NATURE

SATURDAY, DECEMBER 3, 1932

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No. 3292, Vol. 130]

Industrial Surveys and Employment Problems*

AMONG the discussions at the recent meeting of the British Association which were given particular attention in the general Press were those arranged by the Section of Economic Science and Statistics on international migration and on the location of industries. There are, however, still many persons to whom the relation between science and problems of this type is as yet obscure. It is indeed far from being generally realised that the complex issues and intricate problems presented by international migration in the twentieth century can only be resolved by the scientific study of the numerous factors involved.

Similarly, in the national migration problems which are bound up with the unemployment problem, the bearing of scientific determination and analysis of the essential facts is only now being perceived. The social and industrial difficulties of the last two years, the magnitude of the post-War unemployment problems, have led to the active discussion of such questions as whether the present location of industries is the most economic that could be devised; whether, under private enterprise, manufacturing industry is becoming less or more localised and whether its tendency is to render the prevention of maladjustment of labour more or less difficult.

Definite indication of the desire to ascertain the features of a rational location of industry or of the deliberate planning of social in relation to industrial resources is afforded by the invitations extended last year by the Board of Trade to various universities to conduct industrial surveys of their respective surrounding areas. It was suggested that such inquiries should cover not merely the present industrial position of the respective areas but also the prospects of early expansion and new development, having regard to recent industrial developments, and an assessment of the prospective employment capacity of the various industries in the area as a basis of estimating the probable volume of labour surplus to the requirements of individual industries within the next few years.

The mere suggestion that such an inquiry should be entrusted to the universities is significant of a changed attitude to the contribution which the

* Board of Trade. An Industrial Survey of the Lancashire Area (excluding Merseyside) made for the Board of Trade by the University of Manchester. Pp. ix+380. (London: H.M. Stationery Office, 1932.) 6s. net.

universities have to make to the modern State. It obviously indicated an appreciation of the ability of the universities to render services which go beyond the mere training of men and women qualified to fill important positions in industry, in government, municipal or social service. The provision of men and women trained to learn quickly and accurately to grasp the essential problems of a technical problem, to analyse it and develop a plan of action, and possessing a sense of values which enables them more and more closely to relate knowledge to action or policy as their judgment matures with experience, is a function of growing importance in this scientific age, but it is only one of the ways in which the universities can serve the community. The terms of reference of these surveys suggest that the universities possess not merely the powers of conducting such social research but also the perspective and sense of values which are essential to the presentation of an authoritative and impartial analysis of the facts thus assembled.

There have now been presented to the Board of Trade no fewer than five such surveys. A survey of south-west Scotland has been completed by the University of Glasgow, while the University of Wales, Cardiff, has issued its report on the South Wales area. Surveys of the Merseyside area and of the remaining Lancashire area carried out by the Universities of Liverpool and Manchester respectively have followed that on the industrial area of the north-east coast by the University of Durham. The five surveys together not only provide a most valuable analysis of industrial conditions in the areas covered but also afford a basis for assessing the importance of such contributions of university resources to the national welfare.

In the first place, it is pertinent to observe that the presentation of such a report by a university confers upon the report an authority and an assurance of impartiality which is not easily otherwise obtained. The industrial situation has frequently suffered from *ex parte* statements which differed widely in themselves but could not be verified against some reliable and independent authority. An accurate estimate of the problem presented by surplus labour is impossible apart from some such inquiry and analysis, and accuracy and authenticity are essential if confidence is to be placed in the deductions or recommendations based thereon. Mr. A. G. H. Dent, in a paper before the Department of Industrial Co-operation at the recent British Association meeting, specially stressed the value of statistics obtained by absolutely reliable authority as a means of avoiding suspicion and misunderstandings in any industrial dispute.

The Lancashire survey brings to light the high incidence of unemployment among workers in the age group 18–24 years, and sets in its true significance for national or social economy this incidence upon workers at a period in the working lives when they should be rapidly approaching maturity of industrial skill and adaptability and when they should be most capable of moving into other industries or localities. Similarly, the analysis of the inflow and outflow of labour is characterised by a concern for social consequences that could scarcely have been found in any inquiry initiated by industry itself, and leads to definite suggestions for regulating the recruiting of labour for the cotton industry in all districts. The survey demonstrates that in the absence of any organised effort by the cotton industry or the State to control the flow of juveniles into the industry, heavy unemployment and restricted earnings of adults did not deter very large numbers from entering the industry. Nor is there any full and accurate information from year to year as to the numbers entering the industry at the age of fourteen years, or their progress during their early working years. The tracing of the industrial history of juvenile workers in this way is an obvious preliminary to the difficult task of regulating entry and avoiding blind-alley occupations, apart from the opportunity for an attempt to secure for every entrant the advantage of a reasonable period of skilled instruction in his occupation.

The analysis of the position of the cotton industry presented by the report of the University of Manchester emphasises the importance of such independent social research. Thus the immobility of labour in Lancashire is largely due to social factors—the prevalence of the family income, the preponderance of female labour, the custom of women workers continuing at work after marriage, the high concentration of unemployment in relatively isolated districts, and the reluctance of workers to recognise the existence of a permanent surplus. Such proposals as the abolition of the short-time working and under-employment of labour which result from the existence of permanent surplus capacity of capital equipment and labour would reveal the real extent of the labour surplus, but so long as the displacement and recruitment of labour is unorganised, the burden

of unemployment will not be distributed in a manner causing a minimum of loss or damage to the labour resources of the industry.

Nowhere is the advantage of such independent research greater than where it touches the effect of technical changes on the demand for labour. So far as the cotton industry is concerned, it seems clear that no appreciable part of the existing surplus of labour can be attributed to technical 'rationalisation', but there are signs that changes are impending which will radically increase the physical output per person employed and consequently displace labour, if the aggregate output remains the same. The report gives an unbiased analysis of four new methods of production which are considered to present the most serious labour difficulties and its observations cannot be ignored by either side. The 'more looms per weaver' system presents the most serious problems, bringing about a decrease in production per loom but an increase in production per weaver; while the weekly earnings of the weaver are maintained or slightly increased, the weaving labour costs fall and also total costs per unit of output. The report observes that in the negotiations between employers and trade unions, the problem of mitigating the effects of further additions to the surplus of labour in the weaving districts does not seem to have been scientifically examined and urges as an essential condition that collective bargaining should be defended against the inclination of individual firms to break away from existing wage agreements. Given collective bargaining, it is considered that there is no reason why the introduction of the system should not be planned so far as is practicable to give security of employment to the workers who are retained and to regulate displacement so that the burden falls on those best able to bear it.

The value of this survey is equally apparent in its discussion of the position of the expanding industries and of the possibilities they offer of absorbing the surplus of labour from other industries. It is, however, evident that the survey is only a start towards the handling of the unemployment problem on scientific lines: "Lancashire's difficulties," says the report, "are essentially of the type which calls for long-distance treatment and far-sighted planning, based upon the intensive research of a continuing character, and the Survey has provided the opportunity for a critical examination of the existing statistical material and has revealed many serious gaps in the information which must be made available if continuous investigation is to yield the most useful results." The report proceeds to emphasise the importance of compiling much more frequently than at present statistical material, the primary and chief value of which lies in its utility in economic research. "Increased funds devoted to the wider and more complete charting of the national economic system would be a sound investment, despite the urgent campaign for national economy."

The report punctuates its plea for such research by concrete proposals addressed alike to the national and local authorities, to trade unions and to employers' associations, for the collection of the specific statistics required. It thus envisages a definite field of social economic research which is fully in keeping with the programme advocated, for example, by Prof. W. McDougall. These surveys attest both the resources and the capacity of the universities to undertake such research and there is little doubt that it would be to the great advantage of the community if some of the effort at present directed to the advancement of the physical sciences were directed to these ends.

Apart from the corrective to that dangerous tendency in industry and politics to ignore or avoid unpleasant facts and disregard the consequences of a selfish or sectarian policy, research of this type has other advantages. It gives a striking demonstration of the capacity of the scientific worker for leadership and relates university life intimately with the main stream of national life; the recent suggestion of Mr. Alan Chorlton, M.P., for the formation of a Research Council in Manchester appears to be prompted by the survey and indicates the educational value which such research can possess. It also encourages a widespread appreciation of the value of scientific training and technique in the solution of social, economic, and industrial problems. Both factors should promote the production and acceptance of leaders and administrators whose qualifications for office include the indispensable capacity of assessing at first hand the technical factors in the problems they have to solve. Without such capacity, there is no prospect of the planning of our national material and social resources on national lines, of their being wisely co-ordinated with world resources in a spirit of international co-operation, or of that right relation of knowledge to action upon the rapid evolution of which the security of civilisation depends.

Κτῆμα ἐς ἀεί

Faraday's Diary: being the various Philosophical Notes of Experimental Investigation made by Michael Faraday, D.C.L., F.R.S., during the Years 1820–1862 and bequeathed by him to the Royal Institution of Great Britain. Now, by order of the Managers, printed and published for the first time, under the editorial supervision of Thomas Martin. With a Foreword by Sir William H. Bragg. In 7 vols. Vol. 1: Sept., 1820–June 11, 1832. Pp. xxv + 430. Vol. 2: Aug. 25, 1832–Feb. 29, 1836. Pp. xvii + 467. (London: G. Bell and Sons, Ltd., 1932.) 7 vols., £12 12*s*. 0*d*. net.

THE Faraday diary is not a find in the spectacular sense of that of the Boswell papers. Faraday's laboratory notebooks, various lecture notes and account books, the notes which he took of lectures by Tatum and by Davy, with specimens of various books bound by his own hands were gifted, as the expressive Scots word has it, to the Royal Institution by himself or by his widow. No mystery surrounds these possessions; no ebony cabinet has been rifled to reveal manuscripts long lost and long sought, as those destined to make the name of Boswell a by-word in the mouths of the examiners of would-be doctors of philosophy. These treasures have been jealously preserved in the archives of the Royal Institution; privileged observers have been permitted to see and to handle them.

Nonetheless, it is a red letter day which has seen the publication, even in a strictly limited edition, of the laboratory notebooks. These, ranging as they do over the most fruitful years of Faraday's life, afford a picture of the development of the mind of a great genius, of his gropings in the dark, and of those flashes of insight which have led to a solution of some of the fundamental problems of physical science—a picture which will be, in the phrase of Thucydides, 'a possession for all time'.

The publication of these notes is all the more valuable, inasmuch as the extant biographies leave something to be desired. The biographical traditions of the Victorian, and the paulo-pre-Victorian era were, despite the examples set by Lockhart and by Trevelyan, arid and unliving. The two- and three-deckers of the period, equally with the series of smaller volumes in which great reputations were decently buried (how Mark Pattison's "Milton" even now stands out from the ruck!), all serve to show that the contemporary tradition was at one with the tradition of portraiture—what has been described as a head sticking out of a suit of clothes.

Faraday has not escaped. The full-dress biography by Bence Jones is, despite its value as a storehouse of facts, a trifle heavy; Tyndall's affectionate little volume tends to slip, as was Tyndall's wont, from sentiment into sentimentality; Silvanus Thompson's study, by far the best account of Faraday's scientific work, still bears some of the stigmata of the age. The most lively contemporary account of Faraday's vivid and eager personality is to be found in the pages of a lesser-known sketch—that written in 1870 by J. H. Gladstone.

Every document, then, that will help to provide a complete portrait of the man in his habit as he lived, is of importance, for Faraday's is an intriguing personality, not alone in the genius that it shows, in its transparent honesty, gentleness and almost excessive humility, but also in its baffling simplicity. Cheerfulness, eagerness, playfulness are prominent—a contemporary draws a pleasant picture of a British Association dinner at Ipswich in 1851, at which Faraday amused himself by cutting boomerangs of card and projecting them across the table at his friends—but over all and dominating all is a single-hearted devotion to the advancement of science which can rarely have been surpassed in the long history of the development of scientific thought.

This devotion had strange consequences, among them a complete indifference to political events of the first magnitude. Is there any other instance on record, in the development of an active-minded young man of four and twenty, of such an entry as occurs in Faraday's journal for March 1815—three months before Waterloo? "I heard for news that Bonaparte was again at liberty. Being no politician, I did not trouble myself much about it, though I suppose it will have a strong influence on the affairs of Europe."

Nor, great as was his private benevolence, does Faraday seem to have taken any pronounced interest in schemes for social betterment. He lived for his science and his religion, and neither material rewards, nor the highest offices, had the slightest attraction for him. To his friend, pressing him to accept the presidency of the Royal Society, "Tyndall," he said, "I must remain plain Michael Faraday to the last; and let me tell you now, that if I accepted the honour which the Royal

Society desires to confer upon me, I would not answer for the integrity of my intellect for a single year."

The volumes before us testify eloquently to this devotion. They cover the period 1820–1836, and so include some of the most fundamental of Faraday's discoveries. The story of the isolation of benzene, and the examination of its properties, the liquefaction of gases, and the results of that concentrated ten days' work, the centenary of which was celebrated last year, may be read now as they were first set down by Faraday in the heat of the chase.

We do not here, however, attempt any detailed analysis of the two volumes now published. That may more fittingly be done at a later stage, when an opportunity will be afforded to pass in review the contents of the seven stately volumes which are to form the complete diary. Meanwhile we may say with assurance that the publication of the first two volumes has amply justified the policy of the managers of the Royal Institution. The diary is much more than a record of laboratory experiments and figures; it provides the material for an analysis of the development of Faraday's thoughts concerning the problem in hand. Its value, as we have before emphasised, lies in the opportunity which it gives, to a future historian of physical science, to limn a picture of the genius of Faraday and, indeed, of some of his personal qualities which would be quite impossible to anyone who was not fortunate enough to have access to the diary. The entries are, on the whole, restrained enough; here and there one may find italicised a '*very good*'; yet the general impression left after a perusal of the pages of these volumes confirms the pen picture of the "young-looking man of about thirty years of age . . . his cheerfulness of disposition often breaking out in a short crispy laugh, but thoughtful enough when something important is to be done". We can visualise, too, the experimenter of mature years who, ready for the day's work, would "descend into the laboratory, give a quick glance round to see that all was right, take his apron from the drawer, and rub his hands together as he looked at the preparations made for his work. There must be no tool on the table but such as he required. As he began, his face would be exceedingly grave, and during the progress of an experiment all must be perfectly quiet; but if it was proceeding according to his wish, he would commence to hum a tune, and sometimes to rock himself sideways, balancing alternately on either foot. . . . He would put away each tool in its own place as soon as done with . . . and he would not unnecessarily take a thing away from its place. . . . No bottle was allowed to remain without its stopper; no open glass might stand for a night without a paper cover; no rubbish was to be left on the floor."

More than anything else, the cumulative effect of the day by day entries in the diary is to throw into relief Faraday's intense desire to see and do everything for himself. No experimental fact was to be taken on trust; as he himself writes to Becker: "I am never able to make a fact my own without seeing it. If Grove, or Wheatstone, or Gassiot or any other told me a new fact, and wanted my opinion either of its value, or the cause, or the evidence it could give on any subject, I never could say anything until I had seen the fact. For the same reason I never could work . . . by students and pupils. All my work had to be my own." The same characteristic appears in a pleasant record by Mallet of a visit which he paid to Faraday in order to show him how slips of Muntz's yellow metal, ordinarily flexible and tough, became at once rigid and brittle when dipped into a solution of pernitrate of mercury. The demonstration was made, Faraday standing nearby. He made no comment whatever, but picked up a piece of the metal, bent it, dipped it into the solution and broke it into small pieces. Then, "Yes," said he, "it *is* pliable, and it *does* become instantaneously brittle."

So when Tyndall showed him the then novel phenomenon of calorescence he "looked on attentively, putting on his spectacles to observe more carefully, then ascertained the condition of the experiment and repeated it for himself; and now, quite satisfied, he turned with emotion to Dr. Tyndall, and almost hugged him with pleasure."

The complete diary will form a commentary of inestimable value on one of the most romantic lives in the history of science. Looking into its volumes in retrospective mood, we may see something of the mettle of the bright-eyed newspaper lad, the bookbinder's apprentice, the young laboratory assistant, widening his knowledge, and testing his strength at the meetings of the City Philosophical Society; the pages of the earlier volumes will show him in the fulness of his powers, enriching chemical and physical science by discovery after discovery of the first magnitude, yet still retaining that boyishness of disposition

which sent him with his attendant "to Astley's, to see the horses" to celebrate the occasion when he had first made "the wires go round the magnet". It may be that the last volume will show something of that pathetic and yet not wholly painful decline to which he himself alludes in the Friday evening discourse on platinum which he delivered in February 1861, six years before his death, a decline which left him broken in mind and frail in body, yet still preserving his gentleness of spirit and thought for others, still able to find beauty in the rolling of a thunderstorm and the hues of a sunset.

But the story should not end here; there are, surely, records still unpublished to which Mr. Martin may apply his energy and his scholarship. More than all, there still remains to be written an authoritative exposition of the origin and growth of the Royal Institution. Those who know something of the contributions made by London to the advancement of science know, too, that in the vastness of London, individual contributions of the first importance are apt to be lost. Of these contributions none is more weighty than that made by the Royal Institution. The part which it has played in fostering research and in popularising knowledge is well known. From its earliest days, when it was associated with the dramatic discoveries of Davy, it has been fortunate; all Faraday's labours are indissolubly connected with its laboratories, and the work of succeeding directors has added to the lustre of these early discoveries. Even to-day, Faraday's personality dominates its work. To his genius for exposition we owe the inception of the Christmas lectures, and an institution which is probably unique in the scientific world—the Friday evening discourses. Is it too much to hope that the recrudescence of interest in Faraday's life and work which is evidenced by the publication of the diary may extend to the walls of the Institution wherein he laboured so long, and for which he had so deep and so lasting an affection? The story is no jejune one—it is picturesque enough in its details, and touches the development of more than a century's physical science at many points of fundamental interest. Incidentally, it will afford an opportunity to do justice to the memory of a natural philosopher, the story of whose life has been strangely neglected—Faraday's intimate friend and successor, John Tyndall.

It would be ungrateful to close this notice without comment on the skill and discretion which the editor has shown in the by no means easy task which he has faced. It is not difficult to see that, in turning into print some four thousand pages of manuscript written *currente calamo* and illustrated by rapidly drawn pen sketches, various delicate questions will arise concerning the reproduction of the actual punctuation, wording, spelling, and contractions. Mr. Martin has solved these problems with a degree of success that testifies alike to his scholarship and acumen. He has left the text largely to speak for itself, and confined his notes to the minimum necessary for elucidation. In congratulating him on the completion of the first portion of his task, we can offer him no better wish than that the rest of his work may attain the high standard of that already published.

ALLAN FERGUSON.

Botanical and Horticultural Biographies

Curtis's Botanical Magazine Dedications 1827–1927: Portraits and Biographical Notes. Compiled by Ernest Nelmes and William Cuthbertson. Published for the Royal Horticultural Society, London. Pp. xxi + 400 (100 plates). (London: Bernard Quaritch, Ltd., 1931.) 30*s*.

THE intimate relationships subsisting between botany and horticulture are nowhere more clearly seen than in the history of *Curtis's Botanical Magazine*. Founded in 1787 by William Curtis, the author of the "Flora Londinensis", the *Botanical Magazine* now includes more than nine thousand hand-coloured plates, with descriptive letterpress, of plants grown in gardens, public or private, and at the present day under the able editorship of Dr. O. Stapf it enjoys a higher botanical reputation than ever before.

The volume under review contains portraits and short biographies of the founder and of the hundred eminent botanists and horticulturists to whom the volumes of the *Botanical Magazine* have been dedicated during the century 1827–1927. Its publication has been made possible by the generosity of Mr. William Cuthbertson, chairman of Messrs. Dobbie and Co., of Edinburgh. The copying of the portraits has been carried out by Mr. G. Atkinson, artist at the Royal Botanic Gardens, Kew. More than half are reproduced from photographs, engravings and drawings in the Kew collection, the remainder having been obtained from various sources. Only one is wanting, that of Mrs. Wray,

of Oakfield, Cheltenham, to whom vol. 67 was dedicated in 1841. A special request is made that any reader who may know of a portrait of this lady should send particulars to the secretary of the Royal Horticultural Society. Owing to the varied nature of the originals, the standard of the portraits is very unequal, some being exceedingly good, while others, such as that of H. J. Elwes, are unsatisfactory.

The biographical notes are with few exceptions written by Mr. E. Nelmes, assistant botanist at Kew, who was also responsible for assembling the portraits. They are of a general length of 1½–2 pages, and summarise very clearly the principal events in the lives of the persons concerned. Much of the information supplied is not readily accessible elsewhere, and the work will be indispensable to all interested in botanical and horticultural biography. The general absence of critical estimates of the character and scientific work of botanists of the present and past generation is to be regretted, since it makes some of the accounts appear rather colourless to those who knew the men concerned. For this, however, the plan of the work and the limitations of space appear to have been mainly responsible. Apart from this minor defect, the biographical sketches are excellent.

Among the botanists commemorated are three keepers of the Kew Herbarium, D. Oliver, J. G. Baker and W. B. Hemsley, and three directors of the Gardens, J. D. Hooker, W. T. Thiselton-Dyer and D. Prain, while the Royal Botanic Garden, Edinburgh, is represented by J. H. Balfour and I. B. Balfour. More on the horticultural side are G. Nicholson and W. Watson (Kew), R. I. Lynch (Cambridge) and F. W. Moore (Trinity College, Dublin, and Glasnevin). Among those distinguished in both botany and horticulture are J. T. Mackay, David Moore and M. T. Masters. Investigators of the various floras of the British Empire include, besides the above-mentioned botanists, Wight, T. Thomson, G. King and C. B. Clarke (India), Thwaites and Trimen (Ceylon), Ridley (Malay Peninsula), F. von Mueller (Australia), Bolus and Medley Wood (South Africa).

The botanical collectors comprise Welwitsch and Gustav Mann (West Africa), Kirk (East Africa), and Augustine Henry, E. H. Wilson and G. Forrest (China). Henry made a name for himself in a different field by the "Trees of Great Britain and Ireland", written in collaboration with Elwes, who is also included in the volume, and Wilson published numerous works on botany and horticulture including the "Lilies of Eastern Asia", "The Cherries of Japan", and "A Monograph of Azaleas", the last-mentioned written in conjunction with Rehder. Vol. 95 (1869) was dedicated to Walter Fitch, the unrivalled botanical artist, whose published drawings are estimated at ten thousand.

The United States is represented by Torrey, Asa Gray and Sargent, who contributed so much to our knowledge of the North American flora, Germany by Salm-Dyck and H. G. Reichenbach, and Russia by F. E. L. Fischer and E. Regel.

Among the amateur botanists included are James Bateman, the author of the "Orchidaceæ of Mexico and Guatemala", Dean Herbert, a great authority on bulbous plants, M. J. Berkeley, the cryptogamic botanist, George Maw, who published a monograph of the genus *Crocus*, and John Ball, who is perhaps best known by his Alpine guide. The following may be singled out among the many prominent horticulturists whose portraits and biographies are given: W. T. Aiton, Joseph Sabine, Max Leichtlin, H. L. de Vilmorin, and W. Wilks, whose name will always be associated with the Shirley poppy.

The volume reflects great credit on all concerned in its production. T. A. S.

The Moa in New Zealand

The Mystery of the Moa: New Zealand's Avian Giant. By T. Lindsay Buick. (Published under the Auspices of the Board of Maori Ethnological Research.) Pp. xvi + 357 + 27 plates. (New Plymouth, N.Z.: Thomas Avery and Sons, Ltd.; London: Francis Edwards, Ltd., 1931.) 15*s*.

PERHAPS no event in the ornithological world was more astounding than the discovery of the bones of the largest known bird, the moa, which existed in New Zealand, the fringe of the great sunken southern continent. The first mention of this bird in literature was made in Polack's "New Zealand", 1838, but no notice was taken of this by scientific men. Later on, Harris obtained a portion of a bone and gave it to Dr. John Rule of Australia, who eventually brought it to England. Prof. Owen examined it but was sceptical about its being the bone of a bird, but on further examination he was convinced that it

was indeed part of the skeleton of a large extinct flightless bird. This pronouncement was read before the Zoological Society of London on Nov. 12, 1839, and was published in the Society's *Transactions*. This bone became the type of the genus *Dinornis* which Owen introduced on Nov. 28, 1843, in the same publication, vol. 3, p. 235.

Soon afterwards the scientific world hungered for more examples and so New Zealand was exploited and thousands upon thousands of bones were brought to light, so that to-day no museum of any size is without some part of a skeleton of one of the many species of moa. From maps on pp. 163–164 of Mr. Lindsay's book showing the places where finds are recorded we gather how plentiful these birds were.

Mr. Lindsay gives the history of the Moa from the fossils of the Pliocene or post-Pliocene times when they were plentiful, up to their extinction in the seventeenth or even as some think into the eighteenth century. Many different lots of feathers are extant showing their formation and colour.

The author accepts the theory of Mr. Percy R. Lowe that these birds are descended from birds which never flew. They varied in size from fourteen feet or more in height to little fellows of about four feet, and appear to have been more common in the South than in the North Island.

It is surprising how much we are told of the life history of these birds; we know what colour they were; that in June and July they were fattest; the nest of one species is described as are the eggs of several forms; they lived on a vegetarian diet and thousands of their 'crop stones' have been found. Some skeletons were found in caves and numbers were found together in swamps, as many as eight hundred skeletons in one place. Many theories as to how these large heaps of bones were amassed are put forward, only to be rejected. Why did this bird become extinct? Was it change of climate? Was it due to man? Or had they served their turn and passed on?

Many different classifications have been advanced but the author accepts that of Oliver in "New Zealand Birds"; that is two families, five genera and twenty-two species. A bibliography and index complete the work.

This book will appeal not only to ornithologists, but also to a much wider circle of readers; in fact to all who are interested in the story of past ages, and whom it may amuse to speculate on the mystery of vanished races.

Short Reviews

The Quantity and Sources of our Petroleum Supplies: a Review and a Criticism. By Prof. J. M. Macfarlane. Pp. xiv + 250. (Philadelphia: Noel Printing Co., Inc., 1931.) n.p.

READERS versed in the literature of petroleum will recognise in this book the author of "Fishes the Source of Petroleum", published some nine years ago, who now reappears with an extensive thesis of oil origin in which metanemerteans, invertebrate fresh-water animals of widely dispersed occurrence, and apparently related conodonts, are invoked as fundamentally contributive mother substance. The argument is that life originated and thrived in fresh-water areas, spreading both landward and seaward; of this life, the most abundant group was the metanemerteans, the representatives of which are now found in fresh and salt water and moist land-surfaces. Certain strata yield conodont teeth, closely resembling pharyngeal teeth of the metanemerteans, in association with prolific oil pools. By focusing attention on environments, as illustrated by three oil-bearing formations chosen in North America, it is shown that seismic and volcanic phenomena intervened in the evolution thereof.

Great stress is laid on the consequential dust product and on its chemical and petrological composition. Such dust, falling into fresh or salt water, changed into a soft colloidal condition or hydrogel, upset the balance of quiescent aquatic life and resulted in wholesale instantaneous destruction of the most sensitive (sic) of all animals, fish. Thus their bodies were enveloped along with diatoms, algæ, etc., in a shroud of rock-dust; pressure promoted chemical reactions between the alumino-silicic substances and hydrocarbons giving rise to "an alumino-silicate of oil and protein", or definite mineral compound, the "kerogen" of Crum Brown and Scottish oil shale fame. Regard this kerogen as a complex semi-colloid or colloid subject only to change with rise of temperature; divert such changes into separate channels according to the geochemical conditions obtaining at particular epochs, and thus are oil shales on one hand, petroleum on the other, given existence. This is an ingenious philosophy, combining all the weaknesses of the organic and inorganic theories of oil origin, with few of the merits of either, and, moreover, an excellent example of the danger of generalising on two or three particular occurrences. This is a book to look into, but difficult to take seriously.

The Journal of the Institute of Metals. Vol. 48. Edited by G. Shaw Scott. Pp. xi + 350 + 33 plates. (London: Institute of Metals, 1932.) 31*s.* 6*d.* net.

IN the May lecture to the Institute of Metals, Dr. Körber, of Düsseldorf, describes his investigations into the plastic deformation of metals. These are

well known to many from the original German publications, but the convenient and well illustrated summary here given will be of much value to metallurgists, being rich in suggestions bearing on the general problem of deformation. As has frequently been the case in recent years, the light alloys form the subject of a number of communications, perhaps the most striking of which is the description of the protection of magnesium and some of its alloys by the deposition of a film of selenium. The film is self-healing to a certain extent, and serves as a basis for paint or enamels, which it causes to adhere firmly. The 'fogging' of nickel is shown to be due to the action of sulphur compounds in the presence of moisture, a basic sulphate being the final product. It is largely inhibited by a preliminary formation of a thin film of sulphide.

A general discussion on the testing of castings brings out fundamental divergencies of view, some authorities holding that tests should be made on test pieces cast separately, whilst others hold that the test pieces should be cut from the actual casting. As the only conclusive test would involve the destruction of the casting, and even the best of castings will vary greatly in properties from one part to another, it would seem reasonable that the former plan should be adopted, and this view is held widely in Great Britain. The volume contains nearly twenty distinct communications.

The Subject Index to Periodicals, 1930. Issued by the Library Association. Pp. ix + 298. (London : The Library Association, 1932.) 70*s*.

THIS volume has been compiled under the direction of Mr. T. Rowland Powel and contains about 28,000 references. The headings are arranged in alphabetical order by subjects and are mainly chosen from the alphabetical subject headings of the Catalogue of the Library of Congress of the United States. Under each heading the articles are arranged alphabetically by the authors' names.

The range of subjects extends far beyond science even when taken in the widest sense, but fiction and verse are excluded. To restrict the size of the "Index", periodicals already indexed by certain well-known publications such as *Engineering Abstracts*, *Index Medicus*, *Journal of the Society of Dyers and Colourists*, *Revue de Géologie*, *Royal Meteorological Society's Bibliography*, *Science Abstracts* and *Textile Institute Journal* are not dealt with. Yet when these exceptions have been made, there remain no less than 545 English and American periodicals that have been indexed for this catalogue. In addition to these, 24 French, Belgian and Swiss, 20 German and Dutch, and two Italian periodicals have been dealt with.

In spite of attempts that have been made to induce authors to send their papers only to well recognised periodicals, it is still true that important work may be found hidden in publications the very names of which are unknown to most men of science. It is the function of the "Subject Index to Periodicals" to reveal such hidden papers. Such work should be done by international co-operation, but until this is possible, the Library Association should receive every encouragement to continue this series of annual indexes.

Johann Kepler 1571–1630 : a Tercentenary Commemoration of his Life and Work. Pp. xii + 133 + 2 plates. (Baltimore, Md. : The Williams and Wilkins Co. ; London : Baillière, Tindall and Cox, 1931.) 13*s*. 6*d*. net.

THIS little book consists of three addresses given before the History of Science Society in joint session with the American Association for the Advancement of Science, together with a brief introduction by Sir Arthur Eddington and a bibliography of all the important works of Kepler. In "Kepler as an Astronomer", Dr. W. C. Rufus gives a clear and concise account of his subject which adds point to Eddington's picture of Kepler as the forerunner of the modern theoretical physicist. This address also contains general biographical particulars, in addition to a description of his work as an astronomer.

Kepler's mathematical achievements are perhaps not so well known, although they are of great importance—particularly in the infinitesimal calculus, the simplification of computations and the use of logarithms. These and other contributions to mathematics are described by Dr. D. J. Struik ; while Kepler's philosophical and mystical outlook, which was so intimately related to his other work all through his life, is dealt with by Dr. E. H. Johnson.

In spite of some inevitable overlapping of subject matter, and the limitations imposed by its size and origin, the book is a useful contribution to the history of astronomy. The bibliography, in particular, compiled and annotated by F. E. Brasch, chief of the Smithsonian Division of the Library of Congress, should be most valuable.

Flowerless Plants. By Dr. Dukinfield Henry Scott. (Part 2 of An Introduction to Structural Botany.) Tenth edition, re-edited by F. T. Brooks. Pp. xvi + 332. (London : A. and C. Black, Ltd., 1932.) 7*s*. 6*d*. net.

THIS well-known book on the cryptogamic plants needs no introduction and the fact that it is now in its tenth edition speaks well for its success. This edition has been re-edited by Mr. F. T. Brooks, with the result that the new types *Peronospora*, *Saccharomyces* and *Euglena*, have been added. All three additions are important, representing a plant disease, a simple fungus of great economic importance, and a flagellate. *Cladothrix* has been omitted. The results of recent researches in Algæ and Fungi have been incorporated so far as is possible into the text. Written by Dr. Scott, and now revised with the advice and help of well-known specialists, the new edition of this book will continue to be an authoritative introduction to the subject.

Wood Anatomy as a Link between Botany and Forestry*

By B. J. RENDLE

THE conception of forestry as being ultimately dependent for its advance upon the interaction of a number of more or less independent basic sciences is a familiar one. The problems associated with the tree considered as a plant and with the forest considered either as an ecological unit or an artificial crop call for special methods of attack which, while primarily concerned with some aspect of forestry, can incidentally contribute to the general fund of botanical knowledge. The study of wood anatomy, with special reference to the production and utilisation of timber, is a case in point. In modern times this somewhat specialised subject has advanced along several different lines according to the points of view of the investigators concerned. The demand for practical methods of identifying and investigating the physical properties of commercial timbers has stimulated the study of species in this category. This has naturally been carried out more with reference to the important timbers of certain geographical regions than with botanical groups, and the woods of the north temperate zone in particular have received more than their fair share of attention.

In Germany, long before the end of the last century, certain of the timber-producing species of outstanding importance to Continental forestry practice were submitted to intensive studies of their anatomical-technical characters, which, besides yielding results of direct practical application, were of value in instigating further research in the peculiar problems of plant physiology which are associated with the great size and long life of trees. More recently, the opening up of botanical exploration in the tropics has offered a wide field of investigation in wood anatomy. Numbers of new genera and species of great potential value as a source of timber incidentally provide material for the study of systematic anatomy which for richness and variety is far superior to the limited and rather specialised arborescent flora of the north temperate regions.

Botanical exploration in an entirely different direction, geological rather than geographical, has also been the means of advancing our knowledge of the structure of wood, particularly as regards the gymnosperms. Study of the structure of fossil plants has been of the greatest importance in the development of the subject; it has even been observed that at one time woody plants were better known anatomically in a fossil than in a living condition, and it is safe to say that some of the most valuable studies of coniferous woods have been prompted by a desire to elucidate the relationship of their fossil allies and their connexion with recent forms. These researches have resulted in the formulation of criteria capable of wide application, and in this way palæobotany has probably had a stronger influence than either taxonomy or physiology on the progress of wood anatomy.

In considering the systematic value of wood characters, as with any other part of a plant, the first essential is to recognise the kinds of characters that are to be found. Different writers have divided characters into various classes and sub-classes, each with a more or less descriptive name, but for the present it is only necessary to refer to the two main divisions, namely, those which can be regarded as adaptations to environment, that is, 'biological characters', and those which have no apparent relation to the environment and remain unaffected by variations in the conditions of growth; for these the term 'inherent characters' seems to be the most appropriate.

It is abundantly clear that the anatomical structure of wood is a product of two factors, heredity and adaptation, and the successful employment of anatomical characters for systematic purposes depends on our being able to distinguish constant, inherited characters from those which are due to the influence of environment. In the course of generations of research, botanists have arrived at a fair idea of what morphological characters are constant, and to what extent they can be interpreted as indicating relationships. But in the case of wood there is relatively little information on this point and the need for further work of this kind is most pressing. The reason for this is not far to seek. The plants which are the subject of investigation in most fields of applied biology are generally available in a more or less complete condition, or at the least, their naming and classification is based on a study of those parts which are easily obtainable, but in the case of trees the difficulty is that the plant is such a large object; it is a laborious undertaking to examine the complete range of morphological and anatomical variation in a single tree, and when it becomes necessary to take into account the further variations induced by different conditions of growth, the problem assumes a much more formidable aspect.

Systematic botanists who have had to concern themselves with the critical study of trees from herbarium specimens are familiar with the morphological variation which occurs and which has often led to two or more specific epithets being attached to the same species when the trees have been described and named on incomplete botanical material. The similar variation in the structure of wood has not been sufficiently realised by all anatomists and this has in turn resulted in descriptions and keys, based on a study of inadequate material and on characters

* From a paper read before a joint meeting of Sections K (Botany) and K* (Forestry) of the British Association, at York, on Sept. 5.

which are not specific at all but only due to different conditions of growth, being used to differentiate between species. Many of the early researches in wood structure were directed towards the study of the size of the wood elements and their distribution within the growth ring, chiefly for purposes of identification. It is not yet fully realised in certain quarters that these features vary from tree to tree and that they vary more widely in different parts of the same tree.

Now, although this variation is considerable, the position of affairs is not so hopeless as it might appear at first sight. It will not be necessary to cut and examine microscopically the structure of hundreds of sections from dozens of different trees in order to obtain a reasonably accurate picture of the typical wood structure of every species. But it is necessary to examine in detail a few species exemplifying selected types of structure in order to ascertain the limits of variability of each diagnostic feature and to discover if possible the laws governing such variation. Critical anatomical surveys of this kind can only be undertaken by institutions in a position to obtain carefully selected trees and to examine them according to an ordered system of routine.

At the Forest Products Research Laboratory at Princes Risborough, the main consideration which underlies investigations in wood structure is naturally the influence of structure on the technical properties of the timber. There is no need to labour the point that in technological research one of the first essentials is to discover as much as possible about the physical nature of the material concerned. The cellular structure of wood is one of the most important factors in determining its physical properties, and a close correlation exists between changes in structure and changes in technical properties. The variation in the properties of timber grown under different conditions of climate, soil and sylviculture is one of the big disadvantages of the use of wood in industry for purposes which are in any degree exacting. The problem before us is to investigate the structure of a sufficient quantity of each species, grown under different conditions and in different parts of the country, so as to obtain an idea of the normal range of variation that is likely to occur. The same timber that is examined anatomically in the Laboratory is also subjected to technical tests. In this way its general quality is correlated with the growth features, thus indicating to the forester the conditions of growth necessary to produce first quality timber. At the same time, the results of these investigations are the means of increasing our knowledge of the general principles underlying the relation between the structure and the properties of wood, knowledge which is in demand for assessing the technical value of wood from an examination of its structure and for the proper understanding of the peculiar behaviour of wood under varying conditions of temperature, humidity and so on.

The lines of research that have been briefly outlined above, although directed primarily towards the solution of economic problems, are incidentally of importance in increasing our knowledge of the systematic anatomy of wood, and by virtue of their somewhat intensive character they are of special value in enabling us to distinguish between inherent and biological characters. From the severely practical point of view, this is of obvious importance in order to place the identification of timber specimens on a sound scientific basis, and there is ample evidence that the anatomical characteristics of wood can usefully be taken into account in the solution of taxonomic problems. There can be no serious suggestion of attempting a natural classification of woody plants on the sole basis of their vascular anatomy, but on the other hand there is no gainsaying the fact that the nearest approach to the ideal system of classification will be based on a complete knowledge of the external morphology and internal anatomy of plants. Wood anatomy is essentially auxiliary to taxonomy but it is an auxiliary that botanists cannot afford to neglect; it is, for example, of special value in throwing light on the systematic position of anomalous genera and provides a valuable test of the homogeneity of a family.

From the very nature of the subject the study of wood anatomy is confined to a comparatively small number of specialists, most of whom have been led thither by way of forestry or forest products research. In the belief that mutual benefit would result from some measure of organised co-operation between workers in different parts of the world, the opportunity offered by the Fifth International Botanical Congress at Cambridge in 1930 was taken by a few interested parties to discuss ways and means of effecting such co-operation. Eventually an International Association of Wood Anatomists was formed, which has as its object the advancement of the knowledge of wood anatomy in all its aspects; this Association seeks to achieve its object by enabling workers in the same field to get in touch with each other, by facilitating the exchange of ideas, information and material and by working towards standardisation in terminology and methods of description.

Co-operative work has already been started on the preparation of a polyglot glossary of terms used in describing woods. Anyone who has had occasion to study the recent literature of the subject in different languages will have noticed the lack of uniformity in the use of terms and the need for some measure of standardisation. As a first step in this direction a provisional glossary of terms has been compiled in six languages, and by circulating this repeatedly to experts in different countries for corrections and suggestions it is hoped in course of time to achieve an approach to finality.

What is perhaps a still more important undertaking is the effort to increase the amount of

authentic material available for research. This can only be done by inducing collectors to obtain wood samples from the trunks of the same trees from which herbarium material is taken. It should be our aim to build up wood collections comparable to our national herbaria; those that we have are hopelessly encumbered by commercial samples of timbers and specimens collected in all good faith but entirely without regard to the need of ensuring their true botanical authenticity. There can be no better example of the need for co-operative effort than the preliminary work necessary to establish on a sound basis the thorough investigation and successful utilisation of the timber resources of the overseas dominions of the British Empire.

Stellar Radial Velocities

By Dr. R. O. REDMAN

THERE has recently been published by the Lick Observatory a General Catalogue of the Radial Velocities of Stars, Nebulæ, and Clusters by Joseph Haines Moore.* This gives all radial velocities published up to January 1, 1932, and includes 6739 stars, 133 gaseous nebulæ, 18 globular clusters and 90 extra-galactic nebulæ. For some time a need has been felt for such a compilation, and after consultation with the members of the radial velocity commission of the International Astronomical Union, which includes practically all the workers active in this field, Dr. Moore undertook the task. Himself a radial velocity observer of considerable experience, he has carried out this work very thoroughly and the publication forms a compact collection of observational data of extremely great value.

It is very fitting that this catalogue should be issued by the Lick Observatory, which has played such a leading part during the past forty years in the measurement of radial velocities of stars and nebulæ. The first attack on the measurement of the Doppler shift in stellar spectra was made by Huggins in 1866, using visual methods, but the task proved difficult, and reasonably reliable results were not obtained until Keeler's work with the Lick 36-inch refractor about 1890. Even then velocities were obtained only with one or two of the brightest stars in the sky.

However, at about this same time, line of sight velocities were successfully measured at Potsdam by photography. The great superiority of the photographic method was quickly realised and soon extensive work was started, particularly by Campbell and his associates at the Lick Observatory. Observations have been accumulating with increasing rapidity ever since. As is well known, the results have been among the most valuable of astrophysical data and have found many applications, in the determination of masses in binary stars, in the study of variable stars, in stellar motions and the dynamics of the Milky Way system. Radial velocity technique has also contributed support to relativity theory in observations of Sirius B and to the theory of the expanding universe in recent observations of the spiral nebulæ.

The practical problem of radial velocity determination consists in the measurement of displacements of lines in an absorption spectrum formed by light from an extremely faint source. The unavoidable complications present in all astronomical observations, namely a rotating earth and an unsteady atmosphere of varying transparency, have also to be contended with. The average stellar velocity in the line of sight is around 15 or 20 km./sec., which corresponds in the ordinary photographic region of the spectrum to a Doppler shift of approximately one quarter of an angstrom.

The experience of the past thirty or forty years has indicated with little ambiguity the most desirable type of instrument to use. A telescope of large aperture is essential—36 in. is the least size with which any important amount of work is done at present—and, although refractors have in several cases given excellent service, it is generally considered that reflectors are more desirable. Their advantages lie in ease of construction, in their perfect achromatism, in their greater efficiency in the region of shorter wavelengths and in the long equivalent focal length which may be obtained without an inconveniently long telescope tube. The Cassegrain arrangement of mirrors, with a convex secondary reflecting the beam back through a hole in the centre of the primary, is undoubtedly the best.

The spectrograph is normally carried on the telescope, and since it may then be required to work in almost any position, it has to be constructed and mounted with special precautions against flexure or distortion of any kind. Prisms are usually employed since they are less wasteful of light than are diffraction gratings. One prism is most commonly used, although the number may be two or three for the brighter stars, and several interchangeable cameras of various focal lengths are usually available. In this way a fairly wide range of dispersions can be provided, varying perhaps from near 10 to around 100 angstroms per millimetre at Hγ (λ 4340) and suitable for use with stars of a wide range of apparent brightness. Since effectively the observing is done in the open air, the spectrograph should be enclosed in an insulating case and its temperature controlled by a thermostat. Exposure times vary enormously with magnitude and type of stars, with observing conditions and with the particular instrument used. Extensive radial velocity work is rarely carried out where more than one or two hours per photograph are required in fair weather. The

* Publications of the Lick Observatory, Volume 18, 1932.

resulting photographs are measured on special micrometer machines, the positions of the spectral lines being determined with reference to a comparison spectrum of the iron arc or some other convenient standard source.

Particular reference may be made to the work on extra-galactic nebulæ, the spectra of which almost without exception show displacements corresponding to large velocities of recession. The objects in question are generally extremely faint, and in addition their light is spread over an appreciable area of the sky, instead of being concentrated like that of a star. They are more difficult to observe than the diffuse and planetary nebulæ, since they have absorption, not emission, spectra. Pioneer work was done by V. M. Slipher at the Lowell Observatory, Flagstaff, but the more extensive recent measurements have been made at Mt. Wilson, where spectra of extremely small dispersion are taken with a special short focus camera lens working at f 0·6. The slit is used very wide and the exposures are sometimes very long, extending over several nights. In the photographs it is generally possible to distinguish only one or two of the strongest features of the spectrum, but the displacements, thanks to their great size, are usually determined well within ten per cent.

Reverting to more normal stellar work, the errors of measurement of radial velocities, as one might expect, vary a great deal according to the dispersion of the spectra and the nature of the spectrum lines. With a one prism instrument giving 25 or 30 A./mm. at Hγ, the probable error per plate is approximately 1 km./sec. in the case of a star with many sharp spectral lines, but with some spectra where the lines are few and nebulous, this error may easily exceed 5 km./sec. Systematic errors have in the past usually been evaluated by intercomparison of results from different observatories. Their average value is generally rather less than 1 km./sec. Now, however, as work is being pushed further to fainter apparent magnitudes, there is considerably less overlap than formerly between the work at one observatory and another, and standard stars are coming into use for the purpose of checking systematic errors. A list of such stars was published some years ago by the radial velocity commission of the International Astronomical Union and has proved very valuable. It is at present being revised and extended to fainter stars.

An inspection of Dr. Moore's catalogue gives some idea of the total progress made to date in this work. Thanks chiefly to the Lick Observatory, all stars have been adequately observed down to magnitude 5·51, but apart from this no group of stars has been completely observed over both northern and southern hemispheres. In the northern sky various groups of objects such as the Boss stars, the brighter dwarfs, the O to B5 stars down to magnitude 7·5, and certain classes of variables, have been observed, and further systematic work is being pushed forward, particularly at the Lick, Victoria and Mt. Wilson observatories. On the other hand, the southern sky below declination −25°, with the exception of the brighter stars just mentioned, remains practically untouched. Neglecting for the moment the fact that there are known to be many variable and peculiar stars of great interest in this region, knowledge of which would be very greatly advanced by radial velocity observations, this gap in our data is most serious in work on stellar motions. Until it is filled, observational studies of such questions as galactic rotation and certain other features of stellar movements must necessarily be incomplete.

Unfortunately, there seems to be no immediate certainty of a suitable telescope being established in the southern hemisphere for this purpose. At the recent meetings at Cambridge, Massachusetts, the radial velocity commission and later the general assembly of the International Astronomical Union, fully alive to the unsatisfactory nature of the present situation, passed a resolution asking that every effort be made to further any project aiming at the establishment and efficient working in the southern hemisphere of a large reflecting telescope for stellar spectroscopy and in particular for the determination of radial velocities. It seems unfortunate that some of the large sums of money devoted to several schemes at present on foot to build large instruments in the northern hemisphere, could not have been diverted towards filling this need in the southern sky.

Apart from this gap, which will have to be filled at some time, future work in radial velocities is likely to concentrate on refined observations of the brightest stars, on variables and peculiar objects, and on obtaining large numbers of velocities of fainter stars for statistical work. These last need not be of very great accuracy, although systematic errors will have to be carefully watched. There is in these three directions an almost unlimited field for large telescopes.

Obituary

MR. FRANK FINN

FRANK FINN, whose recent death, at sixty-four years of age, we regret to record, was an exhibitioner of Brasenose College, Oxford, and an excellent classical scholar. Whilst at Oxford he took a great interest in ornithology, both as an observer of birds and a systematic naturalist. He acquired a reputation amongst dealers and spent a great deal of his time in identifying collections of skins. This pursuit, unfortunately, occupied much of the time that he should have devoted to classics, with the result that his academic success by no means equalled his capacity. It may be said that this showed almost the leading defect in his character, which prevented him from being really successful in any of his undertakings. He

was always more interested in something which it was unnecessary to do at the time than in the immediate duty before him.

After taking his degree with honours in 'Greats', Mr. Finn went on an expedition to tropical Africa and spent a considerable time travelling, observing, and collecting. On his return he became assistant to Col. A. W. Alcock, who was then in charge of the Indian Museum. There also it was characteristic of him that he devoted more time to observing animals in the Zoological Gardens in Calcutta and its vicinity than to his official duties.

In 1903, Mr. Finn resigned his post and returned to England. The rest of his life was occupied by various minor appointments, none of which he cared to hold very long; by writing for the Press, and by writing books on natural history, the chief of which are: "Indian Sporting Birds", 1915; "How to Know the Indian Waders", 1906; "The World's Birds", 1908; "Game Birds of India and Asia", 1911; "Bird Behaviour", 1919; and with E. Kay Robinson, "Birds of Our Country". 2 Vols. 1922–23.

Mr. Finn had a most remarkable memory for facts, and there is no doubt that in his powers of observation and his real knowledge of birds and mammals, he had the making of a very great naturalist. For many years, however, he suffered from serious ill-health which made him irregular in his methods of working. He had, however, many delightful qualities and every naturalist who came intimately in contact with him had the highest possible appreciation of his knowledge and abilities.

WE regret to announce the following deaths:

Dr. Ernest Clarke, C.V.O., distinguished for his work in ophthalmic surgery, a manager and vice-president of the Royal Institution, on November 22, aged seventy-five years.

Mr. W. H. Patchell, consulting engineer, president of the Institution of Mechanical Engineers in 1924–25, on November 24, aged seventy years.

Mr. Charles M. Stuart, first headmaster (1888–1922) of St. Dunstan's College, Catford, who did much for the promotion of scientific method in education, on November 22, aged seventy-five years.

News and Views

Honour for Prof. Karl Pearson, F.R.S.

PROF. KARL PEARSON, of University College, London, has been awarded the Rudolf Virchow medal by the Berlin Gesellschaft für Anthropologie, Ethnologie und Urgeschichte. The award is made in recognition of Prof. Pearson's conspicuous services for the advancement of the study of human biology, and especially his pioneer work in the field of biometrics and his contributions to the study of eugenics, in which he has carried on and extended the work of the late Francis Galton. In conveying the announcement of the award, Prof. Eugen Fischer, president of the society, recalls the fact that up to the present the only recipients of the medal have been von der Steinen and Koch-Grünberg, the ethnologists; Olshausen and Heger, the archæologists; Toldt and Hans Virchow, anatomists; and lastly Erwin Baur, the geneticist. The value of the award is enhanced not only by its significance as a recognition of the international character of science, but also by the fact that on this, the first occasion on which the award has been made to a scientific worker outside the boundaries of Central European countries, the choice has fallen on one who is British. This, however, is not the only tribute which has been paid recently to the position in international scientific circles held by Prof. Pearson. The Sixth International Congress of Genetics, when assembled last summer in plenary session at Ithaca, New York, in conveying cordial greetings to Prof. Pearson and "best wishes for his health and long success and satisfaction in his scientific work", acknowledged the great indebtedness of the science of genetics to the statistical methods developed by him and now universally used.

To no one could these honours have fallen more appropriately. As Galton professor of eugenics in the University of London and as director of the Francis Galton Laboratory of National Eugenics, Prof. Pearson has attained a world-wide reputation for the originality and fertility of his application of statistical methods to the problems of biology and anthropology. His statistical methods have been developed in innumerable papers contributed to scientific periodicals and in a number of books, of which the "Grammar of Science" (1899) and "National Life from the Standpoint of Science" (1901) have exerted no inconsiderable influence on the development of scientific thought. These methods have been applied to the study of topics to which their adaptability would at one time have been inconceivable to any but the fertile genius of Francis Galton, whose life and letters were edited with discrimination and judgment by Prof. Pearson in three volumes (1914, 1924 and 1930). Yet notwithstanding the range and quality of his output, the great achievement of his fifty years teaching and work in London has been his success in inspiring and directing the work of others, for the most part his own pupils, who with him have contributed to the great advance in the exact scientific study of man and his heredity during the last generation. Prof. Pearson's success in this direction has been conspicuous in his editorship of *Biometrika*, a periodical for the statistical study of biological problems, which was founded by himself, the late W. F. R. Weldon and Sir Francis Galton. Happily, when Prof. Pearson retires from active teaching, as he proposes to do at the end of the current session, he will retain the editorship of this periodical.

The Furthest Depths of Space

THE theory of the expanding universe, which has lately attracted so much attention, formed the principal topic of Sir James Jeans's remarks in the Henry Sidgwick memorial lecture for 1932, which was given at Newnham College, Cambridge, on November 26, under the title "The Furthest Depths of Space". In a brief survey, Sir James introduced his listeners to the universe as we know it to-day, beginning with the naked-eye stars, then passing to the Milky Way system and from there to the extra-galactic nebulæ. These, in themselves objects of great importance, acquire additional interest as straws floating in the stream of space, showing how its currents are flowing. This space is curved, with a texture varying from the local irregularities which cause the electron to twist about in an electric or magnetic field, or the planets to move in curved orbits around the sun, to a bigger, coarser texture which makes space curve round on itself and finally close up. The state of curvature is not quite that of a universe in equilibrium as first conceived by Einstein, for later investigators, Friedmann, Lemaître and others have shown that such an equilibrium would be unstable. Space would immediately commence expanding or contracting with ever-increasing speed. We do not know what was the initial impulse which began the expansion. It may have been the starting of condensation in the primeval gas of which the universe is generally supposed to have consisted, but the suggestion, Sir James thinks, has not yet been strictly proved.

Expansion of the Universe

THE expansion of the universe expected by theory has been strikingly confirmed by radial velocity observations of the spiral nebulæ, which, we may remark, is discussed by Dr. R. O. Redman elsewhere in this issue (p. 836), but a serious difficulty immediately arises. The expansion is so fast that it cannot easily be reconciled with an evolutionary age of the universe greater than about 10^{10} years. Yet all other astronomical evidence requires an age of 10^{12} or 10^{13} years. The rate of expansion has been deduced theoretically by Eddington, who finds remarkable agreement with observation, at least so far as order of magnitude is concerned. If he can put his very daring calculations in a form which will command the general assent of mathematicians, they will provide a very strong confirmation of the whole theory of the expanding universe. Two other recent investigations have tried, in very different ways, to dispose altogether of the cosmical constant, the quantity which on Einstein's original theory fixed the amount of the large-scale curvature of the universe. Milne has supposed that the nebulæ were formerly bunched together in a quite small region of space and endowed with motions which have produced both their present distances and their present velocities. This does not solve the age difficulty and Sir James feels also that the simplicity of this explanation has been achieved by assuming practically all that is to be explained. On the other hand, the recent work of Einstein and de Sitter suggests that really we know no reason which makes space have any inherent curvature. There seems to be a possibility that the universe is undergoing a series of expansions and contractions, in which case we have all the time we want for its evolution. This appears to Sir James to be the only possibility at present in the field which is not exceedingly difficult to reconcile with our general knowledge of astronomy.

Crete and Mainland Greece

FURTHER evidence of the influence of Minoan Crete on the mainland of Greece after the fall of the Palace of Knossos was brought forward by Sir Arthur Evans in his lecture before the Hellenic Society on November 22. It has been derived from a number of inscriptions painted on vases discovered in a cellar by Prof. A. D. Keramopoulos, while excavating the Cadmeia of Thebes. These Sir Arthur has been allowed to examine and copy, and their publication has been reserved for him, by the Greek Archæological Society. The script, Sir Arthur said, answers in an overwhelming degree to that current in the latest phase of the Palace of Knossos as represented in more than 1,400 inscribed tablets. Out of about sixty signs gathered from the Minoan documents, no less than forty occur in the twenty-eight inscriptions from Thebes. In two instances the Theban inscriptions show the same signs as occur in the list of personal names in the inscription found at Knossos in 1902. Further, a comparison with the fragmentary inscriptions found on vases at Tiryns by the German excavators, and a few from Mycenæ, establish the identity of their script with that of Thebes. They also include a Knossian personal name. It may therefore be regarded as proved, Sir Arthur concluded, that in Mycenæan Greece of the fourteenth century B.C., the urban population spoke a language implanted from Crete, a language which in that island can be traced back to the third millennium B.C., and, if personal names count for anything, can be linked to the Carian races on the Anatolian side.

Marine Biology of the University of Sydney

DURING the past three years a scheme of oceanographic investigation has been initiated and conducted from the Department of Zoology of the University of Sydney, under the direction of Prof. William J. Dakin. The work commenced with an examination of the plankton and hydrographical conditions prevailing in the ocean waters off the entrance to Sydney Harbour. This is the first long-continued investigation of the plankton, that is, a study of the seasonal changes over a period greater than a year, to be made in Australian waters. In fact, little or nothing has been published regarding the seasonal changes in the plankton at any one station in the temperate waters of the southern hemisphere. The work has been greatly facilitated during the past year and a half by the acquirement of a small auxiliary yacht of about 12 tons (which has proved more suitable than a launch for ocean waters), and by the erection

of a Marine Biological Station at the entrance to Port Jackson, both being the property of the University. This biological station is at present the only one permanently equipped and in continuous use on the Australian coast.

Seasonal Plankton Rhythm

AT the recent meeting of the Australian and New Zealand Association for the Advancement of Science, it was stated by Prof. Dakin that plankton studies in New South Wales waters had shown a distinct diatom maximum in the spring, followed by a smaller maximum in the autumn. These conditions presented an interesting and close parallel with those so well known in the temperate waters of Europe. In further agreement a scarcity of plankton is recorded during the winter months and the planktonic Crustacea—*Copepoda* and *Cladocera*—rise to maxima in the early summer following the diatom and dinoflagellate maxima. The variations in the abundance of plankton during the year do not seem to be anything like so great as in the Irish Sea or English Channel, and it would almost appear as if the phosphate and nitrate concentrations in the sea water were also more uniform. The study of the relation between the seasonal rhythm of the plankton and changes in the physico-chemical environment is to be continued, whilst particular attention will be paid to the occurrence of fish eggs and larvæ.

Fisheries of the Philippines

THREE fully illustrated accounts of various Philippine fisheries are published in the July number of the *Philippine Journal of Science*, No. 3, vol. 48, 1932: "The Japanese Beam Trawl used in Philippine Waters", by Augustin F. Urnali; "The Fisheries of Lake Sampaloc, San Pablo Laguna Province, Luzon", by Florencio Talavera; and "Fishing Appliances of Panay, Negros and Cebu", by Florencio Talavera and Heraclio R. Montalban. Fishes of many kinds, shrimps and other Crustacea, molluscs and holothurians are all important commercially in the Philippines. In some parts the fishing is deteriorating from over-fishing, lack of attention, or from physical causes. New methods and restrictions are recommended by the different writers. The Japanese beam trawl is at present used only by Japanese, in their own boats, manned by their own men. It is apparently no more destructive than the other methods of fishing, and its use is advised for the native fishermen. Lake Sampalac, the largest of the nine crater lakes in the San Pablo Valley, was an important fishing centre before its height was lessened by approximately 10 metres. Now, partly from this alteration and partly from other causes which are investigated fully by Dr. Talavera, of the Division of Fisheries, Bureau of Science, Manila, the fishes are certainly decreasing, and legislative measures together with restocking are suggested. The shrimps in this lake appear to be inexhaustible. The multiplicity of terms used in the local fisheries and the names for the various appliances are astonishing, but these are all carefully explained and illustrated in the third paper.

Oceanography in Spain

IN June 1933 the first Iberian-American Oceanographical Conference will be held in Madrid. The Council, under the presidency of Prof. D. Odon de Buen of Madrid, was instituted in 1929 in order to facilitate co-operation between the Iberian Peninsula and parts of America, the countries involved being Spain, Argentina, Costa Rica, Ecuador, Salvador, Guatemala, Mexico, Panama, Peru, Dominican Republic, and Uruguay. The publications of the Council consist of a review (*Revista del Consejo Oceanografico Ibero-Americano*), which has been in existence for three years and contains many interesting short papers, and the memoirs (*Memorias del Consejo Oceanografico Ibero-Americano*), eleven numbers of which have been published, each containing one long paper. No. 9, by Prof. Rafael de Buen, deals with all the activities connected with the Spanish Institute of Oceanography, which was founded in 1914 to unite in one centre the coastal marine laboratories already in existence, situated in Palma de Mallorca, Malaga, and Santander. All these are now connected with the main oceanographical laboratories in Madrid, where all investigations are centralised, the director being Prof. Odon de Buen. Various expeditions have been undertaken, mainly in the Mediterranean, and in 1924 Spain joined the International Council for the Exploration of the Sea, among other things working out certain hydrographical problems round Cape Finisterre and studying the biology of the sardine and other fishes, including the hake, tunny, and bonito.

Tasmanian Rock Carvings

A DISCUSSION of the origin of certain alleged rock-engravings at Mersey Bluff, Devonport, Tasmania, appears in the *Papers and Proceedings of the Royal Society of Tasmania* for 1931. In its general bearing the paper is of considerable interest to archæologists and students of primitive art. Mr. A. L. Meston, who argues for the authenticity of the carvings, has examined and describes a number of them. He claims that he has identified representations of fish, coiled snakes, a bird's head, *Haliotis* shells, cup-and-rings, and concentric circles. The carvings are on horizontal surfaces of a hard diabase, and are not scratched but are incised, as if by a hard implement, such as a quartzite tool, impelled by a hammer. The existence of Tasmanian aboriginal carvings and drawings has been doubted, notably by the late H. Ling Roth; but Mr. Meston states that these examples have been accepted by those acquainted with primitive rock-carvings elsewhere. The case against the authenticity of these carvings is taken up by Mr. E. O. G. Scott, of the Queen Victoria Museum, Launceston, who has made an extensive and detailed report on the subject to the Museum Committee. A brief outline of his arguments appears in the *Proceedings*, pending decision as to publication in full. His conclusion is that the 75 rock-markings claimed by Mr. Meston to be carvings are not of aboriginal origin, but are items in an extensive series of natural erosions which have in general occurred along lines

of inherent pneumatological weakness in the Mesozoic region. He also suggests that rock-lichens have played a not unimportant part in the process of erosion of the grooves, and in some instances may have initiated them.

Mammoth Remains in New Jersey

IT is announced by the Academy of Natural Sciences of Philadelphia that five teeth and several fragments of bone of the mammoth (*E. primigenius*) have been discovered near Blackwood, New Jersey, twelve miles south-east of Philadelphia. The discovery was made in the course of work on the golf course of the Hidden Lake Country Club, and the remains were identified by Mr. Edgar B. Howard of the Academy's Department of Zoology. The teeth were found at a depth of 4 ft. within a small radius of what was once the bed of a fairly wide creek, now the bank of a streamlet. Each of the five teeth is fairly whole and one clearly shows the roots, of the size of a man's finger. In size the teeth range from 3 in. × 5 in. × 7 in. to 4 in. × 5½ in. × 9 in. and in weight from 3¼ to 6¾ lb. each. The thin enamel ridges which traverse the chewing surface are still clearly visible. This constitutes the most impressive find of mammoth remains yet made in the eastern United States. Previously no more than a single tooth had been found in any one locality. Previous finds were at Trenton and North Plainfield, New Jersey, and five in Pennsylvania. In the Pleistocene epoch the mammoth had a distribution in North America ranging from Alaska, through British Columbia and the northern United States to the Atlantic, being a migrant by way of the Asiatic-Alaskan land-bridge from Siberia, where frozen specimens, complete with flesh, hide and wool, have been found in recent times. The fossils from Blackwood, with the tooth from Chadd's Ford, are now on exhibition in the museum of the Academy of Natural Sciences of Philadelphia.

Botany Collections at the Natural History Museum

THE Godman Trustees have presented to the Department of Botany of the Natural History Museum a collection of about six hundred plants made by Mr. R. C. N. Young in north-east Angola (Lunda). The Department is particularly rich in Angolan plants having valuable collections from F. Welwitsch and J. Gossweiler. The present set of plants is of considerable interest as it is from an area so far botanically unknown. Three octavo volumes of British plants have been presented by Miss Jackson. The interest in these is bibliographical, as there is a printed title page giving publisher's name and date (1847); there is also a printed preface. The title reads "Specimen Flora or British Botany exemplified by Plants from a Collector's Cabinet". The plants were "arranged by the author of 'The Pictorial Flora'" [Mary Ann Jackson].

Birds of Northumberland

FOR the third time the Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne has published a catalogue of the birds of the district—P. J. Selby in 1831, John Hancock in 1874, and now, as a worthy successor, appears George Bolam's list of 1932. It appears as a special part (vol. 8) of the *Transactions* of the Society, and in order to avoid undue repetition, it takes as its datum line Mr. Bolam's own list of 1912, in his "Birds of Northumberland and the Eastern Borders". Hancock's catalogue included 255 birds for Northumberland, by 1912 the number had risen to 282, now the number well exceeds 300, and this largely because of the finer analysis of species and racial forms. Of course quite a considerable number of the birds in this or any other local list are no more than accidental visitors, the presence of which really means very little from a local point of view. Here, for example, the smew, with four records, takes more space than the swallow, martin, and sand-martin all added together; and yet fluctuations in the numbers of these summer visitors would be more worth recording than the odd occurrences of the winter duck. From a scientific point of view, the day of usefulness of the county list, unless it becomes an intimate and detailed chronicle of local changes and fluctuations, is past, and we venture to think that the third Northumberland catalogue of birds will be the last, notwithstanding its particular value and appeal to the people of the county itself.

Pest Control and Wild Animal Life

IN many parts of the United States of America the destruction of agricultural pests has become an intensified and highly specialised warfare organised by State departments. But it has scarcely been realised that the destruction is apt to reach far beyond the pests at which it is aimed. This would appear to be true particularly of large scale use of thallium and strychnine baits, the former of which is preferred at most seasons and in most areas because it makes 'better kills' than other types of poison. Dr. Jean M. Linsdale has collected further facts concerning losses to wild life in California from these sources, and summarises the reports of 285 observers who have found dead mammals and birds (other, of course, than squirrels and coyotes) unquestionably killed during pest control campaigns (*Condor*, vol. 34, p. 121; 1932). The list occupies 13 pages of the magazine, and it must be remembered that it covers, as a rule, only conspicuous species—many others must have passed unnoticed or unidentified. The author is of opinion that the accelerated development of pest control methods and their uninterrupted practice could so change the native bird life of California within a few seasons that all previous activities for its preservation would be nullified. The publication of these facts, however, should induce the authorities to reconsider their methods of pest destruction.

The Cinematograph as an Aid to Histology

A NEW reconstructional technique is put forward by Messrs. Peacock and Price in the September issue of the *Journal of the Royal Microscopical Society*. Successive photographs of the sections in a uniform series are taken on standard cinema film and after-

wards projected. It is found that an apparently continuous flow of the image on the screen can be obtained if about seven frames are exposed for each section. The camera is mounted between the microscope and a paper screen, sharp focus of the former being secured by exposing a number of frames at recorded settings of the fine adjustment; the camera is then swung out of the optical axis and the image brought to a sharp focus on the screen by means of a supplementary lens. The screen is now used to secure orientation and focus for each successive section, the camera being swung into the optical axis when a suitable adjustment has been obtained. Though much difficulty is at present occasioned through the distortion of successive sections during mounting, the new technique will prove a considerable aid both in teaching and in research.

Development of International Law

THE *New Commonwealth* (monthly, published at Mowbray House, Norfolk Street, Strand, W.C.2., price 6*d*.), the first issue of which has recently appeared, is the organ of a new international society formed to advocate the establishment of a world system of law and order. If "the common sense of all" is to "hold a fretful realm in awe", effective provision must be made for the administration of international justice, and this can be achieved only, in the new society's view, by establishing: (1) an international tribunal, to deal with all disputes threatening the peace of the world which do not at present come within the purview of the Permanent Court of International Justice; and (2) an international police force as the sanction of international law and a guarantee of security against aggression. On these two objectives the society proposes to focus and interest public opinion. As Sir Arthur Salter says in a letter to the editor, the times are dangerous and moral suasion alone cannot be relied upon to defeat the material forces of the world if these are all allowed to be harnessed to policies of evil. In an open letter signed by Norman Angell, Lord Cecil of Chelwood, the Archbishop of York, Sir Oliver Lodge, Prof. Gilbert Murray and sixteen other eminent citizens of nine of the principal countries of the world, the *New Commonwealth* is commended to all those who are interested in the development of the reign of law.

Production and Employment

IN a pamphlet entitled "The Prevention of Future Economic World Crises", Herr Robert Bosch of the Bosch Company, Stuttgart, points out that the present world-wide business depression differs radically from previous ones which were caused principally, if not exclusively, by a preceding unhealthy boom. He argues that the troubles of the present depression are not due to over-efficiency of production methods as commonly supposed but rather to the inefficiency and backwardness of non-technical branches of the world's activities. Foreign relations are handicapped by antiquated political and mercantilist conceptions leading to armaments and tariffs while national prosperity is handicapped by wasteful and inefficient administration and distribution and by antagonism between different groups of society. It is necessary to write off superfluous plant capacity so that the remaining factories may be run efficiently. Herr Bosch visualises a reduction of the yearly working time to 1800 hours or less in place of the present 2400 hours so as to guarantee some employment at fair compensation to every worker, but he recommends that the rigid eight-hour day should be replaced by more flexible arrangements so as to provide the maximum economy in the operation of particular factories.

Scientific Treatment of Delinquency

A NEW era in the investigation and treatment of crime was outlined at an inaugural meeting of the 'Institute for Scientific Treatment of Delinquency' held at University College, London, on November 29. The chairman, Dr. Edward Glover, pointed out that existing criminal and penal codes differ in no essential respect from the behaviouristic codes spontaneously evolved by two-year old children. He emphasised the urgent need for centralisation and co-ordination of effort at present made by small independent organisations. In his opinion any research on the subject should be conducted in an attitude of complete detachment from preconceived views as to desirability. The need for such an Institute was emphasised by a number of speakers. Amongst these, Lord Feversham dealt with the problem from the point of view of adequate probationary handling. Drs. Hadfield, Rees and Emanuel Miller recounted medico-psychological experience of handling delinquents at various clinics and welfare centres. The points of view of general science, ethics and politics were presented by Prof. Winifred Cullis, Canon Donaldson and W. J. Brown respectively. The Institute's immediate plans for co-ordination research, treatment and technical instruction were then outlined by Dr. Glover. It is hoped that within a short time a reasoned report on the present system of criminological work may be put before the various Government departments concerned. All communications should be addressed to the honorary secretary of the Institute, 56 Grosvenor Street, London, W.1.

The Study of an Oilfield

SOME observations on this subject were made by Mr. J. W. Weil in a paper read before the Institution of Petroleum Technologists on October 11. The paper was perhaps timely as representing the case for petroleum geology taking its logical place in the systematic scheme of oil production. Latterly there has been a decided tendency to interpret underground reservoir conditions—even geological data—on the basis of such functions as flowing pressures, oil and gas measurements, gas-oil ratios and other physical determinations which have been advanced as part of the standard technique of production engineering. The author pleads, and rightly so, for a thorough geological investigation as precedent to oilfield development and, in this connexion, he stresses the necessity of adequate study of stratigraphy, structure, factors influencing the accumula-

tion of oil and gas, data necessary for correlation of horizons and the construction of stratigraphical and production maps. While there is clearly nothing strikingly new in this communication, the paper will have done good if it directs the attention of those primarily concerned to the fact that, while geology may be substantially aided by the applications of its contact sciences, its principles as governing the understanding of sub-surface oil pools can never be superseded.

Mining Research at Birmingham

THE Executive Board of Mining Research of the University of Birmingham has issued a report on the work of the Mining Research Laboratory for the year 1931. The Laboratory receives grants from the British Colliery Owners' Research Association, the Department of Scientific and Industrial Research, and the Miners' Welfare Fund, which supports work in connexion with the problems of safety in mines. The report bears witness to the wide range of sciences—physics, chemistry, geology, and physiology—which are focused upon the problems of the coal industry. Much attention continues to be given to spontaneous combustion, as underground heatings are a prolific source of danger and accident. For some years the Laboratory has examined the hydrogenation of coal. While this problem has come to be regarded as technically solved, economic success seems to be so remote that the work has been suspended. Attention is being turned to problems connected with the use of compressed gas for road transport.

Social Conditions of Miners in India

THE September part of the most recent volume of the *Transactions of the Mining and Geological Institute of India* contains an important paper by Mr. R. R. Simpson, chief inspector of mines in India, upon the social conditions of miners in India, together with an animated discussion upon it. The paper is particularly interesting in itself, and all the more so because it discusses in detail a number of the very numerous recommendations made by the Royal Commission sent out in 1929 to inquire into Indian labour conditions, which made its report in 1931. The members who discussed the paper expressed varying views, and evidently looked upon Mr. Simpson's paper as a peg on which to hang the discussion of the recommendations of the Royal Commission. The paper and discussion occupy considerably more than fifty pages, and, therefore, do not lend themselves to any ready abstract, but both are well worth careful study on the part of those who wish to understand thoroughly Indian labour conditions.

Exhibition of Chemical Plant at Cologne

"ACHEMA VII", the seventh exhibition of chemical plant and equipment organised by the Deutsche Gesellschaft für chemisches Apparatewesen ("Dechema"), is to be held at Cologne on June 2–11, 1933. Similar exhibitions have been held since 1920 in Hanover, Stuttgart, Hamburg, Nürnberg, Essen, and Frankfurt-am-Main. The exhibition next year will be associated with meetings of the Verein deutscher Chemiker and other technological associations, in particular the Deutsche Brennkrafttechnische Gesellschaft and the Deutsche Kautschukgesellschaft, and with a Rubber Exhibition which will form the summer exhibition of the city of Cologne and will remain open until October 1933. The three principal halls around the congress hall in the Rheinpark will contain examples of acid-proof stoneware and other ceramic products, technical instruments for measurement and control, non-metallic and non-ferrous plant, laboratory apparatus and instruments, and machinery, with examples of complete plant and processes, raw materials and products. The rubber section will illustrate historically the development of methods for the production of rubber and of its industrial applications. An exhibition of such character will necessarily attract international interest, and nowhere more than in countries where chemical industries and the manufacture of chemical plant have reached a high standard of attainment. Particulars of the exhibition can be obtained from "Dechema", Seelze, near Hanover.

Mosquito Control

UNDER the title of "A Mosquito Summary", Mr. John F. Marshall, director of the British Mosquito Control Institute, Hayling Island, Hants., has recently issued an illustrated pamphlet of an essentially practical character. In a short and concise manner it explains how to recognise a mosquito, how such insects breed and how to distinguish anophelines from culicines in all stages of life. The manner in which mosquitoes carry disease and methods of controlling these insects are also summarised. The pamphlet, which is obtainable from the Institute (price 9*d*.) should prove useful to health officers and others concerned with mosquito eradication.

Dairy Research

WE have received the annual report for the year ended July 31, 1931, of the National Institute for Research in Dairying at the University of Reading. In common with other Institutions, a restricted income has necessitated a percentage reduction upon all salaries and wages and a curtailment of research work, the Government's grants for 1931–32 being less than previously by nearly £2,000. An account is given of the work of the various departments, with brief abstracts of scientific contributions made by the staff. An obituary notice, with portrait, of the late director, Dr. Stenhouse Williams, is included.

Bishop's Ring and the Andean Eruption

MR. J. FRASER PATERSON, writing from Broken Hill, Australia, says :—"The rare phenomenon known as Bishop's ring was visible in the western sky at 5 P.M. on Saturday, July 23. This date is about ten and a half weeks after the Andean eruptions. The colour of the ring was sepia."

Announcements

PROF. DAVIDSON BLACK, professor of anatomy in the Union Medical College, Peking, will deliver the Croonian lecture of the Royal Society on December 8. The title of Prof. Black's lecture will be "The Discovery of *Sinanthropus*".

UNDER the Order in Council dated February 6, 1928, the Lord President of the Council has appointed Dr. T. Franklin Sibly, Vice-Chancellor of the University of Reading, to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

THE following officers and new members of council of the London Mathematical Society have been elected for the session 1932–33: *President:* Prof. A. C. Dixon; *Vice-Presidents:* Prof. S. Chapman, Prof. H. Levy, Mr. T. L. Wren; *Treasurer:* Dr. A. E. Western; *Librarian:* Prof. H. Hilton; *Secretaries:* Prof. G. N. Watson, Mr. F. P. White; *New Members of the Council:* Prof. J. C. Burkill, Mr. W. L. Ferrar, Prof. E. A. Milne, Prof. G. F. J. Temple, Prof. E. C. Titchmarsh.

A CONFERENCE is being called by the Building Research Station of the Department of Scientific and Industrial Research to consider proposals for the establishment of a fire testing station for the building industry. The conference will be held at the Institution of Civil Engineers on Wednesday, December 7, at 11 A.M., under the chairmanship of Sir Clement Hindley. Firms and bodies which have not received invitations to the conference direct, but wish to send representatives, should communicate with the Director, Building Research Station, Garston, Watford, Herts.

THE annual Congress of the British Institute of Radiology will be held at the Central Hall, Westminster, on December 7–9, under the presidency of Prof. F. L. Hopwood. The Congress will be officially opened by Sir George Newman on December 7. In connexion with the Congress an exhibition of X-ray apparatus will be organised by the British X-ray industry. The thirteenth Mackenzie Davidson memorial lecture will be delivered by Dr. J. Chadwick on "The Neutron" and the fifteenth Sylvanus Thompson memorial lecture by the Right Hon. Viscount Lee of Fareham on "Radium as a Therapeutic Agent—The Case for National Control". The papers will be divided into medical, and physical and technical sessions.

THE attention of biologists may be directed to the Peking Natural History Society's *Bulletin* now in its seventh volume. This journal is doing good work in publishing illustrated papers on the fauna, flora, general biology, etc., of China. Its trend is largely zoological and through the medium of its pages additions to the fauna of China are frequently made known. The majority of the contributions are written in English by Chinese investigators, while there are occasional papers by European and other specialists. The editor of the *Bulletin*, to whom contributions and requests for exchange should be addressed, is Dr. Chenfu F. Wu, Department of Biology, Yenching University, Peiping, China.

THE Ministry of Agriculture and Fisheries has issued new editions of three advisory leaflets, dealing respectively with "Cleanliness in Dairying" (No. 140), detailing the causes and prevention of contamination of milk, "Caerphilly Cheese" (No. 141) and "Cheshire Cheese" (No. 142), the last two describing the manufacture of these cheeses. The leaflets cost 1*d*. each, and are published by H.M. Stationery Office.

WE have received from Messrs. Watson and Sons (Electro-Medical) Ltd., 43 Parker Street, Kingsway, London, W.C.2, a copy of a booklet and folder describing a new X-ray outfit for dental work, the "Sunic" Mark III shockproof unit, which, as its name implies, is claimed to afford complete protection from electrical as well as X-ray dangers. The booklet also gives a simple account of X-rays and their production.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary mistress to teach principally arithmetic and geography at the Aston Junior Commercial School—The Chief Education Officer, Higher Education Department, Education Office, Margaret Street, Birmingham (Dec. 5). A civilian photographic officer at the Royal Air Force School of Photography, Farnborough—The Air Ministry, Adastral House, Kingsway, W.C.2 (Dec. 10). A temporary demonstrator in the Department of Biochemistry at the University of Liverpool—The Johnston Professor of Biochemistry, The University, Liverpool (Dec. 12). An assistant director of examinations in the Civil Service Commission—The Secretary to the Civil Service Commissioners, 6, Burlington Gardens, London, W.1 (Dec. 31). Examiners for scholarship and staff examinations of the London County Council, in scientific and other subjects—The Education Officer (G.P.1), County Hall, Westminster Bridge, London, S.E.1 (Jan. 2). A cartographer in the Hydrographic Department of the Admiralty—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (Jan. 12). A Hope professor of zoology (with special reference to entomology) at the University of Oxford—The Registrar, University Registry, Oxford (Jan. 21). A technical assistant for the Public Health Laboratory at Salisbury, Southern Rhodesia—The Official Secretary to the High Commissioner for Southern Rhodesia, Crown House, Aldwych, London, W.C.2. A professor of horticulture at the University of Reading—The Registrar. An assistant lecturer in the Department of Physics at the Battersea Polytechnic, London, S.W.11—The Principal.

ERRATA.—In NATURE for October 29, p. 646, column 2, line 10, for "Sir Robert Boyce" read "Sir Rubert Boyce". In NATURE for November 19, p. 780, Research Item entitled "New Thermophilic Organisms", for "Bax" read "Dax" throughout.

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.*]

The Redwoods of California

As one who once lived in the Redwood country, may I be allowed to thank the Master of Downing for his vivid pen picture in NATURE of November 12 of those inspiring monuments of the past, the Californian Redwoods ?

A few years ago, when camped in a Redwood grove, I was sleeping at night on the stump of a huge tree, felled perhaps in the early days of settlement. A ring of young coppice probably not less than 100 ft. high, growing out of the stump, formed a charming screen, among the branches of which the blue jays chattered and the Californian thrush poured out his cheerful evensong. Looking upward as we lay in bed, the stars could be seen twinkling through the openings of a sky-pattern akin to that shown in Dr. Cannon's excellent photograph. But at intervals of a few nights, the sky would be enveloped in a cold, grey fog ; this condensed in the foliage of the tall spires and fell in a shower so heavy and continuous that unless our beds had been covered with waterproof they would have been wet through.

The ground beneath the Redwood is normally clothed with a layer of decaying foliage three to five inches, and sometimes even a foot, in depth ; this is composed chiefly of Redwood leaves still attached to the branchlets on which they grew, for *Sequoia sempervirens* sheds its branchlets, though unlike the related swamp cypress (*Taxodium*) or the larch (*Larix*) it does not become leafless at any season.

An examination of the layer of dead leaves showed that although it was the 'dry' season of the year, the layer was wet through by the fog-drip from the branches above ; into this spongy mass the Redwood had developed a dense system of rootlets, many being obviously young and in vigorous growth, some of them definitely growing upwards from the horizontal roots into the mass of humus above ; doubtless the tree was drawing therefrom a supply of moisture and of plant food.

This constant renewal of food supply and moisture near to the base of the trunk, and the ability to renew, as it were, its root system at close range, may have something to do with the remarkable longevity of the tree. They explain, also, how the sea-fog compensates for lack of rainfall in the long, hot, rainless summer of California. But they suggest a serious menace to the continued existence of these magnificent relics of a former flora, in the treatment they are receiving—or were then receiving—at the hand of man. With a commendable desire to prevent forest fires, it was customary for the custodians of public camping grounds in the National, State, or County groves, to sweep the ground beneath the Redwoods quite clear of dead leaves. As these surface-rooting trees appear to depend for their water supply during a not inconsiderable part of the year on the moisture stored in the layer of decomposing foliage, it is probable that the sweeping bare, and subsequent consolidation, of the soil, checks the development of the superficial system of new roots, and causes too rapid evaporation of the much-needed summer moisture, from the soil surface. Though in some years the sea-fogs may continue for weeks at a time, they are often discontinuous, lasting about three days together, separated by more or less equal spells of hot, dry weather with almost cloudless skies, resulting in intense evaporation of moisture from a hard, bare, soil surface, though with comparatively little loss from a loose spongy mulch.

These facts explain the limitation of the Redwood to that narrow belt (averaging about twenty miles in width), which is watered by sea-fog in the rainless season, just as the evergreen rain-forest of Central and South Africa is limited to the 'mist-belt' of the eastern mountain chain. They may explain, also, the behaviour of the Redwood in certain parts of England, where it often has a shabby, unhealthy appearance though in other localities it is vigorous and apparently quite at home with its environment. In my garden there are both a young Redwood and a young "Big Tree" (*S. gigantea*) ; each has developed a set of rootlets near the soil surface. Noticing, last summer, that both trees showed signs of check in growth and some die-back of foliage, the Santa Cruz observations came to my mind, and treatment with a thick mulch of rotting grass and leaves (left on throughout the summer and renewed in winter) was tried ; the beneficial effect was quickly noticeable. Late last spring the gardener, when tidying up, cleared the mulch from the Sequoias ; during a warm dry period in early summer the trees again showed signs of suffering ; the prompt application of a fresh mulch had almost immediate effect, followed by a steady growth of new wood equalling that of trees of the same age in their native haunts.

From these observations it would seem likely that in the drier parts of England, on gravelly or sandy soils, the Redwood would benefit from a mulch of leaves or rotting grass, especially during the drier summer months, and that this treatment might be applied with advantage to old-established trees as well as to young ones. If this surface-rooting habit is of regular occurrence in the species, such a mulch would afford protection to the roots against frost also. In fact, the desirability of maintaining a constant mulch under Sequoias seems to be indicated.

J. BURTT DAVY.

Imperial Forestry Institute,
Oxford.

Heterogony and the Chemical Ground-Plan of Animal Growth

IN 1924 in this journal, Huxley[1] first considered the relation between the growth of parts in a living organism, when the parts increase or decrease in relative size. The equation

$$\log y = \log b + k \log x$$

describes the process, where y is the size of the part, x the size of the whole, and b and k are constants (the former giving the fraction of x which y occupies when x is unity, and the latter the ratio of the growth-rate of the part to the growth-rate of the whole). Thus on a double logarithmic grid, straight lines are obtained, the slope of which is determined by the constant k, and the absolute position of which relative to the axis values, by the constant b. Since Huxley's first paper, this simple relation has been abundantly verified for morphological magnitudes in a large number of

animals, vertebrate and invertebrate, as described in his recent book.[2]

It seems likely, however, that the value of these considerations will be found to be just as great for the biochemist as it has been for the anatomist and the zoologist. I have recently undertaken a study (to be published *in extenso* in the *Bulletin de la Société Philomathique de Paris*) of the chemical heterogony of developing embryos, and have extended it to include a number of sets of data covering the whole range of the life cycle in certain animals. For the development of an embryo, the chick, for example, the plotting of chemical entity against chemical totality (such as non-protein nitrogen against dry or wet weight) on the double logarithmic scale, gives almost without exception a straight line. In certain cases, the data seem to demand

In plotting chemical magnitudes heterogonically we 'short-circuit' time. In comparing the heterogonic plots of the same constituent of different organisms we abstract (*a*) from the morphological form, (*b*) from the nutritional factors, (*c*) from the absolute values of the magnitudes, (*d*) from the time taken to perform the work shown on the plot. We have nothing left but a system of relations or ratios, which may be the same in all animals, and seems certainly to be the same in many animals—in a word, a fundamental chemical plan of animal growth. Just as D'Arcy Thompson[3] could transform one actually existing morphological shape into another by systematic deformations of Cartesian co-ordinates, so the chemical ground-plan must be thought of as deformable in space-time. It is probable that the essential processes of growth proceed in all animals, whatever

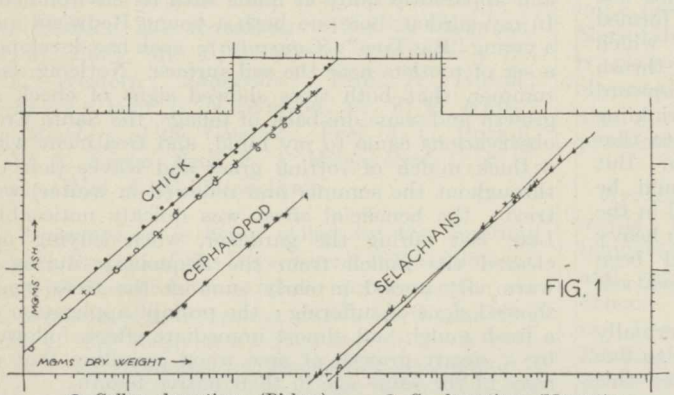

FIG. 1

● *Gallus domesticus* (Bishop); ○ *G. domesticus* (Murray); × *G. domesticus* (Romanov); ✳ *Sepia officinalis* (Ranzi); △ *Scyllium canicula* (Ranzi); ◐ *Torpedo ocellata* (Ranzi); + *Torpedo marmorata* (Ranzi); ◊ *Mustelus vulgaris* (Ranzi).

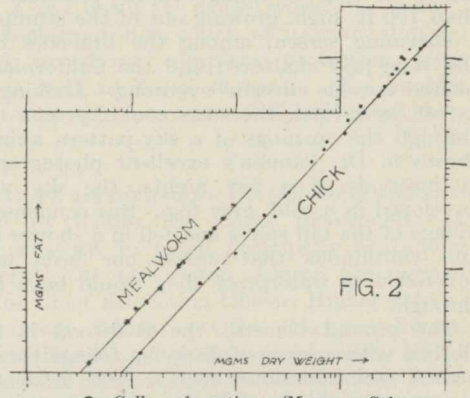

FIG. 2

● *Gallus domesticus* (Murray, Cahn and Romanov); ✳ *Tenebrio molitor* (Teissier).

representation by two or even three successive straight lines, periods of positive or negative heterogony being followed by periods of isogony, or vice versa. It is not, however, upon these critical points that emphasis should, it seems to me, be placed, for closer statistical analysis or the availability of more accurate data, may show them to be artifacts. What does seem important is that in many cases, the slope of the straight line for a given substance or group of substances, is identical or very similar in widely different organisms. Thus in Fig. 1 the total ash is shown plotted on a double logarithmic grid against the dry weight for the embryos of chick, cephalopod, and some selachian fishes. In spite of the great differences in absolute weights and times, the heterogony is the same ($k=0{\cdot}89$ for the chick, 0·86 for *Sepia*, and 0·91 for the selachian fishes). Fig. 2 shows the fat of the chick embryo and the mealworm larva plotted in the same way. Again, the heterogony is the same ($k=1{\cdot}06$ for the chick, 1·07 for the mealworm).

This similarity of chemical development between different animals appears in numerous other instances: (1) water content of mammals, reptiles, birds, amphibians, fishes, cephalopods and arthropods throughout the life cycle, (2) nuclein content of chick and mammals, (3) dry substance of various mammalian brains, (4) proteins, phosphatides, cerebrosides, sulphatides, cholesterol, and extractives, of the brains of rat and man, (5) calcium in chick and mammals. The evidence on which these instances are based will be found in the paper referred to above.

their form and size, according to a definite plan recognisable in the chemical constitution of the organism at any given stage of its life history.

JOSEPH NEEDHAM.

Gonville and Caius College,
Cambridge.

[1] Huxley, J. S., NATURE, **114**, 895, Dec. 20, 1924.
[2] Huxley, J. S., "Problems of Relative Growth", London, 1932.
[3] D'Arcy Thompson, W., "Growth and Form", Cambridge, 1917.

Radioactivity of Samarium

THE discovery that the radioactivity of potassium is due to a minor isotopic constituent, suggests the idea that other common elements may also have radioactive isotopes present in small amounts. This line of thought induced us to investigate the properties of samarium and we found this element to be markedly radioactive.

The activity of samarium oxide is a third of that of a thick layer of potassium chloride of equal surface. It is not due to the presence of any known radioactive element. This follows partly from the fact that efforts to separate the activity by precipitation with barium, lead, zirconium and so on failed and partly from the properties of the radiation emitted. The intensity of the latter is decreased to half its value by a thickness of aluminium of 1·3 μ. Measurements made by the method of Geiger and Klemperer indicate that the radiation is of the α-ray type.

This kind of radiation has not previously been

known. The close vicinity of samarium to the presumably very rare element 61 suggests that the activity may possibly be due to the presence of the latter. However, preparations of samarium so far investigated, mostly kindly given to us by the late Baron Auer von Welsbach and by Prof. Rolla of Florence, all show the same activity.

G. HEVESY.
M. PAHL.

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New Isotopes of Mercury

IN the course of some tests with very sensitive Schumann plates supplied by Messrs. Adam Hilger, I have obtained mass-spectra of mercury of an intensity greater than any previously photographed. On the best of these there are unmistakable traces of two new lines 197 and 203. The first is certainly due to a new isotope. The chance that the second is a hydride of the strong line 202 is considered small, for the conditions were unfavourable to the formation of hydrides, while under very favourable conditions in previous experiments no trace of the line had been seen. Their abundance was estimated by comparison with the faint isotope 196 previously determined to be present to the extent of 0·10 per cent. Assuming this figure, photometry indicated that 197 and 203 were present roughly to the extent of 0·01 and 0·006 per cent respectively. Their effect on the mean atomic weight will therefore be quite negligible.

F. W. ASTON.

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Nov. 19.

Monoacetone Hexuronic Acid

TWENTY grams of hexuronic acid, prepared by Svirbely and Szent-Györgyi, were shaken in 500 c.c. of acetone in the presence of 50 grams of anhydrous copper sulphate for twenty-four hours. After filtration, the fluid was evaporated *in vacuo* to one third of its volume. On addition of a double volume of petroleum ether the monoacetone derivative of hexuronic acid crystallises out in well-formed large, colourless prisms or long needles. These were dissolved in acetone and recrystallised by the addition of petroleum ether. Seventy per cent of the theoretical yield was obtained.

The same substance was obtained when five per cent sulphuric acid was added to the acetone solution of hexuronic acid. After standing overnight, the sulphuric acid was removed by anhydrous sodium carbonate. Further treatment as above gave a yield of fifty per cent.

The acetone derivative is freely soluble in water, methyl and ethyl alcohol and pyridine, less freely in acetone or ether, insoluble in petrol ether or benzene. The melting-point is 220°–222° C. with decomposition. It causes a big depression of melting-point in hexuronic acid (melting-point of hexuronic acid 192° C.). The aqueous solution of the substance reduces silver nitrate, Fehling's solution, and iodine in the cold. The equivalent weight, estimated by iodine titration, is 107; the molecular weight is thus 214 (calc. 216). Analysis gives:

	Experiment.	Theoretical.
Carbon . . .	49·32 per cent	49·9 per cent
Hydrogen . . .	5·90 ,,	5·6 ,,

The specific rotation of hexuronic acid, and the monoacetone derivative, are (at 20° C.):

	Hexuronic acid.	Monoacetone Hex. Ac.
In water . . .	+ 24 (C, 1·0)	+ 20 (C, 1·04)
In abs. ethyl alcohol .	+ 58 (C, 1·03)	+ 15 (C, 1·02)
In abs. methyl alcohol .	+ 50 (C, 1·0)	+ 28 (C, 1·03)

The acetone derivative is readily decomposed by water into acetone and hexuronic acid, which latter substance can easily be recovered quantitatively. Accordingly, dissolved in water, the molecular rotations of hexuronic acid and of its acetone derivative were found to be the same (actually 4224 and 4321 respectively).

This investigation has been aided by a grant from the Josiah Macy, Jr., Foundation.

L. v. VARGHA.

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Oct. 30.

Thermo-Optical Dissociation of Sulphur Dioxide

THE absorption spectrum of sulphur dioxide vapour in the far ultra-violet, which has been investigated by Henri[1] and Wieland between 2,500 and 2,000 A., has now been extended up to 1,700 A. by means of a 2 metre vacuum spectrograph. The analysis of the bandheads will be published in a later paper. Here I am discussing a dissociation process connected with this band spectrum.

The rotational structure of the SO_2 bands disappears gradually at about 1,900 A. This limit of pre-dissociation corresponds to a dissociation of SO_2 into SO + O + kinetic energy, as has been shown by Franck, Sponer and Teller[2]. Now there is no sign of dissociation at room temperature, obviously because the dissociated products recombine instantaneously. But at a temperature of 450° C. and a pressure of 1·5 mm. the absorption spectrum changes completely. The SO_2 bands are replaced by two quite different band systems, a faint one between 2,850 and 2,570 A., which is identical with the well-known S_2 bands, and a strong one between 1,800 and 1,650 A., which does not seem to have been known before, but which very probably also belongs to S_2 (the combinations demand a vibrational frequency of 725 cm.$^{-1}$ in the ground state). At the same temperature and a somewhat higher pressure of 4·5 mm. both the SO_2 bands and the S_2 bands are visible. After recooling the absorption tube at 20° C. the spectrum shows the unchanged SO_2 bands alone as before heating.

These results suggest a dissociation of SO_2 into $\frac{1}{2}$ S_2 + O_2. (The absorption spectrum of O_2 at a pressure of 1 or 2 mm. is too faint to be observed in a 5 cm. tube.) Now a purely thermal dissociation of SO_2 requires an energy of 83 kcal. (or 3·6 electron-volts) (SO_2 + 251·5 kcal. = $\frac{1}{2}$ S_2 + O_2 + 168·7 kcal.) and consequently cannot be caused by raising the temperature to 450° C. only (energy of thermal agitation 0·03 electron-volts). On the other hand, an optical decomposition requires 6·5 electron-volts, if the dissociation process takes the following course:

SO_2 + 6·5 electron-volts (predissoc.) =
SO + O + 0·9 electron-volts (E kinet.).
SO + 5·1 electron-volts (predissoc.)[3] = S + O.

But although the light of the hydrogen lamp is photochemically active below 1,900 A. (6·5 electron-volts) it does not have any appreciable decomposing effect on SO_2 at room temperature. Thus a combined thermo-optical effect only can be responsible for the

observed dissociation. Such an effect can perhaps be understood from a theory on the predissociation of polyatomic molecules, as has been pointed out by Franck, Sponer and Teller[2]. According to these authors the spectral range of predissociation (which is identical with the range of the photochemically active light) even if quite small at low temperatures, can extend very much with increasing temperature. Thus at a high temperature the light of the hydrogen lamp, being photochemically active over a much wider range than at room temperature, could produce an appreciable decomposition of SO_2.

A more detailed paper on this subject will appear shortly.

K. WIELAND.

H. H. Wills Physical Laboratory,
University of Bristol.

[1] *Leipziger Vorträge*, 1931, p. 131.
[2] *Z. phys. Chem.*, B, **18**, 88; 1932.
[3] Martin and Jenkins, *Phys. Rev.*, **39**, 549; 1932.

'Protective' Adaptations of Animals

ON the subject of "ant-mimicry" Mr. Uvarov states[1] on McAtee's authority, "that more than three hundred species of American birds (out of the total number of about eight hundred species including non-insectivorous ones) feed on ants and some of them consume thousands of individuals." He does not seem to have noticed the consequences of McAtee's method in tabulating "the total number of identifications . . . from these stomachs, counting those of whatever degree, once for each time identified, irrespective of the number of individual specimens concerned"[2] (p. 7). Therefore a bird's stomach containing a single ant or a very small number, liable to be swallowed accidentally with other food, would lead to the obviously absurd conclusion that the bird feeds on ants. A woodpecker's stomach containing 2,000 ants (p. 93) supplies evidence which, on this system, is of no greater value than a stomach containing a single ant. It is much to be regretted that McAtee, with all this vast material before him, did not publish all the available data which would have enabled us to know more of the real and habitual enemies of ants as well as of other insects. Mr. H. B. Cott has done this work admirably in his paper[3] on the tree-frogs of the Lower Zambezi. Here we are given incontrovertible evidence that certain species regularly feed upon these powerful and aggressive insects. But who doubts that they have many enemies? Yet it will, I think, be clear to anyone who reads Mr. C. Elton's interesting paper[4] on "Territory among Wood Ants", that insects mistaken for ants in Dr. T. G. Longstaff's bird sanctuary at Picket Hill would, on the whole, be benefited by the resemblance and that the chance of being eaten as an ant by the green woodpecker would be a risk well worth taking.

Those who maintain with Mr. Uvarov that because ants have many enemies there can be no advantage in the mimicry of ants might with even greater force argue[5] "that the danger would far outweigh the advantage of the well-known longitudinal stripes and green colour borne by grass-feeding larvæ". Think of the larger mammalia whose existence is bound up with the grasses. How dangerous to resemble grass when such quantities are eaten at a single meal by these huge animals!

So far from the following line of argument, advanced in 1898,[6] bearing the "aspect of a beautiful fairy-tale" I believe that it is reasonable and will not be lightly dismissed. "When one insect resembles an ant by the superficial alteration of its whole body-form, another by the modifications of a shield-like structure which conceals its unaltered body, another by having the shape of an ant painted, as it were, in black pigment upon its body while all other parts are concealed [by colour]; another by a further modification of its body, so that it represents not an ant only, but the object which the ant is almost always carrying—when the effect of all these results is heightened by appropriate habits and movements, we are compelled to believe that there is something advantageous in the resemblance to an ant, and that natural selection has been at work".

I certainly did not allege in a former letter[7] that Mr. Uvarov had willingly misrepresented the opinions of others. On the contrary, I expressed the conviction that he would *not* willingly do so. Nevertheless his statement, "taken almost verbatim from the original paper", that "A common objection to this [McAtee's] method is that anything found in a bird's stomach would be in an unrecognisable state" is inaccurate and misleading. This supposed "common objection" is not the only rash and incorrect statement or inference in McAtee's paper. Others were criticised at the International Congress of Entomology in Paris last July in a paper which will appear in the forthcoming volume of *Proceedings*. Fellows of the Entomological Society of London and their friends will have the opportunity of hearing further criticisms at the meeting of December 7.

I trust that those who are interested in these important and far-reaching questions will carefully study Dr. F. Morton Jones's paper on "Insect Coloration and the Relative Acceptability of Insects to Birds", which will appear in the forthcoming part of the *Transactions of the Entomological Society of London*.

I cannot conclude without commenting on one other statement in Mr. Uvarov's letter. Referring to the "great problem of natural selection", he writes—"it is time that attempts were made to elucidate it by an unbiassed accumulation of facts". He does not appear to know that one of the greatest problems of natural selection, forming the subject of this correspondence, has been elucidated, and successfully elucidated, by the careful and unbiassed observations of many naturalists, during the past thirty-six years. I need only mention G. A. K. Marshall,[8] C. F. M. Swynnerton,[9] and G. D. Hale Carpenter[10]—naturalists whose work has been undervalued or altogether neglected by McAtee, and now by implication in the above-quoted sentence by Mr. Uvarov.

EDWARD B. POULTON.

Oxford University Museum.
Nov. 11.

[1] NATURE, vol. 130, p. 697, Nov. 5, 1932.
[2] Smithsonian Miscellaneous Collections, vol. 85, No. 7, Washington, 1932.
[3] *Proc. Zool. Soc. Lond.*, p. 471; 1932.
[4] *Journal of Animal Ecology*, Vol. 1, No. 1, p. 69, May 1932.
[5] *Zoolog. Anzeiger* (Wasman-Festband), 1929, Akademische Verlagsgesellschaft m.b.H., Leipzig, pp. 79-86.
[6] *Linn. Soc. Jour.,—Zool.*, vol. 26, p. 595; 1898. Figures illustrating the diverse methods by which the resemblance is produced are given on pp. 589-594
[7] NATURE, vol. 130, p. 202, Aug. 6, 1932.
[8] *Trans. Ent. Soc. Lond.*, pp. 287-584; 1902.
[9] *Linn. Soc. Jour.,—Zool.*, vol. 33, pp. 203-385; 1919.
[10] *Trans. Ent. Soc. Lond.*, pp. 1-105; 1921.

Delayed Split and Pairing of Chromosomes at Meiosis

SOME recent claims in connexion with the cytological explanation of meiosis raise very important questions when taken in conjunction with morphological development. This matter is brought to a climax by the recent report in NATURE of a paper read by Prof. C. L. Huskins[1] to the Royal Society of Canada.

Until recently, pairing in meiosis was generally considered to be due to the occurrence of two sets of like chromosomes, one set from each parent. Cytological study of triploids, tetraploids, etc., and of the detailed structure of chromosomes during pairing caused doubt to be thrown on this interpretation. Evidence and conclusions from it were discussed by Darlington[2] in NATURE. He points out that the threads first discernible in the prophase of mitosis are paired (pairs of chromonemata), whereas in meiosis they are single (chromosomes) but later come together in pairs and, still later, split. Then he states the chiasmatype theory of meiosis, that the pairing of chromosomes (not chromonemata, as in mitosis) is due to a delayed splitting and that the immediate cause of pairing is the chiasmata. The following are quotations from the article referred to :

(1) "Evidently, therefore, the single threads at the earlier stage were chromosomes still undivided although in the earliest visible stage in mitosis they have already divided" (p. 710).

(2) "These observations point to the chiasmata being the immediate cause of pairing between chromosomes" (p. 710).

(3) "The prophase of meiosis therefore starts too soon, relative to the splitting of the chromosomes" (p. 711).

(4) "The decisive difference would therefore appear to be in the singleness of the early prophase threads in meiosis" (p. 711).

Hedayetullah[3] in a very careful and detailed study of the somatic chromosomes of *Narcissus* found that the chromosome consists of two chromonemata each of which splits at metaphase into the two chromonemata of the newly constituted chromosome. The chromosomes at anaphase and metaphase of mitosis thus show as double structures (pairs of chromonemata).

In a paper read on August 22 before Section M of the Australian and New Zealand Association for the Advancement of Science,[4] I pointed out that the double structure of the anaphase and telophase mitotic chromosomes is not consistent with the single structure of the early prophase meiotic chromosomes ; and that the resolution of this inconsistency requires a study of the last premeiotic mitosis (a study about to be taken up in *Acacia Baileyana* where that mitosis can be identified with certainty). In the issue of NATURE received in Australia this week, there is the report of an answer to this question by Huskins[1], who finds that the metaphase split of the chromonemata does not occur in the last premeiotic mitosis.

While Huskins' work appears to resolve the difficulty outlined above, it raises further very far-reaching and important questions. Now, in most ovules and some anthers the last premeiotic division results in the formation of primary parietal and primary sporogenous cells. If in this division the chromosomes emerge not split, then the conditions for meiosis must occur in both primary parietal and primary sporogenous cells of many plants. Darlington[2] (p. 711) says : "If we consider that there is a universal attraction of threads in pairs at the prophase of any nuclear division, as we see it at mitosis, it follows that this condition is fulfilled by the pairing of chromosome threads when they are still single", also quotations (3) and (4) above. Why, then, does not meiosis occur also in the primary parietal cells of those plants the primary sporogenous cells of which function as mother cells ? Such a question (*mutatis mutandis*) becomes still more acute when the archesporial cell functions as a mother cell.

I am undertaking work on the cytology of *Acacia Baileyana* to seek some contribution to the solution of these problems.

It is worth noting that the larger microsporangia which are more easily handled for plant cytological study would not have a morphology that calls up the questions just brought forward. Moreover, it is notorious how little cytological work is done on megasporogenesis where such questions would inevitably arise. Perhaps one might close with a plea for a closer association of cytology with the study of morphological development.

IVOR VICKERY NEWMAN.

Department of Botany,
University of Sydney.
Sept. 15.

[1] C. L. Huskins, NATURE, **130**, 156, July 30, 1932.
[2] C. D. Darlington, NATURE, **127**, 709, May 9, 1931.
[3] S. Hedayetullah, *J. Roy. Mic. Soc.*, (3), **51**, 347 ; 1931.
[4] I. V. Newman, Report Sydney Meeting Aust. N.Z., Ass. Adv. Science, 1932 (in press).

Motions of Bodies of Oil on the Surface of Alcohol-Water Solutions

THE reaction was first observed when preparing a solution of spirit and water in which to suspend a body of oil as a sphere. The density of the solution was too great, and the oil rose to the surface as a thick lens-shaped drop. In this state, it was observed that the drop always moved away from an observer, and, on investigation, this was found to be due to the heat of the observer's body.

The effect was used to illustrate surface tension, but, after numerous repetitions, it was noted that the drop always tended to return to a unique position on the surface of the solution very soon after the disturbing cause was removed, for example, by the observer vacating the room for a few minutes.

To test this fact, the flask was shaken and replaced. This did not modify the tendency of the drop to return to its place on the liquid surface ; this place was then named, for convenience, the rest-position ; it was found to be invariable, in any given position of the flask in the room, so long as the heat field of the room remained tolerably constant.

Further tests of this phenomenon were made by placing the flask on a turn-table and rotating it ; in all cases it was found that the drop returned to its rest-position as soon as the solution ceased to rotate.

Reactions were found to take place in flasks and beakers of glass, china, and metal, but they appeared to be modified by the substance of the vessel. All reactions are modified by plane or curved surfaces of glass, metal, paper, etc., placed outside a vessel like reflectors ; they modify the motion from a warm body, and they modify the path of return to the rest-position, according to the angle at which such reflectors are set.

There is reason to believe that a magnetic field modifies reactions ; it is still in doubt whether a moving magnetic field produces motion in an oil drop.

Light radiation has been found to cause displacement of a drop under conditions which prevented a heated body from producing any reaction. The question remains open whether some portion of light energy had been converted into heat.

Energy given out by an electrified body causes motion of a drop.

It seems probable that those who are interested, and who have facilities for strictly eliminating given forces, will find that all forms of radiation are effective in causing displacement of a drop.

Experiments have been made and repeated numerous times with flasks in lines and in groups. The motions of drops in flasks in groups are suggestive of speculations which it would be premature to present seriously.

All the work has been done with alcohol-water solutions. The reason was that other solutions were tried, but observations were embarrassed by secondary phenomena which could be excluded only by using a fairly constant liquid solution.

It may be mentioned that some experiments were made with an oil drop suspended between a water surface and a petrol surface; the results were quite indefinite, but they seemed to indicate a possibly interesting line of investigation.

The proportions of alcohol to water respectively 1:4 give satisfactory results with the oils named; exact density is not important, but homogeneity of solution is essential. A liquid surface about 10 cm. in diameter with an oil drop about 15 mm. diameter is convenient for observation.

The working hypothesis has been that a liquid surface is, in effect, a neutral gravitational plane where abnormal displacements may be caused by infinitesimal forces.

Glemham, C. T. JACOB.
Harpenden Rd.,
St. Albans.
Oct. 28.

I THINK probably no unusual forces are involved in the motions of oil drops floating on water-alcohol solutions described by Mr. Jacob. A liquid surface, unless of enormous extent, is not a plane; the influence of the curvature at the walls extends several centimetres to the interior of the surface. It is probable that the curvature of a liquid surface in a vessel ten centimetres diameter, or even larger, would be sufficient to cause a floating drop to seek the central position, that is the lowest, by simple gravitational forces; it would move downhill. The curvature in the central part of such a surface would be so small, that very minute forces would suffice to displace the drop from a strictly central position. In the presence of minute, but permanent convection currents caused by differences of temperature in the different parts of the vessel, the position of rest might be some distance from the centre, the natural tendency of the drop to move to the lowest point being balanced by a steady convection current. It is possible that the effect of the electric field in moving the drops is due to a charge on the surface of the drop; but the equilibrium is so easily disturbed that it seems possible that all the phenomena may be due to convection currents, balanced against a minute gravitational restoring force.

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Abnormal Winds in Cordoba

FOR some months past—since about June to the best of my recollection—we have had an abnormal amount of wind from the east and south-east. In fact it could be said that such were and are still the *prevailing* winds.

Ordinarily the winds in Cordoba are from two opposite directions—north to north-east, warm, dry winds, accompanied by clear skies which usually occur the greater part of the time; and cold, strong winds from the south to south-west which follow the passing of a 'low' to the north, for a few hours or a day, seldom longer, often cloudy and with rain. The nights on the pampa are with few exceptions calm. The few exceptions are when a 'low' is passing and not always then. At altitudes above 1,500 metres there are usually high winds at night.

West winds are practically unknown and winds from the eastern quadrant almost as rare, in normal times. For those reasons the large amount of east and south-east winds during the past winter is outstanding and undoubtedly significant.

What is the cause of these deflections? It appears to be suggestive that they are of the kind that might be expected if influenced by the volcanic eruptions in the Andes. The centre of these eruptions is in a latitude slightly south of Cordoba, so that the south-east winds would be blowing counter-clockwise about that region of eruption as about a cyclonic area—a high temperature 'low'.

These south-east winds observed here are *surface* winds, of course, and I have no means of knowing whether the winds in other regions conform to such a possibility or not, or whether the winds at higher altitudes have been affected also.

These east to south-east winds have been accompanied by unusual cloudiness and humidity, and just recently by heavy precipitation in the region to the east, traversed by these winds from the Atlantic, inundating thousands of hectares and destroying the crops. Whether or not the volcanic eruptions have anything to do with the abnormal direction of these winds will require a study of extensive data. If such is not the cause there is some other. From time to time news comes of outbursts from the volcanoes in the Descabezada region. I do not know if they are in continuous eruption, but from the presence of volcanic ash in the air almost continuously during the winter, it seems probable that such has been the case.

The object of this note is to direct attention to a matter which appears to be worth investigating.

C. D. PERRINE.

Cordoba.
Oct. 18.

The Hon. Mrs. Huia Onslow

IT has been decided to prepare a memoir of the late Hon. Mrs. Huia Onslow, better known to the scientific world as Muriel Wheldale Onslow, whose obituary notice appeared in NATURE of June 11, 1932. I shall be very grateful if those who have letters in their possession written to them by Mrs. Onslow would kindly lend them to me for this purpose. They should be addressed to me and will be carefully preserved and returned to their owners.

FLORENCE M. DURHAM.

Hawkern, Otterton,
Nr. Budleigh Salterton.

Research Items

Stone Implements of Choukoutien.—More abundant archæological material and further field work have made desirable a new and supplementary exposition of the facts relating to the stone industry of the Peking man deposits by P. Teilhard de Chardin and Dr. W. C. Pei (*Bull. Geol. Soc. China*, **11**, No. 4). The sediments of the Choukoutien Locality 1 (*Sinanthropus* cave) are a massive hard breccia in which at least three cultural zones can be distinguished. The entire deposit of Zone *A* is of red, yellow and black banded sandy clay in which *Aa*, by a dense accumulation of quartz chips and burnt bones, is strikingly similar to the classical culture layers of the western European caves. Zone *B*, remarkably interesting stratigraphically, has yielded but a small series of flaked boulders (choppers). Zone *C*, with the implements of which this communication deals chiefly, is especially significant as the artefacts were discovered in association with *Sinanthropus* remains. Zone *C* has exactly the same lithological character as Zone *A*. The fauna collected in association with ashes and stone artefacts is abundant and characteristic (*Equus sanmeniensis*, *Rhinoceros 'sinensis'*, *R.* cf. *tichorhinus* (?), *Elephas nomadicus*, etc.) Outside the three zones, artefacts are found from place to place and more may be forthcoming. In Zone *C* several thousands of minor fragments of stone have been found and more than a hundred chipped or intact foreign boulders. The stone is green sandstone, commonly, but also vein quartz and, exceptionally, quartzite or quartz-porphyric rock. Provisionally the specimens are classified as flaked boulders, truncated boulders, choppers, quartz cores, scrapers, pointed implements, and chipped or flaked limestone pieces, possibly anvils or hammer stones. The provisional opinion is expressed that the industry of Zone *C* moderately, but distinctly, exceeds what would be expected to be the most primitive recognisable human industry. The makers already had some definite methods of choosing, breaking and adapting stone to several uses; but in so doing they obeyed, rather than mastered, their material.

Prehistoric Cults in Portugal.—The connexion between Christian shrines and prehistoric sites which has been shown to be highly probable in the instance of Saint James of Compostela in Spain, is demonstrated to be equally probable in Portugal by the Rev. E. O. James in a communication which appears in *Folk-Lore*, vol. 43, No. 3. At Mattosinhos, a few miles from Oporto, is the church of Bom Jesus de Boucas, said to be the oldest shrine in the country, which is visited annually by 30,000 pilgrims. The present church was built in the sixteenth century to house a miracle-working cross, alleged to have been carved by Nicodemus, which floated to Portugal from Joppa under divine guidance. It landed at Leixões, a well-known harbour and refuge for vessels avoiding the treacherous bar of the Douro. Although there is no evidence of megalithic monuments in the neighbourhood of Leixões, a pile of rough stones, now surmounted by a tower, stands behind the chapel which marks the landing-place of the cross, and the whole tradition of Mattosinhos points to a legend of the Santiago type. The country to which the Douro gives access is a wide productive belt full of mines, especially of tin and gold, which were worked by the Romans, and presumably long before their day, while there is evidence of important ancient settlements in the province of Minho. The hermitage of São Romão was founded on the site of a ruined Romano-Celtic town. To this hill pilgrimages have been made annually on August 9. Braga, the seat of the primate of Portugal, is the Roman Bracara Augusta. Near it is the sanctuary of Bom Jesus do Monte, visited by thousands at Whitsuntide, and beyond it is another holy hill, the shrine to the Virgin of Sameiro. On the way up to the latter is a small dolmen, revealed in making a motor road.

Psychological Effects of Noise.—The effect of noise on the human mind and body is a problem of much practical importance. Does noise diminish efficiency and increase liability to accidents? Is there any evidence that it plays a part in the development of nervous and mental disorders? Two recent investigations, one in a laboratory and the other in a workshop, seem to indicate that noise is not a negligible factor in determining industrial efficiency ("Psychological Experiments on the Effects of Noise", by K. G. Pollock and F. C. Bartlett. "The Effects of Noise on the Performance of Weavers", by H. C. Weston and S. Adams. Industrial Health Research Board. Report No. 65. London: H.M. Stationery Office, 1932). Pollock and Bartlett, studying the psychological effect of noise on a simple motor skill and upon mental work in a laboratory, found a diminution of efficiency at first but this initial effect appeared to be only temporary. Weston and Adams carried out their investigation in a Lancashire weaving shed and used ear protectors on the workers to reduce noise. The effect was an increase of about one per cent in the average hourly output. The authors find evidence which suggests that even after years of work in a noisy environment the worker does not become completely adapted to noise. As is inevitable in any preliminary work, these two studies open up at least as many problems as they claim to solve, but taken together they indicate that noise may under certain conditions exercise a disturbing effect upon human efficiency, though to a less degree than is commonly supposed.

Phases of Locusts in South Africa.—Under the foregoing title Prof. J. C. Faure of the University of Pretoria contributes an important paper, of general scientific interest, occupying part 3 of vol. 23 of the *Bulletin of Entomological Research* (September, 1932: pp. 293–405, plates 14–38 and one map). Prof. Faure discusses the main theory of locust phases, due to Uvarov, and proceeds to detail the results of an extensive series of experiments designed to test the theory in so far as South African locusts are concerned. Most of his work was undertaken with the brown locust, *Locustana pardalina*, a species of prime importance in South Africa. His results show that 97 per cent of hoppers in the gregarious phase was obtained in the F_1 generation from adults in the solitary phase taken in the field, by rearing the progeny in a dense crowd. Other experiments showed that locusts in the solitary phase, if collected early enough in their development as hoppers and crowded in cages, acquire the coloration of the gregarious phase before reaching maturity. Owing to the fact that no swarms exhibiting the extreme characteristics of the

gregarious phase occurred in South Africa while the work was in progress, it was not possible to investigate similarly the transformation in the opposite direction, that is, from the gregarious phase to the solitary one. Recourse was consequently made to material in the gregarious phase obtained in cage experiments and to hoppers showing gregarious characters obtained from eggs laid by caught individuals in the transient or intermediate phase. By isolating individuals singly in cages, Prof. Faure was able to show that transformation from the gregarious phase to the solitary phase actually took place under these conditions. Detailed examination of the coloration and of biometric data indicated that actual phases, comparable with those occurring in the field, were obtained. The same conclusions were arrived at with regard to experiments conducted with the subspecies *migratoroides* of *Locusta migratoria*. The effects of environment on colour forms, the influence of heredity on phase production and other experiments are also recorded in this paper. The most important results achieved are shown in the experimental production of one locust phase from another, thus confirming in a significant manner the general truth of the phase theory.

Transmission of Light through Air and Water.—Quantitative measurement of solar radiation, never easy, is not made easier when the passage of light through sea or lake water has to be studied on board ship. Dr. W. R. G. Atkins, in "Solar Radiation and its Transmission through Air and Water" (*J. Conseil International pour l'Exploration de la Mer*, 7, pp. 171–211, 1932) has summarised his own work with Dr. H. H. Poole, as well as that of other workers on both sides of the Atlantic. He proceeds from the examination of light as it reaches the earth by means of colour filters and photoelectric cells to the penetration of light through water. For this purpose recent workers have favoured the pyrlimnometer (effectively a thermopile) and the photoelectric cell. Atkins has found the vacuum cell more reliable than the gas-filled. The photoelectric current may be measured either potentiometrically or by means of the neon lamp. The apparatus assembled for the United States research ship, *Atlantis*, is illustrated.

Thermophilic Amœbæ.—Dr. L. G. M. Baas Becking, Botanical Institute of Leyden, Holland, reports the presence of cysts of an unclassified amœba in waters collected from the hot geysers of Yellowstone Park, U.S.A. These cysts began to germinate on the hot stage at 50°–52° C., and withstood a temperature of a little above 60° C., for an hour. The thermophilic characters of this organism, therefore, approximate to those of the amœbæ recorded by Dr. E. Hindle from the thermal springs at Dax, near Bordeaux (see NATURE, 130, 780, Nov. 19, 1932). It is probable that the examination of material from similar sources would reveal the existence of many other examples of micro-organisms living at high temperatures, in addition to the well-known thermophilic bacteria.

Frost Protection for Plants.—The practical gardener has to wage continual war with frost in the late spring and early autumn, even in Great Britain, but the problem is more acute in the United States. Many types of protector have found their way on to the market, and the relative merits of some of these, together with a physiological study of frost protectors in general, form the subject of Technical Bulletin No. 124 of the Agriculture Experiment Station of the Michigan State College ("The Various Effects of Frost Protectors on Tomato Plants" by R. P. Hibbard, pp. 1–36, 1932). The protectors were in the form of more or less conical caps made from transparent paper or cellulose preparations. In one year of the six during which they were under test they were of definite benefit in preventing frost damage to young tomato plants, in two years of doubtful benefit and in three years none at all. They caused a diminution in intensity of light which was often detrimental, though protected plants were usually larger than unprotected plants. The author believes that the raising of twice as many seedlings as are really wanted is a surer and more economical insurance against damage by frost, since half can be planted early and the other half used to replace them if necessary.

Origin of Leucitites and Related Rocks.—A detailed account of the petrology of the volcanic fields near Ruwenzori has been prepared by Prof. A. Holmes, with chemical analyses by Dr. H. F. Harwood (*Quart. Jour. Geol. Soc.*, pp. 370–442; 1932). The associated rocks include olivine-leucitite, leucitite, potash-ankaratrite, melilite-basalt, and biotite-pyroxenite. It is pointed out that the limestone assimilation hypothesis of Daly and Shand provides no way of ensuring an excess of potash over soda such as characterises the province under discussion. Moreover, no limestones are present either in the rocks exposed at the surface or among the ejected blocks, which provide samples of the underlying crust to a considerable depth. The absence of granitic and basaltic rocks, of related types, and of felspars, suggests that any hypothesis invoking granitic or basaltic origin is untenable for this particular province. The rocks have marked geochemical peculiarities which relate them to kimberlite, the rock of the diamond pipes of South and Central Africa, and this suggests a magmatic ancestry in which peridotite magma plays the parental part. It is thought probable that the magmas of kimberlite and olivine-leucitite may be generated by the abstraction of the constituents of eclogite and dunite from a primary peridotite magma under conditions of high pressure, and that the magmas of melilite-basalt and alnoite may be generated under conditions of somewhat lower pressure by the early crystallisation of enstatite as well as olivine. Evidence of the separated crystalline phases is traced in the eclogite and dunite nodules of the diamond pipes and in the enstatite phenocrysts of the melilite-basalt tuffs of Uganda.

Radium in Hungarian Rocks.—The radium contents of some Hungarian igneous rocks have been determined by S. S. de Finály, using the method of Mache and Bamberger. The results for sixteen rocks, together with new chemical analyses of each, have now been published (*Amer. J. Sci.*, Oct., p. 306). Ten granites gave amounts ranging from $1 \cdot 43$ to $3 \cdot 69 \times 10^{-12}$ gm. of radium per gram of rock, the average being $2 \cdot 50 \times 10^{-12}$. The latter is close to the European average so far determined, but is higher than that for the otherwise similar rocks of eastern North America. In four andesites the radium ranges from $1 \cdot 64$ to $2 \cdot 38 \times 10^{-12}$, and averages $1 \cdot 96 \times 10^{-12}$. In two 'basalts', which seem to be wrongly named in view of the chemical analyses, the radium contents are respectively $1 \cdot 48$ and $1 \cdot 93 \times 10^{-12}$.

A High-Voltage Generator.—The *Physical Review* for October 15 contains an interesting suggestion for a high-voltage generator. It is known that large frictional charges are produced by blowing dust-laden air against a conductor. Experiments show that a charge of 6×10^{-5} coulombs can be produced by blowing 1 gm. of diatomaceous earth, and it is suggested that a machine could be constructed to generate 1 milliampere at potentials of the order of one million volts. An experimental apparatus was constructed in which 1·5 gm. per second of diatomaceous earth was blown through insulating tubes and then through metal tubes arranged diametrically in a spherical corona shield. A voltage of 260 kilovolts was obtained and a current of 8×10^{-5} amperes could be drawn from the sphere at this voltage.

Collisions of Neutrons with Electrons and Atomic Nuclei.—Dr. H. S. W. Massey has discussed (*Proc. Roy. Soc.*, Nov.) the collisions of neutrons with electrons and atomic nuclei. The model of the neutron used is a hydrogen atom in a nearly zero quantum state—this model is not admitted by ordinary quantum mechanics, but a non-relativistic theory is certainly inapplicable to these conditions. The collision relations are worked out by the method of Born, Faxén and Holtsmark. The introduction of the value of the collision cross section with lead nuclei (presumably obtained from absorption experiments) allows an estimation of an upper limit for the radius of the neutron of $2 \cdot 0 \times 10^{-13}$ cm. It is then found that the collision areas with light nuclei vary with the square of the nuclear charge—a much larger variation than is consistent with experiment. The author concludes that the collisions are determined by an internal nuclear field, the penetration being very close. In the case of protons the experiments also appear to require the interaction to be controlled by a powerful intra-proton field. The collisions of the model neutron with electrons are shown to be negligibly probable.

The Hydrogen Isotope, H^2.—In the *Physical Review* for October 1, K. T. Bainbridge describes measurements of the atomic mass of the hydrogen isotope H^2. The measurements are important as a clue to the structure of the H^2 nucleus, since the packing fraction and binding energy of the nucleus may be calculated from them. Ordinary hydrogen and hydrogen fractionated by Brickwedde were successively used in a discharge tube mass-spectrograph. With the enriched hydrogen an ion $H_2^1H^{2+}$ was observed and its position was compared on a microphotometer record with that of He^+. The mass found was $2 \cdot 01351 \pm 0 \cdot 00018$ ($O^{16} = 16$), and if the nucleus consists of two protons and an electron, the energy of binding is 2×10^6 volts. If the nucleus consists of a proton and a neutron of mass 1·0067, the binding energy is $9 \cdot 7 \times 10^5$ volts. Dr. Bainbridge brings forward considerations to show that H^2 is not a very likely unit in the building up of heavier nuclei. In the *Physical Review* for October 15, Hardy, Barker and Dennison examine the infra-red absorption spectrum of hydrogen chloride. In some of the experiments, the gas was an enriched specimen prepared from electrolytic cell residues. The spectra showed band-lines corresponding to H^2Cl^{35} and H^2Cl^{37}; and calculations show that H^2Cl was present to the extent of about 1/35,000 in ordinary hydrogen chloride and about ten times as much in enriched specimens. On the assumption that the molecular fields were identical for H^1Cl and H^2Cl, the atomic mass of H^2 was found to be $2 \cdot 01367 \pm 0 \cdot 0001$, in satisfactory agreement with Bainbridge's value.

Astronomical Topics

Standard Times throughout the World.—A useful brochure, with this title, published by the U.S. Bureau of Standards, contains maps and tables which give the differences between the times used at various stations and those of Greenwich and Washington. The maps bring out the fact that the boundaries of the successive hourly time zones are far from conforming with the theoretical meridians; in fact they are made to conform with the boundaries of States or countries. One might expect that the 180° meridian where the day changes, which is nearly all water, would be straight; but even this shows notable deflections. These irregularities emphasise the utility of such a publication as the present one; without it one might frequently make errors of an hour.

Spectrum of Epsilon Aurigæ.—An exhaustive study of the spectrum of this remarkable eclipsing variable star by E. B. Frost, O. Struve and C. T. Elvey has been published (Pub. Yerkes Observatory, vol. 7, pt. 2). It is chiefly based on spectrograms obtained at Yerkes in the years 1899–1901 and 1917–1931, but results obtained elsewhere have also been utilised. The curve of radial velocities from all sources shows a prolonged minimum about 1910 and another about 1930; the only maximum during the period discussed was about 1925; the extreme velocities are about −13 and +20 km./sec. The light-curve shows that an eclipse began in April 1928; the light declined steadily for six months, then remained constant for a year at 4·2 mag., then returned in six months to the normal value 3·4 mag. Asymmetry in the spectral lines begins about 200 days before the eclipse begins, and continues after it ends; the explanation given is that the eclipsing star has a very extensive atmosphere, the depth of which is determined from the measured velocities to be more than an astronomical unit; the light from the primary suffers absorption in this atmosphere. Other peculiarities in the spectral lines suggest that the secondary star has rapid rotation, producing an atmosphere flattened at the poles and extended at the equator. Its atmosphere is also concluded to be free from magnesium, as this is the only strong line in the spectrum of the primary that is not strengthened during eclipse.

The article also refers to Zeta Aurigæ, which has many points in common with Epsilon; but in its case the spectrum of the eclipsing star (of type *K*5) remains visible throughout the period.

Correction to "Astronomical Notes for December".—The times of occultations of stars by the moon given in NATURE for Nov. 26, p. 817, were those for Edinburgh; the times for London are: ι Aquarii, Dec. 3, 6^h27^m P.M.; μ Arietis, Dec. 9, 11^h8^m P.M.; ρ Leonis, Dec. 19, 0^h24^m A.M.; reappearance 1^h29^m A.M., angle 316°.

Prehistoric Sites near Flagstaff, Arizona*

SOME interesting inferences as to the geographical and economic factors involved in the development and distribution of prehistoric Pueblo culture in parts of northern Arizona are drawn by Dr. Harold S. Colton in a report on a survey of prehistoric sites in the neighbourhood of Flagstaff, which was carried out on behalf of the Museum of Northern Arizona in the course of ten summers between the years 1916 and 1930. It is the intention of the Museum ultimately to survey all sites in the northern area of the State, taking Flagstaff as a centre, but, for the present, attention is confined to those sites which lie to the east, between Flagstaff and the Hopi villages on the edge of the Painted Desert.

The area under investigation culminates in the San Francisco volcanic field, which is the second largest in the United States, and supports two hundred extinct cones, of which the highest form the massif known as San Francisco Peaks (12,700 ft.). From here the land slopes down into the valley of the Little Colorado River, rising again in terraces of vari-coloured cliffs, on the last of which stand the Hopi villages, to the Painted Desert.

The geological structure of the area is seen to have been an important factor in determining the distribution of prehistoric culture. Beneath the fields of volcanic ash and sand lie the Moencopi red sandstones and shales, the only rocks over a wide area which hold water. Wherever they have not been denuded, springs are found. Beneath them lie Kaibab limestone and Conconino limestone, both of which are waterless.

A further factor, which was discovered in 1930 only, is the recent activity of Sunset Crater in early Pueblo times. This was clearly a dominant event in the history and culture of the Pueblos. It took place somewhere between A.D. 600 and A.D. 850. A cover of black basaltic sand was then spread over the land for a radius of about twenty miles, in places near the crater to a depth of as much as two feet. It acted as a mulch, retaining the moisture and affecting the flow of the streams. It was eminently suited to the digging-stick type of cultivation affected by the Pueblo peoples. The population, which had hitherto congregated near the peaks, where a water supply was assured, is seen to have now spread densely over the area covered by the volcanic sand. They withdrew once more to the earlier sites near the peaks, or the shelter of the escarpment, when the prevailing winds in the course of time had removed the sand, except where anchored by vegetation, and had deposited it in the canyons, whence much of it has been carried away by the waters of the Little Colorado.

The operations of the survey with which Dr. Colton deals in the present publication recorded 728 sites situated in the drainage areas of two tributaries of the Little Colorado, Walnut Creek and Deadman's Wash. The intervening watershed is omitted for future consideration.

Four culture horizons were recognised, which, in accordance with the nomenclature now adopted in Puebloan archæology, are classed as Basketmaker III, Pueblo I, Pueblo II and Pueblo III. The tree-ring chronology worked out by Prof. Douglass on the basis of the growth of the trees used in Pueblo architecture, gives *circa* A.D. 900 for a few Pueblo II sites; for Pueblo III, *circa* A.D. 1050–1300; and for Pueblo IV, A.D. 1300–1600. Applying this scheme to sites in the Flagstaff area gives the following as approximate dating for certain sites: Wupatki, 1087–1197; Citadel, 1192; Turkey Hills, 1203–1278; Ruin J, 1192. Pueblo IV and V are not represented. It was in late Pueblo II and early Pueblo III that the improvement in the conditions of agriculture and irrigation afforded by the black volcanic sand fostered the spread of a dense population over a wider area. The sites of these periods are thickly distributed between the Peaks and the Little Colorado. Black basaltic sand first enters into the tempering of material used in pottery in middle Pueblo II.

It is also to be noted that in Pueblo II and Pueblo III the pottery complexes in the Walnut Creek drainage and Deadman's Wash differ markedly and point to a complete dissociation of the two areas in culture. For this entire separation of the two tribes no reason is at present apparent.

No less than eight characteristic types of the Pueblo dwelling have been recorded in the area. They range through all stages from pit-houses to the Puebloan masonry multicellular dwelling. Some of the most interesting and characteristic dwellings are the cliff-shelters of Walnut Creek, south-east of Flagstaff, where the Kaibab limestone, overlying a precipitous wall of Conconino sandstone, weathers characteristically in a series of steps forming ledges with overhanging roofs. Here on each tier, rooms have been built in single rows, though in one or two places outer rooms have been added. Several of the dwellings have seven and eleven rooms; one is estimated doubtfully at thirty rooms. The greater number of these sites belong to Pueblo II and early Pueblo III.

A beginning has been made in the further exploration of the whole area by excavation.

* "A Survey of Prehistoric Sites in the Region of Flagstaff, Arizona." By Harold S. Colton. Bulletin 104, Bureau of American Ethnology, 1932.

The Locust Problem

THE fourth report of the Committee on Locust Control of the Economic Advisory Council* contains a survey of investigations carried out in 1931, and a programme of work for 1932–33. Since the presentation of the previous report of the Committee, in 1930, invasions by the desert locust (*Schistocera gregaria* Forsk.) have continued in almost all the countries in Africa and western Asia that were previously affected. Further, a new and even more serious menace to agriculture in tropical Africa has presented itself in the appearance of great swarms of two other species of locusts, namely, the tropical migratory locust (*Locusta migratorioides* R. and F.) and the red locust (*Nomadacris septemfasciata* Serv.).

* Economic Advisory Council: Committee on Locust Control. Fourth Report: Survey of Locust Investigations in 1931 and Programme of Work for 1932–33. (Cmd. 4124.) Pp. 43. (London: H.M. Stationery Office, 1932.) 1*s*. net.

Information gathered from official sources shows that the damage caused by locusts during the present outbreak (the period 1927–31) can be estimated, in round numbers, as exceeding £6,000,000, while about £1,000,000 has been spent on control measures. The whole course of this outbreak clearly indicates how close is the dependence of the locust situation in any one territory on the general incidence of the pest over wide areas. This interdependence shows that it is almost futile to control locusts in a few isolated districts. There is an urgent need for concentrating on investigations into the original breeding grounds of each locust species. The discovery of such areas would open up the possibility of each species being dealt with under relatively localised conditions before it is able to spread and become diffused.

The events of the past two years all emphasise the urgency of discovering the specific factors that result in locust invasions in order that a far-reaching policy for the prevention, or at least the reduction of future outbreaks, may be devised. The Committee has drawn up a comprehensive programme of work that it recommends to be carried out in 1932–33 and undertaken through the Imperial Institute of Entomology. At the headquarters of the Institute it is advised that the collection, study and analysis of available information on the problems involved should be continued and extended. The work also includes the task of transferring all records, both old and new, of locust migrations and breeding to maps covering defined periods. Such maps should prove invaluable for tracing the courses of all known invasions and in serving as the basis for studies connected with them. Furthermore, as the Institute is acting as the recognised international clearing house for all information dealing with anti-locust investigation, in this way it is in a position to assist all countries directly affected by invasions. The collection of specimens from swarms appearing in different lands, and at diverse times, is also being undertaken and their availability at the Institute will provide essential material for biometrical and other studies of the phase problem.

The field campaign, drawn up by the Committee, covers the investigation of the life-cycles of the locust species already mentioned; studies of their swarming and transitional phases; the correlation of locust activities with meteorological data and the testing of control measures. These aspects of the work will continue under the direction of the Chief Locust Investigator, Mr H. B. Johnston.

The co-operation of the governments of all countries affected by locust invasions is a matter of prime importance. It is now recognised that investigations of the character planned require to be international if the basic problems concerned are to be fully solved. The Committee acknowledges the value of the co-operation already afforded by the French and Italian Governments, and by the administrations of British colonies and territories, but is anxious to develop mutual effort and the pooling of information on a much wider scale. Recommendations are consequently made that the Economic Advisory Council should invite the Secretary of State for Foreign Affairs to communicate copies of the present report with an expression of hope of co-operation, in the work now planned, of governments that were not represented at the Rome conference on locust control in 1931.

In the matter of finance, the recommendations of the Committee are on a very modest scale considering the importance of the schemes involved. The 1932–33 programme, as estimated, can be carried out at a cost of £3,800, of which £395 represents capital expenditure on tents, apparatus, etc., and £3,405 is recurrent expenditure mainly for salaries, wages and travelling charges. It is to be hoped that the campaign now taking shape will be allowed to develop so fully as possible, in view of the magnitude of the losses sustained through locust invasions in so many areas of the British Empire and indeed throughout the world.

A. D. IMMS.

The Rubber Industry of Malaya

A SERIES of memoranda with an introduction by Dr. H. A. Tempany which have recently been issued in Malaya deal with the position of the Rubber Research Institute of Malaya and indicate that four distinct proposals for the future are before the Board. The retrenchment memorandum put forward by the executive committee estimates 350,000 dollars as the sum on which the Institute's activities can be maintained. This involves a reduction in expenditure of 183,000 dollars and at a special meeting of the Board of the Institute held on June 28, the recommendations of the executive committee were adopted with minor modifications.

The proposal of the Hon. B. J. R. Barton that the whole of the work of the Institute should be amalgamated with the Department of Agriculture was prompted by the belief that, while the retrenchment proposals did not go far enough to bring relief to subscribers in any appreciable reduction in payment of cess, they would accentuate a feeling of discontent among the staff of the Institute and that the organisation would not represent the best possible in the interests of the Industry. Mr. Barton stressed the advantages of the Department of Agriculture and while the retrenchment proposals may involve curtailing the advisory work, the activities of the Institute can scarcely be maintained at more than a semblance of their present efficiency. The representatives of the Malaya Estate Owners Association urged that the situation should be investigated by an independent body, but this proposal was also negatived.

The proposals adopted by the Board, after accepting the view that 350,000 dollars represents the minimum upon which the activities of the Institute can be effectively maintained and the maximum which can be at present expected from the export cess levied on rubber, since the area of untapped rubber which escapes all contributions is expected to increase, provide for retrenchment by reduction in salaries, in the personnel and on allowances for cess, etc., on duty. In addition to a reduction of 5 per cent already imposed, a further reduction of 20 per cent on all salaries is now contemplated. With regard to personnel, the research services are graded in the order of importance, chemical, botanical, pathological, soils, field; and restriction of activity by reduction of personnel is advocated to fall with increasing incidence in the descending order shown above. On account of the increasing importance of latex, it is recommended that reduction in the chemical and pathological divisions where research on latex

is principally carried out should be a minimum.

The heads of divisions presented alternative proposals which also were not accepted. These proposals were backed by a strong plea that they were the outcome of careful thought by those who had exceptional opportunities of studying the working of the Institute and the needs of the industry. They recommend a complete reorganisation of the personnel and work of the Institute on two main lines: (i) work on the product—chemical; (ii) work on the tree—botanical, including agricultural and both research and advisory work. They envisage four senior scientific officers and one administrative officer working as an executive cabinet under a director, preferably someone quite free from outside affiliations and selected mainly for administrative ability and experience. Such a scheme, if staffed with officers capable of working in absolute harmony, should develop the team spirit essential to success. A selection and a list of temporary salaries were included with these proposals.

In view of the growing recognition of the importance of Imperial research on Empire products, it is disappointing to learn of this serious threat to rubber research and the uneasiness with which scientific workers and others regard the situation will not be diminished by the Board's dismissal of the alternative scheme and proposals put forward by the scientific and technical heads of divisions. The reductions in salary and personnel adopted by the Board appear likely to have an untoward effect on the recruitment for Imperial services abroad generally. In view of the comparatively early age of retirement in such services and the difficulty frequently experienced in securing an appointment on return to Great Britain, such drastic reductions in salaries will deter many promising scientific officers of high ability from coming forward for service abroad.

Ultra-short Wave Technique in Radio Communication

AT the International Congress of Electricity held in Paris in July last, some twenty-six papers were read before Section 9 dealing with various aspects of radio engineering, ranging from commercial telephonic communication to the study of the electrical properties of the upper atmosphere. Among these papers, two are of particular interest in connexion with the progress of ultra-short wave technique.

The first of these, by I. E. Mouromtseff and H. V. Noble, describes a new type of ultra-short wave oscillator. This consists of a special three electrode valve in which the cylindrical anode and spiral grid form part of a concentric transmission line, which itself replaces the tuned circuit normally associated with an oscillating triode. For cylindrical conductors the diameters of which are of constant ratio, the inductance and capacity of the line will satisfy the condition of uniformity of distribution, and when the necessary supply voltages are connected to the electrodes at suitable points oscillations will be set up on the line at a wave-length equal to twice the length of the line. These oscillations take the form of stationary waves giving rise to no external field or radiation, but a suitable open or closed circuit may be coupled to the line, in order to make use of the high frequency power. A large water-cooled transmitting valve constructed on this principle has been made to generate up to 16 kilowatts at wave-lengths of 3 and 5 metres, with an efficiency of from 20 to 40 per cent.

The use of this principle would appear to overcome some of the difficulties of making high-power valves for short wave-lengths, which arise from the necessity of reducing inter-electrode capacity in valve oscillators using one of the ordinary circuit arrangements. Since the reading of the paper in Paris, a more complete account of this work has been published in the *Proceedings of the Institute of Radio Engineers* for August 1932.

In the second paper, I. E. Mouromtseff and G. R. Kilgore give a description of some experiments on a magneto-static oscillator for the production of oscillations at wave-lengths of 50 cm. or less. The special valves employed are similar to the magnetron type, comprising a cylindrical anode, split longitudinally into two parts, and containing a straight axial filament. This valve is placed in a suitable coil supplying a constant magnetic field in the direction of the axis. The two halves of the anode are connected to two parallel wires forming a Lecher wire system which can be adjusted to resonate at the desired wave-length. Yagi and Okabe had previously remarked that, in the ordinary magnetron, when the conditions were such that the electrons passed very close to the anode without touching it, weak oscillations of a very high frequency were to be observed.

The present researches show that the intensity of these oscillations can be enormously increased if the direction of the magnetic field is altered by a small angle from the axis of the valve electrodes. Graphs accompanying the paper referred to above, show that the oscillations attain a maximum intensity for angles between 2° and 10°, depending upon the dimensions and operating conditions of the valve. Examples are quoted in the paper of valves capable of producing oscillations of appreciable intensity at wave-lengths of 22–55 cm. R. L. S.-R.

University and Educational Intelligence

BIRMINGHAM.—The Executive Board of the Birmingham Hospitals Centre, of which Sir Charles Grant Robertson is chairman, has decided to proceed immediately with the provision of the new hospital at Edgbaston on the site of 100 acres adjoining the University given by Messrs. Cadbury Brothers. The first instalment is to consist of 500 beds. This scheme (which has been suspended for many months in consequence of the national financial stringency) is of vital importance to the University, the Medical School of which is to be housed in buildings forming part of the hospitals centre. It has been disclosed that a contribution of £52,000, hitherto anonymous, was made by Sir William Morris (of Morris Motors Ltd.) on the understanding that the work should be begun by January 1, 1933. A donation of £100,000 was made by Mr. Harry Vincent, treasurer of the fund, and another contribution, by an anonymous donor, of £50,000 has been received. The total cost of buildings and equipment is estimated at above £718,000, of which more than £647,000 has already been contributed or promised.

CAMBRIDGE.—The General Board has recommended that vertebrate zoology be added to the list of subdepartments in the Department of Zoology, with the reader in vertebrate zoology as director of the sub-

department. It has also recommended that a readership in vertebrate zoology be established and that Mr. C. Forster Cooper, of Trinity Hall, be appointed to the readership as from October 1, 1932.

EDINBURGH.—A legacy of £1,300 by the late Prof. Baldwin Brown has been received to establish a "Baldwin Brown Travelling Scholarship in Fine Art" for the benefit of women students in the subject of fine art. It is to be used for the study of archæology, painting and sculpture and the decorative arts among the buildings and collections of England, France, Belgium and Holland.

WALES.—The Council of the Welsh National School of Medicine has appointed Dr. J. B. Duguid as professor of pathology and bacteriology, and Dr. G. I. Strachan as professor of gynæcology.

THE quarterly record of current educational publications issued by the Office of Education, Washington, is, in its recently improved form, an invaluable instrument for enabling teachers in the United States (where about a million persons are, it is said, engaged in educational work) to keep abreast of the literature of their vocation. It includes a classified and annotated list of significant publications selected by specialists in each of the following fields: nursery-kindergarten-primary, elementary, secondary, exceptional children, educational psychology, junior colleges, education of teachers, universities, public school administration, adult education, vocational education and guidance, negro education and foreign education. In addition there are useful itemised lists of proceedings and annotated lists of reports of associations, and, of course, lists of the publications of the Office of Education itself. The space devoted to the subjects falling within the headings "Exceptional Children" and "Psychology" is remarkable. It includes the following among other sub-headings: behaviour and problem cases, gifted children, guidance, heredity, individual differences, learning, measurement, mental tests, personality and character.

THE *Universities Review* for October contains a further contribution to the discussion, begun a year ago, of "What is Wrong with the Modern Universities?" The writer, Mr. P. Mansell Jones, of Cardiff, suggests that "it is our working idea of a university which is wrong". The schemes of study and methods of work lack the elasticity indispensable for meeting the differing needs of individual students, and degree requirements necessitate the pursuit of numerous short courses administered in water-tight compartments. Hence the (alleged) prevalence among British students of an artificial separation between life and work, resulting in indifference to and sterilisation of the intellectual life. In the same issue of the *Review* is a report of a lecture by Sir Josiah Stamp delivered at Princeton University last April on the contribution of academic life to economic problems of the day. Referring to the impression he had received in America of widespread loss of faith in institutions, men, and 'slogans', Sir Josiah exhorted his hearers not to lose faith in the value of striving for intellectual solutions. Not only should economic problems be subjected to strenuous investigation by scientific methods but there is also an economic hinterland and a moral hinterland to every field of specialised knowledge, and this region should be surveyed with confidence by every outgoing graduate.

Calendar of Geographical Exploration

Dec. 5, 1766.—Bougainville's Circumnavigation

Louis Antoine de Bougainville sailed south for the third time in the *Boudeuse*, charged with the commission of ceding the settlement on the Falkland Islands, which he had organised in 1763–65, to Spain, and continuing his voyage across the Pacific. Bougainville returned in 1769, having accomplished the circumnavigation of the globe, the first Frenchman to achieve this. His voyage is of interest because a botanist and an astronomer were taken for purposes of scientific research, an example soon followed by other expeditions, with great benefit to the cause of science. Bougainville discovered many new islands in the Pacific, including the Navigators' Islands in the Samoan group, the Grand Cyclades of the New Hebrides, and Bougainville and Buku Islands in the Solomon group; the strait between the former island and Choiseul is named after him. The simplicity and humour of his narrative of the journey round the world gained great popularity for it.

Dec. 7, 1872.—Start of the *Challenger* Expedition

H.M.S. *Challenger* sailed from Sheerness on one of the most fruitful scientific expeditions ever organised. The British Admiralty and the Royal Society co-operated in organising the voyage, Sir G. S. Nares undertaking the naval command, and Sir Charles Wyville Thomson taking charge of the scientific side. Two traverses of the North Atlantic Ocean were made, and one of the South, the Wyville Thomson ridge being charted. The Pacific and Antarctic were then visited and the *Challenger* returned in 1876 with scientific data which filled fifty volumes published between 1880 and 1895, under the editorship of Sir C. Wyville Thomson and Sir John Murray. Many little-known places were charted and surveyed and the longitude of others was corrected. The contours of the great ocean basins were determined, much new information about deep sea temperatures and about ocean currents was obtained, the structure of coral reefs was investigated and many biological surveys were recorded.

Dec. 10, 1607.—John Smith in Virginia

John Smith set out to discover the source of the Chickahominy River. It was on this voyage that Pocahontas, the little daughter of the great Indian chief Powhatan, saved Smith's life by her pleadings. In the spring of the same year, Smith had accompanied Capt. Newport in an exploration of the James River to the falls at Richmond. In 1608 Smith explored Chesapeake Bay and went up the Potomac to the site of the present city of Washington and up the Rappahannock to where Fredericksburg now stands. Smith's maps of Chesapeake Bay and of the New England coast from Penobscot to Cape Cod are remarkably accurate.

Dec. 10, 1883.—The Masai Country

Joseph Thomson reached Victoria Nyanza after successfully crossing the country inhabited by the Masai, whose fierce exploits had barred the way to Uganda. Thomson had been sent out by the Royal Geographical Society to examine the possibility of taking a caravan through their country. Leaving Mombasa he crossed the Njiri Desert, explored the rift valley and discovered Lake Baringo. In 1878 the same Society had sent an expedition to East Central Africa and when its leader died, Thomson, who was then

but twenty years old, took over the command, crossed the country between Nyasa and Tanganyika and discovered Lake Rukwa. Later, Thomson explored part of the Atlas range. In 1890 he set out from Quilimane and travelled in the regions between Nyasa, Bangweolo and the Zambezi, covering nearly a thousand miles of unexplored country.

Societies and Academies

LONDON

Mineralogical Society, Nov. 1.—H. H. Read and B. E. Dixon: On stichtite from Cunningsburgh, Shetland. Stichtite is found at the above locality as rose-pink patches, partly replacing chromite in a serpentine rock. Characters determined include $D = 2{\cdot}19$, refractive indices γ 1·559, α 1·543. Probably biaxial. Chemical analysis and discussion of earlier analyses give as the most probable formula $2(Cr, Fe)(OH)_3 . 5Mg(OH)_2 . MgCO_3 . Mg[CO_3 . (OH)_2] . 4H_2O$.—H. H. Read: On quartz-kyanite rocks from Unst, Shetland Islands, and their bearing on metamorphic differentiation. Quartz-kyanite rocks occur as vein-like bodies in kyanite-chloritoid-schist, also as blocks scattered over the slopes. They are intimately associated with rocks much poorer in silica and richer in alumina than the normal country rock. The main component of these associated rocks is kyanite, with chlorite, and 'iron ore'. The origin of the rocks and certain general problems connected with metamorphic differentiation are discussed.—L. J. Spencer: A new meteoric iron found near Kyancutta, South Australia. A mass of iron weighing 72 lb. was found in June 1932 just below the surface in a sandy paddock, 28 miles east-south-east of Kyancutta. It shows the characters of the common type of medium octahedrites, and is very similar to the numerous masses of iron found around the meteorite craters near Henbury, in Central Australia, 630 miles distant from Kyancutta.—C. A. Silberrad: List of Indian meteorites. The places of fall of the 106 meteorites that have been recorded in India since 1795 are located as accurately as now possible, and plotted on a map. Percentages are given for the day and night falls, and of the monthly falls.—W. Campbell Smith: Meteoric stones from Suwahib, Arabia. Within 30 miles of Buwah in Suwahib, where Mr. Bertram Thomas found a chondritic meteoric stone in 1931, two other stones were found a year later by Mr. Philby. They closely resemble the Buwah stone and may belong to the same shower. Sixty miles to the south a third stone was found at Umm Tina, near Shanna well. This is a chondrite of Baroti type and differs from the other two, which belong to the Cronstad type.—Arthur Russell: An account of British mineral collectors and dealers in the seventeenth, eighteenth and nineteenth centuries (contd.). Sir Charles Lewis Giesecke, born on April 6, 1761, and died on March 5, 1833, was christened Johann Georg Metzler. He wrote the libretto of Mozart's "Magic Flute" (1791) also other operas. In 1794 he began the serious study of mineralogy and travelled extensively. Later he settled in Copenhagen. In 1806 he undertook a mineral collecting trip to Greenland and remained there seven years, amassing a large collection. The specimens collected during the first two years were captured by an English frigate on their way to Denmark, and were brought to Leith, where they were bought by Thomas Allan. On his return from Greenland in 1813 Giesecke landed at Leith and traced his collection to Allan, with whom he became very friendly. In 1814 he was appointed professor of mineralogy to the Royal Dublin Society, which position he held until his death.—Arthur Russell: Note on an occurrence of witherite at the Morrison North Pit, Stanley, Co. Durham. Pure, massive witherite fills a fault fissure cutting coal at this pit.—M. H. Hey and F. A. Bannister: Studies on the zeolites (4). Ashcroftine (kalithomsonite of S. G. Gordon). The pink zeolitic mineral described by S. G. Gordon in 1924 as a potassiferous thomsonite (kalithomsonite) is shown by X-ray and optical data to be an independent species in no way related to thomsonite, and the name 'ashcroftine' is proposed for it. Ashcroftine is tetragonal with cell sides c 17·49, a 34·04A., a unit-cell content about $40[NaK(Ca,Mg,Mn)Al_4Si_5O_{18} . 8H_2O]$, and D 2·61 ± 0·05. The refractive indices (ϵ 1·545, ω 1·536) are much higher than those of artificial potassiferous thomsonites, and the optic orientation is different.—W. C. A. Guthrie and Christina C. Miller: The determination of rock constituents by semi-micro-methods. The ordinary course of the analysis of an igneous rock can be very considerably expedited by the use of smaller amounts of material throughout, the necessary accuracy of weighing being attained by means of a microbalance. Numerous experiments show that such a procedure is reliable and involves no loss of accuracy.

Royal Meteorological Society, Nov. 16.—J. Edmund Clark, Ivan D. Margary, Richard Marshall and C. J. P. Cave: The Phenological Report, 1931. 1931 was officially described as 'wet and dull', the emphasis is on the latter; yet it was the tenth successive year with excess of rain, the total being that of eleven average years. A fresh table gives for each of the thirteen districts the number of weeks showing 'decided' and 'excessive' divergence from the average for temperature, rainfall and sunshine. December 1930 and November 1931 were alone much on the warm side; March and September cold. Such short cold spells in spring threw the flower records back half a week and although migrants reached our coasts to date their progress inland was belated. Slugs and weeds, as might be expected, caused exceptional trouble. Thanks to a second broadcast in March 1931 the corps of observers slightly exceeded 600. More would be specially welcome in West Ireland and North Scotland.—Sir Napier Shaw and Comdr. L. G. Garbett: A new sort of wind rose. In ordinary meteorological practice, for the representation of wind conditions for stations on land or selected areas at sea, figures or roses for the several months are set out on separate sheets. Consequently, anyone who wishes to visualise the sequence within the year has to take note of information on twelve separate pages. Examples are now given of diagrams in which the results for the twelve months of the year are combined without sacrificing the information for the separate months.—G. S. P. Heywood: Katabatic winds in a valley. A Dines pressure-tube anemometer was erected in a valley in the Cotswolds, with the vane 15 ft. above the ground. The meteorological station at Leafield was situated 2½ miles away, and the records of the anemometer of that station were compared with those obtained in the valley. The speed of the katabatic flow was seldom greater than 1 m./sec., when a katabatic flow was taking place, and the temperature records at Leafield showed an inversion on all those occasions. Observations of smoke drift show that katabatic flow may occur in a layer near the ground without influencing the anemometer at 15 feet.

EDINBURGH

Royal Society, Nov. 7.—W. F. Harper: Supernumerary pectoral fins in *Raia circularis*, Loudon. A male sandy ray (length 43 cm.) caught in the North Sea exhibited a very rare abnormality which consisted of two well-developed fins situated ventrally and associated with the pectoral girdle. Each fin measured 8 cm. long. A single bar of cartilage connected with the coracoid by a fibro-elastic band formed the basal support of each fin, and extended two-thirds of its length before articulating with a series of six jointed radialia. The muscular mass of each fin had a double origin from propterygium and coracoid, and was innervated by the third and fourth spinal nerves.—Amy M. Fleming: The innervation of the uterus. In the uterine muscle there is an irregular asymmetrical non-medulated nerve plexus, the fine nerve fibres of which wind round the smooth muscle cells. Three types of nuclei are present on the course of the nerve bundles. There are four types of plexus-forming cells which show a greater affinity for methylene blue than do the surrounding connective tissue cells. In certain of each type of multipolar plexus-forming cells there are granules sometimes joined by very fine fibrils. A connexion can sometimes be traced between a varicose nerve fibre and one of the processes of the nerve cells.—M. H. Fullerton: Development of the olfactory organ in *Protopterus*. The olfactory organ arises as a solid ingrowth of the deep layer of the ectoderm in which the cavity forms by cytolysis. The anterior portion of the originally slit-like opening which becomes the anterior naris lies in the region of definite ectoderm; the posterior portion which becomes the internal narial opening, lies, however, in the region of heavily yolked cells ('endoderm'). *Protopterus* therefore supports the view that the boundary between ectoderm and endoderm is not a sharp line but a broad 'debatable' zone.—S. L. Hora: Development and probable evolution of the suctorial disc in the tadpoles of *Rana afghana*, Günther. A series of developmental stages enables the author to describe the steps in the formation of the ventral suctorial disc in the tadpole of *Rana afghana*. Some of these steps correspond with the final conditions encountered in the tadpoles of other and different species of *Rana*. The whole process is similar to that in the fish *Garra*. It is concluded that the origin and development of the disc of *R. afghana* can be explained as due to a series of small and gradual changes induced by recognisable factors in the environment which necessitated a change of habit on the part of the organism. The change in habit resulted in the modification of the existing structures and in the ultimate production of a powerful sucking disc.—James Brough: Evolution of the catopterid fishes. A detailed description of the hitherto unknown structure of the head of *Dædalichthys* and the description of a new genus *Campylognathus* is given. The structure of all known forms of the Triassic family of catopterid fishes is analysed, and an attempt is made to indicate the directions in which the family evolved. The trends are of two sorts, those characteristic only of this family and a series of major trends which also went on, independently, in other contemporary groups of bony fishes. A consideration of the latter leads on to a discussion of the general principle of parallelism in evolution.—W. H. Lang: Contributions to the study of the Old Red Sandstone flora of Scotland. Part 7. On *Arthrostigma*, *Psilophyton* and some associated plant remains from the Strathmore beds of the Caledonian Old Red Sandstone. Remains of *Arthrostigma gracile*, Dn. and *Psilophyton princeps*, Dn. (including *P. Goldschmidtii*, Halle) from Scottish rocks are described in detail. In the case of *Arthrostigma* the epidermis and stomata, the tracheidal structure of the central vascular strand, and slender trace bundles in the cortex are described. The epidermis, stomata and tracheidal tissue of *Psilophyton* are compared with the corresponding features of *Arthrostigma*. The spines of *Psilophyton* are described in detail. They agree with the spines of the type material from Gaspé. Sporangia and spores associated with the vegetative remains in Scotland also agree with those from Gaspé.

PARIS

Academy of Sciences, Oct. 24 (vol. 195, pp. 685–724).—Paul Delens: The formal operations of the logical calculus.—D. Pompeiu: Theorems of existence for the zeros of holomorph functions.—Maurice Gevrey: Systems of partial differential equations of the parabolic type.—Marcel Brelot: The point singularities of sub-harmonic functions.—Henri Roure: New formulæ for the calculation of special perturbations.—Gustave André Mokrzycki: The longitudinal balancing of aeroplanes.—Emile Sevin: Cosmic radiation. A theory is developed based on the wave conception of the electro-magnetic radiations leading to the expression for the wave-lengths (λ) which can arise, $\lambda = 3 \cdot 95n \times 10^{-13}$, where n represents a series of simple numbers. The results obtained with this formula are compared with those of Millikan and Cameron and those of Sir James Jeans.—R. Wavre: Certain single layer potentials, generators of real and multiform harmonic functions.—L. Goldstein: A new isotopic effect. The theory developed predicts an isotopic effect in Raman spectra, the order of magnitude of which is the same as that observable in the rotation-vibration bands of isotopic molecules.—P. de Fonbrune: An apparatus for manufacturing glass instruments intended for micro-manipulations. The technique described is based on the use of a source of heat, easily regulated, placed under the microscope.—E. Darmois and Mlle. M. Murgier: The influence of molybdates on the rotatory power of xylose. From the study of the variations of the specific rotatory power, evidence of the existence of the compound $NaHMoO_4.2C_5H_{10}O_5$ is obtained. This compound has a much higher optical activity than that of xylose.—A. Travers and Silice: Dilute perchloric acid as an oxidising agent.—Jacques Bourcart: Sediments of the schlier type in Morocco. An attempt at a palæogeographical reconstitution.—J. Malavoy: The Voltaian and Atacoran (Gold Coast, Togo and Dahomey).—H. Lagotala: Preliminary note on the geology of Loutété-Mounié (Gouéris region, in the middle Congo).—L. Clariond: The extension of the ante-Visean movements in Morocco.—Aug. Chevalier and Conrad Kilian: The presence of the Silurian and of a Palæozoic flora between Kaouar and Tibesti (eastern Sahara).—Pierre Lesage: The progressive acquisition of precocity in *Lepidium sativum*. The heredity of the character of precosity in the open air after life under a frame has been preserved for at least eleven generations at Rothamsted, Rennes, Clermont, Valence, Marseilles and Algiers. At Rennes, this precocity has not been appreciably altered in a series of cultures from the first to the eleventh generation. Diagrams are given shewing the curves of growth at Rennes and at Rothamsted from 1929 until

1932.—Ch. Dubois and N. Sollier: The experimental diagnosis of melitococcia in sheep and goats by means of the allergy reaction. An emulsion of *Br. abortus* has proved to be the best antigen for this reaction: by its means sick animals and germ carriers can be detected. All subjects reacting can be considered as dangerous for other animals and for man.

Forthcoming Events

MONDAY, DEC. 5

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Lieut.-Col. C. W. Furlong: "Tierra del Fuego".

UNIVERSITY OF LEEDS, at 5.15.—Dr. E. J. Holmyard: "Chemistry in the Ancient World and the Middle Ages".

WEDNESDAY, DEC. 7

BRITISH INSTITUTE OF RADIOLOGY, at 5—(Thirteenth Mackenzie Davidson Memorial Lecture at the Central Hall, Westminster).—Dr. J. Chadwick: "The Neutron".

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.45.—Discussion on "Protective Adaptations of Animals, especially Insects", to be opened by Prof. E. B. Poulton.

BIRKBECK COLLEGE, at 8.15—(Foundation Oration).—The Right Hon. Lord Macmillan: "The Sense of Values".

THURSDAY, DEC. 8

BRITISH INSTITUTE OF RADIOLOGY, at 5—(Fifteenth Sylvanus Thompson Memorial Lecture at the Central Hall, Westminster).—The Right Hon. The Viscount Lee of Fareham: "Radium as a Therapeutic Agent—The Case for National Control".

ROYAL SOCIETY, at 4.30—(Croonian Lecture).—Prof. Davidson Black: "The Discovery of *Sinanthropus*".

FRIDAY, DEC. 9

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Davidson Black: "*Sinanthropus*" (second lecture on Dec. 12).

BRITISH INSTITUTE OF RADIOLOGY, at 2.30—(Presidential Address at the Central Hall, Westminster).—Prof. F. L. Hopwood.

ROYAL INSTITUTION, at 9—Prof. J. G. Gray: "Gyroscopic Tops and Combinations".

BRITISH INSTITUTE OF RADIOLOGY, Dec. 7–9. Annual Congress at the Central Hall, Westminster.

Official Publications Received

GREAT BRITAIN AND IRELAND

International Federation of University Women. Bulletin No. 14: Report of the Sixth Conference, Edinburgh, July 27 to August 4, 1932. Pp. 181. (London: Crosby Hall.)

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1931–1932. Pp. 12. (Durham.)

A Study of the Deaf in England and Wales, 1930 to 1932: being a Report by Dr. A. Eichholz to the Minister of Health and the President of the Board of Education. Pp. iv+206. (London: H.M. Stationery Office.) 3*s*. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 71, No. 431, November. Pp. 685–836+xviii. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

The British Mycological Society Transactions. Edited by J. Ramsbottom, B. F. Barnes and H. Wormald. Vol. 17, Part 3, 11 November. Pp. 157–236. (London: Cambridge University Press.) 7*s*. 6*d*.

Transactions of the Geological Society of Glasgow. Vol. 19, Part 1, 1928–1931 (continued). Pp. iv+224. (Glasgow.) 7*s*. 6*d*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1460 (I.C.E. 850): Experiments with a Supercharged Single-Cylinder Unit. By Dr. G. F. Mucklow. Pp. 57+42 plates. 3*s*. net. No. 1468 (T.3263): High Speed Induced Wind Tunnel. By A. Bailey and S. A. Wood. Pp. 21+15 plates. 1*s*. 3*d*. net. No. 1478 (T.3254): Efficiency of Tail Plane behind Wing of R.A.F. 34 Section. By D. M. Hirst and A. S. Hartshorn. Pp. 4+4 plates. 4*d*. net. (London: H.M. Stationery Office.)

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1931–32. Pp. 36. (Aberdeen.)

Philosophical Transactions of the Royal Society of London. Series A, Vol. 231, A694: The Electric Field of Overhead Thunderclouds. By Dr. Sudhansu Kumar Banerji. Pp. 27+6 plates. (London: Harrison and Sons, Ltd.)

Department of Scientific and Industrial Research. Report of Further Tests by the Director of Fuel Research on the Turner Retort installed at the Works of the Comac Oil Co., Ltd., Coalburn, Lanarkshire; Tests carried out 13th November to 3rd December, 1930. Pp. viii+35. (London: H.M. Stationery Office.) 9*d*. net.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 10, October. Abstracts Nos. 1762–1951. Pp. 327–362. (London: H.M. Stationery Office.) 1*s*. net.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1426 (T.3235): Recovery from a Spin. By L. W. Bryant and Miss I. M. W. Jones. Pp. 24+8 plates. 1*s*. 3*d*. net. No. 1474 (T.3161B): The Distribution of Turbulence over the Central Region of a Pipe. By A. Fage and H. C. H. Townend. Pp. 6+5 plates. 6*d*. net. No. 1484 (G26.40): Reduction of Fire Risk by Induction Pipe Flame Traps. By Andrew Swan, Squadron Leader W. Helmore and W. C. Clothier. Pp. 16+11 plates. 1*s*. net. (London: H.M. Stationery Office.)

OTHER COUNTRIES

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 659–A: A Method of Estimating Ground-Water Supplies based on Discharge by Plants and Evaporation from Soil; Results of Investigations in Escalante Valley, Utah. By Walter N. White. (Contributions to the Hydrology of the United States, 1932.) Pp. v+105+10 plates. Water-Supply Paper 659–B: Geology and Ground-Water Resources of the Dalles Region, Oregon. By Arthur M. Piper. (Contributions to the Hydrology of the United States, 1932.) Pp. iv+107–189+plates 11–19. 25 cents. Water-Supply Paper 698: Surface Water Supply of the United States, 1930. Part 3: Ohio River Basin. Pp. viii+292. 20 cents. Water-Supply Paper 700: Surface Water Supply of the United States, 1930. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v+149. 15 cents. Water-Supply Paper 720: Surface Water Supply of the United States, 1931. Part 10: The Great Basin. Pp. v+99. 10 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the American Academy of Arts and Sciences. Vol. 67, No. 5: Bacterial Detoxification. By Robert S. Harris and John W. M. Bunker. Pp. 147–168. 60 cents. Vol. 67, No. 6: Note on Stellar Perturbations of nearly Parabolic Orbits. By E. Öpik. Pp. 169–184. 45 cents. (Boston, Mass.)

Bulletin of the Madras Government Museum. New Series, General Section, Vol. 1, Part 2: Catalogue of the South Indian Hindu Metal Images in the Madras Government Museum. By Dr. F. H. Gravely and T. N. Ramachandran. Pp. ii+144+23 plates. (Madras: Government Press.) 5.8 rupees.

Index to the Memoirs of the Geological Survey of India, Vols. 1–54. 1859 to 1929. By T. H. D. La Touche. Pp. vii+431. (Calcutta: Government of India Central Publication Branch.)

Report on the Zoological Survey of India for the Years 1929 to 1932. Pp. iii+lvii. (Calcutta: Government of India Central Publication Branch.) 1 rupee; 1*s*. 9*d*.

Proceedings of the United States National Museum. Vol. 82, Art. 1: A Remarkable New Genus and Species of Two-winged Flies related to the Œstridæ. By Charles H. T. Townsend. (No. 2942.) Pp. 4. (Washington, D.C.: Government Printing Office.)

Conseil Permanent International pour l'Exploration de la Mer. Faune ichthyologique de l'Atlantique nord. Publiée sous la direction de Prof. Joubin. No. 11. 24 planches. (Copenhague: Andr. Fred. Høst et fils.) 4 kr.

Field Museum of Natural History. Anthropological Series, Vol. 17, No. 4: The Solar Year of the Mayas at Quirigua, Guatemala. By J. Eric Thompson. (Publication 315.) Pp. 365–421. (Chicago.) 35 cents.

Journal of the Indian Institute of Science. Vol. 15A, Part 6: The Equilibrium between Dimethyl Ether, Methyl Alcohol and Water. By N. G. Gajendragad, S. K. Kulkarni Jatkat and H. E. Watson. Pp. 59–70. (Bangalore.) 1 rupee.

U.S. Department of the Interior: Office of Education. Leaflet No. 43: Elementary School Principals, some Data on their Education, Experience and Salaries. By Walter S. Deffenbaugh. Pp. 11. (Washington, D.C.: Government Printing Office.) 5 cents.

Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditures and Condition of the Institution for the Year ending June 30, 1931. (Publication 3142.) Pp. xiii+592+87 plates. (Washington, D.C.: Government Printing Office.)

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