is unwilling to sacrifice the advantages of scientific centralisation. It must be admitted that part of his reluctance to face life under new conditions in the Dominions is due to his womenfolk, who, however enterprising they may be in sensational sports stunts, are on the whole unwilling to face the different and possibly harder life in the Dominions. It is true the burden of this falls mainly on their shoulders, whereas the daily round of the husband in his laboratory is much the same as at home. The difficulties should be realised in the Dominions, and a specially warm welcome extended to the 'Frau Professor' until she is thoroughly acclimatised to the new conditions.

Although, as Prof. Stanton Hicks emphasises in a letter we are publishing elsewhere in this issue (p. 397), the inducements to attract and retain good men in the Dominions have to be greater than in the past, there is one factor working in the opposite direction which should help, namely, the ever-quickening of transport, which makes it possible to retain much closer contact with England. Eastern Canada is within a week of home, at least in the summer, and both South Africa and Australia are less remote than at one time, and even the cost of the passage is less onerous. Adding the fact that people in the Dominions are used to long journeys, it becomes possible, other things being equal, to visit the homeland much more often than has been customary in the past. Amongst other things we contemplate the payment of a passage to England and back every few years under the conditions of the professorship ; this is usual in the case of commercial employees who are sent to the East by their employers. The principle of the sabbatical year is now quite established in the United States, and it should be possible to adopt it, with improvements, within the British Empire. Here the Royal Society might help. It could each year send out one or more of its research professors to the Dominions to take the place of the local professor, who would come home to do a year's research in a British laboratory. We feel convinced that the effects of such exchange on both parties would be remarkable and would in a few years have a profound influence on the whole university movement in the Dominions.

There should be an unwritten law not to overlook workers in the Dominions when awarding scientific honours or making elections to vacant chairs. The Royal Society has always awarded its fellowship with liberality to overseas workers, but it is desirable that the feeling should prevail that the axiom 'out of sight, out of mind' does not apply to them. The difficulty of interviewing candidates overseas for a vacant chair might be overcome by the selection of a carefully chosen panel of seniors, who would meet and record their impressions of them before they first crossed the ocean and during every subsequent visit to the Mother Country. Such a panel would be able to make impartial reports when necessary.

We would go even further in encouraging a knowledge of Empire conditions among professors, by definitely giving preference when filling the senior positions at the universities at home to men who have had such experience. In their turn, the universities in the Dominions must accept the idea of a five years' tenure of their professorships. There will, no doubt, be strong objections to this suggestion because of its disturbing effect on the regular routine of the university, but in the long run there can only be benefit from the new ideas brought in by the new man and the new stimulus he will give to staff and students alike. It is in no way suggested that the term of office should be limited to five years, only that it should form a period after which a teacher would be considered to have discharged his obligations should he wish to return to England.

It is an open question, not suitable for debate here, whether some chairs should not be definitely limited to a five years' period ; others again, after a period of probation, might well be for the period of active life. In those sciences which are in close connexion with the active industrial development of a Dominion, we believe there is much to be gained by a regular change in the occupant of a chair : we can even visualise the new man coming out of industry, the retiring professor entering or returning to industry, to the advantage of individuals, students, industry and the university. There must be a real contact between the university and the town and State in which it is

situated ; it must play a part in the agriculture, in the industries, in the development and in the life of the community and be far, far more than a high school to which the citizens send their sons and daughters. 'Town and gown' must not be different and opposing unities ; the gown must be thrown round the town and the townspeople made proud to wear it.

We have stressed this, the practical function of a university overseas, without any intention of minimising or detracting from the other functions it should have, that of teaching and that of pure research. The best kind of teaching is so much a matter of inspiration—a few words from the right man can make a dull subject an entrancing mystery—that this is largely a question of the individual teacher. Unfortunately, universities must grant degrees, and degrees involve examinations, which in their turn mean a syllabus and courses of instruction, none of which is really education for life's battles in the true sense of the word. There is no hope of changing this state of affairs at the moment at home, though overseas the authorities may perhaps be more enlightened since they are more closely in touch with the realities of life. So long as there are examinations, teaching in the main must be directed to covering the facts contained in a comprehensive syllabus and not to the presentation of a logical approach to the subject itself. Apparently the good students survive even the examination and its preparation, and the inferior might never learn the subject anyway, so the old bad ways are perpetuated.

There are several aspects of the research question at the overseas universities. A good man will prosecute the research in which he is interested anywhere, whatever the conditions. Sir Daniel Hall has reminded us that research proceeds from an artistic impulse, so that it is not under control. The best results in the past have not come out of the institutions with the finest equipment, witness Sir William Ramsay's laboratory in London and that of Emil Fischer in the Dorotheen Strasse, Berlin, both the scene of epoch-making discoveries. More difficult to overcome is the lack of stimulus resulting from the regular contact with other workers. However, the typewriter makes it possible to write lengthy letters with a minimum of effort, which, with the good postal facilities available, should enable the written to replace verbal intercourse. The work achieved in the laboratories of the British Empire—there is no need to mention names—makes it abundantly clear that the right type of man can produce the best work in them and that he need not fear intellectual starvation. It should perhaps also be said that in many of the Dominion laboratories the equipment is of the best, even in advance of much of what we have at home. It is true that modern physics demands a super equipment, such as has just been installed at Cambridge, but there are many other fields of scientific endeavour where the apparatus and materials necessary for a research can be packed up in a few cases and moved from one laboratory to another. The prolific researches of the professors of chemistry at Oxford, for example, give no indication of having suffered as the result of their having worked in several laboratories in the Old World and the New.

The developments in the United States afford an illustration of how universities in cities in remote States, possessing a very inferior cultural background, have developed here and there under the leadership of individuals of the right type into first-class schools of research and teaching. It is true the distances from Yale or Harvard to these centres are small, but a decade or so back it was very difficult to persuade the best men to take up these positions in the Middle West.

We have still to consider our theme in relation to graduates of the Dominion universities who come, as indeed they should, to the Mother Country for post-graduate work. Should they stop in England or return to take up posts in the countries whence they came ? The temptation must vary with the individual. Some will feel family ties and associations and the pull of the freer life and better climate, others will feel the beckoning finger of the academic atmosphere. Each must choose for himself in relation to his inclinations, but one thing is certain, that we at home, spectators in the auditorium, must applaud him who goes abroad as loudly as the man who stays at home. The success of the Empire depends rather on the deeds of the man on the spot than on speeches at Westminster, and no insular narrow-mindedness must be allowed to stand in the way of giving him the best men as his teachers.

It is perhaps trite to say the world is at the cross-roads. There are many who think that for Britain, one way points towards sterling and the Empire and the other towards gold and uncertainty, if not chaos. If we choose the former and build on the foundations laid at Ottawa, unite with people of our own blood and our own tongue into a closer union, leading, let us pray, to Imperial

greatness, then it must be remembered that we are all free men of independent habit of mind, so that Imperial unity means Imperial independence, a centrifugal force opposed to centralising everything intellectual in the capital of the Empire.

In the world as it is to-day, no unit is big enough to stand alone. Economic groupings are necessary, the most beneficial being that of a big industrial nation with a big agricultural nation. Just as some forms of agriculture are so uneconomic that their practice results in raising the cost of living, so also the costs of manufacture must be kept low if Britain is to be the great central industrial country. Success in attaining these ends lies in the advances that science can make, such as will enable, for example, the big agricultural business to compete with the one-man farm, the rationalised industry to meet the competition of the small business. As regards the Dominions, it is clear that when a country has great resources of raw material, it will certainly attempt to establish its own industries, but it should only afford them a protection by tariff when they are reasonably assured of sound opportunities for success.

If the industries of the Dominions, agricultural and otherwise, are to prosper, research at the universities must be fostered, for in agriculture there are no great corporations to endow research. Sheltered places must be provided for the research workers and the shelter must be of a nature that will attract the best. Only thus shall be established our claim to Imperial greatness.

Evolution and Philosophy

The Scientific Basis of Evolution. By Prof. T. H. Morgan. Pp. 286. (London: Faber and Faber, Ltd., 1932.) 15*s.* net.

THE present book, based on a course of lectures at Cornell University, represents the views of a leading geneticist concerning the present position as regards evolution. It contains little that is new to the geneticist, and its statements are apparently designed mainly for the more general reader. The earlier chapters are concerned with such topics as the cellular basis of heredity, Mendelian inheritance and the genes, variability, adaptation and natural selection, mutation, sexual selection, and the evolutionary significance of embryonic development. The last four chapters are essentially a critique of (1) the well-worn theme of inheritance of acquired characters; (2) the social evolution of man; (3) the conception of the 'order of Nature', and (4) of metaphysical interpretations of evolution.

Although the work deals mainly with the more recent developments, occasional pages might have been taken from almost any textbook in the last fifteen years. There are a few inaccuracies, especially as regards plant genetics. For example, it is stated that *two* cases are found where interspecific crossing has produced new stable types with a higher chromosome number. The list of such cases in plants now extends to at least eighteen, and the most significant ones from an evolutionary point of view are not mentioned. Similarly, the statement (p. 44), "Whether this growth [of the chromosomes] takes place at the time of splitting, or after the halves have moved apart, is not certainly known at present", can only be regarded as a very inadequate statement concerning present knowledge of the growth and division of chromosomes.

In the chapter on mutations, the frequency of viable mutants in *Drosophila* is estimated at one in five to ten thousand flies. The discussion of the relation between the mutation theory and natural selection reaches the conclusion that some of the mutants will be an improvement, either on the old characters, or in a somewhat different environment and will therefore be incorporated into the species. It requires more than this, however, to show that mutations furnish the material for evolution. It would seem reasonable to expect that evidence on this head could be obtained in part by a comparison of the mutations in any group of organisms with the interspecific differences found in that group. Hitherto very little work of this kind, involving both mutational and taxonomic studies, has been done.

Elsewhere (p. 182) Morgan concludes that there may have been as many genes in the earliest organisms as at present. Such a view, if pressed to its conclusion, can only mean that the genic differentiation of the chromosomes of an amœba is as great as in man, a conclusion which would certainly not be accepted by many biologists. It would seem that the gene theory can only be reasonably maintained on the assumption that the chromosomes of higher organisms are more differentiated along their length than those of the lower forms. The opposite view savours more of Bonnet's *emboîtement* theory than of evolution in a real sense.

On p. 205 the extraordinary statement appears, that "Only a few strictly dominant mutational

changes are known in man", brachydactyly being cited as an example. In the literature of the subject, dominant abnormalities are very frequent, and probably even more so than recessives. The latter, however, owing to their nature, may of course be more numerous in the human germ-plasm.

In his first and last chapters especially, Morgan wields a stick against the "metaphysicians and philosophers of sorts". Whitehead, Jeans, Eddington, J. S. Haldane, Smuts and others in turn come in for castigation. The author's attitude may be gathered from the statement (p. 239), "By patience and industry and intelligence, biologists hope to advance their work. But so long as they have not found convincing evidence, it is an 'open season' for philosophers, who are too impatient to wait, but must add the biological field to their speculations." Although "philosophers" are thus warned off the field of biology, yet the author appears to recognise that the philosopher may have his function in the scheme of things when he says that "the scientist cannot afford to be entirely contemptuous of the history of philosophic and metaphysical thought, or to assume an arrogant disregard for it". But he accuses metaphysicians of placing limitations on exploration by scientific methods, and of assuming that the methods of science can have no bearing on the topics "reserved by metaphysicians". Behind the mechanistic position which Morgan defends there appears to be the assumption that when a man ceases to be a mechanist in the generally accepted sense, he *ipso facto* loses his scientific status.

This book will doubtless claim the interest of a wide range of readers. R. RUGGLES GATES.

Destructiveness of Earthquakes

Earthquake Damage and Earthquake Insurance: Studies of a Rational Basis for Earthquake Insurance; also Studies of Engineering Data for Earthquake-Resisting Construction. By J. R. Freeman. Pp. xiii + 904. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 7 dollars.

DR. FREEMAN, whose death has recently been recorded in our columns, broke new ground in this large volume, for no other work has yet been published that is devoted exclusively to the damage caused by earthquakes, the methods by which it may be lessened, and the covering of loss by insurance. Naturally, he deals for the most part with the earthquakes of the United States, though chapters are also given to recent shocks in Italy, New Zealand and Japan. But, for workers in all countries, the data here collected with the admirable series of illustrations will be found most useful. The chief regret that one feels in closing the volume is that the author lacked the time for its careful revision. The whole book might easily and with great advantage have been condensed to perhaps half its present length.

As Dr. Freeman points out, there is no region in the United States or Canada that can be regarded as wholly immune from the possibilities of earthquake damage, though the risk is far less on the east, than on the west, side of the Rocky Mountains. Two of the greatest earthquakes in the country—the New Madrid earthquake of 1811 and the Charleston earthquake of 1886—occurred, however, in districts that had been almost, though not quite, free from disturbance since the discovery of America. A very important feature of nearly all American earthquakes is that serious damage is confined within a comparatively small area. The Charleston earthquake, for example, though it was felt to a distance of 800 miles from the centre, was destructive to property only within three areas, each containing less than one square mile. Indeed, Dr. Freeman states that the area of severe destruction in American earthquakes has never exceeded 10 square miles, except in the New Madrid earthquake of 1811, the Owens Valley earthquake of 1872 and the Californian earthquake of 1906, and in the last-named was not more than 400 square miles.

Moreover, even within the central area, the ratio of damaged to undamaged houses is usually small. The buildings that are badly injured in an earthquake, whether of American or other origin, have nearly always been of weak and inferior construction. Well-built structures of wood or brick, or of squared stone laid in strong mortar, have usually withstood an earthquake shock. Even in the destructive earthquakes in Japan in 1923, Santa Barbara in 1925, and Nicaragua and New Zealand in 1931, buildings of monolithic reinforced concrete, deposited round well-designed steel skeletons, have as a rule survived unharmed. Earthquake-proof buildings may thus be erected up to 100 ft. in height, within reasonable limits of cost, whatever the ground on which they stand; and Dr. Freeman therefore considers that it would be possible to combine earthquake insurance with fire insurance in the same policy at an increase in cost that would be small for the

whole region east of the Rocky Mountains, and in California at an amount far less than that at present charged.

No one can deny that many good buildings have been seriously injured by earthquakes, but in estimating insurance hazards we have to deal with averages. The photographs of ruin that are included in published accounts are designed to thrill the reader. There would be no interest in depicting the buildings that have sustained little or no injury. In Charleston in 1886, for example, the ratio, as Dr. Freeman calls it, of earthquake damage to sound value scarcely exceeded 10 per cent. Out of 6,956 buildings examined, only 102 were ordered to be pulled down. In the remaining houses, the damage consisted for the most part merely of broken chimneys or cracks in walls or plaster. In the published accounts the emphasis was laid on the wreckage; little was said about the buildings, of which the author gives nearly fifty photographs, that passed through the trial unharmed.

The strongest earthquakes in North America within the historical period are those of Quebec in 1663, New Madrid in 1811, Owens Valley in 1872, Charleston in 1886, San Francisco in 1906 and Santa Barbara in 1925. It is improbable that an earthquake more violent than any of these will visit the country. Thus, the author suggests that an area of 2,500 square miles may be considered as the limit of serious destruction, and that within this area an average loss ratio of 5 per cent would be an excessively generous allowance. Taking into account the known frequency of destructive earthquakes in the various regions of the United States, he concludes that (rendered in English money) the following rates per £100 value of the property would cover the probable loss of damage from earthquakes, apart from working expenses and profits: California within fifty or sixty miles from the coast and including the Imperial Valley, 2*s*.—after the Santa Barbara earthquake of 1925, the rates actually charged were 5*s*.–8*s*. per £100, according to the type of building—Californian Mountains east of the Great Valley, 1*s*. 5*d*.; Washington and Oregon within a hundred miles from the coast, 1*s*. 2*d*.; Rocky Mountain-Wasatch region, 7*d*.; Great Lakes and Mississippi region below the Missouri confluence and within ten miles of the bottom lands, 5*d*.; the Atlantic region within fifty miles from the coast, 2½*d*.; and more than fifty miles, 1¼*d*.

Electrolytes

Elektrolyte. Von Prof. Dr. Hans Falkenhagen. Pp. xvi + 346. (Leipzig: S. Hirzel, 1932.) 23 gold marks.

THE author of this volume, now professor at the University of Cologne, studied at Zurich under Debye, and then in the United States at Madison, where he came into close contact with American workers on aqueous solutions. His book on electrolytes is only about one-third of the length of Walden's well-known monograph, but is a much more formidable work, since it includes 759 numbered equations, and demands a standard of mathematical knowledge which may perhaps be common amongst physicists, but is certainly rare amongst chemists.

The historical electrochemistry of Faraday is summarised in a single paragraph, and the whole output of the Ostwald school is condensed into a few pages, in which data which were formerly quoted as evidence in support of Arrhenius's 'classical' theory of electrolytic dissociation are now cited as proof of the inadequacy of that theory. The subjects which the author excludes from his principal text are, however, referred to in footnotes, where abundant references are given to the relevant literature, for example, on acids and bases, homogeneous catalysis, pseudo-electrolytes, etc.

After thus clearing the ground in three short chapters, occupying only 38 pages, the author provides two chapters on activity and on the anomalies of strong electrolytes, followed by five chapters dealing with the explanation of these anomalies by the Milner-Debye theory, as applied to the thermodynamics, conductivity and viscosity of aqueous electrolytes. A chapter on concentrated solutions is of interest as evidence of a reaction from the first hasty impression that all strong electrolytes are completely ionised under all conditions. In this chapter methods are discussed for calculating the true degree of dissociation, not only of formic and iodic acids, but also of salts such as potassium iodide, which crystallise in typical ionic aggregates. A final short chapter deals with the statistical basis of Debye's theory as developed by R. H. Fowler and by Kramers.

The book as a whole can scarcely be regarded as suitable for 'arm-chair' reading, but is perhaps not unduly difficult in view of the character of

post-War work on electrolytes. It will therefore be useful to readers who are anxious to bring their knowledge of the subject up to date; and those who are repelled by the mathematical equations may be attracted by the curves which are used to show the deviations of even the best-behaved electrolytes from the ideal laws laid down for them. An introduction by Prof. Debye sets a seal of authority on this exposition of the Milner-Debye theory of electrostriction.

Short Reviews

Plane Algebraic Curves. By Prof. Harold Hilton. Second edition. Pp. xv+390. (London: Oxford University Press, 1932.) 28*s*. net.

IN this new edition of Prof. Hilton's able work on the theory of plane algebraic curves, which was first published in 1920, advantage has been taken to recast several important chapters without disturbing the original pagination. Those who are acquainted with the first edition will agree that the author has considerably clarified the text in these chapters and has added fresh proofs to several important theorems, notably on pp. 76, 101 and 199. This should certainly stimulate a greater interest in an admittedly abstract branch of analysis. A considerable portion of the matter is the result of the author's own investigations into the subject. Especially is this the case in the chapters on quadratic transformations, derived curves, unicursal quartics and quartics of deficiency one and two.

No systematic references to original papers are given except at the end of chap. xx on circuits. As a reason for this the author points out: "in a field which has attracted so many workers, it would be almost impossible to trace the steps by which particular results have reached their present form". Whilst this is quite true, it seems a pity that a few of the more important papers were not mentioned in other chapters so that the reader wishing to pursue his studies further might know where to turn.

Every chapter contains an excellent set of exercises, well graded and of reasonable difficulty. Many of the problems are also supplied with hints for their solution. Valuable guidance in reading is provided in the preface, where also will be found a list of errata, as small typographical errors have not been corrected in all cases.

Statistical Methods for Research Workers. By Dr. R. A. Fisher. Fourth edition, revised and enlarged. Pp. xiv+307. (Edinburgh and London: Oliver and Boyd, 1932.) 15*s*. net.

THE volume under review is the fourth edition, revised and enlarged, of a "Biological Monograph" first published in 1925. As the editors point out, "Conspicuous progress is now being seen in the field of general physiology, of experimental biology and in the application of biological principles to economic problems". This involves the analysis of large masses of data by statistical methods, in the process of which, solutions to many complex problems have to be sought. Stimulus is thus given to purely mathematical researches, upon which the methods dealt with in the book are based. The aim of the author is to apply accurate tests to practical data by systematically attacking small sample problems on their merits. No attempt is therefore made to prove rigorously the various propositions upon which the theory rests; for these the reader is referred to an excellent bibliography at the end.

In this new edition, greater emphasis is laid on the principle of covariance on account of its increasing use in analysis, and a new chapter dealing with the principles of statistical estimation has been added. There are also provided numerical tables of normal distributions, correlation coefficients, etc., in a form suitable for mounting on the faces of triangular or square prisms.

The monograph is indeed a very valuable contribution to the subject by an acknowledged expert, and should prove exceedingly useful to research workers in the field under survey.

Plasticity: a Mechanics of the Plastic State of Matter. By Dr. A. Nádai, assisted by A. M. Wahl. (Engineering Societies Monographs.) Revised and enlarged from the first German edition. Pp. xxiii+349. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 30*s*. net.

IT is not often that one can say, *ex animo*, that a book "fulfils a long-felt want". This is, however, very true of Prof. Nádai's volume, which brings together in a scholarly fashion much scattered information, otherwise difficult of access. The book is divided into two parts. Part I deals with the plastic state of matter with special reference to metals and to mechanical engineering problems, while Part II is concerned with applications of the mechanics of the plastic state to problems of geology and geophysics. The treatment is singularly clear and full throughout, and is built up on a sure theoretical basis in a manner which makes very pleasant reading.

The book is the first of a series of Engineering Societies Monographs published under the auspices of the American Society of Mechanical Engineers. It has been enlarged from the first German edition with the co-operation of the author, and the Publications Committee of the A.S.M.E. is to be congratulated on having made the work accessible to those unacquainted with the German language.

Not only the practising engineer, but also the physicist and geophysicist, will find the volume a very valuable store of information. A. F.

Die Feldspäte und ihre praktische Bestimmung. Von Dr. Karl Chudoba. Pp. x + 54 + 4 Tafeln. (Stuttgart: E. Schweizerbart'sche Verlagsbuchhandlung (Erwin Nägele) G.m.b.H., 1932.) 5 gold marks.

THIS book is intended primarily for the use of the working geologist and petrographer who require accurate but rapid methods of felspar determination applicable to thin sections.

The author has made a wise selection and only those methods are described which give simple and rapid determinations. Twelve pages are devoted to a short description of the general chemical, morphological and optical characters of the felspar group, the remainder of the work being concerned with determinative methods. The main interest naturally attaches to the determination of the plagioclase series, and each method is considered under the headings, "Principal of the Method", "Recognition of the Section", "Determinative Process", "Application of the Method" and "Control of the Determination".

Only the methods suitable for use with the ordinary polarising microscope are considered. Adaptations of these to the Fedorow stage (zonal method of Rittmann) are clearly described but the ordinary Fedorow methods are not treated as they cannot be recommended where speed is an essential. The book is well printed and the figures simple and clear. The text is free from all unnecessary theoretical complications and the book provides an admirable guide to all concerned with felspar determinations.

Almost Periodic Functions. By A. S. Besicovitch. Pp. xiii + 180. (Cambridge: At the University Press, 1932.) 12*s.* 6*d.* net.

THE present book by one of the earliest workers in the subject treated in it promises to become a standard work. In some 190 pages it gives an account of the fundamental theorems dealing with almost periodic functions apart from some special problems connected with differential and difference equations. The first chapter develops the theory of uniform almost periodic functions of a real variable, including the representation by generalised Fourier series and their summation. The second chapter gives various generalisations of almost periodic functions with applications of the Parseval equation and the Riesc-Fischer theorem, topics with which the author is especially familiar through his own researches. The third and last chapter gives an account of H. Bohr's theory of analytic almost periodic functions of a complex variable, their Dirichlet series and their behaviour in and on the boundary of a strip of uniform almost periodicity.

The book, from the abstract nature of its subject matter, makes difficult reading, but will prove most interesting to all those sufficiently well equipped with a knowledge of the theory of functions. It is well arranged and printed in the excellent style associated with the publications of the Cambridge University Press.

The Nidification of Birds of the Indian Empire. By E. C. Stuart Baker. Vol. 1: *Corvidæ—Cinclidæ.* Pp. xxiii + 470 + 8 plates. (London: Taylor and Francis, 1932.) 30*s.*

THE author, fresh from his triumphs of the "Fauna of British India" in eight volumes, has turned his specialist's knowledge to the nidification of the birds, mentioned in his former work. To show how busy the field naturalists have been we mention that the percentage of known eggs has risen from 48 per cent in Oates's work in 1889 to 82 per cent at the present time. The number given to the birds in this volume is the same as the number used in the "Fauna", so that the worker has no trouble in turning up any bird.

In the introduction is given a history of the century of work that has been done on Indian ornithology, with oology not considered until 1864. In 1869 the study of oology may be said to have been begun in a serious way by Hume. It is forty years ago since any book has been published solely on the nidification of Indian birds, so in this volume we again expect the last word on the subject. The author's own collection of eggs, numbering more than 200,000, places him in an authoritative position.

Baker reviews the oology of each species as systematically as possible. Complete breeding area is given, with a description of the place where nesting took place, and the season when eggs are to be found; then a description of the nest and eggs, all full and useful to the worker.

Dielectric Phenomena. 3: Breakdown of Solid Dielectrics. By S. Whitehead. Edited, with a Preface, by E. B. Wedmore. (Published for the British Electrical and Allied Industries Research Association, being Reference L/T. 42.) Pp. 346. (London: Ernest Benn, Ltd., 1932.) 30*s.* net.

THE present volume completes a survey of discharge phenomena in dielectrics. The previous volumes discussed the phenomena which occur in gases and liquids. The experimental evidence is presented first and is followed by a study of the theoretical work that has been published. The author says that when an electric stress is applied to solid insulation, only a small heating current passes initially. As the applied stress increases, the current also increases. At a certain critical value the current becomes unstable. The material can now no longer be regarded as a non-conductor. This sudden fall of resistance is usually taken as the criterion of breakdown. The most noticeable feature in a breakdown is usually the perforation caused in the dielectric, the material being decomposed, fused or volatilised, or the whole three effects may occur together. None of the theories given is very convincing but the author gives a clear presentation of all of them. The work will be helpful to research workers on this subject who are doubtless on the look-out for a theory that fits the experimental data. At the present time the problem appears to be a very difficult one.

The Musk-Rat in Britain

By PROF. JAMES RITCHIE

IN recent months a great deal has been written about the musk-rat in Britain, but too much attention cannot be focused upon its presence and the possibilities of its presence. Besides, a special scientific interest is attached to its story, apart from the economic problems to which it has given rise, for we are watching to-day, from its beginning, the development of an example of the untoward spread and destructiveness of an animal introduced into a new environment, which will take its place with the notorious examples of the brown rat in Europe and the rabbit in Australia.

The interest in the breeding of wild animals for their fur which had been aroused in Europe by the value of the pelts and the success of American experiments, was intensified in Great Britain after the War, since fur-farming, as a new, interesting, and presumably profitable occupation, seemed to offer a way out of the difficulties of unemployment or uncongenial employment. It began with the development of highly specialised breeds of rabbits, led to the introduction of silver foxes for the breeding of which there were already in Great Britain in 1929 thirty-two farms with a stock of eight hundred foxes, and at length brought the musk-rat or musquash (*Odonatra zibethica*). The danger of the arrival of the musk-rat ought to have been foreseen and provided against, for its introduction to the upper valley of the Elbe in Bohemia in 1905 had in twenty years caused serious trouble and entailed much expense throughout great stretches of the valleys of the Elbe and the Danube and their tributaries.

Nevertheless, in 1927, musk-rats were imported for breeding purposes to England and Scotland, and although the value of the imported stock as a rule ensured that in these and later importations care was taken to enclose the animals, in one case at least the musk-rats were turned down on the banks of a stream in order to colonise the area. But whether enclosed or not, musk-rats possess a *wanderlust*, and their habit of burrowing makes them difficult animals to confine by any simple system of enclosure, a fact which was not sufficiently realised in the early days. So that each established colony, except where it was enclosed in escape-proof pens, became a potential centre of distribution. It is said that in the spring of 1931, before the Government had taken any steps in the matter, nearly two hundred people in Britain were keeping musk-rats.

Now it must be admitted, in partial justification of the delayed action of the Government departments concerned, that there was no *certainty* that the musk-rat would thrive under wild conditions in Britain. Central Europe held its warning, but in most of their native haunts in North America musk-rats have shown no undue tendency to increase or spread, nor have the stocks introduced to Finland done so. In the former region, natural control is exercised by carnivorous animals, the mink subsisting very largely upon musk-rats during the winter, while a less share in their destruction is taken by coyotes and lynxes; in the latter region, perhaps unfavourable climate and topography take the place of biological control. In Britain it almost required an experiment to test the possibilities, and such experiments were carried out in the enclosed marshes in which some breeders had liberated their stock. Unfortunately, undesigned experiments came thick and fast owing to escapes, and it was soon apparent that in the absence of biological control, climate and other factors in environment favoured undue multiplication.

Too late in the day to gain an immediately effective hold over the musk-rats in Britain, Parliament passed the "Destructive Imported Animals Act" of 1932, which, with subsequent Orders made by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland, imposed restrictions upon the importation and the keeping of these animals. Since the "Musk-Rats (Importation and Keeping) Order" of March 31, 1932, no licence has been granted for importation, and fourteen licences have been granted for keeping (two of which have become void), under which the animals must be kept in specially constructed pens and must not be kept in the open. On the premises so licensed there are at present about 226 musk-rats. On March 14, a further Order was issued prohibiting absolutely as from April 1, unless Parliament resolves to the contrary, the importation into, and keeping within, Great Britain of musk-rats.

Before the passing of the Act, musk-rats had established themselves in several areas where they have increased and whence they have spread over considerable tracts of country. So that in England wild individuals have been found in Yorkshire, it is said in three of the home counties (Surrey, Kent and Essex) as well as in the Fen district, but the great centre of dispersal has been the Shrawardine Pool, in Shropshire, where on a marshy area of sixty-five acres, two hundred individuals were turned down in an enclosure in 1929, bred freely and, inevitably, contributed a quota of 'escapes'. Radiating from that centre, about seventy miles of the Severn and its tributaries, from Pool Quay to Leighton, have been colonised, and the developments in Montgomeryshire and Shropshire and their immediate surroundings threaten any counties connected therewith by waterways. So far, however, the Ministry of Agriculture and Fisheries has not yet been able to verify any serious case of infestation outside the Severn area, although with so rapidly breeding a creature any local colony may flare up as a new centre of increase and distribution.

In Scotland musk-rats were known to be free in Kincardineshire, the northern limit, although a

locality in southern Aberdeenshire has been suspected, and they are said to have been seen at Thornhill, Dumfriesshire, the southern limit, but the main region of infestation lies in the Midlands, in Perthshire and Stirlingshire, where they may be present in any district which is connected by waterways with the River Allan. In the enclosure at Whitemoss Loch, Dunning, there are about a thousand musk-rats. Since the passing of the Act, more than sixteen hundred individuals have been killed in England, and about a hundred in Scotland.

A difficulty in discovering the exact whereabouts of the musk-rats is that of identification on sight, yet it is of the highest importance that their presence or suspected presence should be reported at once to the local authority and the Government department of agriculture. Two British animals are occasionally confused with the musk-rat, the common brown rat and the water-rat or water-vole. Accordingly a photograph of these three species is reproduced (Fig. 1), from specimens in the Royal Scottish Museum, as the simplest means of showing their differences. The first obvious character is size: the musk-rat is larger than either, 22 inches from snout to tip of tail when full-grown, although exceptionally large brown rats have measured 19 and 20 inches. A second characteristic is the long, dense, rich brown fur, the musquash of furriers, composed of a close under-coat and longer glistening guard-hairs, giving the creature a more robust and 'dumpy' appearance than the sleek brown-rat or water-vole. A final safe distinguishing mark is the tail, which, instead of being round, is flat, compressed sideways, and since it is hairless looks and feels like a narrow black razor-strop. A close inspection would show that the hind feet are large and partly webbed.

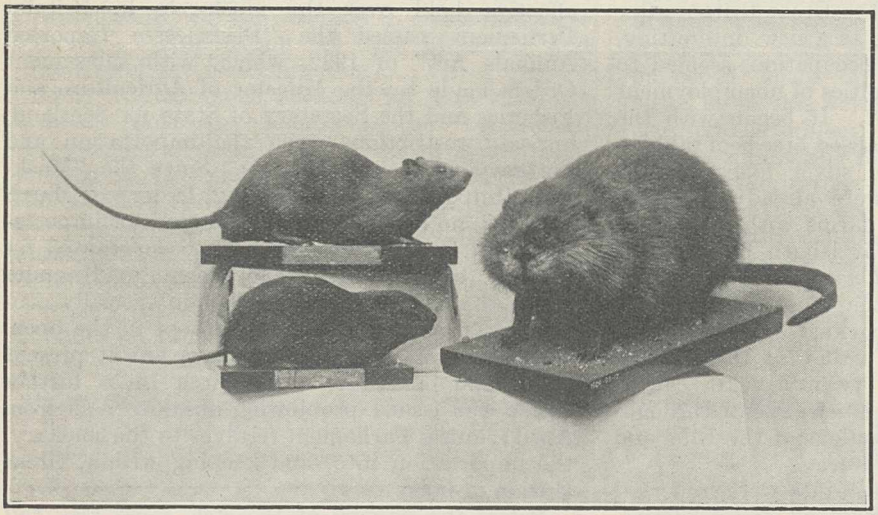

FIG. 1. Right, musk-rat top left, common brown rat; bottom left, water-vole.

Unfortunately, it is rarely that musk-rats show themselves during the daytime even when they are in numbers, so that other signs of their presence must be looked for. Two of these are illustrated, from Scottish localities; a deep shelter channel cut to give screened access between waterway and feeding ground (Fig. 2), and, most characteristic at this time of the year, the mounds of rushes, grass, leaves and twigs (Fig. 3), which stand three or four feet above the level of the marsh, and are the 'lodges' or joint food-stores and dwelling-houses in which many individuals congregate during the winter months.

The remaining activities of the musk-rat are for the most part invisible, but nevertheless in them lies the great danger of its presence. It lives mainly upon aquatic vegetation, although on the Continent it has damaged green and root crops, and it also eats animal food such as fishes and molluscs; but the loss from these sources is not likely to be very serious. On the other hand, in a country such as Great Britain, with extensive valleys and waterways kept from flooding by natural or artificial embankments, its burrows are a permanent and serious source of danger. The musk-rat is never found at any great distance from water, and in the banks of the streams it frequents it drives multitudes of burrows, since each nest-cavity has its own connexions. The burrows open beneath the water level and the excavated earth is deposited in the bed of the stream, so that unlike the mole's tunnelling, that of the musk-rat leaves no apparent traces. An embankment apparently sound may be honeycombed with cavities, ready to give way on any undue pressure, with what consequences in some localities one can imagine. Here lies another sign of occupation not to be disregarded. Every broken bank in any situation near water should be examined to see if the collapse was due to burrowing, and a distinct musky odour in such place, due to a secretion of the perineal glands of the occupants, should be an aid to identification.

Invisible occupation and spread, extensive undermining of embankments, and a gift of rapid multiplication, for there may be from three to five litters in a year each with six to eight young on an average, combine to make the musk-rat a very dangerous invader.

The danger is realised by many, but it cannot be too widely known. An official of the Canadian Pacific Railway Co. has stated that, in America, apart from damage to canal systems, the creatures "have been responsible for the subsidence of enormous concrete structures, such as head-gates, dams and pool walls, whilst similar timber struc-

tures have been completely washed out following the operations of a rat colony in their vicinity" (*Field*, Dec. 17, p. 931, 1932).

What can be done to meet the need of the case? In America musk-rats are easily caught by trapping, and the letter in the *Field* referred to above and another (Dec. 24, p. 966) give excellent summaries of the methods of using traps. But the position in America is a little different; there the musk-rat does no harm in many areas and is an annual source of income, so that the trapper has no wish seriously to deplete the breeding stock. In Great Britain the only aim must be extermination. The departments of agriculture are doing their best, by propaganda against the pest, by the employment of trappers, and by the engagement of Continental experts familiar with the methods employed in Central Europe. These are reported to be confident that "given the men, the means and the time, a properly organised campaign can clear the country". But the condition of Central Europe, with its 100,000,000 musk-rats steadily increasing in numbers and range in spite of every effort, casts some doubt upon the prophecy.

Trapping is necessary but it is not enough, and unconsidered measures run a risk of doing more

Photo *T. Munro*

FIG. 2. Screened access between waterway and feeding ground.

harm than good. Recently the Ministry of Agriculture and Fisheries advised the destruction of vegetable growths in the Thames, on the ground that the removal of a favourite food would prevent the settling down of the musk-rats and lead to the use of the streams only as highways. But a present need is to restrict the distribution of the animals and to discourage the use of highways to new areas, and, apart from that, the destruction of water weeds is likely to affect seriously the

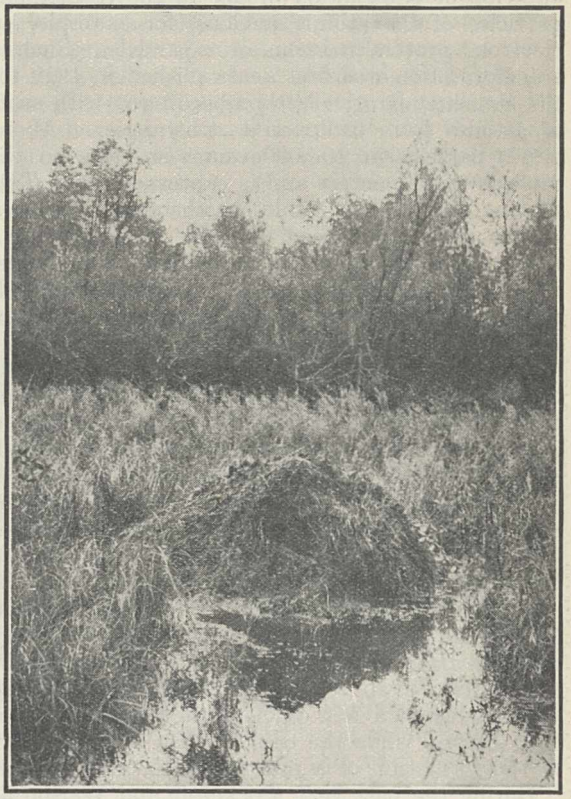

Photo *T. Munro*

FIG. 3. 'Lodge' or joint food-store and dwelling-house.

invertebrate fauna and the shelter of the river and, through these, the valuable fish fauna.

The Scottish Department of Agriculture, in addition to the employment of trappers, offers a reward of 5*s*. for the killing of musk-rats in certain areas, possibly a useful means of obtaining early information regarding new distribution, and it has tested a mode of destruction which seems to have much in its favour. Trapping is a device against individuals, but in winter the lodges are inhabited by congregations of individuals, which offer a target in the life-history against which every effort of control should be concentrated. The bombing of lodges by miniature bombs, or even the dynamiting of large enclosed areas frequented by many musk-rats, so that they should either be killed outright or disabled by the concussion, ought to be fruitful in results. Any and every reasonable means must now be taken to exterminate this destructive alien, while it is still restricted to a few limited areas. Central Europe points not only to the danger of overwhelming multiplication, but also to the need of devising new and more drastic methods of attack against the pest.

Recent Researches on the Transmutation of the Elements*

By THE RIGHT HON. LORD RUTHERFORD, O.M., F.R.S.

IT is now well established that the change of one atom into another can only be effected by the addition or subtraction of one of the constituent particles of the atomic nucleus, for example, an electron, proton, neutron or α-particle. Such a transformation was first accomplished in 1919 for the element nitrogen by bombarding it with swift α-particles from radioactive substances. About one α-particle in 100,000 comes so close to the nucleus that it enters and is captured by it. This violent disturbance results in the expulsion of a proton with high speed, and the formation of a new nucleus of mass 17. A number of light elements can be transformed by α-particle bombardment in a similar way, and in most cases a proton is ejected.

A new and strange type of transformation was discovered last year by Chadwick: when α-particles bombard the metal beryllium, uncharged particles of mass 1 called neutrons are expelled. These neutrons, which have remarkable powers of penetrating matter, are themselves very efficient agents for the transformation of atoms. Feather has shown that both nitrogen and oxygen are transformed by the capture of neutrons, with the expulsion of a fast α-particle. The types of transformations produced by the neutron are thus very different from those observed with the α-particle. The capture of an α-particle in general leads to the building up of a new nucleus three units heavier than before, while the capture of a neutron leads to the formation of a nucleus three units lighter.

During the past year, Cockcroft and Walton at Cambridge made the important discovery that comparatively low-speed protons are very effective in causing the transformation of a number of elements. The protons are generated in large numbers by an electric discharge through hydrogen, and then speeded up by passing through an evacuated space to which a high potential of the order of 600,000 volts is applied. Under these conditions the protons acquire high speeds comparable with that of the α-particle from radium. When a stream of these swift protons corresponding to a micro-ampere falls on the element lithium, a large number of α-particles are emitted of energy comparable with that of the swiftest α-particle from radium. It seems that about one in 100 million of the protons enters a lithium nucleus of mass 7, and the resulting nucleus of mass 8 splits up into two α-particles, each of mass 4. Cockcroft and Walton have later found that the α-particles emitted consist of two groups differing widely in speed.

This transformation of lithium can be produced at surprisingly low voltages. With strong proton streams, the emission of α-particles can be observed for 30,000 volts; the number of particles increases rapidly with the voltage, and the variation has been examined by different observers over a very wide range, from 30,000 to 1·5 million volts.

Protons are also remarkably effective in disintegrating the light element boron, and again α-particles are emitted. It is possible in this case that the boron nucleus of mass 11, after capturing a proton, breaks up into three α-particles. The radiation observed is complex, and has not yet been analysed in detail. A number of other elements have been found to be transformed, apparently in all cases with the emission of α-particles.

In a special form of accelerating tube devised by Oliphant in the Cavendish Laboratory, a narrow, intense proton stream can be generated at voltages up to 200,000 volts. The protons, after being bent by a magnetic field, bombard a target of about one square centimetre in area. By special arrangements, it has been found possible to obtain in the detecting chamber at least a thousand times the number of particles observed by Cockcroft and Walton at the same voltage. By this method it is easy to observe the particles from very thin films of lithium and boron at comparatively low voltages, while the variation of number with voltage has been measured. For example, a number of α-particles are emitted from lithium with voltages so low as 30,000 volts. α-Particles from boron have been observed at 60,000 volts, but the number increases much more rapidly with voltage than in the case of lithium.

Special experiments have been made to test by this sensitive method whether the heavy elements thallium, lead, bismuth and uranium show any evidences of transformation for 200,000 volt protons, but no sign of emission of α-particles has been observed for these elements. At first, marked effects were observed, but these were ultimately traced to a minute contamination by boron, probably originating in the discharge tube. It seems not unlikely that the effect observed for uranium and lead in the original experiments of Cockcroft and Walton may have been due to an unsuspected contamination by a minute trace of the very active element boron.

During the last few years, much energy has been devoted throughout the world to developing methods of obtaining streams of very swift charged particles with which to bombard matter and effect its transmutation. In the apparatus of Cockcroft and Walton at Cambridge already referred to, a steady potential of 800,000 volts can be reached. A new and simple type of electrostatic generator has been designed by Van der Graaf and Atta in the Massachusetts Institute of Technology, with which they have obtained a steady potential of

* Substance of the Friday evening discourse delivered at the Royal Institution on March 10.

1·5 million volts, and a larger apparatus is under construction with which they hope to obtain a potential of 15 million volts to apply to a large vacuum tube. Brasch and Lange have applied high momentary voltages to a discharge tube by using an impulse generator.

A new and ingenious method of multiple acceleration has been devised by Lawrence of the University of California with which he has already obtained protons of energy 1·5 million volts by using a potential less than 10,000 volts. The transformation of lithium has been examined at this high energy using a proton current of about a thousandth of a micro-ampere. It is hoped to develop this method so as to obtain protons of energy as high as 10 million volts or more.

Even if these new projects prove successful, the speeds of particles produced by their aid are much smaller than those observed for the very penetrating radiation in our atmosphere, where electrons and protons of energy from 200 million to 2,000 million volts are present. From the experiments of Anderson in Pasadena and Blackett and Occhialini in Cambridge, it seems certain that these very swift particles are very efficient in causing the transformation of nuclei, probably in novel ways. Strong evidence has been obtained of the production of a new type of positively charged particle which has a mass small compared with that of the proton. This may prove to be the positive electron, the counterpart of the well-known negative electron of light mass.

Obituary

DR. C. A. BARBER, C.I.E.

WITH the passing on February 24 of Charles Alfred Barber is severed a link with the past, for he belonged to that old school of scientific investigators who were the first to turn their attention to the problems lying behind development in tropical agriculture. When he gained his first acquaintance with it, there was an awakening to the fact that a harvest does not necessarily follow planting. In the East, Ceylon had gained experience from coffee; in the West, Harrison and Bovell had pointed the way to a healthier growth of cane.

This, as yet dim, appreciation of the need for investigation, led to Barber's first appointment in 1891 as superintendent of agriculture in the Leeward Islands where, however, his stay was brief, for the post was abolished in 1895. In 1898 he was appointed Government botanist, Madras, and, as director of the Botanical Survey of Southern India, commenced to complete the flora of southern India. But here, as in the West Indies, the need for investigation of the economic crops was slowly gaining recognition and his attention was soon diverted to the study of cane and crops in general. These were the days before the Royal Commission of 1896 had led to the establishment of the Imperial Department in the West Indies and before the organisation of an agricultural service in India. It is to Dr. Barber, not least among the pioneers of this period, and to the practical benefits of his work, that the present-day scientific worker in this field largely owes his security in a firmly established service scattered throughout the tropical parts of the British Empire.

During this earlier period, Barber found time to carry out a detailed investigation of the haustoria of sandal and other plants for which he was awarded, in 1908, the degree of Sc.D. of the University of Cambridge. But the earliest economic problem to receive attention was that of the sugar cane disease which was creating anxiety in Madras. In 1912, when the Cane-breeding Station was opened at Coimbatore, the selection fell on him for the post of sugar cane expert, and his field of investigation was extended to cover the whole of India. The problem that faced him was unique. The main cane tract of India lies outside the tropics where, for climatic reasons, the plant forms no viable pollen. Seedlings had to be raised outside the tract and no mean questions of testing and introduction were raised. There was the further fundamental question of the parental type to be used to impart the resistance to frost and drought necessary for success. Through a detailed study of the Northern Indian canes he was attracted to Katha, a hardy Punjab cane, and its similarity to *Saccharum spontaneum*, the wild Kans. He was led to use this wild plant as one parent and, by crossing it with a Noble cane, raised seedlings of which Co.205 remains as testimony to his originality of thought. In its wider aspect his study led him to a classification of the Indian canes, to which he ascribed a dual origin. Again it is a tribute to his insight that this classification, based on a morphological study, has required so little modification from the later Dutch cytological investigations.

Original, too, was Barber's recognition of the importance of the root in the economy of the plant and of the need for a detailed study of the root system. For his services to India he was created a C.I.E. in 1919 on retirement and, in 1931, was awarded the Maynard Ganga Ram prize for Indian research.

Born in 1860 at Wynberg in South Africa, Barber came to England at the age of ten years. After five years' service in the Manchester and Liverpool District Bank, he entered Christ's College, Cambridge, of which he became a scholar. In 1889 he was appointed University demonstrator in botany and, before proceeding to India, served on the staff of the Royal Engineering College, Coopers Hill, where he succeeded the late Prof. H. Marshall Ward.

PROF. JOHAN VAN BAREN

BY the death on February 7 of Prof. Johan van Baren, agricultural science has lost the leading authority on soil mineralogy. Born in Rotterdam on April 18, 1875, van Baren became assistant in mineralogy to Prof. J. L. C. Schroeder van der Kolk, of the University of Delft, in 1899. In 1903 he went to Wageningen, where he taught mineralogy and geology at the Agricultural College, and when this College was made an Agricultural University, in 1918, he was appointed professor of mineralogy, geology and agro-geology.

When van Baren went to Wageningen, his facilities for teaching and research were of the most meagre kind, but in the thirty years he spent there he built up a department for his subject which at the present time has no equal. The museum and library, to which he devoted much attention, are particularly fine.

Besides his University work, van Baren had interests in many societies. He was one of the founders of the Geological Society of the Netherlands and Colonies, of the Society for Studying the History of Mathematical and Physical Science, and of the Wageningen section of the Dutch Natural History Society. He was for many years on the Committee of the Royal Dutch Geographical Society, and was a corresponding member of the French Academy of Agriculture. In the International Society of Soil Science he was an active member. He contributed papers to various conferences of the Society and took part in the preparation of the Soil Map of Europe. He devoted much attention to the soils of the East Indian Archipelago, and raised the Junghuhn Fund for the study of these soils.

Van Baren's principal work was a handbook, "The Soil of the Netherlands", in the preparation of which he was occupied for more than twenty years: altogether he published more than a hundred scientific papers. He was particularly interested in the Quaternary deposits of Holland and their correlation with the glacial phenomena of the Alps and Scandinavia. He also studied recent volcanic deposits of the East Indian Archipelago. In soil work he specialised in detailed mineralogical studies, and published a series of memoirs treating of the soils of Holland and the East Indian Archipelago (issued from the Geological Institute of the University of Wageningen). More recently he devoted particular attention to the problems of origin and development of limestone soils under the very contrasting climatic conditions of tropical and temperate regions. In pursuance of his studies he travelled extensively both in Europe and the East.

Van Baren was an inspiring teacher. The writer has vivid and pleasant recollections of an excursion to South Limburg with him and his students in the early summer of 1926—busy days spent in field work, meals taken together at one long table in the hotel at Valkenburg, and discussions and amusements in the evenings. The best of good fellowship existed and when the day's work was done, van Baren joined in the students' concerts with the same enthusiasm as he showed in leading the excursions. A vigorous man of kindly personality, he will be greatly missed by his friends and colleagues in soil science in other countries as well as Holland. W. G. O.

MR. F. P. BURCH

WE regret to announce the death on February 11 at the age of thirty-three years of Mr. Francis Parry Burch. He was the second son of the late Prof. G. J. Burch, F.R.S., of University College, Reading, and was a scholar of Winchester and of Gonville and Caius College, Cambridge, where he took the Natural Science Tripos, Part II (Physics) in 1922.

Burch joined the staff of the Research Department of the Metropolitan-Vickers Electrical Co., Ltd., Manchester, in 1922 as a member of the newly-formed Physics Section, devoting much of his time to the problems of heat transmission, and in the early days of the radio industry he made a careful study of the characteristics of filaments for receiving and transmitting valves. With the development of apparatus for producing electrical transients of extremely short duration, it became necessary to extend the existing facilities for recording these transients, and in conjunction with Mr. R. V. Whelpton he constructed the first high-voltage cathode ray oscillograph in Great Britain. To put the recording of high voltage transients on a sound basis, Burch made a careful study of the theory of the potential divider, completing this valuable work by constructing an apparatus to record transients up to one million volts.

Burch then turned his attention to the continuously evacuated power transmitting valve and rectifier, and was largely responsible for the successful completion of a 30 kw. screened grid valve and master oscillator operating at a wavelength of 10 m., the first high power four-electrode valve in the world.

By his death the Metropolitan-Vickers Co. has suffered a great loss, and is robbed of one of its most charming personalities.

WE regret to announce the following deaths:

Dr. John Belling, cytologist in the Department of Genetics of the Carnegie Institution of Washington, an authority on the structure of chromosomes, on February 28, aged sixty-six years.

Prof. G. C. Bourne, F.R.S., emeritus professor of zoology and comparative anatomy in the University of Oxford, who did much work on tropical marine fauna, especially on the formation of coral atolls, author of a "Text-Book of Oarsmanship" published in 1925, on March 9, aged seventy-one years.

Dr. R. T. A. Innes, formerly Union Astronomer in South Africa, known for his discoveries and records of binary stars, on March 13, aged seventy-one years.

News and Views

Sir Frank Dyson, K.B.E., F.R.S.

A LARGE gathering, representative of the Admiralty, the Board of Visitors to the Royal Observatory, the staff of the Observatory, the Royal Astronomical Society and the British Astronomical Association, attended a complimentary luncheon to Sir Frank and Lady Dyson on March 10. Affection and respect for the human and lovable chief of astronomy, and for his attainments and achievements, were the note of the letters read from those unable to be present and of the speeches of Prof. F. J. M. Stratton and Dr. W. A. Parr, the presidents respectively of the Royal Astronomical Society and the British Astronomical Association. Tributes were paid to the unselfish yet competent manner in which Sir Frank Dyson has sunk himself in the work of the Royal Observatory during his tenure of the office of Astronomer Royal and to the friendly and helpful way in which he has co-operated with his astronomical colleagues, professional and amateur alike. The best of wishes for the future were expressed to both Sir Frank and Lady Dyson.

Prof. J. Proudman, F.R.S.

PROF. J. PROUDMAN, the present holder of the chair of applied mathematics in the University of Liverpool, has been elected to the chair of oceanography in the University which has become vacant by the death of Prof. James Johnstone. Prof. Proudman joined the staff of the University in 1913 as lecturer in mathematics, and has held the chair of applied mathematics since 1919. In 1919 he was appointed director of the newly founded Tidal Institute and director of Liverpool Observatory. He is a member of the British National Committee for Geodesy and Geophysics and of its sub-committee for Physical Oceanography. He is also a member of the British Section of the International Committee on the Oceanography of the Pacific. He has served on many committees concerned with tidal matters and inundations. His own researches have mainly been concerned with the dynamical aspects of ocean tides and their currents and with the action of wind and of variable atmospheric pressure upon the sea. For his work on these subjects Prof. Proudman was awarded a Smith's Prize of the University of Cambridge in 1915 and the Adams Prize in 1923.

The Californian Earthquake

THE earthquake that occurred in southern California at 5.54 p.m. on March 10 (1.54 a.m., March 11, G.M.T.), though it was the cause of considerable loss of life and property, can scarcely be regarded as one of the great earthquakes of that State. The number of persons known to have lost their lives is 151, and it is estimated that 7,500 houses were destroyed or damaged, and that the value of the property lost was more than ten million pounds. Most of the places in which houses were injured lie within an area about sixty miles long, running in a south-easterly direction from near Los Angeles to beyond Santa Ana. The place that suffered most is Long Beach, a town on the coast about twenty miles south of Los Angeles. Here, 65 persons were killed and about a hundred wounded. The epicentre thus lies near the coast, possibly under the ocean, so that the earthquake cannot be connected with the great San Andreas rift, which, in this part of California, runs about fifty miles inland. Since 1769, the Los Angeles district has frequently been visited by severe, though not disastrous, earthquakes. About ninety miles to the west lies Santa Barbara, part of which was seriously damaged by the earthquake of June 29, 1925.

Soviet Expedition to the Pacific Ocean

THE expedition to the Pacific Ocean organised under the joint auspices of the State Hydrological Institute and the Ichthyological Institute of the U.S.S.R. has recently returned from the Far East. The expedition made a detailed investigation of the Sea of Japan, the Sea of Okhotsk and the Bering Sea, in which thirty-one members of the Hydrological Institute took part. In the Sea of Japan a thorough investigation was made of the region stretching from the border of Korea to the Gulf of Olta. For the first time in the history of oceanographic research, detailed work was carried out in the parts adjoining the Gulf of Peter the Great at a depth of 8,500 m., and at that depth various organic forms of life hitherto unknown to science were discovered. It has been ascertained that the sharp descent of the coast-line —at an angle of 24°—forms a huge ravine overgrown with tree-shaped corals. One such coral was extracted by the expedition. Samples of the sea-bed at a depth of 8,400 m. have been obtained, and also much hydrological material which makes it possible to determine, according to the seasons, the annual hydrological system of the region of the Gulf of Peter the Great.

CERTAIN inaccuracies of existing maps have been corrected. In some places the depth was found to be 1,000–1,500 m. instead of 100 m.; elsewhere, on the contrary, submarine ridges have been discovered in place of depressions. Much material on hydrology has been collected which point to the penetration of the waters of the Pacific Ocean to the eastern part of the Sea of Okhotsk. In the Bering Sea, hydrological and biological investigations were made, in some places at a depth of 3,800 m. For the first time, the interchange of the water masses of the Bering and Chukhodsk Seas during the summer season was investigated. Numerous measurements were made by the expedition which will enable a more exact map to be made of the western part of the Bering Sea.

Metallurgy Building at University College, Cardiff

IN NATURE of August 5, 1915, an account was given of the new building which had been erected for metallurgy at University College, Cardiff. An

important extension to this building, which completes the scheme, was formally opened on March 16 by Mr. W. D. Woolley, chairman of the Monmouthshire and South Wales Coalowners' Association. The new accommodation provides: ground floor, mechanical laboratory, physical laboratory and lecture room; first floor, three research laboratories, private room, museum and library; second floor, chemical laboratory, balance room, combustion and gas analysis, laboratory and private room. The College has now a well-planned and well-equipped building for teaching and research work, the erection of which is due to the generosity of the Monmouthshire and South Wales Coalowners' Association.

Projected Flight over Everest

In our issue of February 4 (p. 160), reference was made to the two aeroplanes which have been modified to undertake a flight over Mount Everest. According to the Karachi correspondent of the *Times*, the machines arrived at Karachi on March 9. The main base for the expedition will be Purnea. The photographic results of the flight, should it be successful, are likely to be of considerable interest, for nothing is known at present of the south face of Everest. Indeed, if the photographs are available in time, they may be of assistance to the expedition now in India preparing to climb the mountain (NATURE, Jan. 7, p. 10), especially if the snow and ice conditions have changed considerably since the 1924 expedition. Useful data may also be obtained of atmospheric conditions; while we know a good deal about the atmosphere at 30,000 ft. above mean sea level, it is likely that conditions at this absolute height but with high mountains below will be different. The aeroplanes, however, are not suited for making useful cosmic ray observations. The flight will be a great adventure, for should the machines have to come down through engine failure, the chances of finding a suitable landing place in that great area of mountainous country are small.

Discovery of Sexuality in Plants

The discovery of sex in plants is usually credited to Camerarius (1694), and Koelreuter (1761) is generally believed to have made the first systematic study of plant hybrids. Statements of Sachs in his "History of Botany" are mainly responsible for these attributions. Dr. Conway Zirkle is able to show, however (*J. Hered.*, vol. 23, No. 11), that other names really have priority in connexion with these important developments in the history of science. N. Grew, in an address to the Royal Society in 1676, expressed the view that the stamens are the male organs of a flower, the pollen acting as vegetable sperm. Thomas Fairchild, whom Sachs referred to as "a gardener in London", was in fact the leading experimenter of his generation, and his famous cross between sweet william and the carnation is shown to have been made at least as early as 1717. Philip Miller was the first to describe insect pollination by observations on tulips. This was not, however, in 1751, as stated by Sachs, but so early as 1721. He also observed natural crossing in cabbages as well as sexual reproduction in cucumbers and melons. Dr. Zirkle also gives an interesting account of equally early American observations on pollination and crossing, chiefly in maize, by Cotton Mather (1716), Judge Dudley (1724) and Governor Logan (1735). A letter of John Bartram in 1739 shows that he too had made species crosses in *Lychnis* at that date.

Courtship of Birds

The courtship displays of birds, wherein they manifest the amorous emotions which possess them, are now daily becoming more and more assertive. Much has yet to be learned concerning the 'behaviour' of birds thus possessed at this time; and the relation of this behaviour to various and often conspicuously coloured plumage, wattles, bare skin, or inflatable air-sacs. The pheasants afford striking illustrations of apparently conscious effort to display such ornaments to the best advantage before apparently disinterested females. The belief that these displays serve as aphrodisiacs must be regarded as well-founded. This fascinating aspect of bird life can now be studied at the Zoological Gardens, Regent's Park; a number of tragopans, or horned-pheasants, as well as Cheer, Impeyan, and Kalij-pheasants, having just been added to the collections. Blyth's tragopan from Assam, and the crimson tragopan from the south-eastern Himalayas, each bears an erectile appendage over the eye, of a vivid blue colour; and an inflatable wattle at the throat. In Blyth's tragopan this is yellow tinged with blue, while in the crimson tragopan it is orange, barred with blue, and when filled with air presents a strange effect. If the courting antics of the tragopans be compared with those of the golden and Amherst pheasants, wherein the chief ornaments take the form of a great frill of vividly coloured feathers encircling the neck, the contention that both types display deliberate and purposeful movements designed to make the most effective possible use of these ornaments will seem incontrovertible. Though the Darwinian view that these resplendent areas were brought to perfection by the selective preferences of the female, before whom they are displayed, has lost its hold, they are nevertheless instances of 'sexual selection'; since only the most amorous males, the most skilled performers, can succeed in arousing the desired response in their phlegmatic prospective mates.

Vanished Races in South Africa

From time to time news is received of the discovery in South Africa of a new and previously unknown culture, presumed to be the work of a vanished race. More often than not the finds are associated with stone-work or the evidence of metal-working. The latest discovery to be reported (*Times*, March 13) comes from the northern Transvaal, where Mr. D. S. van der Merwe, assistant registrar of mining titles on the Rand, has discovered sacrificial graves of an entirely new type, a sacrificial altar, approached by ceremonial causeways and by staircases, an

irrigation system of enormous extent, together with the remnants of a large dam. There is also a copper tool, which is said to be an authentic mining implement. These finds are ascribed to a vanished race, and on account of the diminutive size of the stairways, it is suggested that its members were pygmies. The collections have been placed at the disposal of the Ethnological Department of the University of the Witwatersrand and are said to be regarded by the Department as very important. As Mr. van der Merwe is a layman in ethnological matters, the verdict of experts in the cultures of the natives of South Africa will be awaited with interest. As a rule, unfortunately, previous claims to the discovery of new cultures and vanished races have not survived their impartial scrutiny.

A New South African Culture?

A CLAIM to have distinguished a new material culture in South Africa is put forward by Dr. Ir. E. C. N. Van Hoepen, director of the National Museum, Bloemfontein (*Argœologiese Navorsing*, Dl. i St. 5), in describing a remarkable stone pipe from a shelter near Bethlehem. Its peculiarity lies in the ornamentation, a system of curved grooves and on one side a sinuous ridge ending in a reversed E, representing a snake. Similar pipes have previously been described, one of clay from the ash-heaps of stone huts at Vegkop by Van Riet Lowe and another of stone by Stow. Van Riet Lowe attributed the pipe he described to the Leghoya, dating the huts at about 1790, but Dr. Van Hoepen does not consider his reasoning or evidence satisfactory, and points out that stone huts are not a characteristic of Bantu culture, the Leghoya themselves using conical grass thatched huts, according to Stow. He himself sees in the pipes and the shelters closer affinities with Hottentot, Bushmen, and Xosa, but concludes that the three characters, the stone pipes, the stone huts and the ornamentation do not belong to any known African culture. We are, therefore, he holds, dealing with something new, a culture for which the name 'stone-hut' culture is proposed. This view, important as it is for the history of South African cultures, should be accepted with some caution. Its confirmation by further evidence will be awaited with interest.

American Archæologists in Yugoslavia

AT a meeting of the American Anthropological Association held in Atlantic City at the end of December, Dr. Vladimir J. Fewkes described the work during the past summer of a joint archæological expedition of the Peabody Museum, the Fogg Art Museum, Harvard University, and the American School of Prehistoric Research in Jugoslavia. Some 150 archæological sites were visited and examined. A large proportion of these were found to belong to Greek, Roman, Macedonian or Byzantine cultures. The most considerable undertaking of the expedition was the excavation of the neolithic site at Starcevo, of which the investigation had been begun in the previous year. The settlement is dated at about 2500 B.C. and is found to consist of a number of irregularly placed groups of semi-subterranean dwellings, of which the foundations have been exposed. Among the material found are crude but well-made cooking pots, painted pottery, needles, awls and spatulas of bone, stone knives and celts, shells, and small libation tables of baked clay. The settlement was one of small farmers with domesticated animals, who supplemented their food supply by hunting and fishing. In a report of the communication from Science Service, Washington, D.C., Dr. Fewkes is said to have stated that the expedition had gathered fresh evidence relating to the early trade routes of this part of Europe, an area he regards as the archæological key-region of the Balkans.

Spectrum Analysis

THE increasingly great interest now being shown in spectrum analysis is well exemplified by two recent developments in the United States. The first of these was the setting up by the American Society for Testing Materials of a committee (E–2) on spectrographic analysis in its application to analytical and metallurgical problems. This committee is now at work and it is probable that tangible results will be forthcoming in the near future. News of the second development has just reached Great Britain. It has been decided that one of the lines of work to be intensively pursued at the magnificently equipped spectroscopic laboratory of the Massachusetts Institute of Technology is the application of spectrum analysis to industrial and related problems. In order that as close touch as is possible may be made with industrial problems, a research conference is to be held at the Institute during the week beginning July 17, and it is hoped that at this conference industrial experts, academic research workers and manufacturers of spectroscopic equipment will meet and discuss those aspects of the problem with which they are individually familiar. It is clear that one of the earliest developed aspects of spectroscopy is again coming very much to the fore, and that the dreams of some of the early spectroscopists regarding the general use of this technique in industry are coming measurably nearer realisation.

Machine Age's Starvation Predicted

THE comparatively rapid depletion of the earth's available resources in this mechanical age was considered by Prof. R. A. Gortner, of the University of Minnesota, in a paper before the American Association for the Advancement of Science in December (Science Service, Washington, D.C.). It is pointed out that irreplaceable stores of natural resources absolutely essential to modern industrial civilisation are disappearing into the 'maws of industry' and so are wastefully dissipated over the earth. While the publicity of technocracy directs attention to the part played by mechanical energy in remaking economic conditions, the shelves in some of Nature's cupboard are showing signs of exhaustion of the materials necessary for a mechanical age. In particular, Prof. Gortner mentions the approaching exhaustion of copper, antimony, tin, lead, zinc, chromium, manganese, nickel and iron, which are stored in parts

of the earth accessible to man. The rate of use of some of these metals is doubling each decade. We still use tin-foil for wrapping up sweets and cigarettes. At the present mining rates, iron will be exhausted in Germany in about fifty years and in the United States in about a hundred years. The supply of sulphur in the United States will fail in fifteen years, the coal of Germany in less than a thousand years and of the United States, notwithstanding its huge lignite deposits, in less than fifteen hundred years. It looks as if the machine age may starve to death before long, a victim of to-day's profligate use of metals, coal and oil. Water power, alcohol from vegetation, solar energy, etc., are at present totally inadequate to replace oil and coal. Will future civilisations look back upon the industrial civilisation of the twentieth century as an age of robbery?

U.S. Bureau of Standards

THE annual report of the Director of the Bureau of Standards (Government Printing Office, Washington, 1932) shows the trend of scientific developments during last year. The increase in the industrial applications of very low temperatures has made it advisable to extend the scale downwards from $-100°$ C. to $-259°$ C. and a temporary scale covering this range has been established. Fire tests have been made on the new welded steel floors which are now being used in buildings. They consist of steel floor plates welded to beams spaced two feet apart. Tests were made with fire both above and below the floor. Gas appliances found quite satisfactory at sea level develop defects when used in cities at high altitudes. The causes of these defects are being investigated. Perhaps the most spectacular advance made during the year has been to increase the accuracy of the primary frequency standard to one part in ten million. Regular transmissions of standard high-frequency waves at a frequency of 5,000 kilocycles per second are broadcast every Tuesday for four hours. The accuracy obtained is one cycle per second, that is, one part in five million. The ionised layer in the atmosphere has been determined to be the major controlling factor in the long distance transmission of radio waves. The measurement of the height of this layer is of primary importance in interpreting transmission conditions and increasing our knowledge of radio wave transmission. Using improved equipment, these measurements were made on one day in each week throughout the year. An automatic recorder is now in use which makes continuous measurements. Useful work is done in making careful analyses of samples of ores, alloys, pure metals, cement and pure chemicals. These samples are sold to industrial laboratories and are used for checking their own methods and results. This plan has contributed greatly to the precision of the analytical work in these laboratories and the project is self-supporting.

Miners' Nystagmus

Two reports on this subject by a Committee of the Medical Research Council were issued in 1922 and 1923. The principal finding of the Committee was that the chief symptom of this disease—the involuntary oscillation of the eyeballs—is caused by an insufficiency of the light reaching the eyes of the miner while at work, and that the most important measure of prevention is to secure for the miner at work adequate illumination. Nevertheless, in spite of considerable improvement in the illumination of mines, the incidence of the disease has, on the whole, steadily increased, for compensation on account of this disability was paid to 10,638 persons in 1930; this is the largest number, with one exception, during the past twenty-three years. The Medical Research Council has therefore considered it advisable to reconstitute the Committee, which has now issued a third report on the subject (Special Rep. Series, No. 176. H.M. Stationery Office. 9*d*.). This reaffirms, in the strongest terms, the conclusions of the former committee. There should be constant illumination of 0·25 foot-candle on the coal face, and it is understood that there are recent developments in the direction of improving illumination in mines. To account for the continued prevalence of the condition, it must be recognised that the oscillation of the eyeballs is but a part of the disease, and various psychoses and neuroses are also present. The practical treatment of the disease should consist in the elimination of a hopeless dependence on compensation by the provision of opportunities for work of some kind, even if restoration of full work underground has to be preceded by a period of work in daylight.

Guard Posts for Road Island Refuges

ILLUMINATED guard posts or 'bollards' are now gradually coming into use on all types of roads which carry fast vehicular traffic. In the *Osram G.E.C. Bulletin* for February, a description is given of a well-designed guard post which should prove useful not only by indicating the refuge to pedestrians, thus prompting them to cross the road at that point, but also to motorists; thus removing a frequent cause of accidents. It is a luminous pillar 4 ft. high, the light being emitted only from the side which faces the traffic. The back of the pillar is made of solid steel tube, so that in the event of a smash the damage done will be probably much less than if it were made of cast iron. The head of the bollard is arranged as a lantern with the red glass fixed around half its circumference. The red glass is generally illuminated by a sixty-watt lamp but sometimes a small auxiliary lamp is used as well so as to prevent a complete 'black out' if the main lamp is extinguished. Complete isolation of the bollard from the electric supply in the event of damage is easily obtained by opening a door near the ground level where the time-switch and fuses are fixed.

Researches on Sedimentation

THE report of the Committee on Sedimentation for the two years 1930–1932 has been published under the auspices of the Division of Geology and Geography of the U.S. National Research Council as National Research Bulletin No. 89, 1932 (pp. 229, price

1 dollar). The report is by the chairman, Prof. W. H. Twenhofel, who contributes a general introduction, and various committee members and others, who are responsible for many valuable records of original research and abstracts of literature on the accessory minerals of igneous and sedimentary rocks. Special attention deserves to be given to the paper on the classification and terminology of the pyroclastic rocks by C. K. Wentworth and Howel Williams. The Bulletin also includes papers on recent advances in the study of peat; recent marine sediments; settling of bentonite in water; relation of the buffer mechanism of sea water to the solubility of calcium carbonate; modern marine sediments in California; bacterial and chemical factors in lime deposition at Tortugas, Florida; varved sediments; chert and flint, concretions, and cone-in-cone; abrasional work of river ice and of glaciers; ground water hydrology in its bearing on sedimentation; rôle of micro-organisms in sediments; accessory minerals of crystalline rocks; and glacial sediments. In addition, there are summaries of work on sedimentation carried out at Stanford University, and also of recent work by German and British investigators; and abstracts of the literature on accessory minerals of igneous rocks and of sedimentary rocks.

Developments in Market Gardening

THE report of the recent conference on "Recent Developments in Market Gardening" held at Rothamsted contains a great deal of information which is not readily available in a collected form. Two of the classical market garden areas, the Bedfordshire early potato and brussels sprouts district and the equally well-known spring cabbage, brussels sprouts and fruit area of Evesham are treated in detail from the point of view of the practical grower, and the subject is also considered from the point of view of the canner, whose part in the industry is becoming increasingly important. In recent years market gardeners have found their province invaded by large-scale farmers, who have in part substituted vegetable growing for the less profitable crops of their ordinary rotation. These men, whose methods form the subject of one of the papers, have several advantages not possessed by the smaller cultivators; plentiful animal manures, large-scale mechanical methods, and a possibility of converting unsaleable surplus into live stock products. The reply of the genuine market gardener has been to move towards greater intensification, and to retire into districts as yet inaccessible to large-scale methods. The conference as a whole leaves the impression that abundant production of market garden crops is relatively easy to secure. It can in fact be an embarrassment, and every additional outlet whether by preservation, more economical distribution, or the education of the public taste, needs careful investigation. Copies of the report, price 2*s*., can be obtained from the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

Institute of Industrial Administration

IN a pamphlet recently issued by the Institute of Industrial Administration, 47 King William Street, E.C.4, outlining its objects and examinations, it is stated that management in industry is essentially the exercise of administrative function and involves the control and co-ordination of the technical functions. The operation of the administrative function does not vary greatly from one industry to another despite differences in the application of some of the technical functions, especially that of production. It is admitted that personality is a highly significant factor in industrial administration but training serves both to develop and inform personality. To the average individual upon whom industry has mainly to rely, training may make all the difference in his efficiency, to his own advantage and that of the nation. In preparing a revised syllabus of examinations, the Institute has endeavoured to collate the principles and practice bearing on the functional aspects of industrial administration. The scheme consists of three stages—fundamentals, intermediate and final—the first of which presents in elementary form a general idea of how an industrial undertaking is conducted and its relation to external affairs. In the intermediate and final stages the subjects of the fundamental stage are extended and amplified.

Physics at Harvard

VOL. 21 of Contributions from the Physical Laboratories of Harvard University consists of separate copies of the papers by members of the staff and other research workers which have appeared in the *Physical Review*, the *Proceedings* of the National Academy of Sciences and of the American Academy and other periodicals during 1930–31. There are forty of them, which differ considerably in type and area of the letterpress, but are all cut to pages $9\frac{1}{4}$ in. × $6\frac{3}{4}$ in. Their subjects extend over almost every branch of physics and they testify to the catholicity and quality of the research work done at Harvard. The completion of the new research laboratory and the improvement of the Jefferson Laboratory during the period covered by the volume afford a suitable opportunity for a 47-page illustrated description of the present buildings and equipment, and a short history of their foundation and of the work done in them, and in the Cruft Laboratory. Nearly 130 men have carried on research in the laboratories during the last thirty years and many of them now fill chairs of physics in American universities.

Mining Facilities in South Australia

ACCORDING to the annual report of the Director of Mines and Government Geologist of South Australia for 1931, an amending act was passed during the year concerning principally mining upon lands, beneath which mineral substances had been alienated prior to the adoption of the principle of reservation of such substances. The act protects land-owners, but under certain conditions allows prospectors to enter such lands under reasonable conditions; the responsibility for seeing that such an authority is not given to an undesirable character is placed upon the Warden.

Anatomy of the Tortoise

THE attention of teachers and students in vertebrate anatomy who include the tortoise in the list of the animals they study by dissection, is directed to an account of the anatomy of that animal published by the Royal Dublin Society (vol. 20, No. 28, Dec. 1932). The late Dr. J. Stuart Thomson was engaged on the preparation of this memoir over a number of years with the view of providing an account of the principal structural features of the tortoise for his own and other senior students. The descriptions, in about eighty pages, of the external characters and the various systems of organs are systematic, clear and adequate, and are supported by twenty-five well-drawn plates. This useful paper is published at the reasonable price of 8*s*.

Land Utilisation Survey

THE second annual report of this survey of Great Britain records that thirty-one counties are now completed or very nearly completed, comprising nearly 8,700 sheets. More than a third of the area of the country is covered by these maps. Compared with the previous year, progress has been rapid. Thirty-six counties, during the last year, have undertaken work for the survey and there are now only four counties in which nothing or very little has been done, namely Essex, Carmarthen, Argyll and Perth, but considerable help is still needed in the West Riding of Yorkshire outside the completed Sheffield area. The director of the Survey also asks for the assistance of volunteer workers in the counties of Somerset, Westmorland, Wiltshire, Peebles, Inverness and Sutherland. Work on the reduction of the results to a scale of one inch for publication is proceeding actively on several sheets in England and Scotland, including Cromer, Ipswich, Ullapool and Liverpool.

Announcements

PROF. P. Debye will deliver the fifteenth Faraday lecture before the Chemical Society on March 29, at 5.30, at the Royal Institution, Albemarle Street, W.1. The lecture will be entitled : "The Relations between Stereochemistry and Physics".

THE memorial fund instituted in memory of Dr. R. Stenhouse Williams, formerly director of the National Institute for Research in Dairying (University of Reading) to which reference has already been made in our columns, has now reached a total of £1,800. It is proposed to close the fund shortly, but further contributions will be welcomed. The fund will be used for the advancement of dairy science at the National Institute for Research in Dairying.

A SERIES of five talks by Mr. Charles Elton, director of the Bureau of Animal Population at the University of Oxford, on "Exploring the Animal World", will be broadcast by the British Broadcasting Corporation on Friday evenings commencing on April 21. During these talks, co-operation will be sought between the amateur observer and scientific worker, especially in the second talk on "Woodland Life", when listeners will be asked to help in a survey of the birds of different kinds of woods all over England.

WITH reference to the note on "Illuminated Fountains" which appeared in NATURE of March 4, p. 302, Mr. A. S. E. Ackermann has pointed out that an article by him on an illuminated fountain at the Barcelona Exhibition appeared in the *Journal and Transactions of the Society of Engineers* (21, No. 3, 115 ; 1930). In this fountain there were 750 incandescent lamps of 2,500 candle-power, besides arc lamps. Photographs of the fountain in action are reproduced.

WE regret to learn that a serious error occurs in the description of the 'soil conductivity bridge' by the Cambridge Instrument Co., Ltd., advertised in the Supplement to NATURE of March 11, p. iv. This should read : "This A.C. Bridge will measure directly the specific resistance of samples of soils ; the reciprocal of the reading being taken as the specific conductivity in mhos per $cm.^3$. The range is from 1 to 100,000 ohms, or 1 to 10^{-5} mhos." The term 'mhos' (reciprocal ohms, measuring conductivity) was altered without authority by the printer to 'ohms', after the proof had been passed for press by the advertiser.

MESSRS. HOPKIN AND WILLIAMS, LTD., 16 Cross Street, Hatton Garden, London, E.C.1, have issued a useful booklet of 60 pages, price 1*s*., entitled "Organic Reagents for Metals", in which working directions are given for the use of sixteen organic reagents, such as picrolonic acid and quinalizarin, which have become important in analytical chemistry in recent years. Improved details are given for some of the methods, and a comprehensive bibliography is appended for each reagent.

APPLICATIONS are invited for the following appointments, on, or before, the dates mentioned :—A registered medical practitioner with experience in bacteriological research for the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W. (March 27). An assistant lecturer in bacteriology in the Edinburgh and East of Scotland College of Agriculture—The Secretary, 13 George Square, Edinburgh (April 7). A principal investigator for the Burden Mental Research Trust—The Secretary of the Trust, B.M.A. House, Tavistock Square, London, W.C.1 (April 10). An independent lecturer in materia medica and pharmacology in the Welsh National School of Medicine—The Secretary, Welsh National School of Medicine, The Parade, Cardiff (April 25). A woman assistant demonstrator in physics in the Royal Holloway College (University of London), Englefield Green, Surrey—The Principal (May 10). An assistant lecturer in mechanical engineering in the Battersea Polytechnic, London, S.W.11—The Principal.

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.*]

Scientific Centralisation in the British Empire

THE leading article entitled "Ottawa and After", in NATURE of October 8, 1932, concludes with an interesting comment on higher education in the Dominions. I can speak with first-hand knowledge of conditions in New Zealand and Australia, and feel that there is a greater fundamental difficulty than the existence of a superior climate which is more conducive to outdoor life. The difficulty is an Imperial one. The Empire is centripetal, not centrifugal, and the tendency is to look to England as the only place where the best may be encountered, or the best work carried on. This influences educational outlook from the secondary schools to the universities, and the public, despite crudely nationalistic tendencies on the parts of some lesser journals, sees greener pastures in all branches of culture, in distant Albion.

Add to this the fact that Dominion universities are primarily concerned with professional training, in the present stage of development of these lands, and it becomes clear that the inducement to attract and retain good men in professional posts involves more than might be supposed. The old-established scientific societies with all their tradition and prestige, their facilities for publication and criticism of original work, and their influence in paving the way to higher posts, are in Great Britain.

The personal contacts made and maintained at meetings of the societies are of inestimable value in fanning the flame of original work. Just as the 'hungry forties' were the driving force in colonisation, so the underpayment of university assistants in the nineteenth century led them to posts in Australia at salaries far beyond their reach for many years had they remained in England and Scotland. But, just as it has become safer for the workers to remain in England, so is it with the professor's assistant, who now cannot be so readily induced to accept a professorial salary of £1,100 in Australia, with a sacrifice of the advantages of scientific centralisation, advantages greatly enhanced by the establishment of medical and industrial research subsidy under the ægis of the scientific societies.

It has long been my conviction that it rests with the better men of the Dominions themselves to save the outer Empire from the intellectual anæmia which highly centralised intellectual advantage and prestige must necessarily provoke. After their post-graduate years in England they must resist the almost overwhelming temptation to accept posts in the British Isles, and must, when opportunity offers, return and fight their lonely battle for its own sake.

Unless and until this happens our claim to Imperial greatness must remain open to question, for otherwise all our technical and governmental skill will have been directed to purely material ends, and the term 'Commonwealth of Nations' must remain a hollow sham.

C. STANTON HICKS.

University of Adelaide.

The Oldoway Human Skeleton

WE should be grateful if the following statement on the question of the age of the Oldoway human skeleton could be published in NATURE.

One of us (L. S. B. L.) brought back to England a large series of samples of the different strata which were collected not only from the region of the 'man site' but also from widely separated points, up and down the Oldoway Gorge. These samples have now been examined at the Imperial College of Science and Technology by P. G. H. Boswell and J. D. Solomon. The following conclusions emerge from their study.

(1) The materials of Beds II and III appear to be very similar to each other so far as their mineral constitution is concerned, but they can both be clearly distinguished from the materials of Bed IV and also from Bed V.

(2) The material of Bed V is so distinctive in its mineral content that it can be immediately distinguished from any of the four lower beds.

(3) Thin layers of steppe-lime, which in places occur at the base of Bed V, are not distinguishable with certainty from the steppe-lime which forms the top part of Bed V.

(4) The thin red-coloured deposit which is present in the section of the 'man site' overlying Bed II and underlying Bed V is a hillwash material in which the characteristic minerals of Beds IV and V occur.

(5) Samples of Bed II, actually collected at the 'man site', at the same level and in the immediate vicinity of the place where the skeleton was found, consist of pure and wholly typical Bed II material, and differ very markedly from the samples of the matrix of the skeleton which were supplied by Prof. Mollison from Munich.

Following from (4) above, it is clear that erosion had removed from the region of the 'man site' the whole of the overlying Beds III and IV before the hillwash, formed during the last stages of this process, was deposited and afterwards covered up by the formation of Bed V. Thus, at some stage before the deposition of Bed V in this area, the top of Bed II was exposed as a land-surface with a thin mantle of hillwash material.

We may further note that all of those who have examined the section at Oldoway are agreed in the opinion that the Oldoway skeleton cannot reasonably be regarded as having been buried after the deposition of Bed V proper, and of the steppe-lime which covers it.

One of the reasons which caused one of us (P. G. H. B.) in his letter in NATURE of August 13, 1932, to suggest a post-Bed V date, was the presence of small pieces of steppe-lime in the matrix sent from Munich. He was not then aware, however, of the presence of steppe-lime below Bed V, as mentioned in (3) above, so that there is now no necessity for upholding this view.

In order that the important question of the age of the skeleton shall be established on as sure a foundation as possible, the evidence outlined above will be supplemented by the results of a further examination, by Reck and his colleagues, of rock collections from Oldoway and the volcanic highlands to the east. Meanwhile, on the basis of the evidence summarised above, it seems highly probable that the skeleton was intrusive into Bed II and that the date of the intrusion is not earlier than the great unconformity which separates Bed V from the lower series. On the other hand, it seems certain that the skeleton was deposited where it was found before the main

mass of Bed V and the overlying steppe-lime were formed, that is, the skeleton appears to have been buried at the time of the existence of the old land surface connected with the steppe-lime at the base of Bed V.

It so happens that there is other and independent evidence which supports this view. On this old land surface, and also in the basal deposits of Bed V, there was found an industry which has very close affinities with the phase C of the Upper Kenya Aurignacian. From the work at Gamble's Cave in 1929, we know that the men of this culture-stage buried their dead in the contracted position, as was the case with the Oldoway skeleton. It seems likely, therefore, that the Oldoway man was one of the race which made the tools that are found on the old land surface and in the basal deposits of Bed V.

The above views accord with those of Mr. E. J. Wayland, director of the Uganda Geological Survey, summarised in letters to NATURE (October 15, 1932) and *East Africa* after his visit to Oldoway last August.

L. S. B. LEAKEY.
H. RECK.
P. G. H. BOSWELL.
A. T. HOPWOOD.
J. D. SOLOMON.

Heights of Nuclear Potential Barriers and Nuclear Structure

I RECENTLY pointed out in these columns[1] that experimental evidence indicates that the heights of the potential barriers of the light nuclei are proportional to the atomic number. This simple relation can be shown to fit in with Heisenberg's suggestion[2] that nuclei are composed of protons and neutrons and that there is an attractive force $J(r)$ between neutron and proton at close distances, and between neutron and neutron $K(r)$, the former being the greater. An α-particle contains two neutrons and two protons, a nucleus contains n_1 neutrons and n_2 protons; there will therefore be an attractive force between nuclear neutrons and α-particle protons *and* nuclear protons and α-particle neutrons, superposed on the Coulomb repulsion between protons. Thus we have (neglecting the neutron-neutron force $K(r)$, since it is less than $J(r)$):

$$V = \frac{2n_2e^2}{r} - \frac{2n_1k}{r^p} - \frac{2n_2k}{r^p}$$

for the potential at a distance r. I have assumed a law of force of the form $\frac{k.\ n_1.\ \text{no. of protons}}{r^p}$ to represent $J(r)$.

This gives

$$V = \frac{2n_2e^2}{r} - \frac{2k(n_1+n_2).}{r^p}$$

It happens that for the light elements n_1 is very nearly equal to n_2, never differing by more than one unit. Thus we have approximately,

$$V = \frac{2n_2e^2}{r} - \frac{4kn_2.}{r^p}$$

This gives for V_c the maximum when $dv/dr = 0$ the value

$$V_c = \frac{2n_2e^2}{(2pk/e_2)^{1/(p-1)}}\left[1 - \frac{1}{p}\right]$$

If p is constant, that is, if the law of force is the same from element to element, we have that V_c is a straight line function of n_2, which is what is found experimentally.

The critical radius for the height of the barrier is $(2pk/e_2)^{1/(p-1)}$ and has, for elements for which n_1 is approximately the same as n_2, a constant value; this would be expected, because both repulsive and attractive forces increase linearly with the nuclear charge. This critical radius does not necessarily govern the volume of the nucleus. An accurate measurement of the barrier heights would afford a means of testing the truth of the assumption made by Heisenberg (and necessary to his theory of nuclear stability) that the neutron-neutron force is less than the neutron-proton force; since if it were not so, the attractive force would depend on n_1 alone, giving different values for those elements (such as lithium and beryllium) for which n_1 does not equal n_2.

The heights calculated for these two elements (both subject to considerable error) do fit in better with an attraction proportional to $n_1 + n_2$ than to n_1. It is interesting to note that the attractive force in the case of a proton does depend on n_1 alone, so that the barrier height to a proton should be rather higher than half that to an α-particle for light elements: for heavy elements, where the number of neutrons is roughly twice the number of protons, the barrier will not rise so rapidly; perhaps this accounts for the relative ease of penetration of heavy nuclei by fast hydrogen ions.

Since the slope of the line relating height and nuclear charge depends on p, the index power of the law of force, it should be determinable from this relation.

E. C. POLLARD.

Physics Laboratories,
University of Leeds.
Feb. 2.

[1] E. C. Pollard, NATURE, **131**, 97, Jan. 21, 1933.
[2] W. Heisenberg, *Z. Phys.*, **77**, 1; 1932.

Arc Spectrum of Iodine

THE analysis of the spectrum of the normal iodine atom has proved relatively difficult, partly because of the wide multiplet separations, and partly because of the transitional nature of the coupling characteristics. Some constant intervals, due to Turner[1], have long been known, and S. F. Evans[2] in 1931 presented a partial analysis which included most of the stronger lines in the region 4700–10000 A. Recently S. C. Deb[3] has published a more extensive analysis, which differs very materially from that of Evans. As he dismisses the latter's results rather summarily, with the remark that they are "mainly incorrect", some observations on his paper may be of assistance in forming a just appreciation of the present position in regard to this question.

In the first place, it may be noted that of the 160 wave-lengths listed by Deb, 75 are identical with those given by Bloch[4] and 19 with those of Evans, although the text implies that they are his own determinations. Further, Bloch classifies all but 9 of these 75 as spark lines, and Evans's observations (unpublished), together with those of Wood and Kimura[5], are in good general agreement. The multiplets proposed take no account of this heterogeneity of the data, including arc and spark lines on an equal footing. It is therefore not surprising that the multiplet intervals show much wider discrepancies than should be permissible by reason of wave-length inaccuracies. As one instance we may take the interval 1459·3 cm.$^{-1}$ which was well established by

Evans on the basis of five values lying within a range of 0·3. Deb's values for this vary from 1451·6 to 1459·5, with a mean of 1455·5. It is clearly essential in work of this kind, first to obtain a homogeneous set of data of the highest possible accuracy, and secondly to accept as significant only those intervals which agree within the order of accuracy of the data. The work under consideration fulfils neither of these requirements.

Again, the evidence obtainable from hyperfine structure work[6] is entirely neglected by Deb, and in fact is only in occasional agreement with his allocations of j values, although it is in harmony with Evans's observations.

Finally, Deb's value for the ionisation potential, 10·548 volts, is open to serious question. It is based on a very doubtful interpretation of an emission continuum with a maximum at 3406 A.; this is presumably that commonly known by the wave-length 3460 A. of its less refrangible edge. He attributes it on very slender evidence to the capture of an electron by an iodine atom in the $5p^4.6s.^2P_{3/2}$ state. The evidence against this interpretation need not be detailed here, but it is of a very convincing character. Although several Rydberg sequences are given they do not lead as usual to independent values of the ionisation potential, since the term values involved are based on the above assumption; neither can they be regarded, in view of various objections to them which can be raised, as affording any support to that assumption.

In view of these criticisms I am bound to say that our knowledge of the structure of the iodine spectrum does not appear to have been sensibly advanced by the paper under consideration.

Armstrong College, W. E. CURTIS.
Newcastle-upon-Tyne.
Feb. 27.

[1] Turner, *Phys. Rev.*, **27**, 397; 1926.
[2] Evans, *Proc. Roy. Soc.*, A, **133**, 417; 1931.
[3] Deb, *Proc. Roy. Soc.*, A, **139**, 380; 1933.
[4] Bloch, *Ann. Phys.*, **11**, 141; 1929.
[5] Wood and Kimura, *Astrophys. J.*, **46**, 181; 1917.
[6] Tolansky, *Proc. Roy. Soc.*, A., **136**, 585; 1932.

Line Absorption of Chromic Salts in Relation to Co-ordination

THE absorption spectra of salts of trivalent chromium are characterised by exceedingly narrow bands in the red part of the spectrum. Their presence in the spectra of co-ordination compounds of chromium was discovered by Lapraik[1] in 1890, whose work is the more remarkable for being completed prior to Werner's theory of co-ordination valency and therefore at a time when the peculiar structure of the compounds was unknown.

We have recently examined the aqueous solutions of a number of chromic compounds by means of a spectrometer and have noticed a very simple fact which would doubtless have been missed had we used a spectrograph. In the case of every compound studied, only *one* narrow band is sufficiently strong to be detected by visual observation of dilute solutions in short observation tubes. In many cases it is as persistent as the neighbouring broad 'molecular' absorption band, for on dilution both disappear at about the same concentration. For convenience we shall refer to this narrow band as the 'characteristic band' of the compound.

An interesting relationship has been established between the chemical constitution of a complex ion and the position of the characteristic band. It is evident from the accompanying table that as the three electrically neutral molecules of ethylene diamine (en) in $[Cr(en)_3]^{+++}$ are successively replaced by negatively charged oxalate radicles, the band moves farther into the red. The position of the characteristic band of a complex ion is sensibly unaffected by the accompanying anions or cations.

Molecular Ion	Approximate Position of Characteristic Band.
$[Cr(en)_3]^{+++}$	6705 A.
$[Cr(en)_2(C_2O_4)]^{+}$	6845 A.
$[Cr(en)(C_2O_4)_2]^{-}$	6915 A.
$[Cr(C_2O_4)_3]^{---}$	6970 A.
$[Cr(H_2O)_6]^{+++}$	6695 A.

The condition of chromic ion in violet solutions of the simple salts is, presumably, $[Cr(H_2O)_6]^{+++}$, and the nearness of its characteristic band to that of $[Cr(en)_3]^{+++}$ is noteworthy. When a solution of chromic sulphate is boiled, sulphate ions displace water molecules from the complex and the green colour is thought to be due to $[Cr(H_2O)_4\ SO_4]^{+}$. We find the characteristic band of the green solution appears, much broadened, at about 6820 A., which is in qualitative agreement with this point of view. Similar results have also been obtained with green solutions of chromic chloride in which one or more chloride ions have entered the co-ordination sphere.

We consider that the bonds uniting ethylene diamine and oxalate radicles to chromium are predominantly, though not purely, covalent, since all these complex ions can be resolved into pairs of optical isomers[2]. The presence of extremely narrow bands in their spectra is at first sight surprising, since such bands are usually associated with electron transitions in free ions, as for example, those of certain rare earth metals[3]. However, the phenomenon is quite in harmony with Linus Pauling's 'model' of the molecular ion[4], for *even when co-ordinated*, chromic ion possesses three unpaired electrons and it may be supposed that the absorption of a quantum of red light produces an excited state in which the spin moments of two of the electrons cancel one another, the multiplicity being thereby reduced from four to two. Thus arises the possibility of pure electron transitions in a covalently linked molecular ion. On the other hand, the co-ordination compounds of cobaltic ion contain no unpaired electrons and no unoccupied 3*d* levels, so electron transitions of the type described above are clearly impossible. Certainly we have been unable to discover any narrow bands in the absorption of $[Co(en)_3]^{+++}$, $[Co(C_2O_4)_3]^{---}$ or $[Co(CN)_6]^{---}$ within the visible spectrum.

C. H. JOHNSON.
Department of Chemistry, A. MEAD.
University, Bristol.
Feb. 7.

[1] *J. prakt. Chem.*, **47**, 305; 1893.
[2] Johnson, *Trans. Far. Soc.*, **28**, 845; 1932.
[3] Freed and Spedding, *Phys. Rev.*, **34**, 945; 1929.
[4] *J. Amer. Chem. Soc.*, **53**, 1367; 1931.

Mycorrhiza in the Genus *Citrus*

RECENT experiment points to a close and direct correspondence between the incidence and character of mycorrhizal infection and differences in the rooting medium. In view of the existence of mycorrhiza as

a regular phenomenon in many crop plants, it appears likely, therefore, that intensive study of the soil conditions controlling its development may be a matter of practical importance to growers.

Although experimental research in the hands of a few specialists has yielded and continues to yield remarkable results for certain specialised groups, ignorance is still profound in respect to the significance and control of the widespread and apparently relatively unspecialised mycorrhiza known as the 'Phycomycete type'[1]. Recorded in an immense number of wild herbaceous species belonging to the most diverse families and from the most varied habitats, and also in a few trees, mycorrhiza of this kind has been observed in certain crop plants of economic importance; for example, strawberry[2], sugar cane[3], wheat[4], and the lychee[5]. It is of some interest, therefore, to place on record its existence in the genus *Citrus*; both in the sweet orange, *C. sinensis*, and the sour orange, *C. aurantium*, in the orchards of southern California. Previous records for the genus from Italy are fragmentary and unsatisfactory[6].

The roots of the cultivated orange are remarkably poor in root hairs, especially when grown in the neutral or alkaline soils of California. As observed in roots of trees from the experimental field plots at this Station, there is a regular and quite characteristic distribution of mycelium bearing large 'vesicles' in the young roots, involving inter- and intracellular infection with periodic digestion of the intracellular system of hyphæ and their contents.

Since oranges and other citrus fruits are cultivated under highly artificial conditions in California and elsewhere, it will be of interest to learn whether there is a similar type of root infection in the species used as stocks when growing wild in their native habitats.

The practical significance of the problem lies in the importance of nitrogenous manures in *Citrus* culture in California, where some form of this element is practically the only fertiliser employed. Experience has shown that nitrogen supplied as sodium nitrate or similar inorganic compounds gives poor results, whereas sodium nitrate treatments combined with stable manure or rapidly decomposable organic matter in the form of cover crops are highly beneficial.

No adequate explanation of these differential results has yet been offered, and the discovery of this type of mycorrhiza suggests that the organic materials supplied to the soil furnish appropriate food for the root fungus and provide the conditions requisite for root infection, a proportion of the metabolised products passing eventually to the root cells during the regular and extensive digestion of intracellular mycelium.

The application of pure culture methods to the problems presented by the mycorrhizal habit has proved the existence of mutualistic relations of fundamental importance in the economy of the vascular hosts, and older theories respecting the nutrition of mycotrophic plants must be reviewed and tested in the light of modern experimental methods. In the case of *Citrus*, carefully devised experiments and comparative observations on roots of trees subjected to different kinds of manuring in orchard plots should provide evidence of the correctness or otherwise of the hypothesis outlined above.

In view of the heavy cost of manuring in Californian orchards and the inconsistent responses shown by the trees, it is clearly of importance to ascertain whether different treatments and results can be related directly and invariably with the condition of the roots in respect to fungus infection.

M. C. RAYNER.

The Citrus Experiment Station,
University of California,
Riverside, California.

[1] Peyronel, B., *Rev. Biologia*, 5, **6**, 3; 1924.
[2] O'Brien, D. G. and M'Naughton, E. J., *West of Scotland Agric. College Research Bull.* No. 1, 1928.
[3] Ciferri, R., *Phytopath.*, **18**, 249–261; 1928.
[4] Peyronel, B., *Bull. mens. inform. e not. della R. Staz. Pat. Veg.*, Roma, **3**, 43–50; 1922.
[5] Coville, F. V. "The Lychee (Litchi chinensis), a Mycorrhizal Plant." From Groff, G. W. "The Lychee and Lungan", New York, 1921, pp. 151–152.
[6] Peyronel, B., loc. cit. (4).

Number of Mendelian Factors in Quantitative Inheritance

IN a note in the current *Eugenics Review* entitled "Evolution by Selection", "Student" has directed attention to some statistical consequences of the inheritance of quantitative characters, in relation to the theory that these are due to the cumulative effect of a number of ordinary Mendelian factors.

"Student" refers in particular to the remarkable selection experiment carried out by F. L. Winter[1], in which a commercial variety of maize was exposed to mass selection from year to year in two diverging lines for high and low protein, and in two more for high and low oil content. For protein the initial value was about 11 per cent with a standard deviation of a little more than 1 per cent, but in the average of the last three years the mean of the high selection line is 16·82 per cent while that of the low selection line is less than half that value, namely, 7·53 per cent. The aggregate change produced by selection in both directions is thus 9·39 per cent, or more than nine times the original standard deviation.

With respect to variability, it may be noted that the high line now varies from 13·4 to 19·8 per cent, while the extremes for the low line are 5·7 and 10·5 per cent; so that the two lines are now separated by a considerable gap, and therefore cannot possibly have any single genotype in common. The variability of the low selection line has shown a slight tendency to diminish, and that of the high selection line a slightly greater tendency to increase, so that no general tendency to a decrease in variability ascribable to selection is to be observed; thus, there is no reason to think that the selective potentialities of the material have been appreciably exhausted in producing the great modification which has been brought about.

"Student" contrasts these well-substantiated facts with the belief, widely held among geneticists not so many years ago, that the selection of small differences (fluctuations) can only lead to unimportant evolutionary effects. They may also be contrasted with the oft-repeated statement that selection can do no more than select the best of the existing variety of genotypes, and with the commonly taught belief that the diversity available for selection is easily exhausted, from which it is inferred that evolutionary progress must wait upon the occurrence of mutations. It was, indeed, often represented as consisting in these occurrences.

The results obtained with oil-content have been even more striking; for the high oil line now contains nearly six times as much as the line selected for low oil content, and differs from it by more than

twenty times the original standard deviation. "Student" uses these data, together with reasonable estimates of the intensity of selection, to obtain an estimate of the least possible number of factors which must be postulated to obtain the results up to the date of the report; he concludes that at least 100–300 factors would be needed; and, taking into account the complete lack of evidence that selection is nearing its limit, considers that it is more probable that the actual number of factors is measured in thousands.

Estimates of the number of factors needed to explain quantitative inheritance are beset with considerable difficulty, and "Student" has admitted to me in correspondence that his calculation fails from over-simplification. Other well-established phenomena in maize, however, such as the flood of recessive defects revealed by every plant which has been used to found a selfed line, combined with the inevitable rarity of each of these defects, taken individually, in the population from which the foundation plant was selected, force one to the conclusion that all commercial varieties must be segregating in hundreds, and quite possibly in thousands of factors influencing the normal development of the plant. This emphatic experience, has, I believe, killed among maize breeders all those doctrines concerning the supposed inefficacy of the selection of minute differences, with which the teaching of modern genetics was at first encumbered.

It should be emphasised that the result of importance for evolutionary theory is not that the number of factors must be very large, thousands for example, rather than hundreds, but the direct demonstration that selection has the exact effects that selectionists have ascribed to it, without the limitations by which its action has been supposed to be restricted, on the strength of an early misapprehension as to the number and variety of the Mendelian factors exposed to its cumulative action.

R. A. FISHER.

Rothamsted Experimental Station,
Harpenden.
Feb. 15.

[1] *J. Agric. Res.*, **39**, 451–476; 1929.

Fourier Analysis and Vowel Curves

IN NATURE of December 24, p. 965, Prof. E. W. Scripture discussed difficulties in applying Fourier analysis to recorded vowel curves, and he published two illustrations of the latter. The second of these, or at least what the corresponding curve would have been if the process of ground noise suppression had not been used in the recording, is strikingly similar to a curve I once drew up to illustrate complex modulation of a carrier wave in radio. The 'interior waves' correspond to the carrier wave, and the regular repetition or pattern corresponds to the so-called 'modulation envelope'.

This suggests that an alternative method of analysis, the applicability of which to a vowel curve similar to that published might repay investigation, would be to consider the vowel curve as that of a 'carrier note' undergoing modulation, the modulation being not necessarily sinusoidal but perhaps more complex. For example, the 'modulation envelope' of the published curve approximates to a saw-tooth form.

This method of analysis might not really be an alternative to Prof. Scripture's method, and might only be an alternative method of stating the latter. An artificial 'vowel curve' corresponding to saw-tooth modulation or other arbitrary modulation would make an interesting test of Prof. Scripture's and of other methods of analysis. Incidentally, such an artificial vowel curve could fairly easily be recorded and reproduced, and the electrical equivalent of it could be generated and reproduced directly without recording.

It may be worth while considering the bearing on these considerations of the fact that a modulated wave may be analysed into a carrier *plus* side-bands. A wave form approximating to a 'saw-tooth' modulated carrier can be constructed out of the carrier and a small number of side bands, all undamped waves. The general appearance of such a wave form would be similar to that of the vowel curve published, and therefore would afford (though in this case erroneously) just as strong grounds for holding that the wave form was inconsistent with analysis into undamped waves and that it required an analysis into damped waves.

The point which emerges from this is that Fourier analysis is not the only analysis into sinusoidal components. Consider a sinusoidally modulated carrier represented by $A(1+k\sin pt+\alpha)\sin\omega t$. If the carrier frequency, $\omega/2\pi$, is much greater than the modulation frequency, $p/2\pi$, the resulting wave form *seems* to be periodic at frequency $p/2\pi$, because the modulation envelope is periodic at this frequency. Close examination of the curve, or mathematical examination of the formula, shows, however, that the carrier waves in one cycle of the modulation frequency are situated differently with respect to the modulation envelope from those in another cycle, there being a phase difference. Unless ω is a multiple of p, the wave is not periodic at frequency p, and unless ω and p are commensurate there is no true period at all. Fourier's analysis is therefore not applicable, but this does not prove definitely that analysis into sinusoidal components is not possible.

R. H. NISBET.

24, Penwerris Avenue,
Osterley, Middlesex.
Jan. 27.

Photography of Faint Transient Light-Spots

PROF. H. HARTRIDGE in his letter in NATURE of January 21, expresses the need for "A lens having a numerical aperture of 0·8 or 0·7, a focal length of 25–50 mm. and adequate definition on the film over an area of 3–5 mm." It is perhaps not commonly noticed that a Mangin lens-mirror out of a motor-car headlight has just about this specification. I have used such a mirror to photograph a cathode ray oscillogram. The definition, though not what one would desire, was yet good enough to be useful.

Apparently there is no other commercial type of optical system that has both the large numerical aperture and the long focal length required, together with passable definition; but I should be glad to be corrected. The tiny image of an achromatic substage condenser was spoilt by scattering in the emulsion.

Some Mangin mirrors are purposely made with considerable spherical aberration on the axis, of a type thoroughly described by A. C. W. Aldis[1]. This aberration can, I find, be very simply corrected by placing a block of glass, having plane parallel faces,

so that the rays converging from the mirror traverse the block and form the image on its outer surface. The principle is the same as that of the correction of the aberration of a microscope objective by using a coverslip of the correct thickness. But the thickness required is very much greater. By piling up plates, I find that 4·8 cm. of crown glass, $\mu_D = 1{\cdot}51$, is just right for an old naval mirror marked "5·25 ins. optical focus". The block does not make the coma worse, and only slightly increases the colour aberration. In a photograph taken with this system working at a numerical aperture of 0·5, point-objects appear as disks 1 mm. in diameter. This holds over an area of about 1·5 cm. diameter on the photograph. The merit of this arrangement of a mirror and block is its cheapness. Better, but presumably costly, lenses for photographing faint objects have been described by Rayton[2], also by McLennan and Ireton[3].

L. F. RICHARDSON.

Technical College,
Paisley.
Feb. 25.

[1] A. C. W. Aldis, *Trans. Optical Soc.*, **21**, 113; 1920.
[2] W. B. Rayton, *Sci. Abs.*, A 3987; 1930.
[3] J. C. McLennan and H. J. C. Ireton, *Proc. Roy. Soc.*, A, **129**, 31; 1930.

Constitution of Vitamin C

IN a recent communication[1] Micheel and Kraft have proposed a structure for ascorbic acid of a furane-carboxylic acid type. This structure was considered by us some months ago, and although attractive as explaining many of the chemical properties, we did not put it forward, principally on the ground that it would not satisfy the crystallographic requirements; these are, briefly[2], that the pseudo-symmetry, optical properties and the thinness of the molecule demand a structure which is almost completely flat. Unless the disposition of the carbon valencies in ascorbic acid is entirely novel, a molecule of the structure proposed by Micheel and Kraft would certainly not meet these requirements. These objections, which were considered in detail by us before the publication of our previous note[3], still hold, and they apply also to variants of Micheel and Kraft's structure containing ethylene oxide or pyranose rings.

E. G. COX.
E. L. HIRST.

Chemistry Department,
The University, Birmingham.
March 3.

[1] NATURE, **131**, 274, Feb. 25, 1933.
[2] NATURE, **130**, 205, Aug. 6, 1932.
[3] NATURE, **130**, 888, Dec. 10, 1932.

Substituted βγ-Diphenyladipic Acids and Derivatives of Chrysene

PROF. R. ROBINSON and Mr. G. R. Ramage in a recent letter[1] state that they are engaged in the synthesis of certain substituted βγ-diphenyladipic acids and of certain derivatives of chrysene. I have been working in this field for some years and work in progress, or projected, in part in collaboration with research students, includes the synthesis of substituted βγ-diphenyladipic acids derived from *o*-, *m*-, and *p*- chloro-, bromo-, iodo-, hydroxy-, methoxy-, nitro-, amino- and dimethylamino- benzaldehyde and from veratrole and piperonal via the benzylidene malonic esters[2] and cinnamic esters[3] with the object of (*a*) effecting the optical resolution of both forms, (*b*) their conversion into derivatives of chrysene[4], and (*c*) their conversion into derivatives of possible therapeutic and industrial value. The research on the reduction of substituted cinnamic esters has been assisted by grants from the Chemical Society in June 1930 and 1931.

A. I. VOGEL.

Woolwich Polytechnic, S.E.18.
Feb. 18.

[1] NATURE, **131**, 205, Feb. 11, 1933.
[2] Vogel, *J. Chem. Soc.*, 1014; 1928.
[3] Oommen and Vogel, *J. Chem. Soc.*, 2148; 1930; Oommen, Ph.D. Thesis, London, 1929; compare Henle, *Annalen*, **348**, 16; 1906.
[4] Compare von Braun and Irmisch, *Berichte*, **64**, 2461; 1931.

Wave Equations and the Conservation of Energy

IN Dirac's "Quantum Mechanics" the "equation of motion" satisfied by any observable ξ not involving the time explicitly is

$$(i\,h/2\pi)\,\dot{\xi} = \xi H - H\,\xi$$

where H is the Hamiltonian. The conservation of energy, when H does not involve the time explicitly, is deduced from this by putting $\xi = H$, giving $\dot{H} = 0$.

Another fundamental assumption of Dirac's theory is his form of wave equation, which imposes another condition on H. He points out that it is legitimate to assume the quantum conditions only for one particular time and then investigate whether they hold for all time, but a similar limitation, which appears to hold for the wave equation, seems to have been overlooked. The condition that the wave equation may hold for all time leads to an equation which expresses the conservation of energy. We thus have two conditions that it seems desirable a wave equation should satisfy, leading to the conservation of energy and charge.

It is known that the second condition is satisfied by Dirac's linear equation and also by Schrödinger's non-relativistic equation, but not by the second-order relativistic equation. I have proved (in the course of work not yet published) that the first condition also is satisfied in the same two cases. These facts seem to provide a stronger reason for rejecting the second-order relativistic equation than those usually given.

A. LEES.

University College,
Nottingham.
Jan. 26.

Band Spectra of Barium Oxide (BaO)

IN the flame of the arc between carbon electrodes containing barium chloride or nitrate, a class of red-degrading bands appear between $\lambda\,4300 - \lambda\,8000$. These have been attributed to the oxide of barium and analysed into two systems with their (0,0) bands at 17,713 ν and 16,060 ν respectively. The rotational structure analysis of (0,1), (0,2) and (1,1) bands for the less refrangible system and (1,0), (0,0), (0,1) bands for the more refrangible system have been done. The two systems have a common lower level, and are due to $^1\Sigma$, $^1\Sigma$ transitions. In the lower state, $B'' = 0{\cdot}3075$ cm.$^{-1}$. The detailed account of the analysis will appear elsewhere.

P. C. MAHANTI.

Applied Physics Department,
University College of Science,
92, Upper Circular Road, Calcutta.

Research Items

Heathen Baptism in Early Britain. A communication from Miss Eleanor Hull in *Folklore* (vol. 43, pt. 4) brings together evidence from various sources bearing on the existence of baptism as a pre-Christian rite in Britain. The fact that it is found in Wales, where Scandinavian influence was small, seems to point to the fact that it had an independent origin in these islands and was not introduced by Norse or Danes. Among the Scandinavian races, pre-Christian baptism, as the sprinkling of the child with water which accompanied the bestowal of a name, was an integral part of the Asa creed. It established a bond between baptiser and baptised, sometimes constituting the latter the heir of the former. The Norse practised lay baptism without religious ceremony; but in Ireland a regular rite, at which Druids officiated, was carried out. Aillil Olum, who succeeded to the throne of Munster early in the third century, was baptised by the Druid who foretold the marriage of his father Eoghan and by his prognostication fixed the propitious day of the marriage. The 'heathen baptism' is also mentioned in the Irish version of "The Travels of Sir John Mandeville" in connexion with the circumcision of Isaac and Ishmael. The tales of the Mabinogion give several instances of heathen baptism, as for example in "Pwyll, Prince of Dyved" and in "Math, Son of Mathonwy". Scottish folk-tales give fewer examples; but in the story of "The Knight of the Red Shield" the knight, it is prophesied, shall be unbaptised "until he shall come to an island and strike a crag of stone on a man". In the Fenian tales baptism is taken as a matter of course by the heroes; and it is considered by Dr. J. A. MacCullock that the Scottish custom of dropping three drops of water on the forehead of a child immediately after birth is a relic of the rite of pagan baptism.

Ancestor Spirits among the Nuba. Mr. D. Hawksworth, in recording some observations among the Nuba of Southern Kordofan (*Sudan Notes and Records*, vol. 15, pt. 2), deals with the cult of ancestral spirits and its relation to the spiritual and secular headship of the social group. The veneration, almost amounting to worship, of the ancestral spirit is the basis of their religion, their exceptional tribal patriotism, their reluctance to leave the home of their ancestors, their reverence for the elders, and so forth. All communications are addressed, not to God, but to the ancestral spirit, and from it come all punishments for sin. Communications to the ancestral spirit are made through the *kujurs*, tribal priests, the mediums of the ancestral spirits, who seize upon them on occasion and throw them into a trance. The office of *kujur* is not hereditary, as the spirit may seize upon anyone; but as a rule, especially in a family group, the ancestral spirit seizes one of the offspring of the deceased *kujur*. *Kujurs* fall into two categories: the great *kujurs* who are seized by the spirit of the original ancestor of the tribe, and the lesser *kujurs* of the family group, who generally specialises in some branch of culture. The great *kujurs*, except in certain tribes which have kings, are the patriarchal heads of the tribe, exercising both spiritual and secular powers. They are entitled to the slaves and booty taken in war, they receive the bride-price of female orphans, and when a male orphan has no family head, they pay the bride-price on his behalf. The *kujur* makes the necessary communications and offerings at stated times to the ancestral spirit, and receives tribute on his behalf. The office is not confined to males; but when a female *kujur* is appointed, her husband immediately runs away.

Stork in Western Europe. Press notices on the Continent frequently state that the white stork (*Ciconia ciconia*) is becoming scarce in western Europe and that its final disappearance is probable. But the stork has never been very common in western Europe, where, as a bird of Asiatic origin, it is at the limit of its range. Nevertheless, according to Jan Sokolowski, the progress of civilisation, particularly as shown in the draining of marshes, has made more difficult the life, and still more difficult the multiplication of storks, so that in some districts of Germany their numbers have been reduced by as much as 60 per cent. The protection of the stork now in force throughout Germany had become necessary, and that it has been efficient is evident from the latest reports, which state that the number of nests in Eastern Prussia has risen to 9,200. In Poland, east of the Vistula, storks are more numerous than in western Europe and the appearance of birds in greater numbers of nesting pairs makes it certain that there the stork is in no danger of extermination (*Ochrona Przyrody*, Warszawa, 12, p. 1, 1932).

Fauna of Hot Springs in North America. In the summers of 1923, 1927 and 1930, Charles T. Briers visited hot springs in the Yellowstone National Park, and in the adjoining States of Utah, New Mexico, Nevada, California and Idaho for the study of their fauna. The present paper is his third on the subject (*Proc. Amer. Acad. Arts Sci.*, 67, No. 7, 1932). In such thermal springs special limiting factors are associated with the abnormally high temperature of the water, the highly variable hydrogen ion concentration, and the variable salinity, which is comparable to that of brackish water. The adaptation to high temperature extends over a narrow range of 5°–20° C., as the animals live at temperatures of 40°–60° C. instead of at 30°–40° C., which is the upper limit of existence for the majority of terrestrial and aquatic animals alike, including pœcilothermic and homœothermic types. As to how the peculiar adaptations of the hot springs' fauna arose, the author is uncertain: perhaps naturally resistant forms were selected, perhaps the constitution of the species has changed towards greater heat-resistance, perhaps the simpler forms are relics of a primordial fauna which has always lived at high temperatures, but the last case is not very likely.

Chromosome Numbers in Vertebrates. Attention may be directed to a useful list of chromosome numbers in vertebrates, compiled by Messrs. K. Oguma and S. Kakino (*J. Genetics*, vol. 26, No. 2). Many of the earlier counts in birds and mammals were clearly much too low, due to clumping and inadequate fixation of the chromosomes. Twelve appears to be a common haploid number both in fishes and amphibians, 11 also being found in certain fishes and toads. Several recent papers conclude that in reptiles, as in birds, the male is *XX* as regards its sex chromosomes, the female being the heterozygous sex. In general, the chromosome numbers in reptiles are higher than in amphibia, where 12 is the commonest

number. Disregarding the earlier and inaccurate counts, the numbers in birds are high in the few species in which a critical study has been made, for example, 38 in the duck, turkey and fowl. Among mammals the numbers are relatively low in marsupials ($n = 6$ to 11), although some of these numbers may require revision upwards. In other mammals they appear to range so high as $n = 43$. As regards man, the $2n$ number 48 and the presence of an XY pair in the male has recently been confirmed by Minouchi and Ohta.

Temperature and Seed Germination. A review by Thos. I. Edwards of great interest to seed-testing laboratories has recently appeared (*Quart. Rev. Biol.*, 7, No. 4, 428–443, 1932) entitled "Temperature Relations of Seed Germination". The conception of the term 'optimum temperature for germination' is shown to be capable of several interpretations, which are discussed in the paper. The minimum and maximum temperatures for germination are also investigated. Many instances where seeds of wheat and other plants have started to grow on ice are given. The highest temperature of germination seems to be that of *Pinus rigida* at 57° C. The paper contains much interesting information about the behaviour of various seeds at different temperatures, but its main result is apparently a vindication of the generally accepted standards of temperature at present employed by seed-testing stations.

Ultra-Violet Light and Fungi. The effect of ultra-violet light on various species of *Fusarium* has recently been studied in detail by Alice A. Bailey (*Bot. Gaz.*, 94, 225–271, 1932). Rays from a quartz mercury vapour lamp were directed on to agar cultures through suitable ultra-violet transmitting screens which were used as the lids of the respective culture dishes. Irradiation always slowed up the radial growth of a culture as compared with a control in ordinary light, and often the growth appeared zoned or had other physical differences. The colour of *Fusarium* colonies was often altered as a result of the influence of ultra-violet rays. The most pronounced effect was in the substitution of microspore for macrospore formation in many species. Exposure to the treatment was made for periods of 15 minutes on each of three successive days, and the culture was placed at a distance of 40 cm. from the lamp. The absence of a filter produced very deleterious effects upon fungus cultures.

Carboniferous Molluscs of the Donetz Basin. The first monograph of Carboniferous pelecypod molluscs found in the Donetz basin in south Russia, just published by D. M. Fedotov (Trans. Geol. Prospecting Service, U.S.S.R., fas. 103) includes detailed critical descriptions and good plates of 120 species. An interesting result of the work is that only 21 out of 120 species have been previously known from the Carboniferous of Western Europe, and a few are Russian species, while the bulk of the Donetz species proved to be either identical with, or closely related to, North American species. The species common to the Donetz basin and North America belong mainly to the Upper and Middle Carboniferous, which correspond to the strata known as Pennsylvanian in America.

Age of Meteor Crater. It is reported by Science Service that recent investigations by Prof. Eliot Blackwelder indicate that Meteor Crater, the great pit in northern Arizona that is believed to mark the impact of a flight of meteorites, is probably very much older than has generally been assumed. Past estimates have ranged from two to ten thousand years, but it is now suggested that the crater was made during the last interglacial epoch, perhaps 40,000–75,000 years ago. The evidence includes indications of a former moist climate that was of relatively long duration. At the bottom of the crater there is a deep deposit of finely pulverised quartz with many remains of diatoms and snails, interbedded with freshwater limestone, coaly material, and a single layer of volcanic ash that records an explosive eruption somewhere in the neighbourhood. The lake beds indicate a long-standing body of water, and not a succession of *playas* or seasonal ponds. At present, permanent water is not struck within 200 feet of the bottom of the pit. Other lines of evidence based on the erosive work of wind and water support the conclusions reached.

Ionisation in Electric Cables. The almost universal use of high electric pressure for the transmission of power to long distances has made it a problem of great commercial importance to increase the electric strength of the insulating wrappings round the cables so that they may be able to withstand for many years the high electric stresses to which they are continuously subjected. In a paper on "Ionization in Cable Dielectrics" read to the Institution of Electrical Engineers on March 9, P. Dunsheath discussed the rapid developments that have recently taken place in the manufacture of these dielectrics. Since its inception a few years ago, the oil-filled cable has given an excellent record of performance and this has perhaps diverted attention from the many thousands of miles of 'solid-type' cable which have been giving very satisfactory service at voltages up to 66,000 in all parts of the world. At 33,000 volts, trouble due to inherent dielectric failures is now almost unknown. The breakdown of cables is generally due to vacuous spaces called 'voids' in the dielectric. The electrical breakdown of the rarefied gas in a cable void is controlled by laws which so far are not completely established. When electrical stress is applied to gas in an enclosed space it first of all speeds up the movement of the relatively few ions present, without causing any of the usual visual or chemical effects of a discharge. When the ions are further accelerated, a stage is reached at which the ions split up neutral molecules by collision and the current through the gas rapidly increases. At this stage the effect is cumulative and a state of ionisation is attained. With our present knowledge, however, we cannot foretell the stress at which the breakdown occurs with any degree of precision. The author concludes that in high-voltage cable dielectrics the most important phenomenon is ionisation. This makes itself evident by increasing the total electric loss at a rate greater than the square of the applied voltage.

Photochemical Decomposition of Diazomethane. Kirkbride and Norrish (*J. Chem. Soc.*, Feb.) find that diazomethane, CH_2N_2, shows two regions of absorption, the first in the blue and violet, with a structure suggesting predissociation, and the second, very intense and continuous, in the ultra-violet beyond 2650 A. The primary photochemical process is an interesting one, since it appears to involve a simultaneous severance of both nitrogen atoms from the

molecule. The subsequent history of the CH_2 radical, leading mainly to ethylene and propylene, but also to other by-products, can be fairly satisfactorily traced. The quantum efficiency is 4–5 for light of wave-lengths 436 and 365 mμ. In no instance could an explosion (which is readily initiated thermally) be brought about by the action of light. There is thus no evidence for a reaction chain of any appreciable length, which is somewhat surprising in view of the strongly exothermic character of the decomposition. The primary process is most probably: $CH_2N_2 + h\nu = CH_2 + N_2$. The close resemblance between the absorption spectra of azomethane and diazomethane indicates that the azo-group is present in the latter, and supports the ring formula for diazomethane. When the reaction was carried out in presence of hydrogen, methane was produced in quantity, no doubt by interaction of CH_2 groups and hydrogen, and there was a corresponding suppression of secondary reactions.

International Atomic Weights. The Table of International Atomic Weights published in the February *Journal of the American Chemical Society* contains two alterations, namely, iodine = 126·92 (in place of 126·93) and lanthanum = 138·92 (in place of 138·90). The accompanying report directs attention to the prevailing uncertainty in the factor for the conversion of values from the physical to the chemical scale. Two values are in use, namely, 1·00022 and 1·00012, the first being supported by Aston's data for the intensities of the lines O^{16} O^{17} and O^{16} O^{18} for comparison with O_2^{16}. "Since the accuracy of the mass-spectrograph is admittedly no greater than 1/10,000 and the uncertainty of the conversion factor obviously is as large, while the measurement of isotopic ratios has inherent uncertainties, the degree of precision of the determination of atomic weights from mass spectrograph data still seems inferior to that of the best chemical methods, although the striking concordance of the two methods in most cases is reassuring". The case of the isotope of hydrogen, H^2, is mentioned. The mass is found by Bainbridge to be 2·01353, assuming He = 4·00216 and H^1 = 1·00778. The atomic weight of hydrogen, with a proportion of H^2 approximately 1 in 4,000 as found from the spectrum of ordinary hydrogen, is therefore slightly higher than the value of H^1 found by Aston. The discovery of additional isotopes of tellurium and their percentages has given (with the packing fraction -5×10^{-4} and conversion factor 1·00022) an atomic weight 127·58, in much closer agreement with the chemical value (127·5) than Aston's 128·03. It may be added that the value for the atomic weight found by Baker and Bennett in 1907 was 127·60, and although 127·5 is adopted in the actual International Table, most recent chemical values are nearer 127·6 than 127·5.

Astronomical Topics

Origin of the Planetary System. A new theory of the origin of the system is proposed by Dr. R. Gunn (*J. Franklin Inst.*, June 1932). Instead of the appulse of two stars, he postulates the fission of a single star by rotational instability. He supposes that the star originally rotated in a few hours, but that after fission the strong tidal action between the components slowed it down. While the two bodies were within Roche's limit, a certain amount of disintegration took place, which is supposed to have given rise to the planets. When the star split, one side of each component had been near the centre of the star when single, and was much hotter than the other side. The reaction of the intense radiation pressure from the hotter sides made the stars separate, and the other component is supposed to have receded to a stellar distance.

The author concludes that Mars must have originally had a large satellite, to increase the time of its rotation from a few hours (less than the 7½ hours which Phobos takes to go round) to its present value. He conjectures that this large satellite escaped, and may have split up to form the asteroid family. The author was led to his theory by the consideration that the close appulse of two stars is acknowledged to be extremely rare, while the prevalence of binary systems makes one suppose that the fission of a star happens frequently. Many of the details are speculative, but it is well in a problem of such difficulty to explore every possible avenue.

Hornsby's Observations of Mercury. Dr. J. Jackson took a large part in the new reduction of the observations made by Dr. Hornsby at the Radcliffe Observatory, Oxford, during the last quarter of the eighteenth century, and the observations of Mercury have recently been discussed (*Mon. Not. Roy. Astro. Soc.*, December). The question of the phase correction is a troublesome one, as it appears that Hornsby tried to observe the true centre; solutions have been made with and without corrections. Tabular places for the sun and Mercury were computed from Newcomb's tables to compare with the observations.

The most interesting point is the motion of the perihelion of Mercury; after reducing from Newcomb's precessions to those of de Sitter, Jackson finds that the excess of the motion over the Newtonian value is 43·1″ per century, with a probable error of 1″. The value deduced from Einstein's theory is 42·9″, a satisfactory agreement.

Rather a large correction is found to Newcomb's obliquity of the ecliptic, namely, 0·53″; it is pointed out in the paper that the evidence from other planets also points to a positive correction though somewhat smaller.

There are 349 observations of Mercury in the years 1774–1798; their reduction adds very considerably to our knowledge of the elements of this planet, and their secular variations.

Annuario del Observatorio Astronomico de Madrid, 1933. This useful almanac and handbook contains particulars of the various calendars in use in the world, extensive extracts from the nautical almanacs, monthly star-maps for the latitude of Madrid, and various geographical and physical tables. The comet table needs bringing up to date; it claims to give all comets that have been observed on their return but omits (*inter alia*) Grigg-Skjellerup, Neujmin I, and Pons-Coggia-Winnecke-Forbes. Also it gives Perrine's comet as observed in 1922, though this identity is highly improbable. On page 122 the mean annual motion of Pluto is given as 1° 45′; it should be 1·45°.

Work of the Forestry Commission*

THE 'forest year' of the Forestry Commission ends on September 30, and that date in 1931 brought to a close the twelfth year of its work. It was inevitable that operations and a policy that are dependent upon Government grants and a present non-productive expenditure should have been subject to a close scrutiny from the May Committee on National Expenditure.

For the second decade of the Commission's work, it had been estimated that the gross cost of the whole business (purchase of land, planting, etc.) and the ancillary operations such as assistance to private forestry, education, research, etc., would amount to £11,275,000 for the decade; working receipts were estimated at £2,160,000 and the net contribution from the Exchequer was expected to be £9,115,000. The chief objectives laid down during the second decade were to plant 353,000 acres and to establish 3,000 worker's holdings. The planting programme was to be on an expanding scale, beginning with 25,000 acres in 1929 and rising to 44,000 acres in 1938, while the holdings programme was to be at the rate of 350 holdings yearly for the first five years, and 250 holdings yearly for the second five years. In order to carry out these programmes, it would be necessary to acquire each year 6,000 acres of plantable land and 2,500 acres of agricultural land.

It has been already stated in NATURE (Sept. 17, 1932, p. 427) in a note discussing a paper by Sir John Stirling-Maxwell on "Forestry and National Economy" that the sum sanctioned for the above proposals received a severe cut at the hands of the May Committee, the majority report making the following recommendation: "After weighing up all these considerations we recommend that no fresh acquisitions of land be made for the present and that no more forest worker's holdings be created, but that afforestation proceed at the rate of 20,000 acres per annum for five years on the land already acquired. This course is estimated to save £478,000 next year and £560,000 per annum in subsequent years as compared with the present policy."

In subsequent discussions with the Government, the Commissioners stated that it was desirable to maintain the main elements of forest policy, which were, briefly, the continuance of planting and of the acquisition of plantable land, and the provision of sufficient houses and holdings to work the forests economically. After due consideration, the Chancellor of the Exchequer undertook that the Government would provide annually for the next five years the sum of £450,000 which, with working receipts, would enable the Commissioners to spend rather less than £600,000 a year on forestry operations.

With this sum at their disposal, the Commissioners anticipate that they will be able to carry out the following work: (1) Maintain a planting programme of 20,000 acres a year. (2) Acquire sufficient plantable land to keep intact the reserve of land which is required for maintaining the planting programme. (3) Provide sufficient forest worker's holdings (numbering perhaps 15–20 a year) for working the forests efficiently, and also repair and maintain such holdings as are necessary for the utilisation of the non-plantable land. (4) Provide grants for planting on the same scale as during the last three years. (5) Maintain intact their research activities and make suitable provision for forestry education and other ancillary activities.

The question of forestry on private estates has been receiving the attention of the Commissioners, and the Consultative Forestry Committees of England, Scotland and Wales were consulted and a joint report presented. This report stated that private forestry is not receiving the same attention as in pre-War days, in spite of the spread of technical knowledge and State encouragement. The causes for the decline during post-War years are admitted and well known to all. In the urgent need for national economy the joint report was unable to suggest any general solution. The Commissioners appear to be of opinion that the State, in the long run, might have to relieve the private owner of his responsibility in maintaining the woodlands of Great Britain.

Apart from the question as to whether this is a correct policy, either for the State or the tax-payer, it is open to doubt whether it is even a truly economic one. In France the State forests form about a third only of the total forest area, in Sweden 20 per cent and in Germany 25 per cent. With a reduction of taxation in Great Britain, with the available technical knowledge and the advantage of the presence in the country of the Forestry Commission, it may be hoped that the land owner will find it possible to follow in the footsteps of his confrères on the Continent. The disappearance of the private forest owner was evidently not contemplated by Lord Clinton, during his tenure of the chairmanship of the Commission. In an address delivered at the annual meeting in 1928 of the Royal Scottish Arboricultural Society (see NATURE of May 5, 1928, p. 697) Lord Clinton said: "I am not at all confident that the State can properly undertake the full duties of afforestation. I think the keenness of the general public, who in theory are very keen on forestry, is likely to evaporate directly they begin to understand the great cost which will fall on them if the State shoulders the whole burden."

Soon after the close of the year under review, the chairman of the Commission, Sir John Stirling-Maxwell, resigned. Of his work for Great Britain in the cause of forestry and that of his two predecessors, Lord Lovat and Lord Clinton, it is impossible to speak too highly. Sir Roy Robinson, a technically trained forester, now assumes the chairmanship. In spite of the fears of some well qualified to speak when the Forestry Bill was passed in 1919, there is little doubt that the new Forestry Department was only able to weather the stormy times of its first twelve years owing to its fortunes being in the hands of three such able and powerful land owners as the past triumvirate of chairmen.

The Report deals in general with the work of the year ending September 1931. The net total area of land acquired in Great Britain to this date was 627,075 acres, of which 393,448 acres were classified as plantable, 58 per cent being in England and Wales and 42 per cent in Scotland. The area planted during the year was 25,630 acres, the total area planted during the twelve years being 188,985 acres, of which 177,456 acres consisted of conifers and 11,529 acres of hardwoods.

An interesting item in the Report is the valuation

* Forestry Commission. Twelfth Annual Report of the Forestry Commissioners for the Year ending Sept. 30, 1931. Pp. 43. (London: H.M. Stationery Office.) 9*d*. net.

by the Inland Revenue authorities of the Crown properties transferred from the Office of Woods to the Forestry Commission. The chief of these were the New Forest and the Forest of Dean, the total valuation of which amounts to £1,227,495.

Under education and research the Report summarises the conclusions of the Irvine Committee on the training of candidates for Government forest services. The Commissioners pass no comment upon these conclusions which, it is understood, are receiving the careful consideration of the universities concerned.

Harvey and Preventive Medicine

A BRIEF account of Sir George Newman's Harveian Oration to the Royal College of Physicians of London appeared in NATURE shortly after its delivery (NATURE, Oct. 29, p. 657). The full text of the discourse has since been published in pamphlet form.*

In his discussion of the new physiology which was inaugurated by Harvey's demonstration of the mechanism of the circulation of the blood, Sir George Newman points out that in 1622, six years after Harvey's first Lumleian discourse and six before his book was published, the demonstration of the lacteals and lymphatic system by which nutriment reached the blood was made by Aselli, Pecquet and Rudbeck. In 1648 the chemistry of digestion and the blood was investigated by van Helmont. Ten years later, the corpuscles of the blood were discovered by Swammerdam and Malpighi, and in 1661 Malpighi revealed the existence of the capillaries, which had been suspected by Harvey who, in the absence of a microscope, had been unable to detect them. In 1669 the contributions to the physiology of respiration by Boyle, Hooke, Mayow and Richard Lower demonstrated the purpose and process of aeration of the blood in the lungs, its selective use of the oxygen in the air, its conveyance to the tissues by the blood, and the resulting vitality and functioning of the tissues.

In the succeeding century, the actual gases which control life—carbonic acid, nitrogen and oxygen—were separated and fresh knowledge of the nervous and digestive systems was acquired. In the middle of the nineteenth century the foundations of endocrinology were established by the work of Thomas Addison, Claude Bernard and Brown-Séquard, and since then the progress of physiology in Great Britain has been pre-eminent in quantity, quality and scope.

Sir George Newman next considers the application of these discoveries to preventive medicine. He points out that from the sixteenth century onwards, the research worker has collaborated with the private practitioner and the public medical officer in the prolongation of life and the prevention of disease. Striking examples of this statement are furnished in the eighteenth century by Lind and Sir Gilbert Blane in their defence of the health and the dietary of seamen, by William Cadogan, the pioneer in maternal and child welfare, and Sir John Pringle, who reformed the health of the Army. In recent times the labours of modern physiologists have contributed not only to the conservation of health but also to the prevention and cure of disease, as is exemplified by their work in connexion with cretinism, goitre, diabetes, anæmia, malnutrition, deficiency diseases, beri-beri, osteomalacia, scurvy and rickets.

The study of the cause and control of infective diseases is taken by Sir George Newman as another example of the Harveian method and spirit. The conveyance of infection by the circulating blood was acknowledged by Harvey's contemporaries, such as Glisson and Sydenham in the seventeenth century, and by the eighteenth century physicians who explored the circumstances and clinical features of infective diseases and observed their relation to external environment, to seasons and to meteorological conditions. Examples of such men were Huxham, who investigated typhoid, typhus, Devonshire colic, scurvy and scarlet fever; Heberden, who studied chicken-pox, measles and epidemic colds; Fothergill, who described epidemic sore throat; Haygarth, well known for his work on small-pox and typhus; Edward Jenner, who introduced vaccination, and Willan, the father of British dermatology. It is noteworthy that in spite of the absence of any exact knowledge of the causation of disease, which was not reached until the advent of bacteriology in the later half of the nineteenth century, two significant conquests were achieved by the English before the end of the eighteenth century in the control of scurvy and of small-pox.

The production of artificial immunity, which Sir George Newman rightly regards as the greatest single advance in preventive medicine, is chosen by him as yet another example of the application of the Harveian method. Although the protective qualities of the blood were known to Harvey, it is only within comparatively recent times that an explanation of this property has been found, thanks to the work of Pasteur, Lister, Metchnikoff and Sir Almroth Wright.

* "The Debt of Preventive Medicine to Harvey and the College of Physicians." (Harveian Oration, 1932: The Royal College of Physicians of London.) By Sir George Newman. Pp. 47. (The British Periodicals Ltd., 19 Cursitor Street, E.C.4.) 1*s.* net.

Spreading of Liquids on Solid Surfaces

IT is generally supposed that on metals as well as on water the fatty oils and fatty acids should possess a more pronounced spreading tendency than the mineral oils, yet experiments show that this is not the case. Buckley and Snyder (*J. Amer. Chem. Soc.*, Jan.) have confirmed this observation and have discovered an interesting phenomenon of rupture of thin layers of liquid on a solid surface due to the instability created by an underlying adsorbed film of low surface energy. Fatty oils and fatty acids lower the static coefficient of friction between metal surfaces more than do mineral oils of the same viscosity, and a mineral oil containing a small percentage of a fatty acid lowers the friction almost as much as a pure fatty oil. This is in agreement with a preferential adsorption of fatty acid on the metal surface, indicating that these acids lower the surface tensions of metals more than do mineral oils.

Mineral oils which spread rapidly on ordinary metal surfaces seem to have no spreading tendency on a metal surface covered with an invisible fatty acid film. When a drop of petroleum oil containing

some fatty acid is placed on a polished plate, the mineral oil spreads in its normal manner, the fatty acid being preferentially adsorbed on the solid and lowering the surface tension until at a minimum thickness of liquid layer, rupture of the film occurs.

Any portion of oil in the midst of an area covered with an adsorbed film pulls itself together into a drop, whilst the oil in contact with clean metal continues to spread outward. It is supposed that fatty oils and fatty acids are prevented from spreading on metal surfaces by the great reduction in the surface energy of the metal which is brought about to some distance in advance of the spreading layer by the breaking away of an expanding ring or by the condensation of vapours.

University and Educational Intelligence

CAMBRIDGE.—Dr. N. J. T. M. Needham, of Gonville and Caius College, has been appointed Sir William Dunn reader in biochemistry in succession to Prof. J. B. S. Haldane.

V. J. Chapman, of Pembroke College, has been elected to the Frank Smart studentship in botany.

The following have been awarded Smith's prizes: E. A. Maxwell, Queens' College, for an essay entitled "The Invariants of Certain Surfaces" and R. H. Stoy, Gonville and Caius College, for an essay entitled "The Planetary Nebulæ". Rayleigh prizes have been awarded to the following for the essays indicated: W. E. Candler, Trinity College, "The Stability of the Rings of Saturn"; C. Strachan, Corpus Christi College, "Reflection by Monomolecular Films"; M. H. H. Walters, King's College, "The Effect of Stellar Encounters on the Orbits of Binary Stars".

EDINBURGH.—The Senatus has resolved that the honorary doctorate in laws be offered to the following: The Right Hon. Craigie Aitchison, Lord Advocate; Sir James Caw, formerly director of the National Galleries of Scotland; Sir Henry Dale, director of the National Institute for Medical Research; Prof. G. H. Hardy, Sadleirian professor of mathematics, Cambridge; Sir Alexander Houston, director of water examination, Metropolitan Water Board; Sir Hugh Rose, chairman of the General Board of Control for Scotland; Mr. J. C. Smith, formerly senior inspector of schools in Scotland; Mr. W. W. Tarn, author of works on the Hellenistic age.

LONDON.—The Armourers and Brasiers' Company and the Carpenters' Company have decided to make grants to the University of £2,000 and £1,000 respectively in the shape of annual payments extending over ten years; and the Ironmongers' Company has granted £500 and the Dyers' Company £105. These benefactions will be applied towards meeting the cost of the new Ceremonial Hall to be erected on the University's site in Bloomsbury.

A munificent bequest by the late Mr. Arthur L. Leon amounting to some £20,000, for the promotion and encouragement of post-graduate or advanced research work, has been accepted with great appreciation.

The Court has appointed Mr. James Stinton Jones to be consultant engineer for heating, lighting, ventilation and electrical services generally, in connexion with the new buildings in Bloomsbury.

THE Salters' Institute of Industrial Chemistry is offering several fellowships for chemists of post-graduate training, and grants-in-aid to people employed in chemical works who desire to extend their education for a career in chemical industry. Further particulars can be obtained from the Director of the Institute, Salters' Hall, St. Swithin's Lane, London, E.C.4.

THE Cecil Peace Prize of £100 is offered annually to graduates or students in any university in Great Britain or Northern Ireland for the best essay on some subject connected with the maintenance of international peace. The subject for 1933 is "Is it true that the British Empire is in itself a League of Nations?" Further particulars can be obtained from the Secretary, Universities Bureau of the British Empire, 88a, Gower Street, London, W.C.1.

THE annual examinations for a Faraday scholarship of eighty guineas per annum, tenable for two years at the Faraday House Electrical Engineering College and one year in manufacturing works, and for a Maxwell scholarship of sixty guineas per annum, tenable for two years at the College and one year in works, will be held at Faraday House on April 4–6. Further particulars can be obtained from the Registrar, Faraday House Electrical Engineering College, 62–70, Southampton Row, London, W.C.1.

THE University of Leeds has recently issued a list of holiday courses open to all students, whether former members of the University or not, to be given during the Easter vacation, on April 19–21. Amongst the courses are one on modern psychological principles by Dr. Ll. Wynn Jones and a course of six lectures in physics, comprised of two by Prof. R. Whiddington on "Recent Advances in our Knowledge of the Electron", two by Dr. E. C. Stoner on "Recent Developments in Magnetism", one by Mr. J. Ewles on "The Photoelectric Effect" and one by Mr. F. A. Long on "Recent Low Temperature Researches". Further information can be obtained from the Registrar of the University.

THE objectives of secondary education are being much discussed in the United States as well as in Great Britain. In the October number of *School Life*, the organ of the United States Federal Office of Education, appears an article by one of the senior staff on "Schools and the Social Upheaval" in which it is argued that a primary function of education, particularly in the high schools and colleges, is to prepare the rising generation for playing their part intelligently in the solution of social, economic and civic problems. Why should the people pay in taxation two and a half billion dollars yearly to support a public school system unless it believes that an educated public is the surest safeguard of its freedom? It is because the high schools, patterned largely on the model of the colleges evolved to serve leisured and professional classes, have failed to adapt their teaching to the task of justifying this belief that the type of education they provide is being found inadequate to present-day needs. To fulfil their task of passing on the accumulated wisdom of one generation to the next the schools must expound the beliefs of acknowledged experts in regard to social and economic affairs, and in the readjustment now due, this function and character training should, it is contended, be treated as of paramount importance.

Calendar of Nature Topics

Ice off Newfoundland

March 20.—During the winter the sea is firmly frozen in Baffin Bay and among the islands of the Arctic Archipelago, and numerous icebergs calved from the glaciers of Greenland are frozen in. Early in spring these ice masses break up and drift into Davis Strait, where they are carried rapidly south-eastwards by the Labrador Current, drifting parallel with the coast of Labrador, and entering the Atlantic off Newfoundland. Here the thin ice-floes quickly disintegrate in the warm water, but the icebergs have a longer life, drifting in the eddying currents off Newfoundland and sometimes penetrating far into the Atlantic, where they constitute a grave danger to shipping. On April 14, 1912, the s.s. *Titanic* struck a berg in long. 41° 46′ N., lat. 50° 14′ W., and sank with great loss of life. Both the amount of ice and date of arrival vary greatly from year to year, but March 20 is about an average date for the bergs to appear in quantity over the Newfoundland Banks.

The Spring Equinox

March 21.—Although in the meteorological calendar spring begins on March 1, it is often nearer the close of the month before the earth begins to awake under the influence of rising temperature and increasing power of the sun's rays. The surface of the soil first responds to the greater insolation, and an apt saying relates that on St. Patrick's Day (March 17) "the warm side of a stone turns up", signifying that about this time heat begins to flow downwards into the ground from above instead of the ground giving up heat to the air.

Spring Winds and some Biological Effects

There is no doubt that wind, especially at certain seasons, is a factor of considerable ecological importance. South-westerly winds cause a drift of the zooplankton towards the eastern shore of the Southern Bight in spring, and herring coming in through the Straits of Dover naturally veer towards their food. The spring maximum, however, of the colonial flagellate *Phœocystis* occurs off the Dutch coast. This organism is disliked by herring. On meeting it in quantity, some of the shoals turn westwards toward English waters (Savage, *J. Ecol.*, **20**, 2). Easterly winds on occasion bring the plankton towards the English coast. The herring follow, unless they are repelled by an accompanying drift of *Phœocystis* in excessive amount and continue north along the Dutch coast without appearing in the Lowestoft zone.

A succession of strong spring winds in many rivers produces a very heavy mortality among the emerging subimagines of the Ephemeroptera and seriously affects oviposition by the imagines. These insects are a favourite food of various fishes, especially of trout, and excessive losses leading to a reduced stock the following year imply an effect on the faunal balance in several ways.

Elvers Arrive

For three years the young of the fresh-water eel, in the strange form of leptocephali, have been drifting across the Atlantic Ocean from their distant birthplace, and now in the post-larval elver stage, they begin to enter the rivers of the western coasts of Europe.

In the Severn the fresh-water migration of the elvers begins in March and in such quantities do they appear that they become the objective of a seasonal fishery which lasts until about the middle of May. The elvers generally ascend the river on a high tide, swimming just below the surface of the water, and they are caught by means of hand-nets of cheese-cloth supported upon a large rectangular frame. Although the elver cake referred to by Isaac Walton and other writers is no longer made, the elvers themselves, packed in buckets or barrels, are still sold as food, the dish generally being prepared by washing the elvers in salt and water and afterwards boiling them in fat.

For many years the German Fisheries Union maintained an establishment at Epney on the Severn, from which they exported 3,000,000 living elvers annually for cultivation in German lakes and rivers. In 1920 this station was taken over by the Ministry of Agriculture and Fisheries, which endeavoured to encourage in Great Britain the introduction of eel stock to rivers and lakes otherwise unprofitable.

Since the eel-migration follows the trend of the North Atlantic drift, it is to be expected that the arrival of young eels in the North Sea will be later than on the west coast of Great Britain, so that in east coast rivers the beginning of the elver migration into fresh waters generally takes place in April or more commonly in May.

Barley

Few of our crops have been studied more than barley. As the raw material for the maltster, its quality takes on great importance, which when reflected in the price, causes farmers to think more about quality than yield. A good malting barley may be worth twice as much per quarter as a coarse sample only fit for feeding. Much work has recently been undertaken to define the illusive idea of quality in scientific terms as distinct from the hand valuation of the market place. The indications are that the good-looking barleys are somewhat favoured and the less attractive rather handicapped by judgment based on external appearance.

Of the factors making for quality in barley, soil and season are the most important and are outside the farmers' control. The choice of a suitable variety of seed is a great help; indeed two varieties alone account for most of the acreage in southern and eastern England, and represent a notable achievement in the production of new strains of cereals. Next comes skilful soil management, and he may count himself fortunate who can so lay his fields that the weather can do most of the work. Finally, there is the matter of manuring, and here the art lies in exploiting the crop-producing powers of fertilisers to the full without running the risk of seriously damaging the quality. It is fortunate that a good yield is not incompatible with a high grade product. It is essential, however, that the manure shall be so measured that the crop can stand up to harvest, and this requires considerable judgment. If the seed can be laid in a good seed bed in the early days of March, the first step towards a useful crop has been taken. The rest depends on the turn of the season.

Societies and Academies

DUBLIN

Royal Dublin Society, Jan. 24. C. BOYLE and J. J. RYAN: Grass silage. Experiments were carried out on the ensiling of grass in a concrete pit silo and on the feeding of the resulting silage to dairy cows. The first cutting was started when the grass had almost arrived at the stage when it might have been cut for hay. The second cutting was taken when the aftermath was about 9 in. long. A portion of each sample was analysed chemically and the remainder weighed and put into the silo in a bag. This was weighed and analysed when recovered. The loss in dry matter in the sample bags amounted to 15·8 per cent. To this must be added the loss due to some of the material on the top and sides being unfit for feeding. This brings the loss in dry matter up to 18·5 per cent. Three feeding trials were carried out in which silage was used to replace (*a*) hay, (*b*) roots, (*c*) hay and roots. Replacement values for hay, roots, and silage, were arrived at on the basis of starch equivalents: 3·2 lb. silage = 1 lb. hay, 0·43 lb. silage = 1 lb. roots, or $2\frac{1}{2}$ stones silage = $\frac{1}{2}$ stone hay and 2 stones roots. M. J. GORMAN: Two forms of sampler used in estimating the number of plants per acre in botanical analyses of grasslands. An account was given of several sizes and shapes of sampler used by various grassland workers. The advantages of taking 1/100,000 acre as a unit were pointed out. This size would be convenient for most purposes; where necessary, simple multiples or fractions of it might be employed. G. C. BROCK: A method of preparing a filter for the 3130 mercury line. A photographic lantern plate is exposed and developed in pyro soda or thiocarbamide developer. Reddish-brown or blue films are produced, and afterwards stripped from the glass. Such filters show a maximum of transmission near 3000 A., as in the case of sputtered silver films, but the absorption at 4000 A. is much higher. A red-brown filter which transmits approximately the same percentage as a sputtered filter at 3130 A., has a sharper cut-off on the visible side.

PARIS

Academy of Sciences, Jan. 30 (*C.R.*, 196, 305–376). The president announced the death of the Abbé Verschaffel, *Correspondant* for the Section of Astronomy. MARCEL BRILLOUIN: Linear partial differential equations in the plane. Domains with multiple connexion. The construction of integrals for given conditions at the boundaries. JULES DRACH: The integration by quadratures of the equation of geodesic lines. J. COSTANTIN: An attempt at a theory explaining the function of the mycorrhiza of the sugar cane. RENÉ LAGRANGE: The theorem of Poncelet. F. LEJA: A property of series of analytical functions limited on a curve. A. WEINSTEIN: The points of detachment of lines of slip. PIERRE GIRARD and CH. CHUKRI: A centrifuge without an axis of perfect stability and of high angular velocity. TCHANG TE-LOU: The measurement of the supply of heat in the cycle of an internal combustion engine with the aid of the indicator diagram. ANDRÉ EGAL: A new method of realisation of thermo-electric phenomena. The construction described and illustrated allows a large number of thermo-elements to be used in series, so arranged that the whole set is not put out of action when individual elements are damaged. V. DOLEJŠEK and K. DRAB: The study of the discharge in an ionic bulb with the aid of a cinematographic apparatus. V. POSEJPAL: The atomic radius of carbon in the diamond. In a recent paper on the passage of the photonic rays by atoms some formulæ have been deduced, and these are now applied to the determination of the atomic radius of carbon in the diamond. The close agreement of the values thus obtained with those given by X-ray methods is regarded by the author as a confirmation of the formulæ. The measurements on which the formulæ are based have nothing to do directly with atomic structure. P. ROUARD: The variations of phase by reflection on very thin metallic films. The metal was deposited by cathode sputtering in the form of a wedge, so that at one end the reflection was from glass to air and at the other from glass to metal. For silver, the change of phase was at first a retardation which, after passing through a maximum, diminishes and then becomes an advance. C. JAUSSERAN: The evolution of the latent image. The density is not sufficient to characterise a developed image. Moreover, the number of variables intervening in the evolution of the latent image are so numerous that it is difficult for different observers to work under absolutely identical conditions. LÉON GION: The photolysis of aqueous solution of ammonia. In the absence of oxygen, hydrogen and nitrogen are evolved, the ratio H/N varying from 2·4 to 3. A reducing substance is formed which is not a nitrite. NÉDA MARINESCO: The preparation of colloids by ultra-sonic dispersion. The method allows the preparation of a number of metallic colloids at the ordinary temperature in any dispersing medium: the particles are spherical and can be kept for a long time in this state. G. DARZENS and ANDRÉ LÉVY: Improvement of the general method of preparation of aldehydes by the degradation of acids. A modification of Blaise's method giving nearly quantitative yields. V. HASENFRATZ: Some properties of *d*-xylonic lactone—URIAN. A 1,6-dimethyl-1, 3, 5-hexatriene. VOLMAR and BETZ: Contribution to the study of emetic derivatives of lactic acid. Description of the preparation and properties of sodium antimoniolactate, $(C_3H_4O_3)_2NaH(SbOH)$. JACQUES DE LAPPARENT: The mica schists of Léon. RAYMOND CIRY: The upper Cretaceous of the western part of the province of Burgos. OTTO PETTERSSON: A gap in the classical theory of tides. E. FICHOT: Remarks on the preceding communication. PAUL BERTRAND: The morphological value of the primary rachis of the Cladoxyleæ and the Zygopterideæ. J. RAYMOND: The formation of the perithecium in *Microsphæra quercina*. A. GUILLIERMOND and R. GAUTHERET: The microchemical characters of the oxyflavonic compounds; their localisation in the vacuoles. The reactions of oxyflavonic compounds towards various reagents have been studied in the vacuole, in extracts and with the pure product. These are tabulated and compared with results for tannin in the vacuole and in solution. Although a single reagent has a limited value, with the tests taken together, oxyflavonic compounds can be identified and distinguished from tannin without difficulty. MLLE. S. NOUEL: Technique for the study of the eye muscles in Selacians. MLLE. ANNE RAFFY: The comparison of the respiratory metabolism of the eel at some stages of its development.

CAPE TOWN

Royal Society of South Africa, Oct. 19. S. M. NAUDÉ and J. E. C. COVENTRY: Intensity of cosmic radiation in South Africa. The results obtained in July, 1932, at eight different altitudes ranging from sea level (Cape Town) to 9,200 ft. (Mont-aux-Sources) show the usual increase of the intensity with the altitude, that is, with the fall of the barometric pressure. The graph of intensity/barometric pressure, for South Africa (mean latitude 28°S) lies between those representing Compton's determinations in New Zealand (42°S) and at a point 4°S, thus verifying the dependence of the intensity on the latitude. H. A. SHAPIRO: The kitchen-middens at Gordon's Bay. The bored-stone would seem to be a late addition to the kitchen-midden or 'strandloper' culture. Pottery would seem to be late, and is not present in all the middens. Previous to the appearance of these two elements the culture produced only formless stone instruments, shaped by their use, and without intention. The middens seem to overlie natural dunes. Two skeletons (the skulls having been removed some years before) were discovered. From Dr. D. Slome's description, these would fall within the San race.

GENEVA

Society of Physics and Natural History, Dec. 15. H. LAGOTALA: The geology of the Comba region (north of Mindouli, French Equatorial Africa). The author continues the study of this region, formed by oolitic limestones and much folded siliceous limestones. M. GYSIN: Petrographical researches in the Haut-Katanga. (1) Geological outline of the southern part of Haut-Katanga. The author gives a geological sketch of this region, which is 300 km. by 60 km. in extent. A series of geological maps (scale 1 in 20,000) have been drawn. R. WAVRE: Polydromy of potentials and topology. M. JUNQUERA: The combined influence of *p*H and glucose on the permeability of yeast to methylene blue. The addition of glucose in acid medium increases the staining effect of methylene blue on yeasts; the increase of coloration due to the glucose changes specifically in alkaline medium.

ROME

Royal National Academy of the Lincei, Nov. 6. L. PALAZZO: Materials for the reconstruction of the magnetic maps of Italy: (4) Piedmont. U. CISOTTI: Finite rigid displacements. G. QUAGLIARIELLO: Presence in the bile of an enzyme which dehydrogenates stearic acid. Previous results have indicated that either the pancreatic juice or the bile contains a dehydrogenase capable of acting on higher fatty acids. Experiments with stearic acid show that such an enzyme occurs in the bile. R. CACCIOPPOLI: A principle of inversion for functional correspondences and its applications to equations with partial derivatives (1). L. CHAMARD: (α) Points as described by Georges Durand. S. CHERUBINO: Further considerations on the classification of hyper-elliptic surfaces from the real point of view. B. FINZI: Vectorial tensors and their derivation. D. D. KOSAMBI: Differential geometry and calculus of variations. M. KOURENSKY: Integration of the equations to partial derivatives of the second order with two functions of two independent variables. (1) General case. G. PFEIFFER: (1) Simplification of L. Bianchi's investigations, generalising the character (S. Lie) that the parameters are essential. (2) Linearly independent solutions of the linear equations to the partial derivatives of the second order with two independent variables. A. ROSENBLATT: The question of unicity for the solutions of equations to partial derivatives. B. SEGRE: Claim for priority. M. GLEIJESES: Theory of 'wake' in perfect liquids; case of the circular cylinder. N. CARRARA: Corollary to the theorem of the derivation of definite functions from integrals; application to the experimental methods of measuring physical magnitudes. E. SEGRÈ: Quadrupole lines in X-ray spectra (2). Various theoretical considerations are discussed and an interpretation is given of the new experimental material which has been acquired during the past year and supports the attribution of the forbidden lines of X-rays to the irradiation of the quadrupole. P. PRATESI: Thiocyano- and thio-pyrroles, and pyrrole disulphides. By direct thiocyanation with an alkali thiocyanate and bromine, 2 : 4–dimethyl–3–carbethoxy–5–thiocyanopyrrole and 2 : 4–dimethyl–5–carbethoxy–3–thiocyanopyrrole have been obtained from the corresponding dimethylcarbethoxypyrroles. They are highly stable, crystalline compounds and may be used for the identification of the pyrrole derivatives. When reduced with zinc and acetic acid, they give the thiopyrroles in good yields. O. RENZ: The tectonic position of the shaly clays between the mesozoic chain of Gubbio and the Tiber valley. M. MITOLO: Avitaminosis and intoxication. (1) Experimental polyneuritis and chemical intoxication from metals and metalloids. The nutritional deficiency of pigeons affected by experimental polyneuritis is enhanced by ingestion of mixtures of salts of various metals and metalloids in doses insufficient to produce poisoning in normal animals. Moreover, the harmful effect of the salts is also increased.

VIENNA

Academy of Sciences, Nov. 17. GEORG KOLLER and GERHARD PFEIFFER: (1) The constitution of pinastric acid. This acid, occuring, together with usnic and vulpic acids, in *Cetraria pinastri* and *C. juniperina*, has the empirical formula $C_{20}H_{16}O_6$ and yields anisic and benzoic acids on oxidation. On the basis of these and other reactions, two alternative structural formulæ are suggested for pinastric acid. (2) Glabratic acid. This acid, a constituent of *Parmelia glabra*, is identical with lecanoric acid. EDUARD HASCHEK and MAX HAITINGER: A simple method of determining colour. By means of a method based on the Young-Helmholtz theory, photometric measurements under three filters give data which allow of the calculation of saturation and brightness. LEOPOLD KÖLBL: The northern edge of the Tauernfenster between Mittersill and Kaprum. FRANZ GRIENGL, OSWALD KOFLER and MARIA RADDA: Experiments on the relations between turbulence-friction and constitution of liquids. MAX PESTEMER and OSCAR PLATTEN: The conductivity of binary or ternary, partially miscible liquid mixtures with one component which is at least slightly electrolytic.

Nov. 24. GUSTAV KÜRTI: Magneto-rotation in coloured glass and rock salt. With these substances, no measurable alteration in the electromagnetic rotation of the plane of polarisation occurs as the result of intense Becquerel radiation. HERBERT SCHOBER: The spectra of rhenium: (3) the arc spectrum with copper electrodes in the visible region between 5400 and 4000 A. ALFRED PONGRATZ and ALOIS ZINCKE: Investigations on perylene and its derivatives (39).

Forthcoming Events

Saturday, March 18

ROYAL ANTHROPOLOGICAL INSTITUTE, at 2.15.—(at St. John's College, Cambridge).—Dr. L. S. B. Leakey: "Discoveries of Human Remains at Kanam and Kanjera (Kenya)".

ROYAL INSTITUTION, at 3.—Developments in Cinematography: A Display of Films, (1) Instructional Films.

Monday, March 20

UNIVERSITY OF LONDON, at 4.30.—(at the Royal Veterinary College).—Sir Arnold Theiler: "The Pathology of Osteodystrophic Diseases of Domesticated Animals and their Causes" (succeeding lectures on March 21 and 23).

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—M. Jean Delacour: "Some Contrasts in the Civilizations of Indo-China".

Friday, March 24

ROYAL INSTITUTION, at 9.—Lord Ashfield: "London Passenger Transport".

Saturday, March 25

ROYAL INSTITUTION, at 3.—Developments in Cinematography: A Display of Films, (2) Colour Films.

Official Publications Received

GREAT BRITAIN AND IRELAND

Reports of the Progress of Applied Chemistry. Vol. 17, 1932. Pp. 728. (London: Society of Chemical Industry.) 12*s*. 6*d*.; to Members, 7*s*. 6*d*.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 29: Factors affecting the Body or Viscosity of Cream and related Matters. By J. Lyons and G. T. Pyne. Pp. 461–500+plate 29. 2*s*. Vol. 2, No. 30: The Influence of Agitation of Milk before Separation on the Fat Loss in the Skim Milk. By W. Finlay and J. Lyons. Pp. 501–513. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 34: A Study of *Phoma Lingam* (Tode) Desm., and of the "Dry Rot" it Causes, particularly in Swede Turnips. By William Hughes. Pp. 495–529+plates 46–47. 3*s*. 6*d*. Vol. 20 (N.S.), No. 35: A Classification of the Biological Elements, with a Note on the Biochemistry of Beryllium. By Dr. William Robert Fearon. Pp. 531–535. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

University of London: University College. Annual Report, February, 1932–February, 1933. Pp. ii+184. (London: Taylor and Francis.)

Journal of the Chemical Society. February. Pp. ii+113–216+viii. (London: Chemical Society.)

The Proceedings of the Physical Society. Vol. 45, Part 2, No. 247, March 1. Pp. viii+135–365. (London: Physical Society.) 7*s*. net.

Journal of the Society of Glass Technology. Edited by Prof. W. E. S. Turner. Vol. 16, No. 64, December. Pp. xi+77–93+375–477+395–575+x+xxiv. (Sheffield: The University.) 10*s*. 6*d*.

Annual Reports on the Progress of Chemistry for 1932. Vol. 29. Pp. 344. (London: Chemical Society.)

University of Leeds. Twenty-eighth Report, 1931–32. Pp. 228. Publications and Abstracts of Theses by Members of the University during Session 1931–32. Pp. 26. (Leeds.)

Committee of the Privy Council for Medical Research. Report of the Medical Research Council for the Year 1931–1932. (Cmd. 4248.) Pp. 140. (London: H.M. Stationery Office.) 2*s*. net.

The Hannah Dairy Research Institute. Bulletin No. 5: The Nutritive Properties of Milk in relation to Pasteurisation; a Review of Existing Knowledge. By Dr. J. D. Stirling and Dr. J. H. Blackwood. Pp. 80. (Ayr.)

Department of Scientific and Industrial Research. Report for the Year 1931–32. (Cmd. 4254.) Pp. iv+193. (London: H.M. Stationery Office.) 3*s*. net.

OTHER COUNTRIES

Cornell University: Agricultural Experiment Station. Bulletin 544: Co-operative Purchasing and Marketing Organisations in New York State. By F. A. Harper. Pp. 117. Bulletin 546: The Marketing of Milk thru Ice Cream. By M. C. Bond. Pp. 88. Bulletin 550: Soils in relation to Fruit Growing in New York. Part 2: Size, Production and Rooting Habit of Apple Trees on Different Soil Types in the Hilton and Morton Areas, Monroe County. By Joseph Oskamp and L. P. Batjer. Pp. 45. (Ithaca, N.Y.)

Sixième Congrès International du Froid, Buenos Aires, Août-Septembre 1932. Première Commission Internationale (Commission Kamerlingh Onnes) de l'Institut International du Froid. Rapports et communications issus du Laboratoire Kamerlingh Onnes présentés par le Président de la Première Commission, W. H. Keeson. Pp. x+460. (Leiden: Eduard Ijdo.)

Government of India: Meteorological Department. Magnetic, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1930, under the direction of Dr. S. K. Banerji. Pp. iv+149+5 plates. (Calcutta: Government of India Central Publication Branch.) 12.6 rupees; 20*s*.

Department of Marine, Canada. Monthly Record of Meteorological Observations in the Dominion of Canada, and in Bermuda and Newfoundland. September 1930. Pp. 53. (Ottawa: F. A. Acland.) 1 dollar per annum.

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 36: Fibre Boards, their Uses and the Possibilities of their Manufacture in Australia. By R. F. Turnbull. (Division of Forest Products, Technical Paper No. 6.) Pp. 51. (Melbourne: H. J. Green.)

Journal of Science of the Hiroshima University. Series B, Div. 1 (Zoology), Vol. 2, Articles 1–3, December. Pp. 47+8 plates. (Tokyo: Maruzen Co., Ltd.). 95 sen.

Pamiętnik obchodu Pięćdziesięciolecia Kasy im. Mianowskiego, 1881–1931. Pp. ii+88+4 plates. (Warszawa: Kasa imienia Mianowskiego.)

Proceedings of the American Academy of Arts and Sciences. Vol. 67, No. 11: The Eclipsing Binaries RW Arae and SW Ophiuchi. By Martha B. Shapley. Pp. 537–550. 40 cents. Vol. 67, No. 12: The Purification and Physical Properties of Organic Compounds, I: The Interpretation of Time-Temperature Curves in Freezing Point Determinations and as a Criterion of Purity. By Evald L. Skau. Pp. 551–576. 60 cents. (Boston, Mass.)

Publications of the Observatory of the University of Michigan. Vol. 5, No. 3: A Spectrographic Study of RT Aurigæ. By R. M. Petrie. Pp. 9–37. (Ann Arbor, Mich.)

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 710: Surface Water Supply of Hawaii, July 1, 1929, to June 30, 1930. Pp. v+101. 10 cents. Water-Supply Paper 714: Surface Water Supply of the United States, 1931. Part 4: St. Lawrence River Basin. Pp. v+160. 15 cents. Water-Supply Paper 719: Surface Water Supply of the United States, 1931. Part 9: Colorado River Basin. Pp. v+121. 10 cents. Water-Supply Paper 721: Surface Water Supply of the United States, 1931. Part 11: Pacific Slope Basins in California. Pp. xi+497. 50 cents. (Washington, D.C.: Government Printing Office.)

Education, India. Education in India in 1930–31. Pp. iv+81. (Calcutta: Government of India Central Publication Branch.) 1.8 rupees; 2*s*. 6*d*.

Canada: Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories) 1931. (No. 728.) Pp. iv+183+2 plates. (Ottawa: F. A. Acland.)

Journal of the Indian Institute of Science. Vol. 15A, Part 8: Organic Manure from Sewage, Town Refuse and Waste Vegetation. By J. Jagannatha Rao and V. Subrahmanyan. Pp. 89–106. (Bangalore.)

Transactions of the Mining and Geological Institute of India. Vol. 27, Part 3, December. Pp. 155–260+5 plates. (Calcutta.) 4 rupees.

Science Reports of the Tokyo Bunrika Daigaku. Section B, No. 11: A Short Note on the Chromosomes of Crickets. By Hikokuro Honda and Shigemori Iriki. Pp. 133–135. (Tokyo: Maruzen Co., Ltd.) 10 sen.

Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University. Vol. 5, No. 4: The Activation of Air by the Electrodeless Ring Discharge, by B. Arakatsu and K. Kimura; The Electrodeless Ring Discharge through Potassium Vapour, by B. Arakatsu and Y. Uemura. Pp. 143–161+4 plates. Vol. 5, No. 5: On the Anomalous Absorption of γ-Rays. By B. Arakatsu. Pp. 163–168. (Tokyo: Maruzen Co., Ltd.)

The Indian Forest Records. Vol. 17, Part 5: The Importance of the Origin of Seed used in Forestry. By H. G. Champion. Pp. vii+76+12 plates. 2.12 rupees; 5*s*. Vol. 17, Part 6: New Cerambycidæ from India (Coleoptera.) By W. S. Fisher. Pp. ii+8. 2 annas; 3*d*. Vol. 17, Part 4: The Sutlej Deodar, its Ecology and Timber Production. By Dr. R. Maclagan Gorrie. Pp. iv+140+6 plates. 3.2 rupees; 5*s*. 6*d*. (Calcutta: Government of India Central Publication Branch.)

Union of South Africa: Department of Agriculture. Eighteenth Report of the Director of Veterinary Services and Animal Industry, Onderstepoort, Pretoria, August, 1932. Part 1. Pp. vii+523. Part 2. Pp. 525–1094. (Pretoria: Government Printer.) 10*s*.

Scientific Papers of the Institute of Physical and Chemical Research. No. 403: Moving Striation and Anode Spots in Neon Tubes. By Toshio Takamine, Taro Suga and Asao Yanagihara. Pp. 63–69. 15 sen. Nos. 404–408: Stereochemistry of Aliphatic Ketoxine, by Shu Furukawa; Studies on the Flavour of "Kasutorishōchu", by Kenjiro Shoji; Über die Polymerisierung der Methylester höherer ungesättigter Fettsäuren, 11: Über die Struktur des Dimers von Methylester der Lindsaure, by Kiichiro Kino; On the Phosphorescence in Human Tissues, Part 1: The Proof of the Phosphorescence in Normal Tissues and its Measurement, by Shirobee Hoshijima; On the Motion of a Peculiar Type of Body falling through Air—Camellia Flower, by Torahiko Terada and Tyokurô Utigasaki. Pp. 71–127+ plates 7–10. 60 sen. (Tokyo: Iwanami Shoten.)

Canada, 1933: the Official Handbook of Present Conditions and Recent Progress. Pp. 192. (Ottawa: Dominion Bureau of Statistics; London: High Commissioner for Canada.) 25 cents.

U.S. Department of the Interior: National Park Service. Plants of Rocky Mountain National Park. By Ruth E. Ashton. Pp iv+157. (Washington, D.C.: Government Printing Office.) 25 cents.

Astronomische Abhandlungen der Hamburger Sternwarte in Bergedorf. Band 4, Nr. 2: Untersuchungen über die veränderlichen Sterne im Kugelsternhaufen Messier 53. By Erwin Grosse. Pp 37–51+2 plates. (Bergedorf.)

Smithsonian Miscellaneous Collections. Vol. 89, No. 3: The Kampometer, a New Instrument of Extreme Sensitiveness for Measuring Radiation. By C. G. Abbot. (Publication 3211.) Pp. 5. (Washington, D.C.: Smithsonian Institution.)