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The Census of India, 1931*

THE Government of India showed both a commendable wisdom and a grasp of the realities of the situation in publishing an abstract of the main statistics of the census of 1931 while the Third Round Table Conference was still in session in London. The figures which are included in the abstract are of the greatest significance. Indeed, they are vital for an appreciation of the essence of the matters under discussion. By sheer weight of numbers, they bring out the magnitude of the problems involved in the proposed constitutional changes; and by indicating tendencies in the movements of population, they afford guidance in judging the possibility of permanence in an arrangement which aims at the form of democracy, but will depend for its working upon a delicate adjustment of the relations between different sections of the people.

The magnitude of the figures alone is stupendous. The destiny of more than three hundred and fifty millions of people is in the balance. The total population of India, as actually given, is 352,837,778, of whom 271,526,933, inhabitants of British India, are to receive the benefits and privileges of democratic institutions—the vast majority of them, however, for the present, in an attenuated form—and the remaining 81,310,845, natives of the Indian States, will be brought within the constitution of India under the scheme for federation.

The area of the Indian Empire, according to the latest estimate, is given as 1,808,679 square miles. This gives on the census figures of total population a mean density of 195 per square mile, the maximum being found in Cochin State, with a population of 814 to the square mile. In British India the most thickly populated area is Bengal, where there is a population of 646 to the square mile. The most sparsely populated areas in the Empire are Baluchistan with 5, and British Baluchistan with 9 to the square mile.

The statistics of total population, impressive as they are, must be taken in relation to the fact that they represent an increase in the ten years which have elapsed since the last census of 10.6 per cent. This rate of increase contrasts with an increase of 1.2 per cent in the previous decade, and has not been equalled since the period 1881-91; but there is no reason to suppose that

* Census of India, 1931. Abstract of Tables giving the Main Statistics of the Census of the Indian Empire of 1931, with a Brief Introductory Note. Pp. 16+2 maps. (Calcutta: Government of India Central Publications Branch, 1932.) 9d.

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with continuing improvements in sanitation and hygiene and the reduction, if not the elimination, of the incidence of famine and plague, a rate of increase substantially little lower will not be maintained, unless some unforeseen cause should introduce any serious modification in the conditions of life among the general run of the population.

Notwithstanding fluctuations in the decennial rate of increase, the growth of population since 1881 represents an increase of 39 per cent. A part of this, however, is due to the extension, from time to time, of the area brought under the operation of the census.

Enfranchisement, however gradually extended to a population of this size, would be an undertaking of sufficient magnitude in itself, especially among a population which speaks some 225 languages, exclusive of dialects, and ranges culturally from the level of a jungle tribe to those whose standard of civilisation may differ in kind, but does not differ materially in degree, from that of a member of an equivalent class in European society. In India, however, as must by now be generally appreciated, the initial difficulty is complicated by sharply marked divisions of race and creed which have given rise to the 'communal' problem. An electoral system, based on a territorial allocation of representatives, has to be adapted to represent justly different races and different creeds, each of which has its own social organisation and habits and, inevitably, its own distinctive and peculiar bias in political outlook arising therefrom. Even in the fairly homogeneous communities of the West, the problem of minorities has never been solved satisfactorily, although many attempts have been made. It has been said that the only right of a minority is that of turning itself into a majority. In India, if only the warmth of discussion and the wealth of argument were taken into account, it might not unreasonably be concluded that minorities alone had a claim to consideration.

This sensitiveness to the claim of minorities, abnormal as it would at one time have appeared to the average citizen of a European State, arises, it is seen, from a very real and irreconcilable incompatibility in thought, habit and religion between the different sections of Indian society, which, particularly as between Hindu and Moslem, at times flames out into acts of open hostility. The facts which the constitution will have to face are revealed in the tables of enumeration according to religions.

Taking the principal religions only, but omitting Buddhism which, practically, is confined to Burma, in all India there are:—Hindus, 239,195,140; Moslems, 77,677,545; Sikhs, 4,335,771; Tribal, 8,280,347; Christians, 6,292,763. In British India, the predominant factor is the relation between Hindus and Moslems; and within the ranks of the Hindus, the relation of the castes to the Exterior Castes, or, as they are more popularly known, the Depressed Classes. Here the figures are Hindus 177,727,988, of whom 40,254,576 are numbered among the Depressed Classes. The Moslems number 67,020,443; Christians, 3,866,660; Sikhs, 3,220,997; and Tribal, 5,779,709. More important than the totals, however, is their distribution and interrelation in the various provinces, upon which the question of representation has to be decided. In the fifteen provinces (including Burma and the Andamans) under which the figures are given, the Hindus are in the majority in ten, while the Moslems predominate in Bengal, the Punjab, Burma (not counting Buddhists), Baluchistan and the North-West Frontier Province. The Sikhs number 3,064,144 in the Punjab, exceed forty thousand in the North-West Frontier Province and the United Provinces of Agra and Oudh and are present in eleven other provinces in varying degree, the numbers, however, being relatively small.

Incidentally, it may be of interest to note the definition of Exterior Castes adopted for census purposes, which differs in certain respects from that of the Franchise Committee of the Round Table Conference. It includes all castes which are excluded from access to schools, wells, public bathing places, temples and in some cases burning ghats, which are refused for service as barbers, tailors or washermen, from whom water is not accepted, and who convey pollution by contact or proximity. The Depressed Classes had expectation of abolishing, by a declaration of equal rights to be incorporated in the constitution, the regulation or custom of exclusion from schools and other like places open to the higher castes, and other distinctions of inferiority.

The figures relating to the religious communities gain in significance when viewed proportionately, especially in their bearing on the political problem. In the decennial period, the increase in the Hindu population has been 10·4 per cent; but among the Moslems it has been 13 per cent; or, expressed in ratios per 1,000, the Hindus have fallen from 684 to 682, while the Moslems have risen from 217

to 222. This latter figure is the continuation of a steady increase which has been going on for the last half-century. The tribal figures also show a decrease in the decade—from 31 per thousand to 24, but this does not necessarily mean that the tribesmen are decreasing in numbers. It is probably to be accounted for in greater part as due to transference to the number of Hindus, in accordance with the process of Hinduising the tribal religions which has been in progress from time immemorial.

Among the remaining figures which may be regarded as having special significance in relation to the transitional phase through which India is now passing, are those giving the degree of literacy, the proportion of urban to rural population, and occupations.

The figures for literacy show a marked advance. The number per 1,000 aged five years and more who can read and write is 156 male and 29 female. In 1921 the corresponding figures were 122 male and 18 female. The number of literate females is now more than four millions, whereas thirty years ago they numbered less than a million. Among the Depressed Classes in British India, the percentage of literacy is 1.6.

The real India, it is always said, is the India of the rural population and the agricultural classes, although the urban population may be more in evidence and may thereby, in changed conditions, obtain more and more a preponderating voice in the affairs of the people. The urban population is undoubtedly growing and may be expected to increase more rapidly as India becomes industrialised and draws a proportion of the rural population to the towns, as it has already begun to do, for example, in Bombay. Since 1921 the increase in the urban population has been 0.9 per cent and it now numbers 11 per cent of the total. In occupations, agriculture accounts for 66.4 per cent of the working population. There is some doubt as to the exact numbers engaged in organised industry; but they are put at about 3,250,000 and at a maximum not exceeding 5,000,000, while the number employed in establishments governed by the Factory Acts is 1,553,169.

These, then, are the more significant of the figures which give the statistical side of the problems confronting those who have to frame a constitution for India. Their object is to adapt an essentially western institution to an eastern community, in which caste, the antithesis of democracy, prevails as the determining factor in the lives of

the vast majority of the community and influences even the Moslem. It may, indeed, be regretted that the opportunity was not sought to develop native Indian institutions; but such regrets are unavailing. It is probable that the die was cast irrevocably in the days when Indian culture was despised and a university system was set up which was devised to throw open to India the way to development along western lines. Time and stress alone can prove the wisdom of the course that has been chosen.

The Spirit of Research

The Spirit of Research. By Dr. T. Brailsford Robertson. Edited by Jane W. Robertson. Pp. xiv + 210 + 2 plates. (Adelaide: F. W. Preece and Sons, 1931.) 8s. 6d. net.

BRAILSFORD ROBERTSON devoted a brief but intensive life to scientific research, during which he found time to write essays of a more general appeal, some of which are collected here in book form. Born in Edinburgh, he went at an early age to Adelaide, and after a period of thirteen years in California, returned there as professor of physiology in 1919, where he died in 1930. This book, which in a sense is a memorial volume, is an all-Australian production: we like to regard it as a symbol that the torch of scientific truth burns brightly under the Southern Cross.

Robertson was an enthusiast: he was fortunate to come early after graduation under the influence of another enthusiast, Jacques Loeb, with whom he worked, and later succeeded, at Berkeley, California. Both were sceptics of accepted doctrines, both were men of fearless independence and unbounded energy. It was Loeb's influence that caused Robertson to attack big problems rather than work in restricted fields, and encouraged him to undertake the problem of growth and senescence as his main life work.

It is the spirit of research that counts. Observations, comparison, deduction, trial are the factors which have established all we know from the days of such a primitive act as the production of fire to the latest hypothesis of the structure of the atom. Loeb used a simple shed on the sea shore with an equipment of the simplest and cheapest character for his experiments on the artificial parthenogenesis of sea-urchins, and yet obtained results which are among the most valuable in biology. The modern physicist requires the

most complex and costly apparatus for his experiments on the smashing of the atom.

Since the War, research has been discovered to have a cash value and it has become popular alike with the Press, public and those persons who practise it as a means of livelihood. There are not wanting those critics who would avoid the use of the term 'research' for such work and prefer to call it investigation. At any rate, no one will deny that a cash reward is not in harmony with the true spirit of research. Precisely in the proportion that the worker devotes himself to research, so he must relinquish the desire for success of the kind expressible in cash. The consciousness of service must suffice as the sole reward. Discoveries creep gradually into public consciousness; suddenly they may become the latest marvel of science, only to develop in a very brief period into a commonplace of existence.

The rate of progress made by science in providing the amenities of life during so short a period as the last decade is amazing, but there is still something to be done to accelerate the coming of a future such as pictured by H. G. Wells, in which we have a control over many things which to-day seem to us almost sacred. The public readily appreciates a showy building; it must be brought to realise that it is experimental research which at all times needs endowment. Most of all, however, we must beware that the budding genius is left unfettered and not destroyed at the beginning of his career, by the system of examinations at school and college. Such mediocrity is exhibited by the papers published in our scientific transactions and proceedings that one can but have serious anxiety in this respect. It is made far too difficult for the unorthodox and eccentric young man to gain his chance of promotion: the investigator in fields of inquiry which are not the fashion of the moment often finds it hard to gain recognition and support.

The ultimate aim of all scientific research is to better the position of man; chemistry in particular, now that the knowledge of the structure and behaviour of the individual substances has been mastered, is in a position to help in the greater biological field. There must be a chemical basis to growth, to senescence, to heredity, even to personality, and all else that happens in the body. Robertson began in Australia the study of such questions as the value of phosphates on wool production, and of a cystine-high diet on the quality and quantity of this staple production of

the country, experimenting with so many as 80,000 sheep. He makes a plea in one of his essays for the fostering of research on a large scale in the wide open spaces of the earth, instead of concentrating it in laboratories among the crowded centres of population.

It is an axiom that a well-balanced mind is essential for a research worker of the highest class, however much he may be a specialist in his laboratory. To be appreciative of art, of literature and of music, with a love for his country, his home and his work are desirable attributes. Such a man was Brailsford Robertson, and the keen spirit of enjoyment which permeates his essays makes them worthy of more than passing perusal.

E. F. A.

Hydrodynamics

Bulletin of the National Research Council, No. 84: Report of the Committee on Hydrodynamics, Division of Physical Sciences, National Research Council. Pp. ii + 634. (Washington, D.C.: National Academy of Sciences, 1931.) 4.50 dollars.

IN each of the processes involved in the study of fluid motion—in observation, measurement, physical explanation, and calculation—this century has seen notable advances. There are improved methods of making the flow visible, and a technique for measurement in thin layers of fluid next to solid boundaries. Enlightenment and understanding have followed recognition of the importance of the motion in such layers, which to some extent has proved amenable to calculation. Such calculations are important mathematical advances; but to most mathematicians the greatest achievements are probably those resulting from skilful use of ideal fluid theory, with circulation and vorticity included. There has been progress in turbulence theory, and in research on compressible fluid flow; and though, on the whole, most attention has been paid to motion past obstacles and in pipes, with their technical applications, it must be remembered that the study of waves and tides has not been without incident in recent years.

There is, then, a wide field on which to report. In any one-volume report selection will be necessary, and we turn to the volume before us to determine first how the selection has been made. Without preface or foreword, after a scanty contents table, the book opens with a short chapter

by Dr. H. L. Dryden, which, called a general survey of experimental hydrodynamics, actually summarises experiments on flow past obstacles. Aerofoils occupy a small space; airscrews are not mentioned. In the next chapter Prof. F. D. Murnaghan gives an elementary presentation of monoplane aerofoil theory, and the parts of ideal fluid theory necessary for it, together with an inadequate account of calculations of flow past a body of revolution.

The rest of the book is by Prof. H. Bateman. In the third chapter, which closes the first part of the report, he writes on the general physical properties of a viscous fluid. There are three more parts—on the laminar motion of a viscous fluid, on turbulent motion, and on compressible fluids—each fairly full. The number of references given is enormous. Each of the first two chapters, and each small section of Prof. Bateman's, is followed by a bibliography, and there are additional references at the end of the book. Many matters not dealt with in the text are mentioned in these bibliographies, which seem, indeed, extraordinarily comprehensive.

The committee has thus succeeded in giving full reports on viscosity, turbulence, and compressible fluids by sacrificing large portions of ideal fluid theory. The omission of waves and tides reflects the influence of aeronautics on hydrodynamical research; and while reports on Levi-Civita's extension of the mathematics of free stream-line motion, the use of integral equations, and approximate numerical solutions would have been welcome, most striking is the omission of a discussion of the Kármán vortex street and the resulting drag formula, all the more so since the presentation of aerofoil theory is similar, in some places, to Glauert's, and space could have been saved by a reference to his book. It is a pity, too, that room could not be found for descriptions of experimental technique.

Dr. Dryden's chapter is one of the best, but too short. Experimental results are summarised as well as possible in the space, and modern theories receive due mention. There are, however, no pictures, diagrams or tables. To print a chapter on experimental hydrodynamics without any of these aids to the understanding is an unwelcome innovation for which no price reduction can make amends.

Prof. Murnaghan's account is connected; his mathematics is clear, and well decorated with illustrations; but the account is restricted to

rather elementary matters, and airscrew theory is completely omitted. The insistence on the *ad hoc* nature of hypotheses in Prandtl's aerofoil theory is unfortunate; the theory is a first order theory capable of development in a rational manner. Prof. Murnaghan's one innovation in the theory is to suggest that the downwash should be compounded with the velocity at the trailing edge, rather than with the undisturbed velocity, in the usual calculation of induced drag. But the velocity at the trailing edge is zero if the angle there is finite. The confusion probably results from a lack of understanding of the approximations.

Prof. Bateman presents us with an embarrassing wealth of information, drawn from many sources, at times presented somewhat uncritically, and not easy to read. The report often has the character of a number of results loosely strung together. The treatment of laminar viscous flow is largely mathematical; formulæ abound; tables and diagrams are absent; so that, of quantitative results, only those expressible by formulæ are presented. Thus the drag on a plate according to boundary layer theory is given, but not the velocity distribution. Neither here nor in the first chapter is there comparison with experiment. How we miss those diagrams!

The reporting appears to be generally accurate, but when so wide a field is covered, errors are inevitable, and some five or six have been noted. Too much space seems to have been given to mathematics with minute physical significance. Occasionally important results remain buried in the bibliographies; and sometimes, also, certain matters find their only mention in odd company. There is an unwillingness to include any detail about general physical ideas; several examples might be given, of which one of the most important is the complete lack, anywhere in the book, of an adequate discussion of the production of circulation and vorticity in fluids of small viscosity.

It is not easy to find the place. The index is far from complete, and the page headings do not help—always "Hydrodynamics" on the left and the title of the part on the right. Prof. Bateman's frequent omission to give references to papers previously mentioned wastes time. But these are minor blemishes on a valuable work of reference to the making of which has gone great learning and knowledge. There is, indeed, a vast store of information here, much of it not to be found in any other book in English.

S. G.

Oceanographical Work of the *Carnegie*

The Last Cruise of the Carnegie. By J. Harland Paul. Pp. xvii + 331. (Baltimore: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1932.) 26s. 6d. net.

THREE years ago the *Carnegie* met her fate when at anchor in Samoa owing to an explosion when loading gasoline for her auxiliary engine. The loss of a fine vessel, built expressly for the study of terrestrial magnetism, was a catastrophe, but this was completely overshadowed by the death of Capt. Ault, fine seaman, skipper and navigator, enthusiastic and generous scientific chief. The *Carnegie* was the most widely known of all vessels, for she had already made six cruises mostly across unknown areas of sea and visited many strange ports. Capt. Ault was in command of three of these, and this story of her seventh cruise is eloquent as to his practical qualities and to his high efficiency as leader. Ventures and dangers are passed by so lightly, as in recent War dispatches, that at times the reader wonders whether the author appreciated them and understood fully the quality of his 'skipper'.

The *Carnegie* was a brig, 128 ft. on the loadline, 155 ft. over all and 33 ft. beam, drawing 14 ft. and setting about 13,000 sq. ft. of canvas, with auxiliary engine of small power. She was built on fine yacht lines and usually set a large leg-of-mutton mainsail. Her peculiarity lay in her build, no iron being used in any part and even avoided in loose tools and gear. This, while highly advantageous to her studies of terrestrial magnetism, had obvious disadvantages, manila rope not forming a good anchor warp, as off Easter Island where it was cut through on the rocks. Phosphor-bronze was a poor substitute for steel in the wire on the winches. This was necessary, for the seventh differed from the earlier cruises in that oceanographic stations were to be established, depths, temperatures, salinities and other chemical factors to be observed, while plankton was to be collected from various depths. Echo sounding gear was also fitted, to be checked by bottom sounding. Clearly no expense was spared in attempting to obtain perfection in equipment, but nevertheless unforeseen accidents were numerous, the sonic gear being out of commission at one period. At the same time, great attention was to be paid to atmospheric electricity and to air movements aloft, so far as could be observed by balloons, to prepare the future "Sailing Directions" for aeroplanes. Further,

perhaps an embarrassing feature, the ship was seldom out of touch by radio with her headquarters at Washington, although sailing in the most distant waters of the Atlantic and Pacific Oceans.

The cruise started on May 1, 1928, and Plymouth and Hamburg were visited for intercomparison of instruments and methods and for additional gear. The course was then set to Iceland, often a bad landfall on account of local compass deviations which demand constantly checked variation charts. Dr. Paul is enthusiastic of this land of "the mother of parliaments" with its culture, "the highest general level of our whole cruise". Regular oceanographic stations were taken across the Sargasso Sea and thence westwards to Barbadoes and Panama, where the *Carnegie* went into dry dock. It was a hard fight to clear the Galapagos and so out into the Pacific, the run to Easter Island taking 42 days. Then follows an excellently illustrated description of this ever-interesting land, famous for its carved figures, centre of a weird civilisation, an everlasting and probably insoluble problem. The suggestion put forward here is that of a relic island of a once large archipelago, but we have failed to find any scientific evidence for any great lands in the mighty Pacific's waste of water.

To reach Callao a great loop to the south-east had to be made to catch the 'westerlies', the least known of ocean areas being traversed. Sectional charts of water temperatures and salinities give food for thought, and an offshore ridge was charted rising 10,000 ft. to within 650 fathoms of the surface. The *Carnegie* then picked up the 'trades' to Tahiti and Samoa, keeping well to her line of latitude and carrying out her routine of magnetic, electrical and oceanographical observations highly successfully. The Tuamotu Group was crossed, but we searched in vain for any hint as to the shape of the underlying foundations of this great coral group. Good samples of the bottom deposits were secured and should prove interesting. A sailing vessel, however, was clearly not suitable for much of the oceanographic work, for to secure the best samples it is advisable to keep the ship's head to sea with the engines going slowly so that she makes no way. The warps for bottom samplers and for water and plankton nets ran out at sharp angles, as much as 75° from the vertical, and closing or reversing messengers were often hung up by animals unintentionally caught up on the wires. The latter sometimes fouled, for apparently the staff tried to carry on all their observations

synchronously, and the loss of water bottles and thermometers was so considerable that the captain must have heaved a sigh of relief when he again got his ship on her course.

From Samoa to Guam, a prosperous United States colony, was clear sailing, and *en route* to Japan was obtained the deepest sounding of the cruise, 8,350 metres. Tokyo was reached after typhoon experiences which must have tried the *Carnegie*. The voyage thence to San Francisco, 36 days, on a very northerly course, heavy seas, overcast skies and perpetual foghorn cannot have been a happy experience, but there were doubtless consolations in a well-earned rest in the home port.

The further plan of the cruise included a visit

to Australia and a complete circumnavigation of the world before the 'westerlies' of the Southern Ocean. Hawaii came first and then the tragic end in Apia Harbour, famous in our naval annals for the feat of the *Calliope* in putting to sea in a hurricane, when six war vessels piled up on that harbour's shores.

The scientific results of the *Carnegie* had all been dispatched home before her end, and Dr. Paul's narrative is a desirable supplement telling us how they were obtained. It is a pleasing and instructive story for all who "go down to the sea in ships"—but why is the vessel pictured on the binding as an idealised three-master that never could have sailed on any sea? J. S. G.

Short Reviews

The Law of Patents for Chemists. By Dr. J. Rossman. Pp. ix+304. (Washington, D.C.: The Inventors Publishing Co., 1932.) 3.50 dollars.

DR. ROSSMAN has packed into this volume much information that is of interest to chemists in Great Britain as well as in the United States, and the sections on essential patent law principles and on the procedure for obtaining the patent are of general interest although primarily relating to American patent law. From this point of view the book should be of real value to chemists in providing a comprehensive survey of the technicalities of patent law in a manner which is intelligible to chemists without legal training. A glossary and a bibliography of books and periodicals add to its general utility.

From a broader point of view the book is disappointing. At a time when the evil of paper patents is generally acknowledged and is so serious and widespread that the suitability of the patent system to modern industry, and especially chemical industry, has been openly questioned, it is surprising to find that the chapter on "What is Invention?" indicates little appreciation of the fundamental problems which now arise in the relations between scientific and industrial research and invention. These difficulties have been ably delineated by Mr. C. C. Paterson in an appendix to the Report of the British Science Guild on the "Reform of the British Patent System". Similar difficulties exist in the United States and some indication of the attitude of patent law opinion in that country, particularly on the suitability under modern conditions of 'inventive ingenuity' as subject matter for a chemical patent would have been welcome, as well as reference to the related question of protecting scientific discoveries or scientific property. These should not have been omitted in a book addressed to scientific workers, and the brief discussion on patent rights, particularly those of employer and employee, would

have gained value from a broader vision and from reference to the studies on the position of the salaried inventor carried out for the International Labour Office and the League of Nations in recent years.

Forensic Chemistry and Scientific Criminal Investigation. By A. Lucas. Second edition. Pp. 324. (London: Edward Arnold and Co., 1931.) 18s. net.

THE second edition of this excellent textbook appears at a time when a reminder of the immense services which the man of science can render in the prevention and detection of crime is more than opportune. Recent discussions on the increase of crime in Great Britain during the last two or three decades have suggested doubts as to whether the authorities are making sufficiently full use of the resources of science in protecting society against those who are prepared to prostitute the discoveries of science for criminal purposes. The new and enlarged edition of this book includes references to many of the important advances which have been made during the ten years since the first edition was published, in the use of scientific methods for the detection of the criminal, notably the use of ultra-violet light.

Much of the book has been rewritten, related chapters having been combined and a considerable amount of new matter has been incorporated, particularly in the chapters on bloodstains, clothing, documents, explosives and explosions. The expansion of the chapter on firearms, cartridges and projectiles well illustrates the growing importance of this subject due to the greatly increased use of firearms for criminal purposes since the War. Excellent bibliographies accompanying each chapter and numerous references in the text enhance the value of a well-written and up-to-date book, which may be read with interest even by those who are not experts in forensic chemistry.

To the general reader it will enforce the

conclusion drawn by the author in his introduction—"the criminal is becoming so scientific not only in his work but in the means he adopts to escape detection, that a scientist is needed to cope with him". The scientific reader will mark that from yet a further point of view his services are urgently demanded by society.

A Text-Book of Organic Chemistry. By Prof. Dr. Julius Schmidt. English edition by Dr. H. Gordon Rule. Second edition, revised and extended. Pp. xxiv+843. (London and Edinburgh: Gurney and Jackson, 1932.) 25s. net.

WE learn from the preface that the two-fold purpose of the author in revising the text of the first edition was to incorporate the main advances which have been made in the subject and to avoid any appreciable increase in the size of the book.

An analysis of the distribution of the 45 pages that measure the increase in the size of the book affords a very fair estimate of the conspicuous success with which the author has achieved his object; for 29 pages go to the general section, 8 to the text dealing with the systematic treatment and 8 to the index.

The large extension in the general section enhances considerably the value of the book, for it includes discussions on such subjects as addition to conjugated systems, the electronic theory of valency, the mechanism of racemisation, epimerisation, conditions for enantiomorphism, isomerism due to restricted rotation around a single bond, asymmetrical decomposition, spiro-compounds, the stereochemistry of nitrogen and sulphur, the Beckmann re-arrangement, tautomerism, the parachor, polar properties of organic compounds and factors influencing the magnitude of optical rotatory power. All these subjects are treated with admirable clearness and supplied with full bibliographical references, and certain of them—the one dealing with tautomerism in particular—are valuable monographs on the subjects.

In the text dealing with the systematic treatment, the whole subject has been carefully revised and brought up to date, and the increase of only 8 pages in this section affords no measure of the extent or completeness of this work. For such a measure we turn to the index, in which an increase of 8 pages represents some 360 and 600 new names of authors and subjects respectively.

Die Tierwelt der Nord- und Ostsee. Begründet von G. Grimpe und E. Wagler. Herausgegeben von G. Grimpe. Lief. 21. Teil 1.d₂: *Einführung in die Hydrographie der Nord- und Ostsee*, von Bruno Schulz; Teil 2.g: *Sporozoa*, von Eduard Reichenow. Pp. 45-88+88. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1932.) 12 gold marks.

THE latest portion of this useful work begins with a concise and good general account of the hydrography of the North Sea and Baltic, with charts and diagrams, occupying forty-four pages. The

remaining eighty-eight pages are taken up by a treatise on the Sporozoa. Omitting the Sarcosporidia as only occurring in the muscles of land vertebrates, Dr. Reichenow divides the group into Telosporidia, Cnidosporidia and Haplosporidia. Most of the known forms belong to the Telosporidia, a fair number to the Cnidosporidia and only a very few to the Haplosporidia. Marine Sporozoa are found in various worms, especially polychætes, in echinoderms, molluscs, crustaceans and tunicates, besides several in fishes. The author wisely places in his lists many species which have not yet been found in the area dealt with, but as they occur in the Mediterranean, parts of the English Channel and the west of Scotland, the distribution may easily extend farther and their inclusion adds much to the value of the work. This also applies to the general account of the structure and biology which covers all these species and not only those so far found in the North Sea and Baltic. Good descriptions and figures are given and the life-histories of many forms are illustrated.

The whole group is extraordinarily interesting and one in which there is still a large amount to be still discovered. Among the Haplosporidia is the unusual case of a sporozoon (*Anurosporidium pelseeneeri*) contained in trematode sporocysts of two genera which themselves parasitise the mollusc *Donax trunculus*.

A Manual of Clinical Laboratory Methods. By Dr. C. L. Cumber. Third edition, thoroughly revised. Pp. xx-17-585. (London: Henry Kimpton, 1931.) 30s. net.

THE third edition of Prof. Cumber's manual maintains the high standard of the former, and the same policy of conciseness is apparent in the new material which has been introduced. Perhaps the most important additions are the more detailed description of Kahn's reaction for the diagnosis of syphilitic infection, and a full technique for the carrying out of Kline's reaction for the diagnosis and exclusion of syphilis. Among other recently developed tests in biochemistry mentioned are the erythrocyte sedimentation rate, Ehrmann's alcohol test meal, the use of histamine as a gastric juice stimulant, and agglutination tests for tularæmia and undulant fever. The Queckenstedt test for sub-arachnoid block is described, but its interpretation is very loosely worded. The author also includes now the long-established Alzheimer method for identifying different types of cells in the cerebrospinal fluid, and the silver staining for treponemata.

This book can confidently be recommended to biochemists and laboratory workers as containing almost everything required for routine work. For the next edition the author might consider including details of blood calcium estimation, and possibly methods of estimating phosphate and lecithin in the blood. For blood cholesterol, also, an all-glass method of percolating the thimble is preferable to that still included.

Origin of Tektites

By Dr. L. J. SPENCER, F.R.S.

SMALL, curiously shaped pieces of green, brown, or, more usually, black glass have long been known from certain regions, and have been called moldavites from the Moldau River in Bohemia and from Moravia; australites or obsidianites from Australia; billitonites from the tin-bearing gravels in the island of Billiton, Dutch East Indies; and Darwin glass from Tasmania. They have also recently been found in some abundance in French Indo-China and in the Philippine Islands. In chemical composition they are peculiar in containing a very high percentage of silica (SiO_2 , 70–89 per cent).

Many theories have been advanced to account for the origin of these bodies, which are known collectively as tektites. Those from Bohemia and Moravia were formerly thought to be relics from a prehistoric glass factory. They have been thought to be 'bombs' or bubbles shot out from volcanoes (even from volcanoes on the moon). The fusion of atmospheric dust or desert sand by lightning has been suggested. Another theory is that they are colloidal bodies formed by the action of humic acids on the underlying rock in certain climates. The view most generally accepted at the present time is that they are meteoric, although they are entirely different in all their characters from any meteorite that has been actually observed to fall.

In a recent elaborate and beautifully illustrated monograph¹ Prof. A. Lacroix gives a detailed review of the whole question. He elaborates a suggestion first made by H. Michel in 1925 that tektites have been formed in the earth's atmosphere from meteoric material consisting of the element silicon and the lighter metals (aluminium, calcium, potassium and sodium). Such material heated by friction with the air would rapidly oxidise with the production of a temperature sufficient to fuse the products of oxidation; and subsequent rapid cooling would yield a glass.

Although much has been written on the subject of tektites, the elementary fact that the material of which they are composed is really an impure silica-glass has been entirely overlooked. Pure silica-glass has a specific gravity of 2.20 and refractive index 1.46—both low values. The values for tektites are 2.27–2.51 for the specific gravity and 1.48–1.52 for the refractive index.

Now the 'cinders' of the legendary city of Wabar, 'destroyed by fire from heaven', which was discovered early this year by Mr. H. St. J. Philby in the Rub' al Khali, Arabia,² consist of such a silica-glass. The vesicular white glass contains SiO_2 , 92.88 per cent, with specific gravity 2.10 and refractive index 1.468; whilst the black glass, almost free from bubbles, contains SiO_2 , 87.45 per cent, with specific gravity 2.24 and refractive index 1.50. The black glass contains

also Fe_2O_3 , 0.28; FeO, 5.77; NiO, 0.35 per cent. At this spot pieces of meteoric iron were found, the largest rusted remnant weighing 25 lb.; and also a series of craters that must have been formed by the impact of a shower of large meteorites. When a large mass of iron travelling with planetary velocity is suddenly stopped, the kinetic energy ($\frac{1}{2}mv^2$) is transformed into heat at a localised spot with the development of a very high temperature. The 'bombs' of silica-glass collected by Mr. Philby at Wabar suggest there must have been a pool of molten silica in the desert sand and that this material was shot out from the craters through an atmosphere of silica, iron, and nickel vapours.

At the group of meteorite craters discovered in 1931 near Henbury in Central Australia³ silica-glass has also been found, but in smaller quantity and only around the largest crater. Here the country-rock is a ferruginous sandstone and the glass that resulted from the fusion of this rock is black and less pure. It contains SiO_2 , 68.88 per cent and has specific gravity 2.31 and refractive index 1.545. It also contains Fe_2O_3 , 8.46; FeO, 7.92; NiO, 0.28 per cent. Nickel is not shown in analyses of tektites, probably because it was not suspected and not looked for.

The pieces ('bombs') of silica-glass from both Wabar and Henbury present many similarities to tektites; especially to the Darwin glass from Tasmania, with which some can be matched exactly in both form and appearance. Beads and tear-shaped drops are common and there are some disc-shaped pieces, but none with the perfect button-like shape of true australites. I have been much struck with this similarity, but now that I have seen pictures of the tektites from Indo-China given by Prof. Lacroix in his monograph, I have no hesitation in concluding that tektites are not meteoric, though they are connected with the fall of large meteoric masses, but that they have resulted from the fusion of terrestrial rocks, especially in sandy deserts, by the heat so developed.

Silica-glass and tektites could, of course, be formed only in very exceptional circumstances. The fall of very large meteorites on the earth's surface is fortunately not of frequent occurrence. With the possible exception of the still debatable Siberian fall on June 30, 1908, none has in fact taken place during historic times. Further, the terrestrial rock at the place of fall must be of the right kind, such as sandstone or quartzite, or perhaps best of all a clean desert sand. The composition of tektites indicates that a certain amount of felspar, mica, or clayey material was present in the rock (arkose or siltstone); and no doubt these extra constituents (Al_2O_3 , 12; CaO, 3; K_2O , 2; Na_2O , 1 per cent) gave to the molten material just the right viscosity for it to

assume particular shapes when spinning through the air after being shot out by the gaseous explosion from the meteorite crater. The craters, supposed to be meteoric, on the Island of Oesel in Estonia are in dolomite, while the rocks in the region of the Siberian fall are basaltic. In neither of these places could silica-glass and tektites be formed.

Silica-glass is very resistant to chemical action and it will withstand weathering processes longer than many other materials. Also, with its very low coefficient of thermal expansion, it will not be affected by changes in temperature—a very potent agent of rock disintegration in desert regions. For this reason tektites are preserved in recent deposits, such as the glacial deposits of Tasmania, the alluvial deposits of Bohemia, Indo-

China, and the Philippine Islands, and in the tin-gravels of Billiton, where by slow chemical corrosion they have acquired a peculiar sculptured surface. The australites found on the surface of the Australian deserts do not show this surface sculpturing and are more perfect in form. They are therefore of more recent origin. An aerial survey of the districts where australites are found would probably reveal the presence of meteorite craters with associated large masses of meteoric iron. In the other districts, all traces of the craters would probably have been obliterated by denudation, and the meteoric iron rusted away.

¹ "Les Tectites de l'Indochine." By Prof. A. Lacroix. *Arch. Mus. Nat. Hist., Paris*, 8, 139, 1932.

² *NATURE*, 129, 932, June 25, 1932.

³ *NATURE*, 129, 781, May 28, 1932.

Recent Research on the Vitamins

ADVANCES in our knowledge of the chemistry of the vitamins have recently been so rapid that a review of the position at any moment may require correction or amplification almost as soon as it is published. A useful summary of our knowledge of the nature and function of vitamins was provided in April and May of 1932 by Prof. J. C. Drummond in his Cantor lectures.¹ Some of the points made by the author may be briefly referred to here, and opportunity taken at the same time to review work which has been published since the delivery of the lectures.

Prof. Drummond summarises some of our knowledge in tabular form: the charts showing the minimum effective doses of the different vitamins in test animals, the functions and properties of the six B vitamins, and the distribution of the vitamins in foods are specially useful. He considers first the water-soluble vitamins C and B. The work of O. and A. Rygh and P. Laland² on the antiscorbutic potency of narcotine derivatives has not been confirmed by S. Smith and S. S. Zilva³. Daily doses of 1.37, 2.75 and 5.5 mgm. of dimethyl and methylnarcotine had no protective effect in guinea pigs kept on a scorbutic diet. It is possible that the doses were incorrectly chosen as Rygh *et al.* state that only optimal doses prevent the onset of scurvy in guinea pigs on a scorbutic diet. On the other hand, the fact that all Rygh's animals given narcotine derivatives died like the controls indicates that these supplements are not acting in the same way as a daily dose of lemon juice.

Negative results have been described also by other observers, including L. J. Harris and I. Mills, who found that irradiated narcotine and methylnarcotine were not antiscorbutic in doses ranging from 10 mgm. to 0.001 mgm. daily.⁴ Zilva⁵ and his colleagues have recently published full details of their work. No narcotine could be isolated from unripe orange juice by ethereal extraction, nor was a concentrate of vitamin C obtained from lemon juice by such means. Methylnarcotine in daily doses ranging

from 10 γ to 2.7 mgm. had no antiscorbutic effect at all in guinea pigs maintained on a scorbutic diet, the experimental animals dying in 30-35 days with all the signs of severe scurvy.

Reference has already been made in these columns to the claim that vitamin C is a hexuronic acid⁶. The experiments on which the claim is based have now been published in detail.⁷ Svirbely and Szent-Györgyi found that 1 mgm. of their product daily completely protected guinea pigs on a scorbutic diet from scurvy for 90 days: the animals also showed normal growth during this period. The minimum protective dose of lemon juice is usually regarded as 1.5 c.c. and this quantity contains approximately 0.5 mgm. of the acid. Since the substance contains a molecule of water less than is required for a hexuronic acid, Szent-Györgyi and W. N. Haworth have now suggested the name "ascorbic acid" for it (*NATURE*, 131, 24; 1933). Waugh and King have also isolated a crystalline solid from lemon juice which was protective in a daily dose of 0.5 mgm. The possible objection that the material isolated from lemon juice was merely contaminated with a more potent antiscorbutic substance is not valid in the case of the work of the former authors, since the acid used was prepared from ox suprarenal glands. If the antiscorbutic factor is ascorbic acid, it is necessary to explain Zilva's observation that it is possible to oxidise the reducing factor in lemon juice without destroying the antiscorbutic potency, although the vitamin is now very labile: Svirbely and Szent-Györgyi suggest that in these conditions the acid may be present in a reversibly oxidised state. The antiscorbutic potency of this acid has been confirmed by Harris and Mills (*loc. cit.*), who also found raw suprarenal cortex potent, the activity running parallel to the acid content.

Turning to vitamin B, Prof. Drummond reviews the work of Jansen and Donath, Otake, and Windaus and his co-workers on the chemistry of vitamin B₁.⁸ All observers now agree that the crystalline vitamin contains sulphur in its molecule, as well as carbon, hydrogen, oxygen and nitrogen.

H. W. Kinnersley, J. R. O'Brien and R. A. Peters, in a recent communication,⁹ also confirm this observation: their crystals were obtained from bakers' yeast, and the hydrochloride is active in a pigeon day dose of 2-4 γ (a pigeon day dose is approximately equal to 1.5 vitamin B₁ international units). Windaus's preparation is active on pigeons in doses of 1.4-3.3 γ : both are more active than Jansen and Donath's original preparation, which contained also vitamin B₄.

Vitamin B₁ is usually considered to be a base. Examination of a number of bases for antineuritic or growth promoting powers has, however, so far given negative results. B. C. Guha and P. N. Chakravorty have recently announced in these columns¹⁰ that irradiation of adenine sulphate with ultra-violet light confers vitamin B₁ properties upon it. In this connexion work on the absorption spectrum of vitamin B₁ concentrates has some interest: a band at 2600 A. was found by Guha¹¹, Windaus (*loc. cit.*) and others. F. F. Heyroth and J. R. Loofbourow have recently reviewed the question and reported some experiments of their own.¹² The absorption spectrum of yeast nucleic acid shows a band of maximum absorption near 2600 A., suggesting that vitamin B₁ concentrates contain purine or pyrimidine compounds. Irradiation of uracil or thymus nucleic acid increased the absorption between 2300 and 2550 A. No decrease in the absorption at 2600 A. was observed when only wave-lengths longer than 2960 A. were used for the irradiation. After irradiation, uracil and adenine develop a blue colour with arsenophosphotungstic acid, similar to that given by vitamin B₁ concentrates. Heyroth and Loofbourow found a fairly close correlation between potency and absorption at 2600 A. in the purest concentrates examined. Compounds which are likely to absorb in this region are those containing a pyrimidine-ring or those closely related to ergothioneine (betaine of thiohistidine). This suggestion is of interest in view of the fact that vitamin B₁ is now held to be a sulphur compound.

It appears likely that pure crystalline vitamin B₁, prepared synthetically, will be available in the near future, as pure crystalline vitamin D is available to-day. Meanwhile, the animal test must be the final criterion. To ensure comparable results in different laboratories, the Permanent Commission on Biological Standardisation of the League of Nations has recommended the issue and use of a fuller's earth adsorbate from rice polishings as a standard for vitamin B₁, 10 mgm. of which is defined as containing one unit. H. Chick and H. M. Jackson¹³ report on the use of this preparation. It has been found stable for a year, its vitamin B₂ content is only 1/25-1/50 of the vitamin B₁ present and it also contains vitamin B₄.

Prof. Drummond referred briefly to the recent work on the physiology of vitamin B₁ and emphasised the importance of distinguishing between the changes due to inanition and those caused by a deficient intake of vitamin B₁, *per se*. N. Gavrilescu and R. A. Peters¹⁴ have found that

the oxygen uptake of parts of the brain in pigeons suffering from polyneuritis is definitely below normal. Administration of vitamin B₁ to the birds or its addition to the minced brain tissue *in vitro* resulted in an increase in its consumption.

Prof. Drummond also summarised our knowledge concerning vitamin B₂. He considers that it is a neutral and not a basic substance, with a molecular weight greater than that of vitamin B₁.

Some recent work on vitamin B₄ may also be mentioned here. Absence of this vitamin from the rat's diet produces redness and swelling of the paws, a spastic gait and loss of co-ordination. Convulsions and paralysis are the characteristic signs of vitamin B₁ deficiency.¹⁵ H. Barnes, J. R. O'Brien and V. B. Reader¹⁶ describe the preparation of a crystalline compound with vitamin B₄ activity, having the empirical formula C₄N₄H₅Cl. It was obtained from yeast extract by adsorption on charcoal at pH 1. The charcoal was extracted with 50 per cent acid alcohol, the alcohol removed *in vacuo* and the extract subjected to successive treatments with mercuric sulphate, baryta, sulphuretted hydrogen and sodium phosphotungstate. A crystalline phosphotungstate was precipitated at pH 2 and recrystallised from 50 per cent alcohol. It was then dissolved in 50 per cent acetone, and the phosphotungstic acid removed with baryta; the acetone was removed from the filtrate, which was hydrolysed with 5 per cent hydrochloric acid: the solution was concentrated and alcohol and ether added. Crystals were deposited, with melting point 248° (with charring).

Although highly potent preparations of vitamin A have recently been obtained, it has not been found possible to crystallise them. Prof. Drummond refers to the recent work of Karrer, Morf and Schopp, suggesting that vitamin A is an unsaturated alcohol, having the empirical formula C₂₀H₃₀O or C₂₂H₃₂O, its structure being related to half the carotene molecule.¹⁷ I. M. Heilbron, R. A. Morton and E. T. Webster¹⁸ have confirmed this suggestion. A concentrate was heated with finely powdered selenium at 300°-330° for 48 hours, and the product extracted with ether. After removal of the solvent, the oil was distilled over metallic sodium; the fraction distilling at 120°-200°/20 mm. was treated with picric acid, when the orange crystals of 1:6-dimethyl naphthalene picrate were obtained.

I. M. Heilbron, R. N. Heslop, R. A. Morton, E. T. Webster, J. L. Rea and J. C. Drummond¹⁹ have described the properties of the most concentrated preparations of vitamin A, which they have recently obtained from halibut liver oil. The unsaponifiable fraction was obtained, freed from sterols and fractionally distilled at a pressure below 0.00001 mm. The main fraction distils at 137°-138°, with increase in potency. It is a pale yellow viscous oil which becomes mobile on warming, and is readily soluble in organic solvents; at 3280 A. $E_{1\text{cm}}^{1\text{ per cent}} = 1,350$ and the Carr-Price

blue value is about 65,000. The analytical figures agree fairly well with those required for the formula $C_{20}H_{30}O$. Similar concentrates were prepared from sturgeon liver oil and mammalian liver fat, but the best material obtained from cod liver oil was only about half as pure. Biological tests on rats showed that daily doses of 0.025–0.1 γ cured xerophthalmia and promoted growth.

The antimony trichloride test indicates that these concentrates still contain variable quantities of a substance which is chromogenic but is different from vitamin A itself. The blue colours obtained with sturgeon and halibut liver oil concentrates show an absorption band at 6930 A. the intensity of which is usually a quarter of that of the band at 6170 A. but in halibut concentrates may be only one-tenth; moreover, no selective absorption was observed at 6930 A. in mammalian concentrates. Morton²⁰ has found that the addition of 7-methylindole to the concentrate inhibits the development of the band at 6170 A. before that at 5830 A. is appreciably affected. In the richest concentrates the intensity of the band at 6170 A. is almost twice that of the band at 5830 A. If 7-methylindole is added to the concentrate in the ratio 4:1 (or 10 mol. to 1 mol.) the two bands appear of roughly equal intensity. The band at 6930 A. is not readily inhibited by this reagent. The independence of the two bands at 6170 A. and 5830 A. indicates either that two chromogens are present or that vitamin A reacts with antimony trichloride in two stages.

Reference has already been made in our columns to the possible correlation between the biological test and certain of the chemical and physical characteristics of oils containing vitamin A.²¹ Another series of cod liver oils has now been examined and further tests have been performed on some of the previous series.²² The variations between the different methods were greater than in the earlier series of tests, but it still appears that the intensity of the band at 3280 A. in the oil itself forms the best measure of its biological activity. The antimony trichloride test was not so satisfactory, although in the case of certain oils, when it was carried out on the unsaponifiable fraction of the oil, a correlation was found between the blue value and the biological activity. The biological tests had a large margin of error. It was found advisable to compare a sample with the standard oil in simultaneous tests rather than to rely exclusively on the curve relating growth to dose given obtained with the standard oil at some earlier date.

R. J. Norris²³ has also noted marked discrepancies between the biological and colorimetric methods of assay. The course of the inactivation of vitamin A by irradiation with ultra-violet rays was also followed. An initial latent period was found by biological test but not colorimetrically; after four hours' irradiation, all the vitamin had been destroyed, but the colour test indicated that the potency had only been reduced about 25 per

cent. The destruction of the chromogen follows the course of a bimolecular reaction.

The discrepancies may be explained in part by the error of the biological test and by the presence in oils containing vitamin A of substances which interfere with the development of the blue colour in the Carr-Price test or with its determination. R. S. Morgan²⁴ has found that the presence of any red in the colour estimated reduces the value of the blue.

The details of the conversion of carotene to vitamin A in the animal body are as yet unknown. The absorption of carotene from the intestine is a slow and incomplete process; it is apparently related to the fat content of the diet. Small amounts may be found in the liver, but it appears that the bulk of the absorbed material is stored in that organ in the form of vitamin A.²⁵ The conversion presumably occurs in the liver, but Ahmad was unable to confirm the observation of Olcott and McCann that this organ contains an enzyme which converts carotene into vitamin A *in vitro*. When the diet is rich in carotene, the vitamin A stores in the liver are high. The stores are utilised when the diet is deficient in carotene or the vitamin, but the exact function of the latter in metabolism is unknown. W. J. Dann has shown that it is only with difficulty passed into the mother's milk, so that to build up a store in young animals it is necessary to give it directly to the latter²⁶; also in the rat, at least, very little reaches the young via the placenta. The failure of growth on a vitamin A deficient diet is not entirely due to loss of appetite. Rats on this diet may consume as much food as their litter mate controls given a supplement of vitamin A, but the amount of nitrogen deposited in the body is less and the amount excreted in the urine greater than in the latter, indicating an increase in the nitrogen metabolism. The increase of body-weight per gm. of food eaten is less when the animal has not available an adequate amount of vitamin A.²⁷ Vitamin A is apparently necessary for the deposition of body tissue. It is well known that certain epithelial surfaces cannot maintain their proper structure when the animal's stores are depleted, with the result that infectious processes develop in different regions of the body. Thus both the growth-promoting and the anti-infective properties of vitamin A appear to depend fundamentally upon its ability to maintain a normal structure in the different tissues of the organism.

The story of the isolation of crystalline vitamin D is now well known and has been referred to previously in these columns.²⁸ Prof. Drummond reviews the different investigations leading to its isolation in his third Cantor lecture and also refers in considerable detail to Mrs. Mellanby's work on dental caries, which has also been described in NATURE²⁹. With the preparation of the pure vitamin, biological tests have become of less importance; the earlier production of highly active compounds and their use in clinical practice led, however, to a great increase in the number

of such tests required, with the result that methods were standardised and their accuracy increased. We have already referred to the analysis of the curative radiographic method given by Bourdillon and his colleagues.³⁰ Working with Miss Bruce, he has recently completed a comparison of the prophylactic radiographic method with that based on bone analysis.³¹ A radiographic scale was prepared showing eight stages from full rickets to normal bone. The relation between scale reading and logarithm of the dose was not linear. With bone analysis, on the other hand, the relation between percentage of bone ash and logarithm of dose was linear between doses of 0.03 and 0.32 unit vitamin D. An analysis of the errors of the different methods leads the authors to the following conclusions: the accuracy attainable is greater with bone analysis than with the use of a radiographic scale, using the prophylactic method, and the range of doses possible is greater; but the method of bone analysis has about the same degree of accuracy as the radiographic when the curative method of dosing is used in the latter instead of the prophylactic. The radiographic method is, of course, much the quicker and more animals can be used for each test. The authors also consider that the chief variations in the sensitivity of a stock fed on a supposedly constant diet are due to some factor other than vitamin D.

The method of bone analysis (with prophylactic dosing) is considered in greater detail by E. M. Hume, M. Pickersgill and M. M. Gaffikin.³² The linear relationship between percentage of ash in the bones and the logarithm of the dose is only observed when eight or more animals are used on each dose. The exact position of the line depends on the severity of the rickets developed by the animals. The increments for percentage ash are smaller in the less rachitic series of rats, so that the straight lines of the graphs tend to converge to the point 54 per cent ash and 5 units dose.

Analyses of the 'line' test have been carried out by K. M. Key, B. G. E. Morgan and R. S. Morgan,³³ whilst the former authors and K. H. Coward have examined the possibility of using the growth-promoting property of vitamin D in its quantitative determination.³⁴ Key and Morgan constructed curves relating degree of healing to dose given, using Dyer's scale to assess the degree of healing. This scale is similar to the radiographic scales but has only six stages. Different curves were obtained in accordance with the different degrees of rickets which may be developed by the animals of different experiments. It is recommended that three reference curves be constructed, for slight, moderate and severe rickets respectively, for use in the assay of preparations for their vitamin D potency. The curves were used in an examination of the effects of changing the ratio of calcium to phosphorus in Steenbock's rachitogenic diet: changing the ratio from 4:1 to 2:1 was equal

in effect to a daily dose of 0.7 unit of vitamin D. A knowledge of the effects of changing this ratio may be required when it is necessary to test food materials containing these elements for their content of vitamin D. R. S. Morgan measured the area of calcification in the 'line' test with the planimeter and found that the degree of healing was strictly proportional to the logarithm of the dose between 0.125 and 1.0 unit. Doubling the dose increased the area of calcification by 59 sq. mm. using a magnification from line to drawing of 11 diameters. With 10 pairs of rats, the probable error of a test is ± 7 per cent: this is less than with the radiographic method since the error in the diagnosis of healing is eliminated. The chief source of error is the variable response of litter mates to a given dose.

It is of interest to note that Coward, Key and Morgan found that there is also a linear relationship between the growth response of rats and the logarithm of the dose given. The animals were kept on the standard vitamin A-free diet without vitamin D. Vitamin A was supplied in the form of carotene. The growth method gives the same results as the line test, but is more laborious and probably less accurate. The growth response to vitamin D is less than that to vitamin A on the same diet.

In conclusion, it may be mentioned that Prof. Drummond considered some of the illnesses which may result from a deficient intake of the different vitamins. It is difficult to estimate how far minor disorders may be due to this cause in Great Britain to-day. It would be of great interest to carry out a dietary survey, on the lines of previous surveys dealing with the protein, fat and carbohydrate intake, but investigating the consumption of vitamin-containing foods, so that the vitamin requirements of the population might be more accurately estimated.

¹ *J. Roy. Soc. Arts*, **80**, 949, 959, 974 and 983; 1932.

² See also *NATURE*, **129**, 283; 1932.

³ *Chem and Ind.*, **51**, 166; 1932.

⁴ *Lancet*, (2), 235; 1932.

⁵ R. L. Grant, S. Smith and S. S. Zilva: *Biochem J.*, **26**, 1628; 1932.

⁶ *NATURE*, **129**, 576, 690, and 943; 1932.

⁷ J. L. Svirbely and A. Szent-Györgyi: *Biochem. J.*, **26**, 865; 1932; W. A. Waugh and C. G. King: *J. Biol. Chem.*, **97**, 325; 1932.

⁸ See also *NATURE*, **129**, 161; 1932.

⁹ *J. Physiol.*, **76**, 17P; 1932.

¹⁰ *NATURE*, **130**, 741; 1932.

¹¹ *Biochem. J.*, **25**, 931; 1931.

¹² *Bull. Basic Sci. Res.*, **3**, 237; 1931: **4**, 35; 1932.

¹³ *Biochem. J.*, **26**, 1223; 1932.

¹⁴ *Biochem. J.*, **25**, 1397 and 2150; 1931.

¹⁵ V. Reader: *Biochem. J.*, **24**, 1827; 1930.

¹⁶ *J. Physiol.*, **75**, 8P; 1932.

¹⁷ See also *NATURE*, **129**, 88; 1932.

¹⁸ *Biochem. J.*, **26**, 1194; 1932.

¹⁹ *Biochem. J.*, **26**, 1178; 1932.

²⁰ *Ibid.*, 1197.

²¹ *NATURE*, **129**, 514; 1932.

²² K. H. Coward, F. J. Dyer, and R. A. Morton: *Biochem. J.*, **26**, 1593; 1932.

²³ *Bull. Basic Sci. Res.*, **3**, 89 and 249; 1931.

²⁴ *Biochem. J.*, **26**, 377; 1932.

²⁵ T. Moore: *Biochem. J.*, **25**, 275; 1931: B. Ahmad, *Ibid.*, p. 1195.

²⁶ *Ibid.*, **26**, 1072; 1932.

²⁷ M. M. Sampson, M. Dennison, and V. Korenchevsky: *Biochem. J.*, **26**, 1315; 1932.

²⁸ *NATURE*, **129**, 178; 1932.

²⁹ *NATURE*, **129**, 83; 1932.

³⁰ *NATURE*, **129**, 514; 1932.

³¹ R. B. Bourdillon and H. M. Bruce: *Biochem. J.*, **26**, 506; 1932.

³² *Ibid.*, 488.

³³ *Biochem. J.*, **26**, 196; 1932: and R. S. Morgan: *Ibid.*, 1144.

³⁴ *Ibid.*, 1585.

Obituary

MR. C. F. BEADLES

CECIL FOWLER BEADLES, pathological curator of the Hunterian Museum at the Royal College of Surgeons, whose death at the age of sixty-six years occurred on January 3, received his medical education at University College and Hospital, London, where he gained honours in histology. In 1890 he obtained his diploma and afterwards passed two years as senior house surgeon at the Cancer Hospital; there he was enabled to perfect himself in microscopical technique and pursue the study of pathological anatomy, the branch of medical science towards which his natural inclination turned.

Mr. Beadles's subsequent career falls into three periods defined by the posts which he successively occupied, namely, those of assistant medical officer at the London County Asylum, Colney Hatch, assistant to Prof. Shattock, then curator of the Hunterian Museum, and finally pathological curator of the Museum. While at the London County Asylum, he was constantly engaged in scientific studies relating both to mental disease and to pathological anatomy generally. Most of his published works at this time were contributed to the *Transactions of the Pathological Society*, which contain no less than forty-five papers from his pen. He communicated a few papers to the Medico-Psychological Association, of which he was a member and from which he received a prize and bronze medal in 1894 for a dissertation on degenerative lesions of the arterial system in the insane. He interested himself particularly in the vascular supply of the brain, the anatomical variations and anomalies of which he considered might have a bearing on mental disease and on the clinical signs of such conditions as embolism.

The results of Mr. Beadles's researches in this direction were embodied in the Hunterian lecture which he delivered at the Royal College of Surgeons in 1907-8. He contemplated writing a book on the subject which should include the literature, and he collected a great number of extracts from British and foreign sources for this purpose. However, the War intervened and his subsequent ill-health prevented him from resuming the work.

In 1909 Mr. Beadles became assistant to Prof. Shattock, who was then engaged on the revision of the pathological catalogue of the Hunterian Museum, and he continued to be connected with the Museum up to the time of his death, a period of more than twenty years. At the outbreak of the War he was appointed, under Government, to deal with the pathological war material which was accumulated at the Royal College of Surgeons. This was an arduous undertaking involving the examination, preparation, and dissection of a vast number of specimens, their selection to form a fully illustrative series of the injuries and diseases incidental to warfare, their mounting and suitable

display. The collection thus formed now constitutes a separate and important section of the Hunterian Museum, consisting of about three thousand specimens; and it will remain as a standing memorial to the honour of Mr. Beadles.

The final period of Mr. Beadles's career, that of the curatorship, is mainly one of steadily declining health. When he succeeded to Prof. Shattock in 1925 he was already afflicted with bronchial and pulmonary trouble. The commencement of this he considered to have dated from the time of his work on the war material, and it is quite possible that the inhalation of the vapour of formalin to which he was constantly exposed at that time was responsible for his illness, although his ill-health was aggravated by other complications. His untiring energy and devotion to museum work, however, did not desert him even to the end, although the work became an obvious burden.

Mr. Beadles was a pure pathological anatomist of a type now gradually disappearing amid the experimental tendencies of the time. He was entirely absorbed in his subject, beyond which he had but few interests, and he lived a life of absolute seclusion. The well-merited honour of the fellowship of the Royal College of Surgeons was conferred upon him shortly after his promotion to the curatorship.

PROF. R. DONALDSON

PROF. ROBERT DONALDSON was a man of very great culture. Before commencing his medical studies, he took an arts course in the University of Edinburgh and graduated M.A. in 1899. In 1904 he obtained his M.B., Ch.B., and the same year received the diploma in tropical medicine. He gained his fellowship of the Royal College of Surgeons of Edinburgh in 1908, the diploma of public health in 1912, and his M.D. degree with honours in 1918.

Donaldson commenced his pathological career as assistant with me in the University of Sheffield. From there he went as assistant to Prof. Walker Hall in the University of Bristol. Later he was appointed pathologist to the Royal Berkshire Hospital, Reading, where, during the War, he was specialist officer in charge of the laboratory. From Reading he went to St. George's Hospital as lecturer in pathology and in forensic medicine, and in 1928 he was appointed to the Sir William Dunn chair of pathology tenable at Guy's Hospital.

Dr. Donaldson took a very active part in research work, and his knowledge of modern languages was a great help to him. The mass of routine work which falls to the lot of a lecturer and professor in departments which are inadequately staffed—and this seemed always to be Donaldson's lot—limited his output of published work; but his knowledge of the subject which he taught—and he was a great teacher—is evidenced in his excel-

lent book on morbid anatomy, of which the second edition appeared only last year.

Dr. Donaldson had wide interests outside his department. He was a Scot with all the keenness for knowledge which is so characteristic of his countrymen. He loved his native land, and he had a wide knowledge of its customs, its songs and its language. His wanderings in the Highlands and Islands inspired him to learn Gaelic. He was a man of deep religious convictions, and his home life was an inspiration to many. Those of us who knew him regarded him as a great pathologist and teacher, we welcomed him as a colleague, but we loved him as a man, and, as one of his greatest friends has said of him, "Allied to a keen analytical intellect was a heart of the warmest emotions". To his wife and his two daughters we tender our heartfelt sympathy.

J. M. BEATTIE.

DR. MALCOLM E. MACGREGOR

It is with regret that we have to record the death at the early age of forty-three years of Dr. Malcolm Evan MacGregor, who was in charge of the Wellcome Entomological Field Laboratories at Esher, Surrey. Born in South Africa, he studied at Cambridge and later as a Carnegie fellow at Harvard, where he came under the influence of Dr. L. O. Howard, and decided to study the medical aspects of entomology. He first came into prominence during the War when he served with the R.A.M.C. in East Africa in connexion with mosquitoes and other insect carriers of disease. From East Africa he was invalided home, and on recovery was placed in charge of a War Office Research Laboratory at Sandwich to study mosquitoes in their relation to the spread of malaria

in Great Britain from returned soldiers carrying the disease.

After the War, MacGregor took charge of the Entomological Field Laboratory founded by Sir Henry Wellcome. Here he continued his studies of mosquitoes, particularly with the view of solving some of the fundamental problems underlying their mode of life, feeding, hibernation and reproduction. For a period, these researches were interrupted by a visit to Mauritius on behalf of the Colonial Office, to study the mosquito-malaria problem. A valuable report was the result, and it was shown that a second important malaria-carrying mosquito occurred in Mauritius, namely, *Anopheles funesta*, which had been overlooked both by Sir Ronald Ross and Sir Andrew Balfour during their visits to the island.

On his return to England, MacGregor resumed his mosquito studies. He showed that the diverticulum, a sac which opens into the oesophagus of the mosquito, is a kind of reservoir into which the mosquito can direct at will or by reflex action fluids unsuitable for the stomach. He studied the extraordinary effect of ultra-violet rays on the larvæ, the various reactions of waters in which they occurred, and strove to establish the fact that the larvæ of culex and anopheles mosquitoes live in waters of different but particular hydrogen ion concentration. Latterly, he had been studying a so-called autochthonous race of *Culex pipiens*, a race which is able to complete its life-cycle without any blood meal and does not hibernate.

MacGregor's death at the height of his scientific career is nothing short of a tragedy, inflicting a serious loss upon the science of medical entomology. He was the author of numerous scientific papers dealing with the subjects of his particular study, and of a book entitled "Mosquito Surveys".

News and Views

Gold in Kenya and Native Reserves

THE memorandum issued by the Colonial Office on the position in Kenya in relation to the leasing of lands in native occupation on native reserves for mining purposes cannot be regarded as satisfactory. It affords no guarantee that the more objectionable consequences of the amendment of the Ordinance will not ensue. For example, while admitting that "the matter of immediate importance is to ensure that any individual native . . . shall receive compensation and an alternative piece of ground on which he may live and work in proximity to his market", it states that the Governor "does not contemplate any difficulty in providing individual dispossessed natives with land". But when the amendment was introduced, and also when it was discussed in the House of Commons, it was stated definitely that the reason for payment of a money compensation was that land could not be provided for all the natives who, it was anticipated, would be dispossessed. Nothing is said of the terms of

tenure of the land on which the dispossessed natives will be settled, a matter of the first importance in tribal organisation, as has already been pointed out in NATURE.

THE Chief Native Commissioner himself, in introducing the amendment, stated that the natives would not lease their lands voluntarily and that their "most sacred traditions" would be violated by "removal from their own land on which they had the right to live, and setting them up on another piece, the owners of which had the right to eject them". No attempt is made to meet this difficulty. As the explanatory memorandum issued to natives had been circulated before the Chief Native Commissioner made his statement, it is therefore to be presumed that it did not assuage native feeling in this matter. Yet every anthropologist is well aware that it has been through neglect of susceptibilities of this character that our Colonial administrations have been involved in innumerable difficulties and

even, in some instances, in native risings. The small area which may be required on any given holdings, and the temporary character of the exclusion, both points which are stressed, are irrelevant. There are other points in which the memorandum of the Colonial Office falls short in facing the difficulties of the situation. These cannot be discussed within the compass of a brief note; but it is evident that further deliberation is a vital necessity.

George Edwards, F.R.S.

AN illustrated article by Mr. T. E. James in the first quarterly issue of *Science Progress* for 1933 recalls the work and interests of George Edwards, an eighteenth century naturalist (1694–1773) and Copley medallist in 1750 of the Royal Society. Edwards was made library-keeper of the Royal College of Physicians in 1733, on the recommendation of Sir Hans Sloane, its president, remaining in office at Warwick Lane for thirty-six years. During that period he devoted himself to the portrayal in colour of birds, quadrupeds and fishes (mostly new to science) from actual specimens. The Linnean Society has recently received from Major V. Seymer a set of Edwards's works, containing annotations and memoranda by a contemporary and correspondent of Edwards, namely, Henry Seymer, of Hanford, Dorset. It may be of interest to mention that the Linnean Society already possessed copies of Edwards's works, these having originally belonged to Joseph Grote, a collector of rare books on natural history and botany. At his death in 1805, his brother inherited his property, and ultimately the books, with many fine engravings, passed into the ownership of George Grote, the historian. His widow gave the greater portion of the collections to University College, London. Mrs. Grote reserved, however, the works by Edwards, but in 1877 placed them at the disposal of Sir Joseph D. Hooker, whom she designated as "the worthy and distinguished president of the Royal Society". In the end, Sir Joseph gave the books to the Linnean Society.

Arthur Woolf, 1766–1837

ONE of the most interesting chapters in the history of the steam engine is that relating to the Cornish pumping engine. Early in the eighteenth century, Newcomen engines were installed for pumping at the Cornish mines, and in 1777 these began to be superseded by the low-pressure condensing engines of Boulton and Watt, which required much less coal. While the mines gained greatly by the use of the latter, the all-embracing patent of Boulton and Watt prevented other inventors from putting their ideas into practice. The expiry of this patent in 1800 was a boon to the whole county and through the work especially of Woolf and Trevithick, the pumping engine of the nineteenth century proved as superior to the Boulton and Watt engines as the latter had been superior to the Newcomen engines. Of Trevithick's work a great deal will be said at the forthcoming centenary celebrations, while of Woolf's work a review was given in a paper entitled "A Cornish Engineer, Arthur Woolf, 1766–1837", read

to the Newcomen Society by Mr. Rhys Jenkins on January 18. The first great improvement due to Woolf and Trevithick was the use of steam pressures up to 40 lb. per sq. in., while Woolf was one of the pioneers of the compound engine. Like all their contemporaries, these engineers worked at a time when the caloric theory still held sway, and they were quite ignorant of the true theory of heat. Carnot, however, in his famous essay of 1824, referred to Trevithick and Woolf as being among the veritable creators of the steam engine, and it is as such they will be remembered.

British Science Guild Research and Development Lecture

THE Council of Management of the British Science Guild, at a meeting held on January 19 last, decided to establish an additional lecture to be known as the Research and Development Lecture. The main object of this annual lecture, which will be delivered in London in April or May, is to promote attention to the importance of research—both purely scientific and technical—and the utilisation of its results in the service of mankind. The increase of knowledge thus secured has direct relationship with industrial development, the daily needs of the community, economic principles and social problems, human welfare and progress as well as methods of thought and the trend of civilisation. Each lecturer will be asked to select from his own particular field suitable examples of contacts with any of these factors of progressive thought. In establishing the lecture, the British Science Guild associates it with the name of Sir Richard Gregory and his work as editor of *NATURE* in securing increased recognition for scientific work and scientific workers in national life and in international affairs. The first of these research and development lectures will be given in May by Sir Harold Carpenter on "Metals in Industry".

Papal Observatory in Castel Gandolfo

HIS HOLINESS POPE PIUS XI has shown himself a frequent patron of science. On the occasion of the official opening of the new academic year at the Papal Academy of Science, in the presence of the Pope, Dr. Joh. Stein, S.J., who has succeeded the late Father Hagen as director of the Papal Observatory, announced, as reported in the *Osservatore Romano* of December 19–20, that the Papal Observatory is to be moved from the Vatican to Castel Gandolfo, where it is to be rebuilt on a much larger scale. Castel Gandolfo is an old summer residence of the Popes, which has been returned to them by the Italian Government according to the terms of the Lateran Treaty and is being thoroughly restored. Joined to this historic building, a new observatory with the most modern equipment is to be constructed at the Pope's instructions, with easy access from the State apartments for his convenience during his summer visits to Castel Gandolfo. The contract for the supply of the instruments has been placed with Messrs. Carl Zeiss, Jena. The equipment includes two domes of about 8½ m. diameter, a large double astrograph with a 400 mm. refracting and a 600 mm. reflecting camera, a

co-ordinate measuring apparatus, a spectrograph, several objective prisms, a Blink comparator and an astro-wedge-photometer, as well as a new refractor-mounting for an existing telescope objective. The domes will each be equipped with an observation platform of the latest type, the so-called tilting platform, which is moved by electric motors controlled by switches within easy reach of the observer. On these sliding platforms the observer can easily follow any movement of the telescopes. The instruments and apparatus are to be supplied within two years.

Crystals of the Living Body

THE first Friday evening discourse of the new session was delivered at the Royal Institution on January 20 by Sir William Bragg, who chose as his subject "The Crystals of the Living Body". Growth and purpose require directed arrangement of the protein or other molecules of which the body is made. The protein of a silk fibre is a long chain-like molecule consisting of a sort of backbone in which two carbon atoms and one nitrogen make the regularly recurring links, and this structure is common to the various forms of protein. Of every pair of carbon atoms one has, so to speak, a spare hook to which other atoms or strings of atoms may be attached, like pendants to the links of a mayor's chain. In the case of silk these pendants are very simple, consisting alternately of a hydrogen atom and a group containing one carbon and three hydrogens. The new methods of X-ray analysis enable us to prove the arrangement of these chains, and to measure the dimensions of the links. They show that the chains tend to group themselves into bundles, and they find the forms which the bundles take. This arrangement is obviously appropriate to the functions of the silk fibre, to its flexibility and its tenacity. The fibre is spun, in fact, just as we spin a rope on a far grosser scale, laying the vegetable fibres side by side. Such a parallelism is no surprise, for in all our examinations of organic substances in the laboratory, physical, chemical, or biological we have always found that our best practice is foreshadowed. A particularly interesting comparison can be made with the structure common to hair, wool, horn, feathers and the like. These are built on the same principle as the other proteins, from which they differ only in the nature of the pendants. The latter in this case attract each other strongly, and in drawing together give the chain a wavy or crumpled form: the process has lately been explained by Astbury. The in-curved proteins, with their internal attractions satisfied, are not susceptible to many reagents which bring about the dissolution of proteins of the extended form. Thus hair long outlasts other parts of the body in their decay.

Synthetic Sound Films

ACCORDING to a report in the *Times* of January 11, an interesting curiosity has been on exhibition in Germany in the form of a sound film "Die Tonende Handschrift" in which the sound part was originally prepared without the use of sound. Details are not

available but from the illustrations it appears that the film uses the contour method of sound recording in which a constant density of blackening is produced over varying widths of the film. Normally this is produced by light reflected on to the moving photographic film from an oscillograph operated by electric vibrations transformed from the original sound vibrations. Herr R. Pfenninger in the new process makes templates each containing several sound waves and photographs a reduced image of these in turn on to the stationary film. Both the preparation of the templates and their photographing naturally take much longer and the object is not to reproduce graphically the tones of well-known musical instruments but to construct music of new timbre. The report states that the laboriousness of preparing the templates is to be reduced by the use of a typewriter which uses wave-outlines instead of letters, a separate sound-wave typewriter being used for each timbre. It would be interesting to know if the characteristic wave-forms of singing or string playing of exceptionally good quality could be successfully copied so as to give reproductions of melodies which had not been actually performed. This might make possible the performance of a new musical work by the voice, or playing, of an artist no longer living.

Migration from and to Great Britain

A PAPER by Mr. H. Leak and Mr. T. Priday on the subject of migration from and to Great Britain was read at a meeting of the Royal Statistical Society on January 17. Factors affecting post-War migration, of which the chief are social insurance, national assistance to emigrants, and the United States quota system, were fully considered and also the main features of post-War migration, particularly in regard to the inter-censal period 1921-31. A comparison of pre-War and post-War migration shows that the annual average of the net outward movement of British subjects from the British Isles to places out of Europe was about 193,000 in the ten years 1904-13 and 112,000 in the years 1921-30. In 1931, however, there was a change from net emigration to net immigration, the excess inward in that year amounting to 37,000, while for 1932 the figure is estimated to be about 50,000. Although, in the future, emigration may be on a considerably smaller scale than in pre-War days, it may still, within the next one or two decades, be on a scale commensurate with the ability of Great Britain to release population of the ages which the Dominions require, regard being had to the diminishing numbers of new entrants into the labour market.

Anomalous Eskimo Vertebrae

SOME suggestive results, which may possibly turn out to have a bearing on the question of the existence of evolutionary tendencies in modern man, emerge from an examination by Dr. T. D. Stewart, of the Smithsonian Institution, Washington, D.C., of skeletal material brought back by one of the Institution's recent expeditions to Alaska. The material consists

of some two hundred Eskimo skeletons, which were obtained by excavation. Dr. Stewart's observations point to the possibility that they may prove an exception to the generally accepted view that the human body has attained a high degree of specialisation, which shows little tendency to vary. Approximately 12 per cent of these Eskimo skeletons have 25, instead of the normal 24, presacral vertebrae. The anomaly is present in nearly sixteen per cent of the males, but in only less than one per cent of the females, and it is considerably more frequent in skeletons secured north of the Yukon. In a preliminary report on these results, which has been issued by the Smithsonian Institution, it is pointed out that this frequency is nearly twice as much as the maximum previously recorded among the northern Eskimo. Among Europeans it runs to only 3-6 per cent; but one study notes 7 per cent among the Japanese. In the material examined by Dr. Stewart, the tendency seems to be towards a lengthening of the spinal column from the sacrum. There is no variation in the cervical vertebrae to show a tendency towards the lengthening of the neck. The predominance of the anomaly among males is held to give some indication of a hereditary character. Dr. Stewart's material will appear in full in the *American Journal of Physical Anthropology*.

Research Work of the Metropolitan-Vickers Electrical Co. Ltd.

NOTWITHSTANDING the industrial depression the activities of the Research Department of Metropolitan-Vickers have not been in any way curtailed. The research on the properties of steel at high temperatures is being continued, particular attention being paid to an examination of the combined influence of time and temperature on the changes of physical properties. The investigations of carbon steels have raised difficult problems in connexion with carbide spheroidisation as well as the obscure phenomenon of embrittlement shown by some of them. The results already obtained have been useful in determining suitable working stresses in advance of present practice. The general problems of the corrosion of metals and methods for their protection have been under continuous investigation. Experiments have been made on the corrosion of aluminium alloys when in contact with beverages and food stuffs. The importance of studying engineering noise problems is shown by the fact that the acoustics laboratory has been more than doubled in size. Using the methods of continuous evacuation developed in the Metropolitan-Vickers laboratories, rapid progress has been made in the technique required for the production of high vacua and its many applications to engineering problems. An X-ray set specially adapted for studying engineering problems has been developed and standardised and is now on the market. Progress has been made in inventing methods of protecting zinc and zinc base alloys by means of electro-deposited coatings. Special solutions have been discovered for cleaning, pickling and plating base metals of this kind. Accelerated corrosion tests have been devised

which enable the protective value of different thicknesses of deposit to be rapidly determined.

Tariff of Electricity Supply

THE Central Electricity Board in conjunction with the National Consultative Technical Committee has prepared a form of tariff laying down the principles under which electricity will be supplied directly to authorised undertakings. This form of tariff applies to the whole of the supply given to undertakings which do not own 'selected' stations. It applies also to that part of the supply to selected stations which they do not generate for themselves. The new tariff consists of three parts. The first is a service charge in respect of each point of connexion to the grid, the second a fixed annual power charge based on the maximum demand for power during the year at each point of connexion, and lastly, a running charge for each kilowatt hour supplied. No service charge is made for the first point of supply. The kilowatt charge is based on the maximum demand for the year. This maximum demand is taken to be twice the largest number of kilowatt hours supplied during any half-hour in the months of January, February, November and December. This tariff has been agreed with the District Committee for mid-east England and the central Scotland tariff will be decided shortly. The tariff system, although at first sight complicated, is based on sound principles and should prove practical. Various modifications have to be applied when the energy supplied is less than the product of the volts and amperes, that is, when the power factor of the load is low. The application of the Act has necessitated the evolution of instruments which will measure both kilowatts and kilovolt amperes respectively. Accurate instruments of this type are now available. It will be interesting to see the magnitude of the reductions in price to the consumer in mid-east England.

Restoration of Prosperity to Transport

AT the present time the industry of transport seems to be far from flourishing. In the aggregate, statistics show that road, rail, air and water transport are losing money. We welcome therefore the paper by W. Rees Jeffreys, chairman of the Roads Improvement Association, on transport problems of the Empire, which was read to the Royal Society of Arts on November 29. He takes a world-wide view of the whole problem, pointing out some of the causes of the depression and making many helpful suggestions. All forms of transport are the servants of the community. They serve trade and industry, and so long as they are serviceable they are entitled to a fair remuneration. They are not entitled to place a burden upon trade or industry by excessive charges or by dictating to the producer and the manufacturer what kind of transport he shall employ. Anti-road transport legislation within the Empire for the purpose of protecting State investments in railways has failed to bring prosperity to the railways concerned. Railway finance has often failed because

it proceeded on the assumption that railways are permanent and can always be made profit-earning by regulating rates. In Great Britain, road finance has proceeded on sounder lines, as highway expenditure has been met largely out of current expenditure. The ill-conceived legislation which has introduced rigidity into railway rates, wages, hours and conditions of labour has hindered progress to recovery. Co-operation between all kinds of transport is necessary, and rigidity is fatal to it. The closing down of non-paying railways and their conversion into roads should be encouraged. In the discussion, Mr. C. Erlund stated that an enormous saving could be effected so far as goods are concerned, by electrifying several of the main-line railways. This makes electrification a far more attractive proposition than it appears in the Weir Report.

A Modern Japanese Power Station

SINCE the inception of the Kyushu Hydro-Electric Railway Co. Ltd. about twenty years ago, the policy of using steam power in Japan as distinct from hydro-electric power has thoroughly justified itself. A description is given of their new 50,000 kilowatt steam generating station, in the *Metropolitan Vickers Gazette* for October. It was completed in September 1931 having taken little more than a year to construct. The total cost of this station is much lower for its output than any station previously built in Japan. The main buildings are heavy steel structures designed with a view of resisting earthquakes and the walls of the building are of corrugated sheet steel. The chief coal supply is transported by land, the power station being quite close to the main railway line. Special arrangements have been made to minimise the labour and time involved in handling coal. The flue gases are thoroughly cleansed before emission into the air. The larger particles of grit are caught in mechanical collectors and the fine dust and fumes are washed by high-pressure water sprays. The molten slag is tapped from the furnaces, broken into fine pieces by strong water jets, and removed by pump sluicing. The two steam turbine generating sets having outputs of 25,000 kw. at 11,000 volts were made by the Metropolitan-Vickers Electrical Co. Ltd. Electroflo steam instruments are used and Kent, Negretti, Siemens, Kelvin, Cambridge and Bailey boiler instruments have been installed. It is interesting to notice that power is transmitted to a substation at 22,000 volts by cables of the Emanuelli oil-filled type, paper insulated with a double sheathing of lead.

Fur-bearing Animals in Michigan

REFERENCE to some results of Dr. Ned Dearborn's investigation into the food of predatory fur-bearing animals in Michigan has already been made in these columns (Dec. 17, 1932, p. 905). The pamphlet (52 pp.) in which the results appear, initiates, with the title of *Bulletin I*, a series of publications by the School of Forestry and Conservation in the University of Michigan, which will contain for the most part the results of studies by the Bureau of Forest

Research. Conditions as regards the fur-bearing animals have changed much since the early days of colonisation, and although Michigan still ranks third amongst the States in fur production, the destruction of the forests—hard-woods and soft-woods in the north, nut-trees in the south—and the draining of the swamps, have vastly reduced the numbers of fur-bearers. It is said that the numbers are not half what they were twenty-five years ago; even the weasel (*Mustela noveboracensis*) is no longer common in many localities, and the only upland fur-bearer which has held its own is the skunk. It may seem strange that while in Britain we are engaged in a war of extermination against that new invader, the musk-rat, Dr. Dearborn should regret its disappearance with the draining of Michigan marshes for agricultural purposes. He says that in some cases marshes are now more profitable for the musk-rat fur they produce than they would be for agriculture if drained, and cites the case of a drained marsh near Athens in Calhoun County which to-day is said to be worth no more than a single crop of musk-rats would be were it still undrained. "As matters now stand," he writes, "it behoves the owners of marshes to consider well before attempting to drain them". Other conditions, other advice!

Preservation of Fossil Bones

THE difficulty of preserving fossil bones found in deposits of the later phases of the Ice Age or more recent beds is known to collectors and museum curators; often enough the bones crumble to dust after a night's exposure to the air. Much can be done by immediate attention to preserve such relics for examination and permanent exhibition, and a paper on the "Bakelite Impregnation of Fossil Bones" by H. W. Nichols and Phil C. Orr, of the Field Museum of Natural History in Chicago, ought to be widely known (*Museums J.*, vol. 32, p. 47, May 1932). In the Field Museum, most of the older impregnating materials have been tried, paraffin, glue, gum arabic, shellac, wolfit and several mastics. In some respects these are all deficient. Of the older materials, shellac was found to be the most satisfactory, but Dr. Case's bakelite process is better than any other. Broken bones are cemented with a mixture of plaster of Paris and dextrin, and when the cement is dry, the bone is placed on a screen and lowered gently into a tank of bakelite reduced to a suitable condition of fluidity by the addition of bakelite thinner. The bones thus treated are allowed to dry and the surface cleaned. The greater number of bones require no further treatment, but if a specially strong surface is required the bones may be baked at a temperature of about 208° F. or more, when the bakelite, undergoing polymerisation, gains full strength and becomes no longer soluble in the thinning solution.

Dr. Arnold Berliner

A SPECIAL issue of *Die Naturwissenschaften* for December 16 celebrates the seventieth birthday on December 26 of its founder and editor, Dr. Arnold Berliner. It extends to 73 pages, includes scientific

contributions from more than forty authors and a frontispiece portrait of Dr. Berliner. Prof. Einstein in a short note recounts how twenty years ago Dr. Berliner saw that a periodical was wanted in Germany which would give accurate information on all branches of science and thus enable research workers in special fields to form their own opinions of advances in other fields. That his periodical has succeeded so well in this object is due to the catholicity of his interests and to his insistence that his contributors should express themselves in concise and clear language which could be understood by non-specialists. His fights to secure well written articles led him to say that a scientific author should be "a cross between a mimosa and a porcupine".

Spread of Influenza

ACCORDING to Science Service, Washington, D.C., the influenza epidemic appeared to have reached its height in the United States at the end of December; for the week ended December 24, 123,138 cases were reported to the United States Public Health Service. In England and Wales a large increase in the number of deaths from influenza is shown in the Registrar-General's return for the week ended January 14, the figures being 1,041, compared with 681 the previous week. Greater London was the worst affected area, though considerable outbreaks are reported in many parts of the country.

Wensleydale Earthquake

FATHER J. P. ROWLAND, S.J., has given in the *Times* of January 21 his determination of the epicentre of the earthquake of January 14. The records at six observatories, from Stonyhurst (34 miles) to Oxford (187 miles), agree fairly well with a position half a mile to the north-east of Hawes Junction and a time at the origin of 8h. 30m. 20s., G.M.T. The shock was also observed at Felton in Northumberland, 70 miles from the above epicentre.

Cerebro-Spinal Meningitis

THE period of the highest incidence of cerebro-spinal fever in Great Britain is approaching and it is clearly desirable to secure accurate observation on the efficiency and potency of all the serums in use. Since the most valuable test of the efficiency and potency of serums is clinical and it rarely happens that any one hospital has sufficient cases for useful differential study, the Ministry of Health is now endeavouring by means of individual case inquiry to collect and examine all evidence on serum treatment and the co-operation of medical officers of health, hospital medical officers and medical practitioners is invited. Forms for the purpose can be obtained on application to the Senior Medical Officer, Med. I., Ministry of Health, Whitehall, S.W.1.

Guide to the British Pharmacopœia

THE British Drug Houses, Ltd., Graham Street, City Road, London, N.1, have issued a "B. D. H.

Guide to the B. P. 1932", which will be of use to all who are interested in drugs, chemicals, galenic preparations, and the standards of the new British Pharmacopœia. The volume contains xvi+122 pages, and, like the similar guide to the British Pharmacopœia of 1914 (of which a few copies are still available), is published at 2s. 6d. It is pointed out that the new "B. P." contains 128 articles and preparations which become official for the first time; while there are 357 deletions. Special attention is directed in the Guide to the former, and to innovations and alterations in general.

Announcements

MR. LL. B. ATKINSON, a past president of the Institution of Electrical Engineers, has been elected an honorary member of the Institution.

THE annual congress of the South-Eastern Union of Scientific Societies will be held at Norwich on June 7-10, under the presidency of Prof. E. J. Salisbury, Quain professor of botany at University College, London. Further particulars can be obtained from the secretary, Mr. Edward A. Martin, 14 High View Close, London, S.E.19.

THE following have been elected officers of the Royal Microscopical Society for the present session: *President*: Mr. Conrad Beck; *Hon. Treasurer*: Mr. C. F. Hill; *Hon. Secretaries*: Mr. J. E. Barnard and Prof. R. T. Hewlett; *New Members of Council*: Dr. E. Hindle, Dr. J. E. McCartney, Mr. E. K. Maxwell, Mr. J. Rheinberg, and Mr. E. A. Robins.

THE inquiry organised by the Inter-Parliamentary Union of Geneva and published in 1931 by P. S. King and Son, Ltd., at 16s., under the title "What Would be the Character of a New War?" has been re-issued by Victor Gollancz, Ltd., at 5s. net. The original publication was reviewed at length in *NATURE* of February 13, 1932 (p. 219).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A member of the scientific staff of the Radio Research Station, Slough—The Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1 (Jan. 30). Assistant civil engineers for the Civil Engineer-in-Chief's Department, Admiralty and H.M. Naval Establishments—The Civil Engineer-in-Chief, Admiralty, London, S.W.1 (Feb. 18). A male assistant superintendent of traffic in the London Telephone Service and a male assistant traffic superintendent in the provinces, General Post Office—The Secretary, Civil Service Commission, Burlington Gardens, London, W.1 (March 2). A technical assistant in the Directorate of Technical Development, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants. A research assistant in mycology in the Department of Agriculture, University of Cambridge—The Secretary, School of Agriculture, Cambridge.

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.]

A New Impulse Generator for Three Million Volts

OF recent years considerable attention has been focused on the behaviour of insulation under electrical stresses of very short duration. The importance of these studies need not be emphasised; suffice it to say that investigations in conjunction with the cathode ray oscillograph on all forms of insulating material at fairly low voltages and on all forms of assembled electrical high-tension apparatus at high voltages have still to be made, as the information at present available is of the most meagre nature.

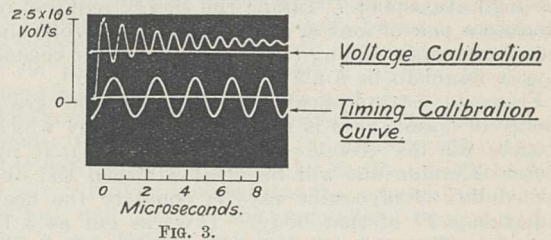
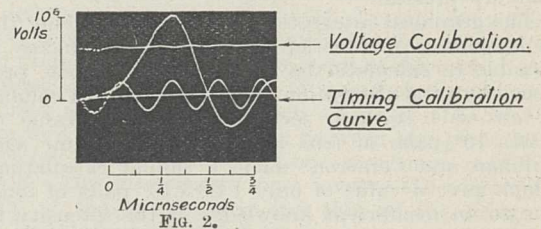
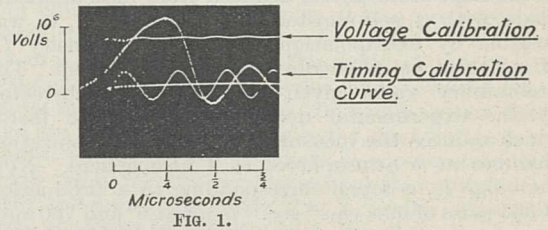
These studies are very important, because every time an electrical circuit is made or broken a transient is propagated, and in addition, lightning is responsible for the occurrence of transients of large magnitude in exposed circuits, such as overhead transmission lines. In the laboratory, low voltage transients are easily produced, but the apparatus required for the generation of high voltage transients has hitherto been very bulky on account of the large clearances which are necessary between all the active parts of the generator. To extend the scope of our investigations with higher voltage transients would necessitate buildings of enormous dimensions, and the object of this note is to indicate how such requirements can be obviated.

The circuit most commonly used for the generation of transients comprises essentially a condenser and a spark gap. For high-voltage impulses, it is not economical to construct a condenser to withstand the full required impulse voltage between the poles, and recourse is therefore made to a number of lower-voltage condensers connected in series. These may be charged in parallel with a voltage V and discharged in series, a voltage nV being thus generated, where n is the number of condensers. The switching over from parallel to series connexion is performed by spark gaps. When suitably constructed, these spark gaps are known to break down in times of the order of 10^{-7} sec., so that a generator having many condenser and spark gap stages can still produce a transient of very steep wave front.

An obvious method of reducing the size of the generator is to immerse the whole of the apparatus in a medium of higher electric strength than air, for example, in oil. Unfortunately, the time lag of breakdown of the spark gap is thereby considerably increased, and the rate of rise of voltage of a multi-stage impulse generator is therefore very seriously diminished. Furthermore, the gas bubbles and carbon liberated in the spark gaps are undesirable features, and the energy absorbed in the gaps greatly reduces the efficiency of the generator. By the removal of the spark gaps from the oil chamber containing the condensers, most of the economy in dimensions gained by the use of the oil container is sacrificed, and difficult bushing problems are introduced.

It has been found that in air the time lag of a sphere spark gap decreases with increasing air pressure, while it is well known that for small spacings the air pressure/breakdown voltage curve of the sphere spark gap is approximately linear. Here we

have the exact requirements for a compact, oil-immersed impulse generator capable of producing transients of steep wave front. If all the spark gaps are segregated into a column of air at high pressure, the compact features of the oil-immersed generator are preserved together with the advantageous electrical features of spark gaps operating in a gaseous instead of a liquid medium. On these principles, we have constructed an impulse generator capable of delivering 3 million volts in an oil container 5 ft. in diameter and only 10 ft. in height. The condensers are of the oil impregnated type and are all charged in parallel through resistance columns arranged vertically in the cylindrical container. Connexions from each condenser are taken to the spark gaps, arranged also in a vertical column in a tube immersed in the same oil chamber and under a



pressure of many atmospheres of air. Only the low voltage connexions to the condensers and the lead carrying the full impulse voltage appear outside the oil container, as even the potential divider for connexion to the cathode ray oscillograph is incorporated in the same oil tank, and is therefore of very small linear dimensions.

Figs. 1 and 2 illustrate the effect of air pressure on the steepness of the wave front of the transient, the rate of rise at atmospheric pressure (Fig. 1) being 3000 kv./ μ sec., while at a pressure of 3 atmospheres (Fig. 2) this has increased to 4800 kv./ μ sec.

The transient was applied to a sphere gap set for about 1000 kv. and the oscillograms show the very short time lag before breakdown of the gap.

Fig. 3 shows the open circuit wave of the generator operating at approximately 2500 kv. The rate of rise of voltage is 6000 kv./ μ sec., and a time of 200 μ sec. elapses before the voltage has fallen to half its maximum value. The oscillations can of course be removed by the introduction of an appropriate resistance into the circuit.

Our thanks are due to Mr. H. C. Thompson for

help in the construction of the apparatus, to Messrs. W. G. Hawley and R. V. Whelpton for their assistance with the cathode ray oscillograph, and to Mr. A. P. M. Fleming for permission to publish this note.

T. E. ALLIBONE.
F. S. EDWARDS.
D. B. MCKENZIE.

High Voltage Laboratory,
Research Department,
Metropolitan-Vickers Electrical Co., Ltd.,
Trafford Park, Manchester.
Dec. 12.

Energy of Cosmic Rays

IN NATURE for September 3, 1932, p. 364, I published the curve of the intensity of cosmic radiation in the high atmosphere, deduced from measurements made with a self-registering electrometer. It was possible by extrapolation to find the intensity I_{∞} of radiation at its entrance in the atmosphere. The preliminary value given has now been corrected by the experimental determination of the factor which reduces the measurements with the ionisation chamber at 5 atmospheres to 1 atmosphere. Now the value I_{∞} is found corresponding to a production of 333 pairs of ions $\text{cm.}^{-3} \text{sec.}^{-1}$ in air at 0° and 760 mm. mercury pressure.

The graphical integration of the curve, giving the ionisation as a function of the height, makes it possible to calculate the total number of ions, produced by total absorption of cosmic rays by a column of air of 1 sq. cm. section. The high value of 1.02×10^8 pairs of ions is found. Some time ago, Millikan and Cameron¹ made a similar calculation, which gave a value of only 1.28×10^7 pairs of ions, due to an insufficient knowledge of the intensity in the high atmosphere. Taking the energy required to produce a pair of ions in air² as 32 electron-volts the flux S of energy coming to the earth from the cosmic rays is found to be $5.2 \times 10^{-3} \text{ erg. cm.}^{-2} \text{ sec.}^{-1}$.

From an astrophysical point of view, the great energy of cosmic rays is remarkable. A body which absorbs all the cosmic rays would be heated by them. Equilibrium will be attained when the absorbed flux S of cosmic rays is equal to the heat radiation σT^4 of that body. T works out as 3.1° Kelvin. The value is equal to the temperature (3.18°) which Eddington³ finds for a black body heated only by the heat and light radiation of stars. Eddington's calculation relates to a point in our local system of stars, but not in the neighbourhood of one of them. If at such a point the flux of energy of cosmic radiation is equal to that on the earth, the temperature of a black body, absorbing entirely the two radiations, rises only to 3.7° Kelvin, according to the T^4 law. But at a point in space among the spiral nebulae, the ordinary radiation is very small and causes only a very small rise of temperature. Supposing that cosmic rays originate in such intergalactic space, they would produce an elevation of temperature corresponding to the flux of cosmic rays.

A more detailed report will be published shortly in the *Zeitschrift für Physik*.

E. REGENER.

Physik. Inst. d. Techn. Hochschule,
Stuttgart.
Dec. 31.

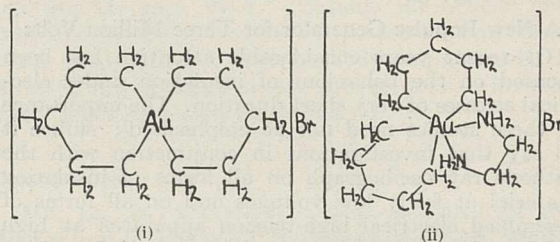
¹ *Phys. Rev.*, **31**, 930; 1928.

² H. Kulenkampff, *Phys. Z.*, **30**, 777; 1929.

³ "Internal Constitution of the Stars", German edition, p. 468, 1928.

Organic Compounds of Gold

THE reaction between hydrobromoaauric acid and magnesium pentamethylene bromide in ethereal solution proceeds somewhat differently than with the simpler magnesium alkyl bromides¹. A colourless, crystalline, sparingly soluble salt is obtained which must be *spirobis*(pentamethylene)gold bromide (i).



This compound has been identified through its ethylenediamine derivative, ethylenediaminospirobis-(pentamethylene)gold bromide (ii), which is a fairly stable colourless crystalline salt having a greater solubility in water than compound (i).

These compounds present several points of interest. In (i), the gold atom, as in many gold compounds, is 4-covalent with an octet of electrons and it is significant that a gold atom attached to four carbon atoms can function as a cation. In (ii) the gold atom is 6-covalent, and while gold compounds have been described in which the gold atom is 6-covalent, they are very few. Further, since the groups attached to the gold atom must have an octahedral configuration, compound (ii) should be capable of being resolved into optically active isomers. This is the first compound to be described in which a configuration of groups attached to a gold atom permits of this possibility.

The investigation indicated is being continued and extended in various directions. The small amounts of these organic gold compounds obtained at present in any one reaction which takes at least two weeks is only one of the factors which explain the slow progress of the work.

Chemistry Department, C. S. GIBSON.
Guy's Hospital Medical School,
London, S.E.1.
Dec. 31.

¹ Pope and Gibson, *J. Chem. Soc.*, 2061; 1907. Gibson and Simonson, *ibid.*, 2531; 1930. Gibson and Colles, *ibid.*, 2407; 1931. Gibson, "Chemistry at the Centenary (1931) Meeting of the British Association", p. 260.

Iodoacetic Acid, Glutathione and Tissue Glyoxalase

DUDLEY¹ has shown that the action of tissue extracts in converting methyl glyoxal to lactic acid, or phenyl glyoxal to mandelic acid, is inhibited by iodoacetic acid. Lohmann² considers, however, that this is probably not the cause of the poisoning action of iodoacetate on animal tissues, since, in the case of the crude extracts used, a much higher concentration of iodoacetate was needed than that required to stop glycolysis.

Quite recently Lohmann³ has made the important discovery that reduced glutathione can function as a co-enzyme to methyl glyoxalase deprived of its activity by dialysis. Working either with such extracts of rat liver purified by isoelectric precipitation of much of the protein and by dialysis, or with undialysed extracts, I find that the action of iodoacetic acid in arresting glyoxalase activity is com-

pletely reversed by the addition of reduced glutathione to the inhibited extract. The reaction occurs at once even in the presence of a ten-fold excess of the inhibitor, and clearly shows that the action of iodoacetate does not involve irreversible destruction of the enzyme itself. Further, in a dialysed extract activated by a known amount of glutathione, the quantity of iodoacetate required to stop lactic acid formation is approximately equivalent to the glutathione added to that extract. Thus the powerful activity of the purified extract, conditioned by the presence of added glutathione in 10^{-4} to 3×10^{-5} molar concentration, is rapidly retarded or inhibited by iodoacetic acid in the same molecular concentration.

On the other hand, the glyoxalase activity of the crude extract is quite unaffected by this concentration of iodoacetate; it must be increased about a hundred-fold in order to arrest or retard the lactic acid formation. The behaviour of fresh liver slices, studied by Warburg's method, I find much more nearly corresponds with that of the purified extracts; with concentrations of iodoacetate down to $1.5-5 \times 10^{-4}$ molar, the inhibition of glyoxalase action is well marked, and here also the activity is immediately restored by the addition of reduced glutathione (10^{-3} molar) to the contents of the vessels.

These results suggest the occurrence of a direct interaction between glutathione and iodoacetic acid; and this has in fact been observed. If dilute neutral solutions of iodoacetic acid and purified glutathione are mixed, a vigorous reaction occurs in which acid (HI) is liberated and the sulphhydryl group of the glutathione is attacked. The progress of the reaction is followed by mixing the bicarbonate solutions of the two reactants in an atmosphere of nitrogen and carbon dioxide (pH of solution 7.4) and measuring manometrically the carbon dioxide evolution due to acid production. It is then found that for each molecule of reactant decomposed one equivalent of acid is set free; the kinetics and chemistry of this reaction are now being further investigated.

How far the other actions of iodoacetate may be referred to a similar mechanism, or to oxidative reactions in the way suggested by Waldschmidt-Leitz and Schäffner⁴ and by Bersin⁵ is not yet clear.

FRANK DICKENS.

Courtauld Institute of Biochemistry,
Middlesex Hospital,
London, W.1.
Jan. 14.

¹ *Biochem. J.*, 25, 439; 1931.

² *Biochem. Z.*, 236, 444; 1931.

³ *Biochem. Z.*, 254, 332; 1932.

⁴ *Naturwiss.*, 20, 122; 1932.

⁵ *Biochem. Z.*, 248, 3; 1932.

Structural Formulæ of the Chlorophylls

SOMEWHAT more than a year ago, a structural formula for chlorophyll-*a* was suggested¹ in which a carbomethoxy residue was placed in the β -position of one pyrrole ring. This seemed necessary as a monomethyl ester (phæopurpurin 7) was obtained as one of the products of an oxidative hydrolysis ('phase test') and the position of the methoxyl group in this phæopurpurin was clearly established. We have now found that the purest samples of the phæophorbides of the 'a' series do not yield any phæopurpurin 7. Under special conditions of oxidative hydrolysis, a monomethyl compound can be isolated (as the sole product) and the carbomethoxy group in this sub-

stance can be shown to be part of the side chain attached to the bridge (the so-called γ -position). This finding is in accord with the position of the methoxyl group in Fischer's formula for chlorophyll-*a*.

We have found in the mother liquors from the purification of the phæophorbides, considerable quantities of a material very similar to the normal members of the 'a' series but which on oxidative hydrolysis yields phæopurpurin 7 (a monomethyl ester). The presence of this material in our original samples was thus responsible for the phæopurpurin 7 which we obtained. It is difficult to separate this substance from phæophorbide-*a*, which it appears to resemble closely in physical and chemical properties. There seems no escape from the conclusion that we are dealing with a substance very similar to phæophorbide-*a*, but differing in the position of the methoxyl group. The oxidative hydrolysis of crude chlorophyll or of chlorophyllides has shown that a precursor of phæopurpurin 7 is present to the extent of 1-5 per cent in a variety of plants. The mother liquors from crystalline ethyl chlorophyllides from *Datura* contain as much as 20 per cent. It would appear that there are two forms of chlorophyll-*a*, and we are now engaged in an attempt to isolate in a pure state the second form (or the corresponding chlorophyllide). There are some indications that a similar situation exists in regard to chlorophyll-*b*, but there has been no definite evidence as yet published establishing the position of the methoxyl group in the 'b' series.

If there are two very similar forms of chlorophyll-*a*, differing only in the position of a methoxyl group, a formula must be found which allows of the interchange of the methoxyl group between two potential carboxyl groups without serious structural modification. This interchange must involve the carboxyl group of the pyrrole ring and that of the bridge. The lactam formula, which we mentioned previously² as an alternative of our anhydride formula, satisfies these requirements; the anhydride formula does not, nor do the formulæ containing a carbocyclic ring connecting the pyrrole nucleus and the bridge.

The analyses of the pure phæophorbides present a difficulty as we have realised for many months, and has recently been emphasised by Stoll³ and Fischer⁴. We are strongly inclined to the opinion that on isolating and drying the crystalline compounds, water is lost, leaving an unsaturated grouping which then adds water again in solution, regenerating the hydroxy compound.

A more detailed discussion of the structural formulæ of chlorophyll-*a* and -*b* will be given in a series of papers to be published shortly.

JAMES B. CONANT.

EMMA M. DIETZ.

Converse Memorial Laboratory,
Harvard University,
Cambridge, Mass.
Dec. 8.

¹ *J. Amer. Chem. Soc.*, 53, 2382; 1931.

² *Ibid.*, 53, 2384; 1931.

³ *Ann.*, 499, 84; 1932.

⁴ *Helv. Chim. Acta*, 15, 1128; 1932.

'Raw' Weather

I EXPECT that Sir Leonard Hill's remarks in NATURE of January 7 (p. 28) on this subject go a long way towards answering the inquiry about the physiological effects of raw weather, but I doubt if they cover the case of deep-seated pain to bedridden rheumatic people. Yet such people are sometimes

very sensitive to climatic conditions, so sensitive indeed that some of them will predict a change in weather unfailingly. They will tell you they can feel it in their bones and it may be, with people so situated, that actual changes in humidity or temperature can scarcely be invoked as causative factors, that they are directly susceptible to barometric fluctuations.

The suggestion might be checked if a group were willing to allow the experimentalist to subject them to slight variations in pressure.

Barnato Joel Laboratories, SIDNEY RUSS.
Middlesex Hospital.
Jan. 7.

In his letter dealing with 'raw' weather, Dr. Dobson¹ has raised a question of considerable human interest which will probably require the combined experience of physicists and physiologists for its solution.

One explanation has already been mooted by Sir Leonard Hill², but apparently rests on the misapprehension that: "Cold moist air has a much higher conductivity than cold dry air." Reference to the "International Critical Tables" shows that, so far as information relating to the thermal conductivity of water vapour is available, this is not likely to be the case. At 46° C. the conductivity of water vapour is 12 per cent less than that of dry air, and there is no apparent reason why it should be greater at lower temperatures. It is difficult to imagine, therefore, how the admixture of a comparatively small proportion of water vapour with air could result in an *increased* thermal conductivity of the mixture.

Although the explanation of 'rawness' based upon the effect of moisture in the atmosphere appears to be untenable, it may be that the moisture content of clothing is important. There is evidence that even a small quantity of water adsorbed on the fibres of a textile material causes a considerable reduction in its insulating efficiency. Cold weather in England—at any rate in the south-eastern part of it—is usually dry enough to allow free transpiration of water vapour through the clothing. In 'raw' weather, however, the water excreted by the skin is retained in the clothing, with consequent feelings of chill and discomfort.

Another physical condition which may prove significant is the ionic content of the atmosphere. Work now proceeding on the Continent and in the United States^{3, 4, 5} indicates that this factor, which is very variable, can produce remarkable physiological effects. In a cold environment the feeling of 'rawness' may well be one of them.

Building Research Station, H. E. BECKETT.
Garston, Herts.
Jan. 17.

¹ NATURE, 131, 28, Jan. 7, 1933.

² *Ibid.*

³ *Acta Rheumatolog.*, 4, 12; 1932.

⁴ *Heating, Piping and Air Conditioning*, 3, 865; 1931.

⁵ *Aerologist*, 8, 26; 1932.

Molecular Fluorescence of Antimony

WE have obtained a rather strong fluorescence of diatomic vapour of antimony illuminated by a mercury arc of high luminosity; the temperature was about 950° C. and the pressure corresponded to a temperature of about 650° C.

There are four mercury lines which certainly excite a resonance spectrum and two other probable ones; the results are given in the accompanying table.

	Exciting Hg lines	No. of negative terms.	No. of positive terms
Certain	2967 A.	1	13
	3022	2	11
	3126	2	6
	3132	4	7
Probable	2925·5	1	1
	3342	1	5

The frequencies of the resonance terms can be accounted for by the equation

$$\nu = \nu_0 - 277 \left(\nu'' + \frac{1}{2} \right) + 0.68 \left(\nu'' + \frac{1}{2} \right)^2$$

Details of the investigation will be published shortly in *Bull. Soc. Roy. Sci., Liège*, Belgium.

JEAN GENARD.

Department of Astrophysics,
University, Liège.

Absorption of Light in Cæsium Vapour

WE have measured the absorption of light in cæsium vapour, by photographic photometry, from the series limit (λ 3184 Å.) to λ 1935 Å. The absorption cell was a quartz tube two metres in

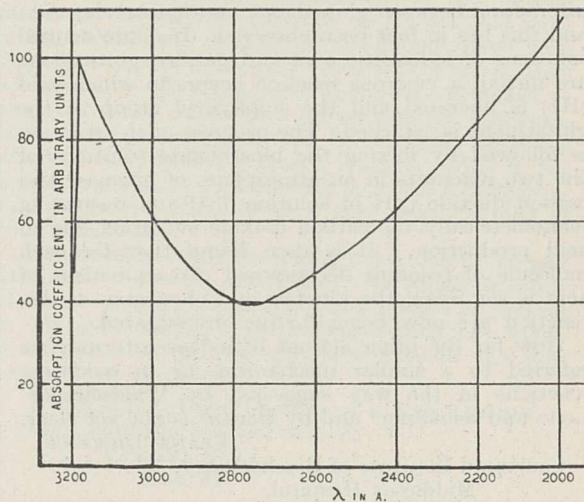


FIG. 1.

length. The vapour was superheated to about 270° C. and the vapour pressure was varied from 0.15 mm. to 0.6 mm.

The absorption at any one wave-length appears to be directly proportional to the pressure, and the variation with wave-length is shown in Fig. 1.

The results may be compared with those obtained for the photo-ionisation of cæsium vapour^{1, 2, 3, 4}. Mohler and Boeckner¹ made absolute measurements of the photo-ionisation for λ 3130 Å. and obtained a value corresponding to an atomic absorption coefficient of 1.85×10^{-19} cm.⁻¹. Our experiments give, as a preliminary value⁵ for the total absorption at the same wave-length $1.92 (\pm 0.1) \times 10^{-19}$ cm.⁻¹. These agree within the limits of error and indicate that the whole absorption at this wave-length is photo-electric.

The form of the curve agrees more closely with the curve obtained by Little² and by Cooke⁴ than with that obtained by the other workers^{1, 3}. The rise in the absorption in the far ultra-violet is interesting and

difficult to explain. We made special experiments which verified that this absorption is proportional to the vapour pressure. It therefore appears to be an atomic phenomenon.

We hope to complete the experiments and to publish a full account shortly.

H. J. J. BRADDICK.
R. W. DITCHEBURN.

Trinity College,
Dublin.
Dec. 19.

¹ Mohler and Boeckner, Research Paper No. 96, U.S.A. Bureau of Standards.

² Little, *Phys. Rev.*, 30, 109; 1927.

³ Lawrence and Edelfsen, *Phys. Rev.*, 34, 233; 1929.

⁴ Cooke, *Phys. Rev.*, 38, 1351; 1931.

⁵ This value is based on a caesium vapour pressure derived from the formula given by Mohler and Boeckner (loc. cit., p. 307)

[Reversal of the Current from a Cuprous Oxide Photo Cell in Red Light

WHILE testing the sensitivity of photo cells of the rectifier type for various wave-lengths, we have observed a small reverse current with a cell of the 'Serpodox' make exposed to red light. As we have seen no reference to this effect, a few details may be worth noting. The cell is a commercial form of that described by M. Auger, the cuprous oxide film being covered with a thin conducting film, which we believe to be of gold. Contact is made with the latter by a metal ring, the inner edge of which forms the rim of the pupil, 17 mm. in diameter.

The inverse effect is irregularly distributed over the cell, as was shown by successively illuminating various areas, each about 4 mm. in diameter, with a beam of light of wave-lengths between 6070 Å. and 6270 Å. For a region some 5-6 mm. square, not quite central in the pupil, the current obtained was in the same direction as that for green, blue, or white light. For all other parts of the disc a varying negative response was obtained. Illumination of the metal rim is not necessary for the inverse effect, a relatively large negative response being obtained from a region near the centre. On the average, however, the central part of this cell gives a positive, and the marginal a negative response, the net effect of the whole cell being negative for this light.

The following figures indicate the behaviour of the cell for yellow and red light, λ being the mean wave-length of the light, and S_1 and S_2 the sensitivities of the central and marginal regions, respectively, expressed as percentages of the maximum sensitivities, which, in each case, occurred near 5,000 Å.

λ (in Å.)	5840	5940	6060	6170	6280	6380	6480
S_1 (per cent)	51.1	36.4	23.2	7.5	2.8	0.1	0.05
S_2 (per cent)	53.4	39.4	16.7	-5.0	-10.6	-7.1	-1.9

For longer wave-lengths to the end of the visible spectrum, S_1 was zero and S_2 had small negative values.

A cell made, and kindly presented to us, by M. Auger showed the inverse effect to a very slight extent. A second 'Serpodox' cell mounted in one of our marine photometers gave a reverse current when covered with a Schott and Gen. R.G.1 or R.G.5, or a Wratten No. 88 red filter and exposed to daylight in the laboratory. No reverse effect could be detected with a Siemens cell, which had a relative sensitivity about +1.4 per cent at 6380 Å. In this cell the conducting film is of silver.

As the current flowing in the external circuit of any of the above cells under the influence of white light is from the copper back to the transparent film, it would seem probable that it is due to a front surface effect of the cuprous oxide film, the back surface being screened by the opacity of the film. If we assume that red light penetrates the thinner parts of the oxide film in the Serpodox and Auger cells to such an extent as to cause the back surface effect to preponderate, we obtain at once an explanation of the patchy nature of the red reversal.

As an alternative explanation, we might attribute the reversal to the presence of cupric oxide, which Athanasius has shown to give a reverse E.M.F.¹ As the cupric oxide, unlike the cuprous, is sensitive to wave-lengths greater than 6500 Å., he obtained a reversal with a mixed oxide photo-voltaic cell in red light.

The possibility of such an effect occurring in these cells is obviously of importance if they are used to compare illuminations of different colours.

H. H. POOLE.

Royal Dublin Society, Dublin.

W. R. G. ATKINS.

Marine Biological Laboratory,
Plymouth.
Dec. 28.

¹ *C.R. Acad. Sci.*, 195, 767; 1932.

Twisted Trees

To one who has long been working on the problems presented by twisting (spiral grain) in trees, the suggestion made by Dr. Copisarow¹ that the phenomenon may be traced back to the mineral constituents of the cells, comes as a further possibility calling for examination in light of the facts so far as they have been recorded. Knorr's article in the *Journal of Heredity*, which was noticed by NATURE in the issue of July 23 (p. 136), 1932, and called forth the suggestion now under consideration, was apparently written without reference to the existing literature, even American literature, and leaves the reader with the impression that a new field was being examined for the first time, whereas it has attracted attention for at least a century.

Dr. Copisarow uses Knorr's data showing right- and left-handed twist to be approximately equally frequent as an argument in support of his suggestion, whereas the typical mode of occurrence is for either right- or left-handed twist to predominate strongly according to the species concerned. In certain species of pines in Europe and India, almost a hundred per cent of the trees over extensive areas may exhibit definite left-handed twist without a single example of right-handed twist. A change over in the individual from left-handed in youth to right-handed later in life is a fairly common phenomenon, recorded, for example, by McCarthy in America for *Picea rubra*. The mode of occurrence of twist often suggests that the soil may be the cause, but, at least in *Pinus longifolia*, twist may be equally prevalent on limestone with a deep clay loam soil, as on mica schist with sandy loam or on coarse granitic gneiss. Knorr's observation is significant that of several species, all liable to twist, perhaps only one would be found to be twisted in a given area, and another in a second area.

Twist in trees certainly appears to originate during

the secondary growth of the stems and there are indications that the so-called sliding growth of the tracheids in conifers may be intimately connected with the development of an increasingly inclined slant to the grain of the wood. Further knowledge on the growth of wood elements from the cambial initials is required to enable us to understand exactly what happens, knowledge to which Prof. Priestley's studies in Leeds are making important contributions.

Unless Dr. Copisarow can develop his suggestion so that it will account for twist predominantly in one direction or another irrespective of soil, and for a change over in direction with time, it does not take us much further than my own made in 1925, that such a detail as the prevalent direction of circulation of the cell contents (if they do circulate at all) might decide the initial direction, and sliding growth might accumulate small inclinations (if the tracheids do slide or anything like it).

H. G. CHAMPION.

Forest Research Institute,
Dehra Dun, India.
Dec. 1.

¹ NATURE, 130, 541, Oct. 8, 1932.

Spectrum of γ Cassiopeia

SINCE photography was first applied for recording the spectrum of this bright star, its spectrum has always been considered to be of a constant character. In 1928, I announced that a slight change had taken place, and since then I have made numerous observations which completely corroborate its variability. The relative intensities of the bright components of the hydrogen lines in the latter half of 1931 were such that the red components were a little brighter than the violet components. Since then, the violet components have been steadily increasing in intensity, and now (January) they are very much stronger than the red components, so much so that, in the case of $H\epsilon$ and $H\zeta$, the red components are scarcely visible while the violet components are quite strong.

A detailed discussion of all my observations since 1921, which include more than sixty photographs, will be published at a later date.

WILLIAM J. S. LOCKYER.

Norman Lockyer Observatory,
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Jan. 15.

Heterogony and the Chemical Ground-Plan of Animal Growth

IN his letter in NATURE of December 3, Dr. J. Needham suggested that "the chemical ground-plan [of development] must be thought of as deformable in space-time". In this connexion, the deformations which are obtained by a change in the unit of time measurement seem to be particularly interesting. Needham showed that if we have two animals a and b and measure in each of them several chemical magnitudes M_a, M_b, N_a, N_b , etc., such as fat content, dry weight, etc., we find relations of the type $\log M_a/M_{a_0} = k \log N_a$ and $\log M_b/M_{b_0} = k \log N_b$ where M_{a_0}, M_{b_0} are specific constants and k is a general constant relating M and N for all animals. Now M and N are also functions of the time t . If we have $\log M_a/M_{a_0} = F(t)$ and $\log M_b/M_{b_0} = F(t)$ we can clearly choose another variable p such that

$F(p) = f(t)$. That is to say, by choosing a suitable unit for the measurement of time, we can convert the growth curve of M_b into that of M_a : and further, the same system of time measurement will convert all the growth curves of chemical magnitudes of animal b into those of animal a , provided only that in each case there is the linear relation between the logarithms, with the general constant k which Needham discovered. Thus we could regard the two systems of time measurement defined by t and p as the relative time scales of chemical development of the two animals.

Such relative time scales may become very interesting when data are available for comparing them with relative developmental time scales derived in other ways. The relative time scales of morphological development can be obtained fairly easily. Now it has been shown in various cases that the morphological stage at which an organ becomes embryologically determined may vary widely in nearly related species. These two criteria, namely, stages of morphological development and times of determination of different organs, should provide two other systems of relative time measurements. It would be very interesting to know how these two are related to one another and to the time scales of chemical development.

C. H. WADDINGTON.

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Jan. 2.

The Constant of Gravitation, G .

IT appears that before the advent of the theory of relativity the constant of gravitation was purely empirical. No theoretical estimate or discussion of it has at any rate come to my notice. It is perhaps worth while to obtain a theoretical explanation of the constant, even from the point of view of Newtonian gravitation, in view of the remarkable success of the latter in the regions of space that have already been explored. Following Mach, one expects that the constant G should be dependent upon the distribution of matter in the entire universe: it may be explained in terms of the other universal constants of relativistic cosmology.

Suppose that the total matter in the universe is distributed at random in a sphere of radius R where the boundary condition is furnished by corpuscular radiation going round with the velocity C . Then, according to Newton,

$$MG/R^2 = C^2/R \text{ or } MG/C^2 = R,$$

where M is the total mass in the universe. We may compare with this the relativistic formula

$$M^+ G/C^2 = (\pi/4)R \text{ for the Einstein world.}$$

There are two reasons why M and M^+ should differ slightly as they do; first, in estimating M^+ the entire mass is supposed to be at rest, which is far from the truth, and secondly, there is the mathematical difficulty of measurement pointed out by Painlevé¹.

V. V. NARLIKAR.

Hindu University,
Benares.
Dec. 7.

¹ C. R. Acad. Sci., 173, 873.

Research Items

Excavations at Kuala Selinsing, Perak. Mr. Ivor H. N. Evans, having carried out further excavations on the Tanjong Rawa site, Kuala Selinsing, Perak, Malay Peninsula, has now summarised his conclusions in an account of this later work (*J. Fed. Malay States Museums*, vol. 15, pt. 3). The inhabitants were not Mohammedans, and were traders in beads of semi-precious stones and glass. Some of these were of local manufacture. The stone beads probably came from India; others show affinities with Borneo and Sarawak, and with ancient beads found among Kachins and Chins, these in the latter instance being derived ultimately from both China and India, sources with which the Selinsing people may have been in touch. A piece of yellow lead slag may point to a connexion with the southern Shan States. The beads from Kuala Selinsing belong to a late iron age to early porcelain age culture that existed in India, the Malay Peninsula, Borneo and the Philippines. The people were almost certainly Hindus, as a definitely Hindu type of gold object has been found in the lower layer of the excavations; while a cornelian seal with a Pallava inscription (one of the most remarkable objects found in Malayan excavations in recent years) points to a connexion with southern India. The village would appear to have been built originally over the water, but accumulations of household refuse produced an island above the level of the highest tides. Burials took place under or among the houses, the bodies being placed in canoes and broken porcelain strewn over them. There are many types of pottery, mostly wheel-made with patterns akin to ancient Korean and Chinese. The settlement appears to have come to a violent end soon after A.D. 960, a date indicated by the presence of celadon wares. The earliest date suggested for the seal is about A.D. 400, but it was not found in the lowest level and may have been treasured for hundreds of years after the date of its manufacture, or perhaps be a survival of a script obsolete in India.

Shamans and Spiritism on the Mosquito Coast, Honduras. In an ethnographical survey of the Miskito and Sumu Indians of Honduras and Nicaragua (*Bull.* 106, Bureau of American Ethnology), Dr. Eduard Conzemius describes religious manifestations which have appeared among these peoples within the last forty years. These Indians are inhabitants of the tract of land once familiar under the name of the Mosquito Coast. The Miskito, who number about 15,000, are largely mixed with negro blood, as they intermarry freely with foreigners and assimilate all races readily. The Sumu, on the other hand, are exclusive. They number about 3,000 only and are decreasing. Many of the tribes, of which the names are preserved, have died out. Their language has many variants, some of which are mutually unintelligible. The shamans play a great part in the lives of these peoples, acting as medicine-men, doctors, augurs, rain-makers, conjurers, wizards, and the like. Their opinions carry great weight in tribal assemblies. According to tradition, their art was introduced from the east by a white man. The Sumu have only one class of medicine man, the sukya, whose office is hereditary. Nearly every village has its sukya. Among the Miskito, however, there is also a higher type, the okuli; but of these there should not be more than

one at a time. He is a special representative of the Thunder God, and controls the elements. The new movement in religious manifestations is not unlike the nyalism of the Jamaican negro. It is a form of possession which seizes on the people when they are engaged in earnest prayer. They claim that they then have no control over their movements, which are due to the presence of the Holy Ghost. They are believed to be able to cure the sick by the laying on of hands, and to have revelations from God during their dreams. Obeah, brought from Africa by slaves, still exists.

Spread of the Great Crested Grebe in Britain. A very thorough collection of information relating to the great crested grebe in Britain has been made by T. H. Harrison and P. A. D. Hollom with the help of 1,300 collaborators, and this together with the analysis of the data makes a most important account of the history of the species (*British Birds*, Aug. to Nov., 1932). In 1860, following a period of slaughter for the sake of the feathers, only about 42 pairs were left in England; but a continuous and progressively rapid increase has raised the number in 1931 to about 1,154–1,161 breeding pairs and a total population of some 2,650 adults. The spread has in general been from east to west, and there can be no doubt that the Wild Birds Protection Acts of 1880 and earlier have been a main factor in the increase, although the fact that increases have also occurred on the Continent points to a widespread influence. There too, however, increasing protection by law has to be reckoned with. In spite of protection, human interference is still the main cause of recorded deaths (36 per cent). The authors have estimated that a pair of grebes and their young consume 300–630 lb. of fish in the course of a summer; which gives a total fish consumption from England and Wales of 900,000 lb. a year. A careful analysis is made of mortality factors, and it is pointed out that the habits of covering the eggs when the nest is left and of carrying the chicks upon the back have been important acquisitions in reducing mortality from the attacks of egg-eating birds and of pike.

New British Copepod. Mr. D. J. Scourfield has discovered at Tenby a new species of *Cyclops* which he describes in a paper entitled "A New Species of *Cyclops* found on the Cliff-face at Tenby (*Cyclops (Bryocyclops) demetiensis*, sp.n.)" (*Ann. and Mag. Nat. Hist.*, ser. 10, vol. 10, p. 559, December 1932). It is an event of importance when British copepods new to science are found because this group is one of the best known. The present species was found, at first one specimen only, in some wet greenish earthy material from a spot on the cliff-face of the North Bay at Tenby, Pembrokeshire, where a minute trickle of water came oozing out of a small fissure in the rocks. Later on, further specimens were found in the same place but where there was a slight admixture of moss. Only this one restricted locality yielded the copepods. This find is specially interesting because all other known *Bryocyclops* are tropical, coming from Java and the New Hebrides, living in wet moss, cups formed by the leaves of plants or in empty coconut shells. Mr. Scourfield is of the opinion that his new species is not truly a moss-dweller but

rather that its true habitat is in the fissures in the rocks. *Cyclops (Bryocyclops) demetiensis* is a pretty little copepod with a peculiar eye of very unusual form surrounded by a mass of black granules in three parts, one dorsal and two lateral. It is possible that the form of the eye may have something to do with its mode of life in dark places. It is an active swimmer. Although no ovisacs were seen, a few nauplii were discovered in the bottle containing the copepods. These nauplii showed a separation of the eye parts which is very characteristic.

Mites of Fruit Trees. Literature dealing with the mites attacking fruit trees is not very accessible to the general horticulturalist, so that a lengthy synopsis by Mr. A. M. Massee is very acceptable (*J. Pomol. and Hort. Sci.*, vol. 10, No. 2, 1932, pp. 106-129, "Some Injurious and Beneficial Mites on Top and Soft Fruits"). The mites are dealt with according to the trees they attack, and apples, pears, plums and damsons, cherries, peaches, nectarines and apricots, nuts, walnuts, quinces, currants, gooseberries, raspberries, blackberries and strawberries are mentioned. It is interesting to note that there are several beneficial mites which are either predaceous, like the red velvet mite of apples which feeds on woolly aphid, or they may feed on moss and lichen, as the flat scarlet mite (*Tenuipalpus glaber*) or the beetle mite (*Euzetes lapidarius*). The control methods which are given for the injurious species include many new treatments and it is interesting to note that the application of tar distillate winter washes is not an unmixed blessing, for it kills off many beneficial mites.

Inheritance of Flower-Size. There are very few published studies showing how flower-size is inherited in crosses between species with large or small flowers. The memorial volume to the late Prof. Julius Philipschenko (*Bull. Lab. Genetics, Leningrad*, No. 9.) contains a paper on this subject by Prof. Ruggles Gates. He has tabulated some thousands of measurements of petal length in four generations of hybrids descended from *Enothera novæ-scotiæ* × a strain of *Ærubricalyx*. The former species has a mean petal length of about 12 mm., and the latter about 36 mm. This applies to flowers on the main stem. Those on the lateral branches always fluctuate about a mean 2-4 mm. less. The mean petal length of the F_1 hybrids was 18 mm., thus showing incomplete dominance of the small flower. Later generations showed striking segregation in flower-size, the modes for different plants of one culture ranging from 17 mm. to 30 mm. The number of factors for flower-size involved has not been determined, but must be two or perhaps more. Heterozygous plants, which will produce some larger flowered descendants, can be recognised since they show an exceptionally wide range of fluctuation which is generally bimodal. The segregants may breed true or they may again segregate. By tabulating the daily measurements from pure strains, the graphs of fluctuating flower-size can be compared with the changing meteorological conditions. In this way it is shown that a correlation exists between mean flower-size and the weather conditions on the day the flowers opened.

Earthquake Series at Nagasa, Japan. Messrs. A. Imamura, T. Kodaira and H. Imamura have described what they call an "earthquake-swarm" at and near Nagasa on the west coast of the Kii peninsula

(*Earthq. Res. Inst. Bull.*, 10, 636-647; 1932). At Wakayama, which lies about three miles to the north of this district, the average number of sensible earthquakes recorded each year from 1911 to 1919 was 14. In 1920, the number rose to 104, increasing to 299 in 1923, and then declining to 142 in 1927. At Hikata, close to the central area, the total number of shocks in the swarm was 934. In May 1929, a network of seismological stations was arranged around the central area, and, from the records obtained at them, the positions of 91 origins were determined. The shocks were all local, few of them were felt more than 12 miles from the centre, and only two or three of the strongest cracked plaster or threw down stone fences. The shocks originated at various places within an area of about twelve miles in diameter in Wakaura Bay, and at depths that seldom exceeded $2\frac{1}{2}$ miles. Two series of levellings along the west coast of the Kii peninsula, separated by an interval of thirty years, reveal a marked change in the level of the land. A block, about six miles wide, from Wakayama to Siotu, has bulged upwards. The maximum uplift is only $3\frac{1}{2}$ in., but the summit of the dome is occupied by a fault along which most of the earthquakes occurred. The uplift is due to lateral pressure acting from north and south, and, with a persistence of the pressure, may end in a fracture. As the Kii peninsula has been the seat of devastating convulsions in the past (for example, in 1854), it is obvious that these earthquakes, weak though they may now be, require careful study.

Earth-Magnetic Effect and the Corpuscular Nature of (Cosmic) Ultra-Radiation. In an important paper with this title (Part 4), read by Prof. J. Clay before the Amsterdam Academy of Sciences on December 17 last, an account is given of a valuable series of observations on the intensity of the cosmic rays, made for him by Dr. J. Berlage on a vessel proceeding from Genoa to Batavia. The ionisation chamber filled with 22 litres of carbon dioxide at a pressure of 11 atmospheres was maintained at 130 volts, and shielded by 13 cm. of iron. The integrated ionisation current during each hour was registered photographically, using an electrometer. The results show a marked decrease from the Amsterdam value ($I=1.83$) to Genoa (1.75), and thence to the magnetic equator (1.56), with a small subsequent rise to Batavia and Bandoeng (about 1.62). Combining these with other recent results, Clay concludes that I is nearly constant from the poles to about magnetic latitude 46° (Amsterdam), and decreases by 16 per cent from there to the magnetic equator. He infers from this and other evidence, which he reviews, that the cosmic rays are corpuscular, having a Maxwellian energy distribution at the hardest end, with a mean energy of 3×10^{10} volts, which is cut off at the lower limit of 4×10^9 volts by the atmosphere; he attributes the reduction of intensity below about 50° magnetic latitude to the exclusion from this region (according to Størmer's theory) of the less hard components of the radiation. This view implies that the hardness of the observed rays should increase towards the equator, and he quotes observations in support of this.

Relativity of Time. An experiment has been carried out by Kennedy and Thorndike (*Phys. Rev.*, Nov. 1) to verify directly the restricted relativity expression for time in a moving system. Homogeneous light is split into two pencils which traverse paths of different length and are then allowed to interfere.

Assuming the null result of the Michelson-Morley experiment, it is possible to show that the phase relationship of the interfering systems depends on the translational velocity of the system unless the time is given by the Lorentz-Einstein transformation. The experiment therefore consists in building a very stable interferometer and observing the fringes at different parts of the sidereal day, the circumferential velocity of the earth being alternately added to and subtracted from the motion of the solar system in the universe. The interferometer was built entirely of fused silica and was kept in a vacuum in a constant temperature bath. The 5461 line of mercury was excited in a special lamp to give very homogeneous light and a path difference of about 30 cm. was used. Special methods were used to measure the photographs of the interference pattern to 1/1,000 of a fringe. The result showed that the relativity expression was verified, provided that the velocity of the solar system is not less than a few kilometres per second. The apparatus was found to be stable enough to enable comparisons to be made over an interval of six months and thus to utilise the orbital velocity of the earth; and here it was found that an effectively null result was obtained. Since internebular velocities run in thousands of kilometres a second, this is interpreted as meaning that time—as measured by the radiation from a mercury atom—varies according to the Lorentz-Einstein law.

Hæmocyanin of *Octopus vulgaris*. Svedberg and Eriksson (*J. Amer. Chem. Soc.*, Dec. 1932) have

determined the molecular weight of the hæmocyanin of *Octopus vulgaris*, the chemical and physico-chemical properties of which have been much investigated. The sedimentation method was used and it was found that solutions of the crystallised hæmocyanin contained two constituents, for one of which (called *B*) the sedimentation constant varied strongly with the hydrogen-ion concentration of the solution whilst the sedimentation constant of the other is independent of hydrogen-ion concentration. This second component, called *A*-hæmocyanin, is regarded as a definite molecular species, like the hæmocyanins of snails (*Helix*, *Limulus*) previously investigated. It has a molecular weight of about two million, thus resembling the other hæmocyanins, and differing markedly from other proteins. The molecule is not spherical in shape. The molecular weight is the same in the oxygenated and in the reduced state. The results show that the *A* and *B* components are not two different proteins but represent two different kinds of aggregation in equilibrium, the change from *A* to *B* being reversible. This peculiar behaviour with regard to its dependence on hydrogen ion concentration is without parallel in the other proteins so far investigated by the ultracentrifuge method. The hæmocyanin from octopus gave a titration curve with three inflection points, one at $pH\ 4.8$, the isoelectric point, one at 6.3 and one at 7.5. The first two being characterised by great change in hydrogen ion concentration when the amount of acid or alkali present is but slightly changed.

Astronomical Topics

Astronomical Notes for February. Jupiter, Mars and Neptune are all near opposition, and are observable for most of the night. The northern hemisphere of Mars is turned towards us; this is less well known than the southern hemisphere, being turned to us at aphelion oppositions. The diameter of Mars increases during February from 12" to nearly 14". There is an eclipse of Jupiter IV on February 12; the disappearance is at 8.11 P.M. when Jupiter will be too low; but the re-appearance at 11.54 P.M. is observable. Two stars in the Pleiades are occulted by the moon on February 3, disappearing at 8.43 and 9.34 P.M.

Minima of Algol occur conveniently for observation on February 17 at 11.24 P.M. and February 20 at 8.18 P.M. It should be noted that the times in the B.A.A. Handbook are one day too great from February 18 until the end of April. Mira Ceti reaches maximum towards the end of February, and should be watched; it is only observable very early in the night. Its magnitude at maximum is subject to fluctuations, so comparisons with other stars are useful.

February and March are the best months for observing the zodiacal light in the evening; it should be looked for along the ecliptic as soon as it is dark when the moon is absent.

The central line of the annular eclipse of February 24 crosses Africa; a small partial eclipse is visible in southern Sicily and Greece.

Tidal Shifts in the Earth's Crust. Dr. Hecker announced about twenty years ago that the crust of the earth has tides of a few feet in height. Drs. H. T. Stetson

and A. L. Loomis suggested the existence of a much larger shift in a paper read at the recent meeting of the American Astronomical Society at Atlantic City. They have discussed the differences between the time-signals distributed by wireless from the leading observatories of Europe and America, and find discordances between them that are considerably larger than the probable errors of observation. If the whole discordance be ascribed to an actual change in the distance between Europe and America, it would correspond to an oscillation of 63 feet every 12 hours. They also note that the time of transmission of the wireless waves is longer than the light-time for the distance, nearly in the ratio of two to one; they infer that the waves travel by a zigzag route, with about thirty reflections between the Heaviside layer and the surface of the earth or ocean.

Stars of the μ -Cephei Type. Mr. W. Zessewitsch, of Leningrad University Observatory, has sent a note dealing with the double periodicity of stars of the above type. He tabulates for nine stars of the type the shorter period *P*, the longer period *M*, the ratio *M/P* and the logarithm of *P*. From these data he deduces the following empirical relation between *M* and *P*:

$$M/P = 80.2 - 44.5 \log P + 6.7 (\log P)^2.$$

P ranges from 16.5 days to 907 days; *M* from 600 to 6,200. The above equation gives sufficiently small residuals to suggest that some such equation exists between the two periods. He states that stars of the RR Lyræ type give a similar formula and expresses the hope that it will give a clue to the nature of the pulsations.

Air Waves from Experimental Explosions

By Dr. F. J. W. WHIPPLE, Superintendent of Kew Observatory

IN the article in NATURE of December 31, p. 1008, with regard to the Oldebroek explosions of December 15, it was mentioned that a number of observations had been received at Kew Observatory. The observations have now been scrutinised with the object of arriving at a definite answer to the question whether the waves from the explosions were received in England.

The observations have been put in three classes. Those in Class A were made at such times as were consistent with the passage of the air waves with the normal velocity of sound along the ground or with a delay not exceeding five minutes. The observations placed in Class B were those which were too early or considerably too late, whilst those in Class C were made at such times that there was evidently no connexion with the explosions. There were 12 observations in class A and 10 in Class B.

minutes after 6.0. At Farnham (normal time 24.3 minutes) a door gave a short sharp rattle at approximately 6.30 and again at 7.30, that is, 24 minutes after 6.6 and after 7.6. At Arundel (normal time 24.3 minutes) there was a violent rattle of a sash window but the estimate of the time, 6.30, is very rough. At Lymington (normal time 27.7 minutes) a window gave a clear thud at 28 minutes after 7.6.

Observers at Nuneaton and Maidenhead may possibly have heard sounds with the same trajectory as infra-sonic waves. On the other hand, sounds reported at Maldon, Cleethorpes and Boar's Hill, if coming from Oldebroek, were delayed by at least two minutes. In itself that is not improbable, but in view of the facts that none of the three observers in question heard more than one of the four explosions, that another observer at Boar's Hill reported that he could hear nothing and that noises

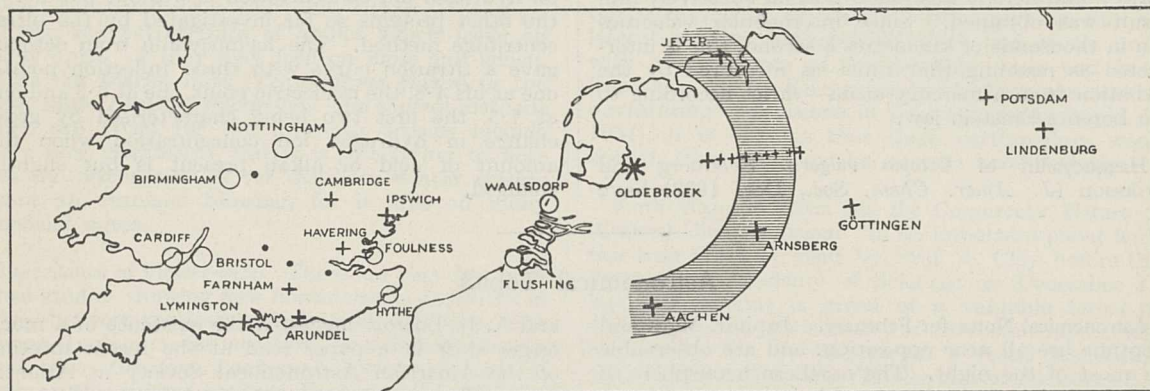


FIG. 1. Sketch map showing places where observations were made on the Oldebroek explosions of December 15, 1932.

- + On the Continent, received by undographs; in England, some evidence of reception of infra-sonic waves.
- On the Continent, not received by undographs; in England, not recorded by hot-wire microphones.
- Sounds heard at appropriate times—Cleethorpes, Nuneaton, Oxford, Maldon, Maidenhead and South Croydon.

Six of the twelve observations falling in Class A refer to secondary sounds such as the rattling of windows. The agreement of these observations with the normal time of passage of air waves is very good. The most satisfactory observations are those at Cambridge. The normal time (reckoned at 3 seconds per kilometre) for waves from Oldebroek to Cambridge is 20.2 minutes. The times that elapsed between the explosions at 6.0, 6.6 and 7.6 and the observations at Cambridge were $21\frac{1}{2}$, $20\frac{1}{2}$ and $20\frac{1}{2}$ minutes respectively. As the observer noted the first of these receptions when she was awakened by the vibrating motion of the window, a mistake of a minute is not unlikely.

Confirmation by the observations at Ipswich, Havering-atte-Bower, Farnham, Arundel and Lymington indicates that there was a large area over which the aerial disturbance was appreciable. This area lies between the microphone stations at Hythe and Foulness and those at Nottingham, Birmingham, Cardiff and Bristol. It is known now that at none of these stations could the air waves be detected.

At Ipswich (normal time 16.5 min.) a lady felt her bed quiver and heard a faint rumble $16\frac{1}{2}$ minutes after 6.6. At Havering-atte-Bower (normal time 20.3 minutes) birds were disturbed between 19 and 22

of all sorts are only too common in England, these observations must be regarded as somewhat doubtful.

The reception of the air waves at Cambridge at the time appropriate for normal transmission is remarkable. The condition which favours the passage of air waves westwards close to the ground or sea is the presence of east wind, increasing in strength with increasing height, or alternatively, west wind decreasing with increasing height. On December 15, however, the wind was from south-west and moderately strong. Unfortunately, there was much low cloud and no information is available as to the wind at a greater height than 600 metres; at that height the velocity at Felixstowe was about 15 m./s. It is not impossible that the wind fell off rapidly above the lower cloud and that the air wave was therefore able to travel westwards at a moderate height.

On the other hand, the possibility that air waves travelled very rapidly westwards at a great height, so rapidly that the time lost in ascent and descent was compensated, must not be overlooked.

It has been realised since the War that in this part of the world the sounds of explosions produced at points far to the east at distances of 200 km. or more are likely to be heard in summer but not in

winter. Accordingly, it may be anticipated that if the Oldebroek experiment is repeated at some time during the coming summer, more positive and therefore more interesting results will be obtained.

I should like to take this opportunity to thank all correspondents who kindly communicated their observations and also to express my appreciation of the trouble taken by the observers who manned all the microphone stations which were in operation.

A preliminary report on the observations made on the Continent has been circulated by Prof. H. Hergesell, president of the International Commission for the Investigation of the Free Atmosphere. Of the German stations provided with undographs close to the direct line from Oldebroek towards Lindenberg, those at distances of 105, 136, 155, 161, 170, 183, 190, 198, 201, 213 and 225 km. were successful in obtaining records of the air waves, as were the stations at Aachen, Arnsberg, Jever, Lindenberg, Göttingen and Potsdam. No waves could be recognised on the undograph records in Holland.

Observations of audibility show an abnormal zone which has, in Germany, a mean radius of 145 km. and a maximum of 215 km. This zone extends to eastern Belgium. The inner zone of normal audibility

was narrow; there was some extension to the east, as was to be expected from the prevalence of west wind.

That the air waves were received at places to the east of Oldebroek and not at the principal English stations to the west is in accordance with expectation, as is the fact that there was abnormal audibility in the eastern part of Belgium (south of the source) but not in the western part (south-west of the source). The very small inner radius of the outer zone of reception of air waves, 105 km., is also typical of winter observations. The reception of air waves at Cambridge and other places in England was unexpected and therefore, if the evidence is accepted, all the more interesting.

It is understood that the experimental explosions which were to have taken place in Novaya Zemlya on the same morning as the Oldebroek ones had to be postponed.

Similar experiments, organised by Dr. Bruno Rolf, were to be inaugurated in Sweden on January 11 by the explosion of 300 kgm. of guncotton near Boden. Five undographs provided by the International Meteorological Association were to be used for the first time on this occasion.

British Industries Fair

SCIENTIFIC INSTRUMENT SECTION

THE Scientific Instrument Section of the British Industries Fair will again be situated in the Grand Hall at Olympia. Of the 14,500 sq. ft. of space to be occupied by this section of exhibitors, nearly a quarter will be taken up by the composite exhibit of a group of British scientific instrument manufacturers who have co-operated for this purpose. The whole of the exhibits may roughly be divided into two categories, namely, (a) technical instruments and apparatus, such as are used for control and testing in works, for laboratory research or for the teaching of science in colleges and schools; (b) scientific instruments of a more or less domestic character, such as barometers and thermometers. A very wide field of scientific instruments will thus be covered, ranging from a simple pocket magnifying lens to the equipment required for the most refined micro-photographic work.

Among the new, improved, or adapted products of the instrument industry, about which advance information is available, the following may be mentioned. James Swift and Son, Ltd., will exhibit Nicol and other polarising prisms such as are used in the latest apparatus for television and picture transmission. A new model of the tintometer, very light and portable, and enabling rapid measurements to be made, will be shown by The Tintometer Ltd. This instrument enables the specification or definition of colour to be made in terms of reproducible units or standards, in the form of graduated and numbered glass slides. A stereo-prism binocular, with an extra wide field, a magnification of 7 diameters, and a 50 mm. object-glass, having a light-transmitting power very greatly in excess of that of any prism binocular previously made, will be one of the exhibits of Ross Ltd. Among other products, W. Watson and Sons, Ltd., will show a new low-power microscope for the rapid examination of specimens varying in thickness from 1 mm. to 6 in. This firm's exhibits will also include a special microscope 'for crime detection' and a new form of photometer for the

measurement of the comparative densities of photographic plates and for the measurement of reflections from papers and other materials. This last instrument makes use of a photoelectric cell with a suitable magnifying system.

The Foster Instrument Company is exhibiting at the Birmingham Section and, besides a complete range of automatic temperature controllers, will show a 'Blackie Heat-Loss Gauge'. This last named instrument, it is claimed, is the only known instrument of its kind, and, since it is directly calibrated in B.T.U's / sq. ft. / H.R., it can be used even by unskilled operators.

Thermometers reading to an extremely high degree of precision—for example, to the nearest 0.005° C.—for use in research and industrial work will also be among the exhibits at Olympia.

Another noteworthy exhibit will be the projection microscope to be shown by Vickers. It is designed primarily for the purposes of metallography, and will deal with specimens up to 50 lb. in weight and enable magnifications varying from 3 to 5,000 diameters to be obtained. The apparatus will, as desired, provide for visual observations, or take photomicrographs or project the images on to a screen for demonstration purposes. The Cooke optical comparator is designed for the quick and accurate comparison of machine parts produced in quantities. It is intended to supersede the use of high and low limit gauges in works' inspection departments. A total magnification of 1,000 is achieved by means of a system of mechanical and optical levers, and a variation of 0.0001 in. from the standard can be detected. An instrument for observing the precise character of the movement of any rotating or oscillating part of a machine or apparatus is the 'Whidbourne' stroboscope. By means of this instrument—to take one example—gear wheels can be observed in motion without having to stop the machine. The observer, on looking through the

stroboscope, sees the gear wheels apparently stationary, and can thus readily detect any defects. Analytical balances will be shown which, it is claimed, will at least equal, if not surpass, the corresponding foreign balances which were widely used until a few years ago. In these balances the beam is made of an alloy having a negligible coefficient of expansion. One special balance has been designed for the estimation of moisture in tea, tobacco, flour and other materials.

Of the various instruments and apparatus used for instructional purposes in schools and colleges, mention may be made of the 'Simplex' ripple projector which throws on to a screen images of wave forms and motions, the ripples being produced in a glass

trough by means of an electro-magnetic vibrator. This instrument enables experiments to be made showing, for example, the effect of sound in rooms and halls of various shapes.

Of the numerous other exhibits that will be on view in the Scientific Instrument Section of the Fair we have space merely to mention the 'Stormoguide', an instrument designed to 'forecast' the weather, and two popular British-made cameras at low prices—one fitted with an anastigmat 3.5 lens at 75s., and the other a 3¼ in. × 2¼ in. box camera at 6s. 6d.—the lowest priced camera, it is claimed, on the market.

Altogether, the visitor will find scientific exhibits of abundant interest at Olympia.

Prevention of Roof Falls in Mines

DURING the early years of the Safety in Mines Research Board in Great Britain, the staff recruited consisted almost exclusively of chemists with no actual mining experience. Their energies were directed towards chemical aspects of the safety problem, and in particular to the phenomena of explosions, a study which lends itself readily to laboratory investigation. Calamitous as gas or dust explosions may be, the reports of the Secretary for Mines show that they normally account for only about five per cent of the total fatal accidents occurring annually in the coal mines of Great Britain, whereas the fatalities caused by falls of roof or sides account for approximately fifty per cent. Thus whilst explosions create most public interest in the safety of mines, falls of roof and sides cause by far the most casualties.

The activities of the 'Safety in Mines' movement have now been extended to include a co-ordinated research on the causes of falls of roof and their prevention. In consequence of the great variation in mining conditions, these investigations are being carried out in all the important coalfields of Great Britain. They are under the direct supervision of committees consisting of leading mining engineers in the respective areas. Progress reports are circulated

periodically. The North of England Institute of Mining Engineers (Support of Workings in Mines Committee) has just issued a pamphlet, "Safety in Bord and Pillar Whole Workings", for free circulation among all concerned. The 'bord and pillar' method of mining, that is, dividing a coal seam into a system of large squares or blocks ('pillars') by first developing narrow roadways (called 'bords' and 'walls') and afterwards extracting the coal left in the 'pillars', is extensively adopted in the Northumberland and Durham coalfields. The factors involved in the movement of the overlying strata when driving the narrow roadways are discussed together with the best methods of controlling the roof movements. Measurements have shown that the rate of roof movement is greatest closely adjacent to the working face and, hence, the necessity of effectively supporting this critical area so as to reduce the danger of fracture of the roof with consequent falls is stressed by the Committee.

In addition to the circulation of this pamphlet a cinematographic film has been made showing a system of coal-getting at a Northumberland colliery where the methods of roof support advocated are now in use. This film is to be exhibited throughout the northern coalfield.

Fatigue Limit of Medium Carbon Steel

IT has been known for some time that iron undergoes several small changes at temperatures between that of the room and say, 350° C. These changes can be detected by variations in several physical properties and also appear to have some influence on the mechanical properties of the material. So far, however, no attempt has been made to investigate any effect of these change points on the fatigue limit of the metal. A paper by Mr. J. W. Cuthbertson, read before the September meeting of the Iron and Steel Institute, endeavours with considerable success to fill this gap in our knowledge. He has shown that the fatigue limit of a medium carbon steel rises as the temperature is increased to about 90° C. It then falls very rapidly, and at 120° C. or thereabouts, is less than at room temperature, to what degree, however, is still unsettled. As the temperature is still further increased the fatigue limit rises again very rapidly and at about 190° C. is some three tons per square inch higher than at room temperature. A second rapid drop then ensues, and a minimum occurs at about 220° C. followed by a further small

rise. In an atmosphere of nitrogen the increase is progressive up to at any rate 350° C., but in air the fatigue limit begins to fall when the temperature exceeds about 300° C. The marked depression around 120° C. particularly is an observation of very great interest.

The paper, further, is of importance in connexion with the general measurement of fatigue limits. One method which has been suggested for their rapid determination is to plot the load deflection curve which, at first a straight line, shows a change in direction when the fatigue limit is attained. The method, however, has not been deemed completely satisfactory since certain cases are known where the results have differed appreciably from those obtained in the normal long time tests.

Mr. Cuthbertson has gone far to show that if this method is so modified that the load is steadily applied and is not increased suddenly, the results obtained are far more satisfactory, and as a practical test at any rate the method would appear to have very valuable applications.

University and Educational Intelligence

CAMBRIDGE.—Dr. G. Salt, research student of Gonville and Caius College, has been elected as first holder of the Stringer fellowship, tenable at King's College, which is open to graduate members and research students of the University whose study and research fall within the fields of chemistry, experimental physics, or the chemistry or physiology of plant or animal life. Dr. Salt is a B.Sc. of the University of Alberta, and Sc.D. of Harvard University. He was elected to a Royal Society Moseley Research Studentship in 1932.

"WHAT is General Science?" An editorial on this question in the October number of the *Progress of Education* (Aryabhushan Press, Poona; monthly, 12 annas) criticises the course proposed by the Academic Council of the University of Bombay in view of the inclusion in the matriculation syllabus of general science in place of the four alternative groups, physics and chemistry, botany and zoology, physiology and hygiene, and domestic science. The proposed course consists of only the elementary study of physics and chemistry, botany and zoology and physiology and hygiene, and the article points out that whilst this is perhaps advantageous to those who will later specialise in science, it is ill-adapted to the professed object of the change in the syllabus, namely, to equip every student with that modicum of scientific knowledge which is indispensable for the intelligent appreciation of his material environment, a knowledge as necessary to-day as that of language, history, or arithmetic. The scope of modern science and its applications is so vast that there cannot be at the matriculation stage the same general science for students with all sorts of environments and there should be, it is suggested, a choice of several courses which would include (a) for students in big cities—mainly physics and chemistry; (b) for those in rural areas—mainly agriculture and allied topics; (c) for industrial areas—practical arts like weaving, wood or iron work, machine repairs, printing, moulding; (d) for girls—domestic science; (e) for all—science of health. After matriculation, the student should supplement this course until he has acquired such further knowledge of science as he will need, not as a specialist in science but as a man of culture.

THE problem of improving examination methods has received much more attention in the United States than in Great Britain, and the Carnegie Corporation has spent large amounts in recent years in devising objective tests in modern languages. It has now taken steps to further investigations in Great Britain, and, as a result of a private international conference held in 1931 at Eastbourne, under the auspices of the Carnegie Corporation, the Carnegie Foundation, and the International Institute of Teachers College, Columbia University, five independent committees have been set up, and promised a grant for three years, in England, Scotland, France, Germany, and Switzerland, to investigate such problems connected with examination systems of the countries concerned as they deem desirable. The English "International Institute Examinations Enquiry" Committee is constituted as follows:—Sir Michael Sadler (chairman), Dr. P. B. Ballard, Dr. C. Delisle Burns, Prof. Cyril Burt, Sir Philip Hartog (director), Sir Percy Nunn, Prof. C.

Spearman, and Prof. Godfrey H. Thomson (replacing the late Prof. Graham Wallas, who was an original member of the Committee). The Scottish Committee, which is a committee of the Scottish Council for Research in Education, is constituted as follows:—Prof. Godfrey H. Thomson (convener), Dr. William Boyd, Prof. James Drever, Mr. Thomas Henderson (honorary secretary), Mr. W. A. F. Hepburn, Dr. J. Mackie, Prof. W. W. McClelland, Dr. Robert Rusk, and Dr. J. C. Smith. The chairman of the French Committee is M. Desclos, Sous-Directeur, Office National des Universités et des Ecoles Françaises, Paris; the chairman of the German Committee is Prof. C. H. Becker, formerly Prussian Minister for Education, and the chairman of the Swiss Committee is Prof. A. Malche, professor of pedagogy in the University of Geneva.

Calendar of Nature Topics

February Fill-dyke

In western Europe, February is proverbially associated with flowing streams and a damp countryside. In the French Revolutionary Calendar of 1793, the period January 20–February 18 was the month 'Pluviôse' or 'rainy', but even allowing for its shortness, February is no rainier than January or March. The name 'Fill-dyke' may have originated from the melting of the January snows, but during the present century deep snow has been rare. The title is still justified, however, for in winter evaporation is negligible and the rains of December and January replenish the underground reservoirs and leave the soil in a water-logged condition. Thus the streams are often at their highest in February and fall rapidly under the drying conditions of March.

Tilling the Soil

Writing in 1661, Mathew Stevenson in "The Twelve Moneths" says of February: "Now methinks I see the Husbandman dresse afresh his rusty plowshare to teare up the stiffer clay grounds . . ." Although mechanical science has greatly improved the structure and design of cultivating implements, until quite recently all the major cultivations, whether by horse or tractor, were on the age-old principles of the turning action of the plough or the shattering effect of the hoe. A new system is now being introduced and scientifically examined. Rotary tillage, the milling of the soil by revolving tines, instead of the bodily movement or disturbance by the drawn implement, is the most natural way in which the internal combustion engine can be directed to the comminution of the soil. Rotary cultivation is gaining ground in small occupations, where it is employed as a substitute for the joint action of spade and rake; but larger machines are being developed for full-scale cultivation, where they will do in one operation the work of tractor plough and the cultivators and harrows which follow them. The aim of all cultivation should be, so far as possible, to let the weather do the work. Alternate wetting and drying, frost and thaw, have a wonderful mellowing effect on soil, and this greatly assists the formation of a seed-bed whether by the older or newer implements. To force a tilth against the weather is an expensive operation and at best only a makeshift; but in case of need the rotary cultivator presents more opportunities in this direction than the traditional implement.

February 1. Partridge Shooting Ends

The close of the partridge shooting season is adjusted to avoid disturbance of the new season's crop of partridges, for during February the birds begin to pair. Indeed, pairing sometimes begins in January and may be delayed until March, but a mean date about mid-February justifies the end of the legal open season. The courtship period is prolonged, for eggs are scarcely to be expected until the beginning of May, and although there is an absence of the elaborate plumage displays in which many game-birds indulge, the excitement of the occasion is expressed in challenges between cocks and continual 'scrapping'.

Frost and Shore Animals

In February 1855, when Robert Chambers was in the chair, Hugh Miller described to the fellows of the Royal Physical Society of Edinburgh his experience of the result of "the late severe frost" upon the shore animals of the Firth of Forth. "The present intense frost, coincident at new moon with a stream tide, has killed many of the littoral shell-fish around our shores, and they now lie by thousands and tens of thousands along the beach. On the beach below Portobello, and for at least a mile on the western side of the town, they are chiefly of two species—*Solen siliqua*, or the edible spout-fish or razor-fish, and *Mactra stultorum*, or the fool's cockle, both of them molluscs which burrow in the sands above the low water mark of stream tides. The spout-fishes when first thrown ashore were carried away by pail and basketfuls by the poorer people, and yet of their shells enough remain, in the space of half a mile, to load several carts; but the fishes themselves, devoured by myriads of birds, chiefly gulls, have already disappeared. The *Mactra*, though they may be picked up in some places by basketfuls, are less abundant. . . . Their wholesale destruction by a frost, a few degrees more intense than is common in our climate, strikingly shows how simply, by slight changes of climate induced by physical causes, whole races of animals may become extinct. It exemplifies, too, how destruction may fall upon insulated species, while from some peculiarity of habitat, or hardness of constitution, their conquerors escape. There are two species of *Solen* in the Firth, *S. siliqua* and *S. ensis*; but we have not seen, on the present occasion, a single dead individual of the latter species; and of at least four species of *Mactra*, *Mactra stultorum* seems alone to have suffered." Later on, Hugh Miller found, in addition to these two species which at first were almost exclusively cast up, considerable numbers of smaller molluscs, amongst which *Solen ensis* was represented. Of the smaller forms *Tellina fabula* suffered most.

Frost as an agent of death was apparently selective; but absence of knowledge about the relative numbers of different species living on the shore in question, made speculation hazardous. Hugh Miller was satisfied, however, that "none of the molluscs killed in any considerable abundance by the present intense frost seem to be truly arboreal species".

Selective Mortality in Shore Waters due to Frost

A recent example, in which successive annual populations have been compared, supplies the data which Miller lacked. The early months of 1929 brought a spell of exceedingly cold weather which was duly recorded in the temperature readings taken

in the sea at the oyster beds of Blackwater Estuary. The average temperature is lowest in mid-January, when for the years 1926–28 it reached slightly under 4° C. The seashore differs from the open sea in that its water temperature shows little of the lag which throws the minimum temperature of the ocean back into March, because of the readiness with which shallow waters cool and of the inflow in estuaries of chilled fresh water from the land. Therefore exceptionally cold air temperatures were reflected over the oyster beds, so that in February 1929 a minimum water temperature of less than -1° C. was recorded. (See J. H. Orton and H. M. Lewis in *J. Mar. Biol. Ass.*, 17, 301–313; 1932; and J. H. Orton in *Acta Phænologica*, 1, 129–132; 1932.)

The result was selective destruction of the molluscs associated with the oyster beds. In 1928 the relative percentages, amongst 1,739 individuals, of three well-known species were: *Urosalpinx cinerea* 7.8 per cent, *Murex (Ocinebra) erinacea* 41.2 per cent, *Purpura (Nucella) lapillus* 51 per cent. After the great frost in 1929, the relative percentages were respectively:—1929—83.4, 0.1, and 16.6, in a total of 1,184 individuals; and in 1930—84.5, 0.1, and 15.4, in a total of 7,927 individuals. There can be little doubt that the mortality traceable in the *Murex* figures was due to the unusual conditions. Further, it was noted that on the Whitstable oyster beds, where the sea-urchin *Psammechinus miliaris* was abundant in the years 1920–28, so that Prof. Orton could obtain samples of five hundred individuals without difficulty, after the opening months of 1929 the species entirely disappeared on the shallower inshore grounds, where the hydrographical conditions are similar to those over the Blackwater beds. But in small numbers the sea-urchin could still be obtained in the deeper off-shore waters.

Societies and Academies

LONDON

Royal Society, Jan. 19. C. N. HINSHELWOOD, E. A. MOELWYN-HUGHES and A. C. ROLFE: The combination of hydrogen and oxygen in a silver vessel. The reaction shows the characteristics of a surface reaction up to 700°. There is no sign of the development of reaction chains in the gas. The inhibition of the gas reaction is attributed to the catalytic destruction at the silver-silver oxide surface of the active species which would normally propagate the chains. R. L. SMITH-ROSE: The electrical properties of soil for alternating currents; with particular reference to radio-frequencies. The first part of this paper comprises a summary of previous investigations of the conductivity and dielectric constant of soil at various frequencies from 50 cycles per second up to 200 million cycles per second. The second part of the paper describes the application of a laboratory method for measuring these constants on samples of soil taken from selected sites at the National Physical Laboratory, Teddington. The conductivity varies from less than 10⁵ E.S.U. for dry soil, up to a value of approximately 10⁸ E.S.U. for normal moisture content. Corresponding values for the dielectric constant range from 2 or 3 for dry soil up to about 20 for moist soil at high radio frequencies. Measurements on a number of samples of soil taken at random from several other sites are included, and show that both the normal moisture content and the conductivity can have values which are appreciably

higher than those experienced at Teddington. The paper concludes with a brief discussion of the penetration of radio-frequency currents in the earth, and the effective depth of penetration has been calculated in some instances. C. B. O. MOHR and F. H. NICOLL: (1) Inelastic electron scattering in gases. The angular distribution of inelastically scattered electrons has been investigated in helium, argon and mercury vapour for the angular range between 20° and 160° . The scattered electrons of different energies were sorted out by a uniform radial electrostatic field. The results suggest that the problem of the scattering of electrons by atoms is not so serious as might be expected from a consideration of the various complicating processes which are involved, and that in the explanation of the observed results for the elastic and inelastic scattering of electrons by the heavier atoms, it is merely the 'size' of the atom which is of fundamental importance. (2) The large angle scattering of electrons in gases (2). With an apparatus described in a previous paper the angular distributions of scattered electrons have been measured to 160° for 30-150-volt electrons. The elastic scattering has been investigated in hydrogen, carbon dioxide, nitrogen, neon, methane, hydrogen sulphide, and phosphine, while the inelastic scattering has also been measured in the first four gases. The diffraction maxima and minima which appear in the inelastic angular distributions are closely similar to those obtained for the elastic scattering. The curves for the elastic scattering show a gradual change in form for successive elements in the periodic table. The general shape of the experimental curves for the elastic and inelastic scattering is qualitatively accounted for, with the aid of a simple picture involving merely the 'size' of the atom.

PARIS

Academy of Sciences, Dec. 5 (195, 1049-1112; 1932). L. CAYEUX: The modes of existence of glauconite in limestone. A discussion of the relation between the presence of glauconite and Foraminifera in limestone. EDM. SERGENT, A. DONATIEN, L. PARROT and F. LESTOQUARD. The experimental suppression of sexual reproduction in *Theileria dispar*. In this organism, which by the artificial means of blood transfusion is perpetuated by schizogonic multiplication, the sexuality disappears. As a practical consequence, a benign virus of theileriosis can be used as a vaccine without creating carriers of dangerous germs. BERTRAND GAMBIER: The intersection of two plane algebraical curves. JACQUES DEVISME: A quasi-Euclidian space of three dimensions connected with P. Humbert's equation. MAURICE GEVREY: Complements to a preceding note on systems of the parabolic type: problems with non-linear limits. ED. and G. GUILLAUME: The definition of the unit of value. RENÉ LUCAS: The diffraction of light by elastic waves. G. A. BEAUVAIS: The total reflection of Hertzian waves. Experimental study of the reflection of Hertzian waves (18 cm. wave-length) by a paraffin wax prism. MAX MORAND and A. HAUTOR. The fine structure of the carbon line K_α . The line is complex and contains at least two components: the approximate distance of the two components is 0.6 Å. ADRIEN KARL: The analysis of primary radioactive minerals. The method is based on the treatment at 500° - 550°C . with carbonyl chloride, thus removing metals forming volatile chlorides. JEAN GALIBOURG: Certain singularities of the extension curves of steels at high temperatures.

P. VALLET: Study of the decomposition of some complex platinum compounds at progressively increasing temperatures. Experiments on the reduction of chloroplatinic acid and its salts, with the view of preparing finely divided platinum at the lowest possible temperature. A. PERRET and A. M. KRAWCZYNSKI. The action of some organo-mercury compounds on solutions of hexamethylene-tetramine. R. SUTRA: The acetolysis of starch. P. CARRÉ and D. LIBERMANN. The mechanism of the reaction of phosphorus pentachloride on neutral alkyl sulphites. The primary reaction gives phosphoryl chloride, alkyl chloride and the chloride AOSCl, where A is the alkyl group. Four secondary reactions may occur, depending on the temperature. CH. PRÉVOST. A colouring matter derived from tripropynylcarbinol. HUBERT CERF: Researches on the nitro-amines. AURÉLIO COCCO: A new method of amination of organic compounds. PAUL GAUBERT. The rotation of crystals floating on the surface of liquids. H. LAGOTALA and CH. COUCHET. The tectonic on the French Congo. LOUIS MENGAUD: The structure of the Cantabrian chain. P. RUSSO: The tectonic significance of the folds with reference to the Eocene to the east of Kasbah Tadla (Central Morocco). ALBERT DE LAPPARENT: The neighbourhood of Bauduen (Var). FRANCIS RUELLAN: A bank of shingle and a fossil sea floor in the cliffs of Trez-Bihan at Telgruc (Finistère). G. GRENET: The geothermic gradient in Limagne. Advantage was taken of a 200 metre boring to measure the temperatures at a depth of 192 metres and at the ground level. The results were in good agreement with the earlier observations of Macholles, confirming the view that the geothermic gradient is of the order of 14 metres over the greater part of the Limagne. A. SAVORNIN: Some measurements of magnetic anomalies at Madagascar. Data are given for 23 stations: the observations were made in May and June, 1932. L. J. and F. MERCIER: A new method of preparing marrubiine. A simplification of Gordin's method of extraction from the plant, yielding a crystalline product melting at 3°C . higher than Gordin's product. EM. MIÈGE: The anabiosis and revitalisation of wheat embryos. ALEXANDRE LIPSCHÜTZ: New researches on the transplantation of ovaries preserved outside the organism. An ovary, isolated and kept at 12° - 18°C . for eleven days, has survived as an intrarenal graft for two years: another dried before transplantation, after losing about 40 per cent of its weight, has survived as an intrarenal graft for 30 months. P. CHEVEY: The nature of the influence exercised by the inundated forest of the Grand Lac of Cambogia on the velocity of growth of fishes. Mlle. YVONNE GARREAU: The oxidation products of levulose by ammoniacal copper carbonate and atmospheric oxygen, in dilute solution, $\text{pH}=7$, and at the ordinary temperature. Oxalic acid and oxymethyl-4-imidazol were identified among the oxidation products. A. ROCHAIX, P. SÉDALLIAN and MME. CLAVEL: Inhibiting properties towards *A* paratyphic, shown in paratyphic cultures.

GENEVA

Society of Physics and Natural History, Nov. 3. G. TIERCY and P. BERGER: Note on aerological soundings and the wind gradient in Switzerland. Pilot balloons give very uncertain results. The theoretical equation for the vertical movement of pilot balloons shows that the upward velocity of the balloon is continually varying, starting from the ground. The

velocity of the wind theoretically calculated and based on good observations in the mountains corresponds better with the true wind velocity. G. GUTZEIT and R. MONNIER: The utilisation of some azo derivatives of oxyquinoline as reagents in qualitative analysis. In a preliminary study, the authors describe the spot colour reactions of the cations of the heavy metals with several azo derivatives of oxyquinoline. The presence of a sulpho group in the substituted molecule makes the colour reactions more clear. H. LAGOTALA: The stratigraphical study of the Mindouli-Mines region. The author makes clear the stratigraphical complexity of this part of the French Congo, due to numerous faults leading to repetition of facies. J. WEIGLE: Dispersion in the Hertzian domain. Experiments show indubitably that polarised molecules dissolved in a viscous medium associate in part to form large groups in the solvent. Certain X-ray measurements had suggested this arrangement, but the full proof had been lacking up to the present.

Forthcoming Events

Monday, Jan. 30

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—(Geographical Film).—Lieut.-Commander J. L. F. Hunt: "The Sahara and the Ivory Coast".

Wednesday, Feb. 1

UNIVERSITY COLLEGE, LONDON, at 5.30.—K. Ryde: "The Reference Library of a Modern Town and What it Can do for You".

Thursday, Feb. 2

UNIVERSITY COLLEGE, LONDON, at 5.30.—(Newman Lectures in Statistics).—Dr. L. J. Comrie: "Modern Methods of Calculation" (succeeding lectures on Feb. 9, 16, 23, March 2 and 9).

Official Publications Received

GREAT BRITAIN AND IRELAND

The Quarterly Journal of the Geological Society of London. Vol. 88, No. 4 (second half), No. 352 (second half), December 29th. Pp. 711-916+plates 47-62. (London: Longmans, Green and Co., Ltd.) 7s. 6d.

Quarterly Journal of the Royal Meteorological Society. Vol. 59, No. 248, January. Pp. 94. (London: Edward Stanford, Ltd.) 7s. 6d.

The Slaughter-House Problem: being the eleventh Benjamin Ward Richardson Memorial Lecture delivered before the Modern Abattoir Society at the Royal Sanitary Institute on November 30th, 1932. By T. Topping. Pp. 16. (London: Model Abattoir Society.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 8, No. 1, January. Pp. 105. (London: Cambridge University Press.) 12s. 6d. net.

The Proceedings of the Physical Society. Vol. 45, Part 1, No. 246, January 1. Pp. iv+133. (London: Physical Society.) 7s. net.

Medical Research Council. Special Report Series, No. 176: Third Report of the Miners' Nystagmus Committee. Pp. 36. (London: H.M. Stationery Office.) 9d. net.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 2, No. 14: Submarine Faulting in Kimmeridgean Times—East Sutherland. By Prof. E. B. Bailey and Dr. J. Weir. Pp. 429-467+3 plates. 6s. Vol. 57, Part 2, No. 15: Development and Probable Evolution of the Suctorial Disc in the Tadpoles of *Rana afghana* Gunther. By Dr. Sunder Lal Hora. Pp. 469-472+1 plate. 1s. Vol. 57, Part 2, No. 16: The Innervation of the Uterus. By Dr. Amy M. Fleming. Pp. 473-490+4 plates. 4s. Vol. 57, Part 2, No. 17: Contributions to the Study of the Old Red Sandstone Flora of Scotland. 8: On Arthrostroma, Psilophyton, and some associated Plant-Remains from the Strathmore Beds of the Caledonian Lower Old Red Sandstone. By Dr. W. H. Lang. Pp. 491-521+4 plates. 5s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Twenty-fifth Annual Report, 1931-32, presented by the Council to the Court of Governors on the 25th October, 1932. Pp. 44+5 plates. (Cardiff.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 72, No. 433, January. Pp. 92+xxii. (London: E. and F. N. Spon, Ltd.) 4s. 6d.

OTHER COUNTRIES

Indian Lac Research Institute. Annual Report for the Year 1st April, 1931, to 31st March, 1932. Pp. 44. Bulletin No. 10: The Influence of Orpiment in Shellac on the Protective Properties of the Varnish. By M. Rangaswami. Pp. 8. 8 annas. (Nankum, Ranchi.)

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 15: July, August, September, 1932. By Ernest A. Hodgson. Pp. 247-261. (Ottawa: F. A. Acland.) 25 cents.

Indian Forest Records. Vol. 15, Part 5: Provisional Volume Tables and Diameter Growth Curve for Semal (Bombax malabaricum DC.) in the Central Provinces. By Ishwar Das Mahendru. Pp. ii+6. 2 annas; 3d. Vol. 15, Part 6: Branch Smallwood Tables for Shorea robusta, Tectona grandis, Cedrus deodara, Pinus excelsa and P. longifolia. Pp. iii+7. 3 annas; 4d. (Calcutta: Government of India Central Publication Branch.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 4: Geology and Mineralogy. Vol. 1, Nos. 3-4, November. Pp. 257-390+plates 19-52. (Sapporo.)

Report of the Secretary of the Smithsonian Institution for the Year ending June 30, 1932. (Publication 3183.) Pp. vii+89. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 81, Art. 18: On a Newly Mounted Skeleton of Diplodocus in the United States National Museum. By Charles W. Gilmore. (No. 2941.) Pp. 21+6 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Geological Survey. Fifty-third Annual Report of the Director of the Geological Survey to the Secretary of the Interior for the Fiscal Year ended June 30, 1932. Pp. ii+94. 10 cents. Bulletin 837: Tertiary and Quaternary Geology of the Lower Rio Grande Region, Texas. By A. C. Trowbridge. Pp. viii+260+45 plates. 75 cents. Professional Paper 174: Physiography and Glacial Geology of Eastern Montana and adjacent Areas. By William C. Alden. Pp. viii+133+51 plates. 1 dollar. (Washington, D.C.: Government Printing Office.)

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Edited by Dr. Joseph Pearson. Vol. 17, Part 1, October 11th. Pp. 71+11 plates. 3 rupees. Vol. 17, Part 2, November 3rd. Pp. 73-148+plates 12-27. 3 rupees. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.)

The University of Colorado Studies. Vol. 20, No. 1: Abstracts of Theses for Higher Degrees, 1932. Pp. 113. (Boulder, Colo.) 1 dollar.

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