



SATURDAY, APRIL 16, 1932

CONTENTS

	PAGE
Scientific Aspects of Fiscal Policy	557
Social Economics	558
A Survey of Radioactivity. By A. S. R.	560
The Migratory Impulse of Birds. By Prof. E. W. Macbride, F.R.S.	561
Psychic Sounds	562
Short Reviews	563
Flame Movements in Gaseous Explosions. By A. C. E.	565
Screen-Plate Colour Photography. By L. C. M.	566
Industrial Bursaries. By R. T. G.	567
Obituary:	
The Right Hon. Sir Horace Plunkett, K.C.V.O., F.R.S. By A. D. H.	568
Mr. H. Chapman Jones. By J. C. P.	570
Dr. Michael Perkins. By J. H. Q.	570
News and Views	571
Letters to the Editor:	
Hexuronic Acid as the Antiscorbutic Factor.—J. L. Svirbely and Prof. A. Szent-Györgyi; Prof. W. N. Haworth, F.R.S.; Dr. E. L. Hirst and R. J. W. Reynolds	576
Biological Estimation of the Quality of Sewage Effluents.—Dr. L. Lloyd	577
The Variation of Penetrating Radiation with Zenith Distance.—Gilberto Bernardini	578
Geophysical Prospecting.—Prof. T. H. Laby	579
Automatic Recording of Heavyside Layer Heights.—Eric L. C. White	579
Photo-Conductivity of Diamonds.—Sir Robert Robertson, K.B.E., F.R.S., Dr. J. J. Fox, and A. E. Martin	579
The Hydrogen Chromosphere.—J. Woltjer, Jr.	580
Polarisation of Raman Scattering.—S. Bhagavantam and S. Venkateswaran	580
Constitution of the Keratin Molecule.—Dr. Claude Rimington	580
Preparation of Anhydrous Chlorides and Metallic Couples.—S. D. Nicholas	581
Degree of Weathering of Soils.—Prof. G. W. Robinson and Dr. Minnie Richardson	581
Function of the Spiracles of Insects.—T. L. Green	582
Preparation and Mounting of Deliquescent Substances.—Nora Wooster and A. J. P. Martin	582
Research Items	583
Astronomical Topics	585
The Wheat Problem	586
Recent Excavations in British Honduras	586
Forecasts of Fisheries. By G. A. S.	587
Mobilities of Atmospheric Large Ions. By E. V. N.	588
University and Educational Intelligence	588
Calendar of Geographical Exploration	589
Societies and Academies	589
Forthcoming Events	592
Official Publications Received	592

Scientific Aspects of Fiscal Policy

IN a pamphlet entitled "The State and Industry in 1932", printed for private circulation, Capt. Harold Macmillan, M.P., elaborates further the scientific policy which should be the natural accompaniment of the British Government's general tariff plan and the creation of the Import Duties Advisory Committee (see NATURE, Feb. 20, 1932, p. 271). Capt. Macmillan directs attention to the positive aspects of this new departure in fiscal policy, to the administrative problems which it presents, and to the vital importance that the opportunities under the new policy of securing the development of our industries on deliberately planned lines should be wisely, efficiently, and expeditiously used. The administrative methods adopted make the Import Duties Advisory Committee the keystone of the structure, and upon its efficient functioning depends the success of the whole policy. Altogether apart from the abilities of those chosen for this work, there is serious danger that the Committee may become a bottle-neck rather than an efficient clearing-house, resulting in delays exasperating to the applicants and endangering precariously situated industries, or in ill-considered judgments which will later bring discredit upon the Committee and upon the policy it is endeavouring to apply.

The execution of a constructive policy which is to be prospective and not merely retrospective involves the consideration by the Committee of many involved and highly technical problems on which it will require expert advice, and Capt. Macmillan proceeds to discuss the methods by which such expert advice can be obtained from representatives of industry before blockage occurs and irreparable damage to public confidence has been done. In doing so, Capt. Macmillan stresses the complexity of the economic problems involved and the high degree of social co-ordination required for their solution.

Scientific advance and large-scale production have so knit the nation into a compact unit that almost every question is now a national question and every action taken has its repercussions through the whole economic structure. While the field of Government responsibility is constantly increasing with every effort to deal with the acute problems arising out of changes in the balance and technique of production throughout the world, the close relation of those problems to industry involves increasing dangers from bureaucratic methods. Capt. Macmillan sees in the existence of a National Government an opportunity of reviewing the whole

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situation and avoiding a drift into future difficulties, by inquiring into the whole agenda of government and, if necessary, providing new machinery.

To enable the Committee to exercise a guiding hand in the wider problems of reconstruction and to liberate it from detailed consideration of separate applications for additional duties, and at the same time to preserve industrial self-government, Capt. Macmillan suggests as the necessary liaison with industry a representative Department of Industry or an industrial sub-parliament consisting of two or three representatives from national councils for industries or groups of industries. These representatives would be available for consultation by the Import Duties Advisory Committee in its efforts to reconcile the interests of producing and consuming industries where protective measures were under discussion, following the precedent of the Dyestuffs (Import Regulation) Act, and, if unsuccessful in reaching a satisfactory agreement, would enable the necessary information to be collected and the Committee to reach a rapid decision.

This 'sub-parliament' would consider questions for the adequate discussion of which there is no present provision, including the displacement of labour through rationalisation; the balance of national production in the light of home requirements and export possibilities; the possibilities for the expansion of certain industries and provision for contraction of others; the conditions required for the development of new industries suitable to the country; the distribution of employment and its relation to housing, transport, road, water, gas, and electricity facilities; the gap between producers' and consumers' prices; the variation in wage rates between productive industries and sheltered services; the closer co-ordination of British financial organisation and British industry; the complementary development of British Empire production; the protection of any one industry from the high costs of inefficiency in another.

These proposals, which thus envisage the co-ordination of national activity in the general interests of trade and industry, are rightly regarded as involving a functional system of representation, and on this ground alone would merit the attention of scientific workers. Although some skeleton organisation already exists in the Federation of British Industries and the Association of British Chemical Manufacturers, etc., which covers the ground to a limited extent for the chief industries of Great Britain, other industries are less effectively organised for the expression of representative views.

The plea for the scientific examination of these

difficult questions, for the substitution of decisions based on ascertained facts instead of opinions which may or may not be prejudiced, and, above all, for the evolution of a definite plan on national lines to which sectional interests are subordinate, must command the sympathy of all scientific workers. Their support and help will be demanded in many ways if answers are to be found to the intricate technical and scientific questions involved; and if the evolution of a planned economy involves to some extent a transition to functional representation in parliament, it will undoubtedly indicate simultaneously ways in which the knowledge and training of the scientific expert can be more efficiently placed at the service of the community for the solution of the innumerable social, economic, political, and industrial problems in which vital scientific factors are involved.

Social Economics

The Work, Wealth and Happiness of Mankind.

By H. G. Wells. Pp. xiii + 850 + 32 plates.

(London: William Heinemann, Ltd., 1932.)

10s. 6d. net.

MR. WELLS writes of himself: "He is attempting a book, a survey of the world, a scheme and map of *doing*, which will enable him to say to anyone whatever: 'This is the whole world of work and wealth, of making and getting and spending, and here at this point is your place, and this is where you come in. . . .'" Seeking Mr. Wells's place in his own scheme, we find that he claims for his book the function of transmitting, correlating, and interpreting for the general mind the essential living thought of the world. In his "Outline of History" and "Science of Life" he attempted this task for history and for biology; now it is the turn of economics and sociology. Mr. Wells holds that mankind's ideology, or system of ideas about life in general, has become dangerously out of date, and out of correspondence with the realities of human affairs, since the "change of scale", the "abolition of distance", of the last few decades. He regards as essential for a modern ideology some understanding of world history (as against local, national, and period history), some assimilation of biological ideas, and—most urgently necessary of all—some conception of economic life, industrial processes, trade, and finance. Valiantly he has attempted to supply all three sides of this ideological triangle, and his third compendium, like its forerunners, is a remarkable, stimulating, valuable, and most readable book.

In the development of a modern ideology, the first step, says Mr. Wells, is to learn to think. "Most of us do not think enough about thinking." Children and primitive peoples do a large part of their thinking by imagination; their thinking is a spontaneous, uncontrolled flow of images, with which impulses to act are connected. There is no critical element, and scarcely any use of generalisations or abstract ideas. Things not themselves physically real are apprehended in a symbolical and often a personified form. The thinking of many adults is still of this kind, corresponding to what has been called the 'mythological' phase of human development. This was followed by the gradual appearance of exacter discrimination; the mythological passed insensibly into the metaphorical; abstraction became possible; classification and examination of ideas began, and 'logical' thinking followed.

"This change from a mental life that was merely experience-checked imagining to an analytical mental life aiming at new and better knowledge and leading on to planned and directed effort, is still in progress. . . . Over a large range of his interests man has still to acquire the habit of thinking with self-control and precision." "The man who orders his knowledge and thinks things out is as far above the natural man of impulse and traditional usage as the latter is above an ape which has not even tradition but only instinct."

Logical thinking, however, contains in itself a pitfall: Are words as true as material facts, or truer, or less true? If they are truer, then a logical conclusion is truer than an experience, and that, on the whole, was the 'Realist' assumption of classical and medieval times, the view that classes or Platonic ideas were the only reality, the view which nowadays is sometimes loosely called 'Idealism'. Realism was opposed by the 'Nominalist', for whom an experience is truer than a word. The defeat of philosophical Realism over large areas of human interest in the late Middle Ages and after was a necessary preliminary to the release of experimental science, and to the material triumphs following on the application of the scientific method of 'trying back to facts' all the time.

"The discovery of Evolution, the realisation, that is to say, that there are no strict limits set to animal and vegetable species, opened the whole world of life and its destiny to Nominalist thinking. The realisation by the world of mathematical physics that the universe can be represented as a four-dimensional universe of unique events has abolished the conception of a quantitative equivalence of cause and effect and made every atom unique."

The detachment of logical thinking from the Realist predispositions of the human mind remains, however, incomplete, and in the world of international politics the Realist way of thinking holds almost undisputed sway and lies at the root of the greatest dangers that threaten our race.

"Plainly a man who takes the Nominalist way and regards such a word as 'France' as merely covering a great area of country, climatic and social associations, and about forty million human beings of very diverse kinds (numbers of them not even speaking French) will regard international politics from an entirely different angle from a Realist who finds in the word France something more real and vital than any single individual or thing that contributes to the ensemble of that idea. . . . The Nominalist and Realist of contemporary life, all unaware of this difference in the very elements of their thought, find each the other stupefyingly obtuse. . . . The Realist 'patriot' calls his brother Nominalist 'traitor' or 'cosmopolitan scoundrel', and the like, and is amazed that he does not wince; the Nominalist humanitarian calls the Realist, obdurate dogmatist or romanticist, and accuses him of a perverse taste for contention and blood."

Mr. Wells, then, would have mankind abandon emotional for logical thinking, and in logical thinking beware of 'Realist' assumptions and remember the fruitfulness of the scientific appeal to fact. His early chapters recite some of the practical triumphs of science; the conquest of materials—iron and steel, rubber, petroleum, dyes, drugs, cellulose—the conquest of power, the organisation of transport, the transmission of facts, the application of artificial fertilisers and mechanical methods to agriculture, all the modern developments in the feeding and clothing and housing of mankind. He discusses the ways in which work is organised, and then turns aside to inquire why people work. He divides mankind into three classes, according to their guiding idea of themselves, or "persona": the "peasant", characterised by the idea that toil is virtue, and by intense acquisitiveness; the "aggressive nomad", generous, reckless, and rapacious; and the "educated" man, originally priestly in function, who works not for his own enrichment, or for his own honour and glory, but is devoted to some end transcending personal considerations. With the peasant type and derived from it, Mr. Wells places the peasant-minded townsman, giving rise on one hand to a crop of "petty" and "big bourgeois", and on the other to a multitude of "expropriated" proletarians who have lost their grip upon property.

The peasant persona and its modifications will tend to cause the possessor to work for personal

gain, the nomad persona for personal glory, the educated persona for some ideal of service. Mr. Wells denies the Individualist creed that the peasant-craving for tangible property generally is a fundamental incentive to work. "The human animal wants a feeling of security and it wants freedom and the feeling of power. These wants are truly fundamental." The experience of the educated types shows, he thinks, that the satisfaction of these desires can be guaranteed in quite other ways than by the actual possession of land, wife, children, goods, and chattels. With the extension of literacy, the mentality of the learned clerk begins to penetrate everywhere, carrying its traditional disposition to find the satisfaction of good achievement greater than the satisfaction of possessions. The search for security, comfort, and liberty becomes the ruling motive in keeping mankind busy.

Mr. Wells pauses to note a common confusion between independence and liberty: "independence is no doubt being abolished . . . in the case of individuals just as in the case of sovereign states, but independence is not freedom. An 'independent' peasant or small tradesman is tied, with scarcely a day's holiday, to his cultivation or his shop." But the worker under modern conditions has real personal freedom in the way of daily leisure, holidays, choice of activities and purchases. To provide such modern satisfactions, and to free himself from tangible burthensome ownership, man has made use of the abstraction of a monetary system. Mr. Wells discusses currency, financial methods, banking, and investment, and gives an account of the world depression with the monetary factors well emphasised. He describes recent proposals for monetary reform, indicating here, as in many other parts of the book, the imperative need for international action.

The closing chapters bring him again to education, and to his reiterated thesis that a civilised World State can only develop in correlation with the spread of the 'educated' persona, with the replacement of the motives of profit and privilege by the motive of service in affairs of every kind. Such a co-operative outlook has become essential; nothing less than world planning for political and economic change can avert disaster. Mr. Wells is optimistic enough to believe in the necessary educability of mankind, for is not educability the main distinguishing characteristic of *Homo sapiens*?

If "The Work, Wealth and Happiness of Mankind" is not on the whole as satisfactory as the "Outline of History" or the "Science of Life",

the defect is probably inherent in the less developed state of economic science as compared with history or biology, and perhaps also in our more primitive type of thought on economic subjects. One misses those diagrams and tables which were so useful a feature of the two earlier books, and which are replaced by a few casually selected photographs in the present volume. Yet Mr. Wells has given us what is likely to remain for a long time the most comprehensive and lucid account available of the tangled complexity of economic processes in their human aspect, and the ways in which those processes are affected by the decisions we all have to make.

A Survey of Radioactivity

Lehrbuch der Radioaktivität. Von Georg v. Hevesy und Fritz Paneth. Zweite, völlig umgearbeitete Auflage. Pp. xii + 287. (Leipzig: Johann Ambrosius Barth, 1931.)

THIS book was first published in 1923 and immediately found an appreciative public on the Continent. It became more widely known to British and American readers in 1926 when it was brought up to date and translated. That edition was reviewed in these pages at the time (see NATURE for Oct. 2, 1926, p. 475).

The work has now been thoroughly rewritten, revised, and enlarged to embrace the more important advances made in the subject since 1923. The new matter forms about a quarter of the present book. It deals with such subjects as the radioactivity of potassium and rubidium, the 'packing effect', the structure of the nucleus, the distribution of electrons in atoms, the origin of the actinium series, and the interpretation of the facts of radioactivity on the new quantum mechanics.

The data of radioactivity have been brought up to date and given accurately. In one or two cases where constants have different values from those given in "Radiations from Radioactive Substances", they are those approved by the International Radium Standard Committee, the report of which appeared recently. They give the half-value period of the potassium isotope of mass 41 as 7.5×10^{11} years on the assumption, indicated by the experimental work of the senior author, that this mass is responsible for all the β -particles emitted. They follow Lord Rutherford and Dr. F. W. Aston in deriving the actinium series from a uranium isotope of mass 235. This is, of course, the right thing to do at present, since there is little or no doubt that the series ends on the mass actinium-D,

207, but a series of products, the masses of some of which are of odd number, may not have the simplicity of the thorium and radium series, where the only massive particle expelled is the α -particle. There is a possibility that another massive particle is expelled. The final work of Dr. F. W. Aston on the complexity of uranium should be an important contribution to this interesting problem. In the tables of isotopes and elements the new isotopes of carbon, nitrogen, and oxygen found by American workers are included, but nothing is said about elements 61, 85, and 87, except that they are still undiscovered.

This new edition has had the great advantage of being revised after the publication of the authoritative work of Lord Rutherford, J. Chadwick, and C. D. Ellis. Its authors have succeeded in making it an informative, critical, and accurate textbook, covering not only the physical side of the subject with its many topics, but also the chemical and geological sides. It is wider in scope than the larger and more learned treatises. It is clearly written, and the text gains much from the fifty figures and nearly fifty tables which accompany it. It should be on the shelves of every physicist and inorganic chemist reading German who wishes a general, as opposed to a highly specialised, knowledge of this interesting range of subjects.

A. S. R.

The Migratory Impulse of Birds

The Riddle of Migration. By William Rowan. Pp. xiv + 151. (Baltimore, Md.: The Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1931.) 11s. 6d. net.

THE author of this book is professor of zoology in the University of Alberta and he has most courageously undertaken the experimental study of the causes of the migration of birds. Some most astounding facts—experimental and observational—are recorded in his book. Edmonton, the city in which the University is situated, has wonderful advantages for this study. The tremendous contrast between the seasons in Canada compels practically all the birds to migrate. The minimum temperature in winter may drop to -52° F., whilst the summer temperature may rise to 100° . Then to the north an unbroken plain stretches to the shores of the Arctic Ocean, whilst to the south-east a similar plain reaches the Gulf of Mexico, so that the physical obstacles to migration are slight.

Preliminary observations had suggested to

Prof. Rowan the theory that the impulse to migration might arise from the swelling genital organs; and accordingly he selected a common native bird, the junco sparrow, as the subject of his experiments. This bird has about the size and appearance of the ordinary British sparrow, but it is at once distinguished from our sparrow by the white colour of its under-side and of the outer tail-feathers. A number of juncos were confined in a large cage and subjected to the influence of a powerful electric light for periods approximating to the length of a summer day until the winter solstice, whilst an equal number of controls in another cage experienced the gradually decreasing hours of daylight. Both cages were unheated. The gonads of the controls shrunk in size until at Christmas time they were mere shrivelled rudiments, whilst those of the illuminated birds grew in size and by January had attained almost their maximum development. Further, whilst the control birds remained inactive and were silent, the illuminated birds were in full song in the middle of winter.

The mode of action of the light was next considered. Was its action direct or did it act by keeping the bird in a high state of vitality? The answer to this question was found by keeping two sets of juncos in practical darkness, broken only by the glimmer of electric 'night-lights'. In one cage the controls were kept, whilst in the other an ingenious arrangement of moving perches was installed so that the birds had to keep hopping up and down. These birds developed large gonads in spite of the darkness and the cold.

We may say that this result of Prof. Rowan's is confirmed by the experience of poultry-breeders in eastern Canada. 'Christmas eggs' were notoriously difficult to obtain in Canada, and their price used to reach fantastic heights. The old practice was to keep the birds in closed hutches heated by oil lamps. They became comatose in winter and refused to lay. Then the experiment was made of keeping them in hutches sheltered above but open below to the ingress of fresh air, and entirely unheated. The grain given as food was mixed with bran and sawdust, so that the birds had to kick and scratch vigorously to find it. These birds continued to lay eggs all through the winter.

It is therefore established that the impulse to migrate northward in the spring is called forth by swelling gonads. But how do the birds find their way over such enormous distances? According to the author, the Pacific plover annually migrates from British Columbia to Hawaii over two thousand

miles of sea; the golden plovers winter in Mexico and Central America, and when, after finishing their breeding, they return to their winter homes, the adults go through the eastern States and even over the sea, whilst the young leave after the adults and fly directly south through the central plains.

Only two plausible explanations of migration have ever been put forward: (1) that it is due to tradition and memory, (2) that it is the result of inherited habit. Prof. Rowan suggests that quite possibly the first explanation will hold for the movement of the older birds, since there is a rich harvest of autumn berries to be found on the east coast, but only the second will avail to account for the migration of the young birds, since they have never been south before. Prof. Rowan pathetically remarks that this second explanation has a dangerous resemblance to Lamarckism, and that although no one has disproved Lamarckism, yet all the most elaborate experiments designed to test Lamarckism have given a negative result.

Prof. Rowan may take heart: the elaborate experiments referred to—presumably Weismann's attempts to show that the mutilation of the tail is not inherited in mice, Brown-Sequard's assertion that epilepsy in mice induced by spinal section was transferred to offspring, etc.—were planned to prove something which Lamarck himself would have utterly repudiated. Lamarck says, "But whatever environment may do, it does not work any direct modification in the shape and organisation of animals, but great alterations in the environment of animals lead to great alterations in their needs, and these alterations in their needs lead to others in their activities. Now if the new needs become permanent, the animals adopt new *habits* which last as long as the needs which evoked them. All these are preserved by reproduction to the new individuals which arise." An 'acquired character', therefore, according to Lamarck, is an acquired habit, and if Prof. Rowan will look into the matter he will find that there is abundant experimental evidence for the effect of acquired habits on the next generation—not in the sense that the young retain in full force a habit acquired by the parent in a different environment, but that the young exhibit a trace of the parental habit, a trace which can be strengthened by constant repetition.

Prof. Rowan is at present engaged in testing whether his birds forced into sexual maturity during the winter will migrate if released, and, if so, in what direction. The control of this experiment

is obviously extremely difficult, owing to the wide field open to the migrants and the difficulty of recapturing the migrants. At the time of writing his book little progress had been made, but we understand that since that time Prof. Rowan has had more success, and we look forward with interest to the appearance of a second edition of his book.

E. W. MACBRIDE.

Psychic Sounds

On the Edge of the Etheric: being an Investigation of Psychic Phenomena based on a series of Sittings with Mr. John C. Sloan, the Glasgow Trance and Direct Voice Medium. By J. Arthur Findlay. Fifth impression. Pp. 177. (London: Rider and Co., 1932.) 3s. 6d. net.

THIS volume, which has reached its fifth impression in four months, is the record of a series of sittings with a Scottish 'direct-voice' medium. The author, who during his residence in Glasgow was a well-known business man, was fortunate in having secured a considerable number of sittings with this medium—an ordinary working man, by name John C. Sloan—who is said to possess the most marvellous powers. Not only is he clairvoyant and clairaudient, whatever these terms may mean, but also in his presence, and generally in darkness, voices are heard which purport to be those of deceased persons, voices which are recognised by their friends and relatives still alive, and give striking evidence of identity.

Mr. Findlay is of opinion that Mr. Sloan is certainly not normally responsible for these voices, and he has come to the conclusion that they are what they purport to be; the spirits borrowing material wherewith to form some kind of materialised 'mask' in the likeness of a mouth and throat with which they make intelligible sounds. This borrowed substance is alleged to be taken from the medium and sitters, and is then manipulated by the unseen entities for the purpose for which it is intended. Although Mr. Findlay claims to be interested in physics, and therefore, presumably, in scientific work, he appears to have made no experiments to test this remarkable phenomenon, concentrating his attention upon the evidence given by the voices in support of their claims, and, even more oddly, upon the information vouchsafed by the spirits regarding their surroundings. Much of this material seems clearly derived from popular manuals dealing with the supposed 'etheric' body, and a good deal of it is directly traceable to spiritualistic literature having a wide circulation.

The book is typical of many that are being published to-day. No one can deny that the phenomena, as they are described, are puzzling, and, if independent examination confirmed the account here printed, are worthy of the closest scientific scrutiny. But from reading Mr. Findlay's records, the scientific method might be thought not to exist. He seems to have no appreciation of the implications underlying many of his remarks; no desire to see the phenomena described in accurate and scientific terminology. The explanations given by the spirits (who include, it may be added, Huxley, Faraday, and Wallace) are just what would be expected from a man who had read the works of Lodge, Crawford, and Schrenck-Notzing, and had combined scraps of each for his purposes. As explanations, they are worthless: as suggestive of human origins, they are significant.

Short Reviews

(1) *International Address Book of Botanists: being a Directory of Individuals and Scientific Institutions, Universities, Societies, etc., in all parts of the World interested in the Study of Botany.* Prepared in accordance with a Resolution passed at the Fifth International Botanical Congress, Cambridge, 1930. Published for the Bentham Trustees. Pp. xv + 605. (London: Baillière, Tindall and Cox, 1931.) 12s. 6d. net.

(2) *A Biographical Index of deceased British and Irish Botanists.* Compiled by James Britten and George S. Boulger. Second edition, revised and completed by Dr. A. B. Rendle. Pp. xxii + 342. (London: Taylor and Francis, 1931.) n.p.

(1) At the Fifth International Botanical Congress held at Cambridge in 1930, the necessity for a new address book of botanists of the world was emphasised and an International Committee was appointed to make all arrangements for the publication of such a book. The Committee consisted of Prof. L. Diels (Berlin), Dr. E. D. Merrill (New York), and Major T. F. Chipp (London). After Major Chipp's untimely death in 1931, his share of the work was carried on by Miss M. Verbrugge. This volume is the result of the splendid effort of the Committee. Realising that it would be impossible to incorporate all available information in a compact volume of useful size, the compilers have made a wise choice of material and given such facts as they decided would be most sought after.

The arrangement is by countries alphabetically. The entries in each country include botanical societies, institutions (wholly or chiefly botanical), educational institutions having botanical departments, and an alphabetical list of professional and amateur botanists with their offices, qualifications, addresses, and special botanical interests.

It is certain that this book will prove invaluable to botanists throughout the world.

(2) Though the title would scarcely suggest it,

this book has proved very useful to botanists in the past, thus calling for a second edition. The compilers have been liberal in their choice of names to be included in the list, though nothing is redundant. The names are arranged alphabetically and are followed by dates of birth and death (in most cases place of burial has been omitted in the second edition), position and occupation, titles and degrees, dates of election to the Linnean and Royal Societies, reference to botanical work, portraits, and genus or species dedicated to the person in question.

The information, brought together in 342 pages, should be of great use to botanists in general, and especially to British botanists.

A Handbook of the British Seaweeds. By Prof. Lily Newton. Pp. xiii + 478. (London: British Museum (Natural History), 1931.)

IN order to fill the gap in botanical literature left by the absence of any up-to-date account of the British seaweeds, Dr. A. B. Rendle, formerly keeper of the Department of Botany of the British Museum, arranged with Dr. L. Batten, now Prof. Newton, to prepare this handbook. The basis of the arrangement is the "Catalogue of the British Marine Algæ", by E. A. L. Batters, which has long been out of print. In all, about 260 genera and 750 species are described. The drawings were mostly made by the late Mr. Percy Highley, though some are by Prof. Newton. The aid of members of the staff of the Department of Botany of the British Museum is freely acknowledged, thanks being especially due to Mr. G. Tandy for his help on the taxonomy and nomenclature. This very useful book starts with an account of methods of collection, preservation, and of the distribution and ecological relationships of algæ. An outline of the classification is given, also some data on economic uses. It may be remarked that the account of the preparation of iodine from kelp sounds like a translation from the German, and, according to the construction of the English, is incorrect.

The book should prove a great stimulus to the further study of this branch of botany, which has been neglected in Great Britain so long. Those who studied this branch of botany a few years ago cannot help being somewhat puzzled by the numerous changes in names; thus even our old friend *Fucus platycarpus* has disappeared and is not even mentioned as a synonym. The work appears to have been carried out with the care which one would expect, considering its origin. The illustrations have been well done, and the whole book can be heartily recommended.

Handbook of Protozoology. By Prof. R. R. Kudo. Pp. vii + 451. (London: Baillière, Tindall and Cox, 1931.) 25s. net.

NUMEROUS excellent textbooks of protozoology have already been published and at first sight it might seem that to add another to the list was superfluous; yet, as the author of the present one points out, most of the modern publications emphasise the parasitic forms and do not give much space to the

taxonomy and biology of the free living forms, from which the parasitic groups were undoubtedly derived.

The book is divided into two parts, the first consisting of chapters devoted to the general morphology of Protozoa and, though briefly treated, gives the student a good elementary knowledge of the principles of protozoan structure and physiology. The second and more important section of the book is concerned with the taxonomy and general biology of the different groups of common Protozoa. This is probably the more useful section of the work, for, owing to the numerous comprehensive and widely scattered monographs that have appeared on the different groups, it is often difficult for the average student to obtain all the necessary literature.

The author, by gathering together in a limited space as much of such material as possible from various authorities, has rendered good service, and the book should prove valuable to teachers in universities—but perhaps more particularly to those engaged in applied biological science who are cut off from libraries but desire to identify the organisms found in their several fields of research.

Die Insektenfauna des Böttinger Marmors: eine systematische und paläobiologische Studie. Von Dr. Friedrich Zeuner. (Fortschritte der Geologie und Paläontologie, herausgegeben von Prof. Dr. W. Soergel, Band 9, Heft 28.) Pp. viii + 247-406 + 19 Tafeln. (Berlin: Gebrüder Borntraeger, 1931.) 25 gold marks.

THE Böttinger marble fills a fissure 10 metres wide and 400 metres long at the margin of a crater of Upper Miocene age near Münsingen in Swabia. In Upper Miocene times hot carbonated waters flowed up the fissure and deposited calcareous sinter within it. A varied insect life abounded in the bushes and grasses surrounding the well. Individuals of this fauna, venturing too near the fatal waters, were killed, their bodies fell into the well and were quickly encrusted with sinter. A swarm of bees was entombed in this manner. Thus was provided the beautiful material studied by Dr. Zeuner, who gives a lively picture of conditions around this Upper Miocene poison hole.

Dr. Zeuner describes in detail the insect fauna of this well, making four new genera and eleven new species. He discusses the phylogeny of the Upper Miocene insect faunas and the climate of the time. He concludes that the climate of separate periods of the Tertiary cannot be deduced independently from insect faunas, since many groups have changed their habitats since the Tertiary. Harrassowitz came to a similar conclusion in connexion with Tertiary floras.

Physiography of Western United States. By Prof. Nevin M. Fenneman. Pp. xiii + 534. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 25s. net.

THE central theme of this book is geological rather than geographical. It treats land forms, which are its main concern, as effects and not as causes. Nevertheless, it will be of value to the geographer

as well as the geologist, for it gives accurate descriptions of the topography, with special stress on the drainage systems. The area covered lies approximately between long. 100° W. and the Pacific coast, and the treatment is by natural physical units called provinces and sections. These, as determined by the Association of American Geographers and United States Geological Survey, are shown on a large folding map which accompanies the volume. This useful map has also been separately published as an official American map.

The volume is clearly written and well arranged, though, of course, the treatment of different areas depends on the knowledge available. In a few parts little more than a description of the surface topography can be given. The many illustrations and block diagrams, and above all the copious bibliographical references, add to the value of the book. A companion volume on the Eastern United States is announced to be in hand.

Botany for Matriculation. By Dr. F. Cavers. Revised by L. C. Fox. Second edition. Pp. viii + 509. (London: University Tutorial Press, Ltd., 1931.) 6s. 6d.

To any candidate for university matriculation who is studying 'privately' with the view of matriculating only, and no ultimate aim of assuming an interest in, or attaining a sound knowledge of the science of botany, "Botany for Matriculation" is to be recommended. Such an opinion is offered to such 'private' students only, for we would prefer to leave the choice between a stimulating book and a 'cram' book to the teachers of other students.

The book begins, as it ends, with bald statements of fact and theory. It is profusely illustrated with diagrams fit to reproduce before an undiscerning examiner, but serving no other purpose. The subject matter has apparently been chosen to conform to the average matriculation syllabus. At the end of each chapter, a set of questions are given; in one case, the set of twenty-four questions contains sixteen which begin with the word 'Describe', and this is more or less the ratio throughout.

L. J. F. B.

Recent Advances in the Study of the Psychoneuroses. By Dr. Millais Culpin. (The Recent Advances Series.) Pp. vii + 348. (London: J. and A. Churchill, 1931.) 12s. 6d.

THE study of the psychoneuroses, or, as Dr. Culpin sometimes prefers to call them, the minor psychoses, is a peculiarly wide and difficult subject. Dr. Culpin in this book gives a very compact and readable account which well maintains the standard set in this series. The book is written from the point of view of psychoanalysis, that is, a strictly Freudian attitude. The views of Jung and Adler are well set out in separate chapters by Dr. Young and Dr. Redfern. Dr. E. Miller deals with the psychopathology of childhood and Dr. Rees with psychotherapeutic clinics. While stressing the Freudian approach, the author is careful to maintain an even balance, so that the physical side of the picture is by no means neglected.

Flame Movements in Gaseous Explosions

PROF. W. A. BONE and Mr. R. P. Fraser have recently described their further experiments upon detonation of combustible gaseous mixtures.* Some very beautiful photographs of the phenomenon of 'spin', first observed by Campbell and Woodward (1926), have been taken by means of

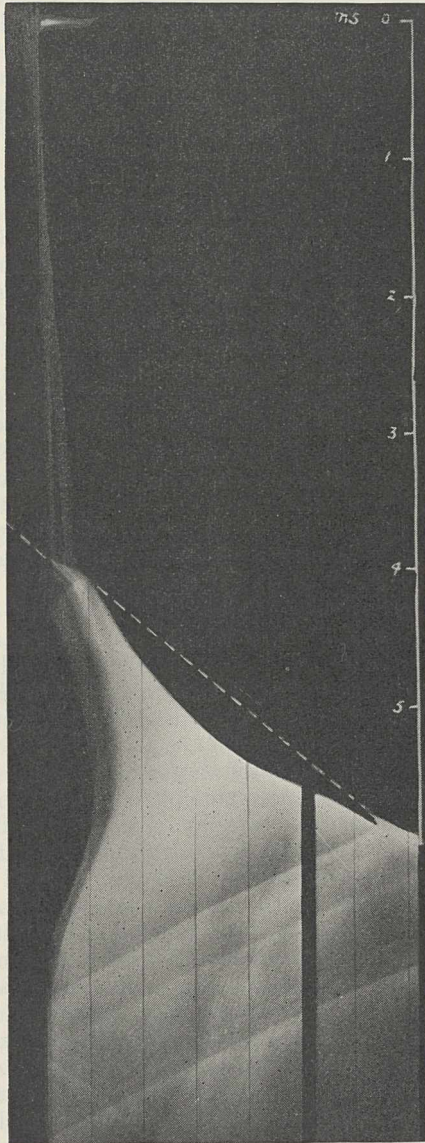


FIG. 1.—Compression wave (indicated by dotted line) overtaking advancing flame in $2\text{CO} : \text{O}_2$ mixture.

the Fraser high speed camera, especially designed for this work, and described in *Phil. Trans.*, vol. 228, 1929, p. 197. The larger machine was able to provide a vertical peripheral film speed up to 200 metres per second, so that resolution of the high speed movements of the flame front is obtainable.

Explosion of the gas mixtures in the long glass tubes was initiated either by a spark or by a high

explosive detonator. Ignition could also be brought about farther down the tube, either by a spark or by means of a detonator which provided a shock wave in nitrogen contained in the first part of the tube. Depending on the strength of the detonator, the shock wave could either be allowed to follow the explosion flame, to catch it up, to proceed with the same speed, or to pass through it: it was shown that in the latter case the shock wave could initiate flame in the gas mixture ahead of the flame front, as is shown in Fig. 1. The flame is here travelling in the direction left to right, and the photographic paper moving rapidly in the upward direction at right angles to the direction of the flame. The sudden acceleration of the flame when the com-

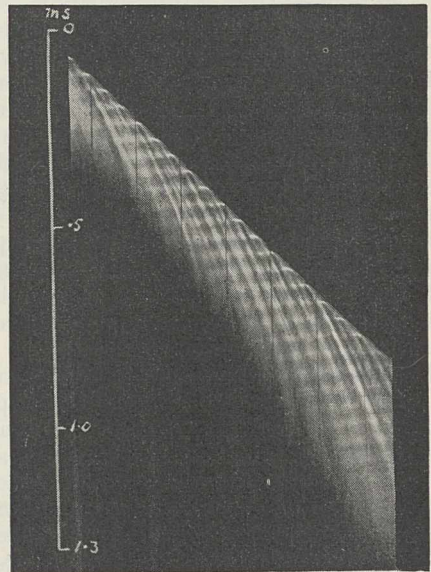


FIG. 2.—Spiral path of detonation in $2\text{CO} : \text{O}_2$ mixture.

pression wave passes through it, and the subsequent ignition ahead of the compression wave prior to the arrival of the flame front, are clearly shown. The detonation wave can be seen travelling back through the burning gases, where the original flame front meets the auto-ignited flame. Impact of the shock wave on an advancing flame does not necessarily lead to detonation, but if the shock wave is sufficiently powerful, detonation is set up; it can even be caused to occur in this way close to the initiating spark. Prof. Bone and Mr. Fraser have confirmed that the velocity of the detonation wave during the early part of its course is more rapid than the subsequent uniform rate to which it settles down.

Part vi. of the paper deals with the phenomenon of spin already mentioned, which is well illustrated (Fig. 2). The flame does not appear to travel axially down the tube in the forward direction, but takes a spiral path: not only is this the case for the detonation wave, but also in some cases the phenomenon is observable in the advancing flame prior to detonation. Bands are visible in the gaseous

* Photographic Investigation of Flame Movements in Gaseous Explosions, Parts iv., v., and vi., *Phil. Trans.*, vol. 230, p. 363.

products behind the flame, which have a frequency connected with the rotation of the 'head' of detonation—frequencies of more than 100,000 a second being sometimes observed. The distance traversed per second by the head of detonation along its spiral path is constant in a given gas mixture, and the ratio of pitch to the diameter of tube is nearly constant, but in some cases two or more rotating 'heads' of detonation are observable.

In the initial stages of an explosion the gaseous medium is moved forward along the direction of the tube axis: this forward impulsive motion would set up rotation about lines which may roughly be described as circles on a plane perpendicular to the axis and with centres approximately on it, and if

this were superposed on an axial rotation a spiral vortex system would be initiated. Whether an explanation on this basis can be derived, or whether the rapid agitation of molecules through the gaseous medium sets up a disturbance along the axis, changing to a spiral wave front or 'head' which in turn gives rise to periodic waves in the 'tail' behind, are matters which are to be the subject of further investigations. Thirty-four photographs which Prof. Bone and Mr. Fraser have presented in their paper afford very considerable food for thought, and no such remarkable records of the behaviour of rapid flame motion have been published since those in Prof. H. B. Dixon's memoir in the *Phil. Trans.* of 1903. A. C. E.

Screen-Plate Colour Photography

THE two great lines of attack on the problem of colour photography are undoubtedly comprised in the 'subtractive' processes on one hand and the 'screen-plate' processes on the other. In spite of the initial simplicity of negative-making in the subtractive process and the application to three-colour work in commercial printing, the production of the following 'positive' colour pictures by the amateur is still a matter requiring some experience, skill, and patience. Although undoubted progress has been made, the results are not of a very certain character, and they are hard to control in any precise manner.

On the other hand, the 'screen-plate' processes are of a nature much more amenable to precise control. Their disadvantage, if it be a disadvantage, is that the immediate result is a transparency rather than a picture on paper; and the transparency cannot be seen to advantage without some care in its illumination or without the use of projection apparatus. We may, however, remark that the reason why so many amateurs nowadays are dissatisfied with their photographs is because the *viewing* of photographs has never received a tithe of the attention which has been so lavishly given to their taking. A small print made with a 4-inch lens is viewed from a distance of twelve or fifteen inches. The result is a false rendering of the perspective and a general impression of an insignificant little picture. If the same photograph is printed as a transparency and viewed under proper illumination with a lens of 4-inch focal length, the perspective is seen under the proper angle and the result is vastly more satisfying and impressive. The projection of the picture is an equally good alternative.

The present writer has tried in vain to convince manufacturers upon this point, but if those who produce colour transparencies take the matter to heart they are not likely to tire of their pictures, even those made on a very small scale. Properly viewed or projected, transparencies have a wealth of beauty and satisfaction to give as compared with the finest pictures on paper.

The well-known Autochrome and Agfa plates have the colour mosaic incorporated in the first

layer underneath the sensitive emulsion, and the positive picture is obtained by photographic 'reversal' of the negative obtained by exposure through the mosaic. The alternative procedure uses a colour screen printed separately on another plate of glass, the screen surface being held in contact with the emulsion of a panchromatic plate during the exposure. The negative resulting on development is printed as a positive and can then be bound up with a 'viewing screen' containing a corresponding mosaic; details are generally given in articles on colour photography. In this way, any number of copies can be made.

Examples of such processes were the Joly screen plate ruled in lines, and dating from 1904, and the plates developed by Mr. C. L. Finlay, which have been embodied in the 'Thames' and 'Paget' plates. The modern form is being marketed as the 'Finlay' process.

The progress made by photographic plate manufacturers has rendered possible corresponding progress in colour photography, since it is vitally dependent on satisfactory panchromatic emulsions. An Ilford panchromatic plate (700 H and D) is specially coated for the Finlay process, and a series of five carefully adjusted compensating filters is available for use with different conditions of natural and artificial lighting. The high speed of the plates allows of snapshot exposures under favourable lighting conditions if a lens working at an aperture of $f/4.5$, or thereabouts, is used.

The 'taking screen' with its mosaic of squares is printed by a secret process, but it is being claimed by the makers that a system of efficient inspection of the plates, and standardisation of the dyes, has enabled them to eliminate the variability which used to be experienced sometimes in the older types of plates. Methods of measurement of colour for microscopic objects are now easily available, and the efficient standardisation of the taking screens, filters, and viewing screens ought to be possible.

This is a matter of the very greatest importance for the technical use of the process in cases where pictorial colour records are required. The use of such records in microscopy, surgery, medical research, metallurgy, and other subjects would be

legion. It is impossible with a three-colour screen to make the photograph an absolutely exact rendering of the original visual impression, but it would be a great step to have a genuinely reproducible action, so that a definite colour difference occurring, say, in two photographs (taken at an interval) of a case of skin disease would have to be ascribed to an actual colour change in the object. This kind of reproducibility may be within the reach of really rigid standardisation, but this applies equally to the user's end of the business, where proper attention will be necessary in exposure, time and temperature of development and so on.

The use of a separate positive and viewing screen has now been superseded by the Finlay positive colour screen made by coating a viewing screen with a positive emulsion. Very careful registration is naturally necessary before the positive is printed, but the special system adopted in the process allows this to be done satisfactorily. The result is a picture entirely free from colour changes depending on the angle of view. It is easily understood that, granted the registration is exact, the disappearance of the parallax between the positive and the screen will result in the elimination of diffusion between the edges of the corresponding square elements in the two layers and a consequent improvement of the 'saturation' of the colour rendering. It is claimed by the makers that these plates can be used effectively for reproduction purposes for half-tone work.

Of course, the chief difficulty in making half-tone blocks from screen plates with a regular pattern has been that the pattern of the screen plate is likely to clash with that of the half-tone screen and produce moire effects. This difficulty can, however, be overcome by placing the lines of the two screens at a suitable relative angle, and using a very slight softening of the focus; it is a matter calling for some care and skill.

Development work recently in progress has been concerned with a screen-plate for photographic reversal, the application of the colour screen to kinematograph film, and the adaptation of a modified collotype process to the production of colour prints on paper, starting from the original screen-plate record. It is also claimed that it is now possible to reproduce the Finlay pictures in colour by colour gravure, collotype, and by photolitho offset. Many interesting and excellent pictures have been made for exhibition by these various processes.

In spite of difficulties and discouragements it seems that this screen-plate process should find an increasing sphere of interest and utility. Success will be the reward of a steady improvement and standardisation of the materials, and of persistent investigation of the various possibilities of the process in printing, in amateur and professional photography, and in science, but the experience of the last twenty years indicates that progress can best be made by persistent expansion from modest beginnings.

L. C. M.

Industrial Bursaries*

IN articles in NATURE nearly two years ago (June 21 and 28, 1930), the late Sir Francis Ogilvie gave an interesting account of the development and work of the Royal Commission for the Exhibition of 1851.

At that date the Commissioners had just published the Record of their Science Research Scholars, of whom the first was appointed in 1891. The Record of their Industrial Bursars, now issued, tells of a more recent branch of that work, only just alluded to by Sir Francis Ogilvie, to whose help much of its success has been due. It affords further evidence, should that be needed, of the far-reaching extent and valuable results of the activities of the Commission.

Founded in 1851 to administer the surplus funds of the Exhibition, the Commissioners have for eighty years employed their resources generally in accordance with the lines laid down by the Prince Consort. "For its application", he wrote in the autumn of that year to Baron Stockmar, "I have devised a plan", and to this plan, with such minor modifications as changing times demanded, they have adhered. It has been their object to assist in the establishment of institutions which, in the words of their Supplemental Charter, "might increase the means of Industrial Education and extend the influence of Science and Art upon productive industry".

* The Record of the Industrial Bursars of the Royal Commission for the Exhibition of 1851, 1911-1929. Published by the Commission, 1 Lowther Gardens, Exhibition Road, S.W.7.

In 1911 the Science Scholarships had been established for twenty years, and their value was generally recognised. They had opened a scientific career to students from all parts of the Empire, and the results achieved by those students were even then of marked importance. Now forty of their scholars are on the roll of the Royal Society.

Among the means whereby improvement and progress can be obtained in any branch of knowledge, the Prince Consort noted the "acquisition of knowledge by ocular observation, comparison, and demonstration". To make this possible for their scholars was a primary object of the Commissioners. Knowledge must first be gained and scientific investigation advanced, but this alone did not extend the influence of science on productive industry. It was with this latter object, then, that their Industrial Bursary scheme was devised—directed, as stated in their Report for 1911, to encourage the training of 'captains of industry'. At that date the engineering faculties of the universities and the technical colleges established in many large towns were well organised. Students were leaving in numbers, who might with great advantage be utilised in factories and engineering works, but they were not welcomed. It was the object of the Commission to guide in the right direction this stream, broadened by the inflow of that practical experience without which the science of the schools was of little use to the engineer, the

electrician, or the shipbuilder. Such practical experience, they saw, could only be gained, in the future as in the past, by a period of apprenticeship, during which, in the opinion of most employers at that date, the apprentice was of little or no value and was paid accordingly. Since then conditions have changed to some extent, and far-seeing employers have come to recognise that it may be well worth while to pay an apprentice with a trained mind and a competent knowledge of science a living wage, because of the additional value he will possess in consequence of his previous college training, when he has acquired practical experience in the works or office.

However, in 1911, this was not the case, and the Commissioners—Lord Esher was their chairman, supported by Sir Arthur Rücker, and to their active help the scheme owes much—sent their secretary, Mr. Evelyn Shaw, on a tour of the principal provincial universities and technical colleges to obtain information on which to base a plan for introducing more men with scientific training into industry. The secretary's conversations with the authorities of the institutions he visited led him to formulate the scheme of the Industrial Bursars which was afterwards adopted by the Commission. His scheme was a simple one, and from the first it worked. Each year a selected number of colleges and technical schools are invited to nominate students, desirous of entering industrial work, who have passed through their course with credit and are certified by their teachers to be suitable for such work, but are unable to meet the expense of an apprenticeship course without some financial help.

To these nominees some twenty or twenty-five bursaries are awarded. Each case is examined carefully: the Commissioners assure themselves that the man is competent—the school records and the statements of the teachers afford material for this; inquiry is also made as to his means, and not the least interesting part of the work has been the insight it has afforded into the efforts made by parents to secure for their children a college training and by the children to profit by it. An examination of the returns made to the secretary in some seventy pre-War cases taken consecutively from the Report gives these approximate averages: family income, under £175; number of children in family, 2·7; wage of bursar (per year), under £35.

The Record of the Industrial Bursars just issued gives the careers of about three hundred appointed*

* The total number appointed has been 353, but a number obtained remunerative posts without assistance from the Commission, and for this reason their record is not included. The scheme was suspended during the War.

in the fifteen years up to 1929. The bursars are placed in selected works, chosen frequently by themselves, but subject to the approval of the Commissioners, who receive periodically reports as to the progress of their bursars. They are paid an amount which, with the wage received—in too many cases, only a small one—will bring the income of each man up to a sum on which he can live. The value of a bursary necessarily varies from man to man: in some cases the holder must spend from two to three years in learning the technique of his trade, for others a few months suffice; the average cost spread over the whole period works out at about £150 for each bursar.

The Record gives a list of the nominating institutions, with the number of bursars appointed from each, and continues with the names of the bursars and the period of their tenure. A statement follows as to the course of training and the subsequent career, so far as particulars are available. The compilation of these has involved no small amount of labour on the part of the secretary and his staff, who have well earned the thanks of the Commission—one may add, also, of the readers of the Record—for the interesting results of their work.

Of the bursars, some few have in the end devoted themselves to educational or scientific pursuits, while the War claimed a number among its victims; but the analyses at the end of the volume show that they are to be found holding responsible positions in the government services, the coal, iron and other allied industries, in every branch of engineering, as well as in the chemical, textile, and other leading trades. Of the three hundred whose careers are recorded, it will be found that, although the oldest among them cannot be much above forty years of age, at least forty have become directors or managers or reached some equally important positions. This fact in itself may fairly be cited as evidence that the scheme has rendered valuable service to industry, and while the need for a scientific training is now much more fully recognised than it was twenty years ago, and applications for suitable student-apprentices are made frequently to the universities employment bureaux, there is still need for the Industrial Bursary Scheme of the Royal Commission.

Much of the success of the scheme is due to the support given to it by employers, who have learned to appreciate the value of the trained men whom it supplies; it is no longer a pioneering effort but has gained the right to rank as one more of the successful endeavours made by the Commissioners to give effect to the "plan" devised by their founder.

R. T. G.

Obituary

THE RIGHT HON. SIR HORACE PLUNKETT,
K.C.V.O., F.R.S.

ON March 26 died Sir Horace Plunkett, after a brief illness, though it was only the culminating attack of many years of ill health. He was born in 1854 of distinguished stock belonging to one of

the oldest families of the Pale, the third son of the sixteenth Lord Dunsany. Educated at Eton and University College, Oxford, considerations of health led him to America soon after taking his degree, and there he took up cattle-ranching in Wyoming. He was successful enough to be able to return to

Ireland ten years later with a fortune and a stock of experiences from which his gentle humour often drew an illuminating commentary on the subject under discussion. His business interests took him back to America almost every year, and the friendships he formed with leading men in the United States were often of service in enlightening public opinion both there and here.

From 1890 onwards Plunkett threw himself wholly into the movement for the regeneration of Irish life and particularly of its agriculture. From the outset the movement aimed at remaining outside party and uniting men of all classes and creeds in the single cause of economic and social progress. In 1894 he launched the Irish Agricultural Organisation Society, the pioneer and for many years the example of agricultural co-operation in the English-speaking world. On its Board sat parish priests and Presbyterian ministers, landlords and tenants, Orangemen and Jesuits, and as they worked together in amity under Plunkett's inspiration they set a standard of public service that was new in Irish affairs. Soon afterwards Plunkett got together the famous 'Recess Committee', again representative of every grade of Irish opinion, and its Report was a detailed consideration of what could be done by the State to promote the regeneration of the agricultural and industrial life of the country. It bore fruit in legislation which set up in 1899 the Department of Agriculture and Technical Instruction with an endowment independent of Treasury sanction and the annual vote, and of this new body Plunkett was made vice-president, in effect, acting minister. Plunkett chose his lieutenants well, unorthodox as were the appointments from an Irish party point of view. Mr. T. P. Gill was made secretary and administrative chief; Prof. J. R. Campbell was brought from Leeds to organise the agricultural side, and Mr. George Fletcher was put in charge of the general education—a Scotsman and an Englishman who rapidly removed any reproach of alien origin. Campbell's practical outlook and sympathy with the Irish peasant found expression in a different policy from that adopted in England, where efforts were chiefly directed to higher agricultural education, but as time went on its wisdom was abundantly justified.

The appointment, however, of T. P. Gill, who had been prominent in Nationalist politics, raised an immediate storm, so contrary was it to the strict tradition of Irish party life. The extreme conservatives started a vendetta against Plunkett; his seat was contested and he was defeated in 1900, and though he stood later for a Galway division he never succeeded in re-entering Parliament. He was allowed to retain his vice-presidency until the advent of a Liberal Government in 1906, when he had to resign. For the Nationalists had declared against him; they would allow no other organisation in Ireland, and the party drew much of its funds from the country traders, who felt threatened by the co-operative movement. Plunkett then resumed his presidency of the Irish Agricultural Organisation Society, and became more active than ever in his efforts for the reconstruction of Irish

rural life. About this time came his chief books, "Ireland in the New Century", "The Rural Life Problem in the United States", "Noblesse Oblige", and "Plain Talks to Irish Farmers", a series of articles in the *Irish Homestead*, the paper he had founded as the organ of the co-operative movement and for which he had enlisted George Russell (*Æ.*) as editor. Plunkett had no great interest in literature as such, but he took infinite pains over his writing and succeeded in giving eloquent expression to his convictions. Meantime the co-operative movement, guided by the I.A.O.S., was making steady progress, and in 1913 was allowed to receive a grant from the Development Commissioners in the face of the declared opposition of the Nationalist party. The War cut across all these activities, and the passions then let loose destroyed the hopes of those who saw in that body, where Nationalists and Ulstermen, Catholics and Protestants, worked harmoniously for a common purpose, the spirit out of which a new Ireland would grow.

In 1917, Plunkett was chosen chairman of the Irish Convention, a representative conference of Irishmen to draw up proposals for the future Constitution of Ireland. Plunkett laboured unweariedly and nearly achieved a success that would have saved much of the terrible aftermath of war in Ireland, but the extremists prevailed and the Convention broke down. It was in these later troubles that his house near Dublin, built by Plunkett as a home in which he could gather all friends of Ireland, was destroyed, and henceforward he lived in England. In 1919 he endowed the Trust which bears his name, a foundation charged to keep before the public the principles of rural betterment; and on its behalf he was still working until a few days before his death. In recognition of his services to the scientific development of agriculture, Plunkett was elected to the Royal Society in 1902, and at the Dublin meeting of the British Association in 1908 he was the chairman of the newly formed Sub-Section of Agriculture. He had no working acquaintance with science, and in one sense his mission was to counteract the disintegrating effects of science upon the old fabric of rural society, but he was interested in the progress of science and knew that science among things must be controlled by science among men. He had no hostility to modernities; he became an early and passionate motorist, and was learning to fly only three years ago.

Such were the main items in the life of one who was indeed the most unselfish of all public men of his time. Of his personality it is difficult to write, by one who was honoured by his friendship. He was the true aristocrat, dedicated to the service of others, beyond all suspicion of self-seeking, free even from vanity. He made friends in all classes and treated them all on the same terms, but he always preserved his quiet dignity, the dignity of one in pursuit of a noble ideal. In this pursuit he never wavered or spared himself, though he suffered from a succession of illnesses which might have given any man an excuse for withdrawal from unnecessary fatigue. *Noblesse oblige.* A. D. H.

MR. H. CHAPMAN JONES

THE death of Henry Chapman Jones on March 7, at the age of seventy-seven years, removed one who has held an honourable place in the teaching of chemistry and in the development of the science and practice of photography. Apart from an early association with Birkbeck College, Chapman Jones's career as a teacher of chemistry was bound up with the Royal College of Science, where he was successively assistant, demonstrator, and lecturer, from 1881 until 1914, when he retired. In the first few years of this long period he was on Sir Edward Frankland's staff, and later he served under T. E. Thorpe, W. A. Tilden, and H. B. Baker. For a number of years he presided over the North Laboratory in the old Royal College of Science buildings, and many who worked there will recall the quiet, serious, and kindly way in which he went about his duties, as well as the high standard of industry and accuracy which he expected of his students.

The main contributions to knowledge made by Chapman Jones were in the domain of photography, and were published principally under the auspices of the Royal Photographic Society. Following Sir William Abney in the application of scientific method to the problems of photography, Chapman Jones dealt with such matters as the densities of negatives, the factors affecting the sensitiveness of plates, media of high refractive power for photomicrography, and the relationship between the size of the particle and the colour of the image.

Besides original papers on these and other topics, Chapman Jones contributed many articles on photographic subjects to the technical press, while two books on photography came from his pen, namely, "Science and Practice in Photography", which ran to four editions, and "Photography of To-day", a popular treatise published in 1913. His associations with the Royal Photographic Society were very close, and after being honorary secretary from 1892 until 1897, and vice-president from 1897 until 1902, he became president of the Society in 1912. In addition, he was a fellow of the Chemical and Physical Societies and of the Institute of Chemistry.

Chapman Jones was a single-minded man, whose integrity and ideals were of the highest. His quiet, almost shy, old-world courtesy and his modesty were marks of an interesting personality which only those who knew him well could appreciate. At the same time, he held strong opinions on many subjects, and he did not hesitate to express these in his own direct, unimpassioned way. His gentle, warm-hearted nature revealed itself to best advantage in the circle of his own family and of those who knew him intimately. He is survived by a widow and two sons.

J. C. P.

DR. MICHAEL PERKINS

MICHAEL GERARD LAURENCE PERKINS died, following an attack of scarlet fever which developed apparently into a general septicæmia, on March 14, at thirty-three years of age. Perkins was educated at St. Peter's College, Westminster; King's

College, London; and Trinity College, Cambridge. He was Huxley Prizeman at King's College and a Senior Scholar of Trinity. He was elected to the Mackinnon Research Studentship of the Royal Society in 1925. He took his M.A. in 1926, his Ph.D. in 1930, and joined the Westminster Hospital Medical School in 1927.

Michael Perkins had many interests, his greatest love being that of natural history. He had a keen intelligence, a vivid imagination, and boundless enthusiasm and energy—qualities which might have earned him a prominent place in the ranks of science. He published work on the Coleoptera of Guernsey and Wicken Fen, on Cambridgeshire Planarians, and, becoming interested in the Crustacea, published in 1928 a simple key to the crabs (Brachyura) of Britain and the north-eastern Atlantic. His own observations on local varieties of a species of Platyhelminth worm, of which the peculiarities seemed to be correlated with slight changes in environment, led him to take an active interest in the work of the late Dr. Kammerer. It was partly through the influence of Perkins that Kammerer was invited by the Cambridge Natural History Society (of which Perkins had been secretary for two years) to demonstrate his specimens and to discuss his much-disputed experiments. Perkins' interest in the problems of parasitism brought him into touch with the remarkable sex change induced in crabs by *Sacculina*, a phenomenon which he studied from the biochemical point of view in Cambridge (see NATURE, 124, 299; 1929). He was also engaged upon work on the respiratory metabolism of bats.

Perkins' work was perhaps marred by the diversity of his interests, his restless mind preventing that concentration necessary for the successful completion of a single piece of work. Time, however, was steadying him, and there is much that is valuable in the mass of unpublished data left by him.

Perkins' lovable nature was his chief characteristic; his ready optimism, his wit, and his profound knowledge of a multitude of subjects, ranging from folklore to mystery plays, won him innumerable friends and made him a most agreeable and interesting companion. His boundless energy and zeal were ever at the service of others. His early death has come as a great shock to all who knew him and loved him so well. There are many who will sympathise with his bereaved parents in their great loss.

J. H. Q.

WE regret to announce the following deaths:

M. Guillaume Bigourdan, president in 1924 of the Paris Academy of Sciences and formerly director of the Bureau International de l'Heure, on Feb. 28, aged eighty years.

Dr. R. M. Brontë, pathologist to the Home Office and formerly Crown Analyst in Ireland, on March 22, aged fifty-two years.

Prof. Wilhelm Ostwald, emeritus professor of chemistry in the University of Leipzig, Nobel prizeman in chemistry for 1909, and an honorary fellow of the Chemical Society, on April 4, aged seventy-eight years.

News and Views

Sir William Pope

By awarding the Messel medal to Sir William Pope, the Society of Chemical Industry has paid a well-deserved tribute to one of Great Britain's most distinguished chemists. Moreover, the news of the award will be received with interest and satisfaction outside as well as within the boundaries of his own country, for Sir William, as president of the Federal Council and a former president of the Union Internationale, is well known to foreign chemists as the principal ambassador of their British colleagues. He held office from 1917 until 1919 as president of the Chemical Society, and from 1920 until 1921 as president of the Society of Chemical Industry. Sir William Pope, who was born in London in 1870, was one of Prof. H. E. Armstrong's pupils, having studied chemistry at the Finsbury Technical College and at the Central Technical College (now an integral part of the Imperial College of Science and Technology) at South Kensington. In 1897 he became head of the chemical department at the Goldsmiths' Institute, New Cross, and in 1901 became professor of chemistry at the Municipal School of Technology, Manchester; in 1908 he was appointed professor of chemistry and director of the Chemical Laboratories at Cambridge. Sir William's greatest triumphs in the domain of original research are associated with advances in stereochemistry, but other studies, for example, those with Dr. W. H. Mills on photographic sensitizers, are equally important and well known. Working in collaboration with Peachey, he succeeded in 1889 in resolving phenylbenzylmethylallylammonium iodide, an optically active compound containing an asymmetric nitrogen atom, and so demonstrated the quinquevalency of nitrogen. This extension of the scope of stereochemistry beyond the range of asymmetric carbon compounds was followed by the preparation of optically active substances containing asymmetric atoms of sulphur, selenium, and tin. In association with Barlow, he published work on the relation between chemical composition and crystalline form which led to interesting conceptions concerning the size and arrangement of atoms.

Mellon Institute of Industrial Research

MR. ANDREW MELLON, the newly appointed American Ambassador in London, has a claim to fame in relation to the promotion of scientific research which has escaped recognition in announcements of his appointment. He and his brother, Richard B. Mellon, gave their name and a generous benefaction to the Mellon Institute of Industrial Research in the University of Pittsburgh. Of the original benefaction of £100,000, half was used to provide the permanent building accommodating 70 research workers, £12,000 for equipment and apparatus, £4000 for the chemical library, and £8000 a year for at least five years for maintenance. The objects of the Institute are stated to be: "The increase of useful knowledge through the application of contemporary science to industrial processes, the promotion of American industry, and

providing opportunities for the training of men for high industrial appointments, and, in addition to this, the training of men in advanced chemical engineering and industrial chemistry for specific industries". The principles on which the work of the Institute was based were enunciated by the first director, Prof. Robert Kennedy Duncan, and were explained for English readers in Educational Pamphlet No. 30, entitled "An Experiment in Industrial Research", by T. Ll. Humberstone, published by the Board of Education in 1915. It is a tribute to the wisdom of the founders of the Mellon Institute, and the essential soundness of the principles on which the Institute is based, that the Liberal party in an official statement of policy recently published has urged the establishment in Great Britain of an institute on similar lines.

Industrial Bursaries

It is now almost platitudinous to say that industrial efficiency can be furthered by the introduction into works and factories of men trained in science and ready to use such training in industrial pursuits. The difficulty, however, is to find really suitable openings for students whose special scientific training will ultimately fit them for responsible posts. It is true, of course, that employers are realising more and more the value of such men to industry, but it is not always easy for students to gain practical experience when their financial position is such that they cannot accept employment at the nominal remuneration which usually accompanies the 'learning period' in industry. In these cases the Industrial Bursaries of the Royal Commission of 1851 are specially useful. The scheme is designed to assist "young men who, after a course of training in a University or approved technical college, desire to take up Engineering, Chemical or other industrial work". It has no intention of facilitating collegiate studies; it is solely "to enable suitable applicants to tide over the period between their leaving college and obtaining remunerative employment in industry". To carry out its full intention, the candidate must be under twenty-five years of age, must have been a *bona fide* student of science for three years, must be able to obtain an industrial post approved by the Commissioners, and must be in need of pecuniary assistance to enable him to hold such a post. He is not allowed, except in particular circumstances, to accept less than the standard wage. Elsewhere we publish an article dealing with the record of bursars appointed between 1911 and 1929, and we shall not, therefore, deal with the actual record here. In spite of that part of the regulation which we have indicated above, however, it would appear that the bursars were nominated chiefly by universities: only the Heriot Watt College, Edinburgh, would fall under the heading of "approved technical college". We would, therefore, direct the attention of technical colleges to the scheme, for we feel that it would be of enormous value to students who may not contemplate proceeding to universities

but whose whole training fits them admirably to fulfil just that purpose which the Commissioners have in mind.

Volcanic Eruptions in the Andes

ALARMING reports of vast showers of volcanic ash from eruptions of Descabezado and other recent volcanoes of the group which occurs on the chain of the Andes south of Santiago de Chile, appeared in Tuesday's daily papers. The eruptions began on April 10, and the neighbouring towns of San Fernando, Curico, and Talca were said to be in darkness through the fall of fine dust from the volcanoes. The ash is reported to be three feet deep in Curico. Trains arriving at Mendoza, on the line about a hundred miles east of Santiago, were covered with volcanic dust, and the streets of the city were thickly coated with it. At Buenos Ayres, which is about six hundred miles farther east, there has been a steady fall of volcanic ash, and even at Monte Video (Uruguay), still farther east, the shower of dust is reported to have lasted for ten hours. Shocks have been felt over a wide area, but at the time of going to press no details are available as to the actual character of the eruptions or exactly what volcanic peaks have again come into activity.

Overlapping of Government Research Funds

It has been common knowledge, amongst those conversant with such matters, that a certain amount of overlapping has existed in connexion with the grants made by Government to various bodies who utilise the money for assisting research and other work in the British Empire. The system underlying these grants has developed by instalments and does not, therefore, represent a carefully thought-out scheme. For this reason the first report of the Estimates Committee, of which Sir Vivian Henderson is chairman, recently presented to the House of Commons, will be welcomed. It is understood that the Committee has examined the estimates of the following funds: Empire Marketing Board, Colonial Development Fund, Development Fund, Ministry of Agriculture, Colonial and Middle Eastern Services, and University Grants Committee. The Estimates Committee's object was to ascertain to what extent in recent years Parliament has been asked for funds to assist the same object or body through different channels, since the Parliamentary estimates do not themselves indicate clearly the sources of the demand. The Committee has noted, for example, that grants are being allotted to the Empire Marketing Board for many purposes which are also assisted by the Development Fund, the Forestry Commission, the Ministry of Agriculture, or the Department of Scientific and Industrial Research. Again, in the case of the Colonies, grants are being made from the Colonial Development Fund for the ordinary purposes of Government, whilst at the same time, the Colony concerned may be receiving a grant from the Colonial Office. It is not suggested that the departments or bodies receiving such grants are in ignorance of what is being done by others working on the same lines, but the fact remains, as the Committee

remarks, that many institutions in Great Britain are receiving assistance from the State through two or three, or even as many as four or five, or more, channels. This position of itself justifies the appointment of the Estimates Committee, the work of which should also prove of service to Government at the Ottawa Conference.

Race Prejudice and World Peace

SIR ARTHUR KEITH in his address, "Can Race Progress be Rationalised?", delivered on April 5 at Oxford, before the Universities Congress of the National Union of Students, turned once more to the problem of world peace as it presents itself to him as an anthropologist and a follower of Darwin. As he has expressed himself on more than one previous occasion, Sir Arthur is convinced that racial and national instinct is an all-powerful factor in the evolutionary progress of mankind, producing new and, perhaps, better races; but, as he points out, this spirit is incompatible with man's economic needs, and the result is the disharmony which is to be seen in the world to-day. Granting that this spirit is ineradicable, and accepting the inevitable consequence that the nations of the world can never be welded into a whole, is it then possible, Sir Arthur asks, to bring about conditions in which each nationality may work out its destiny by peaceful progress? Ethically the nations of to-day are in no respect superior to their predecessors; each pursues its own ends selfishly. Nothing daunted, Sir Arthur sees hope for the future in such manifestations as the suppression of separatist tendencies by reason in Scotland and Wales, and in the spread of English-speaking peoples, which he regards as the greatest attempt to rationalise the peoples of the world that has ever been made. Race progress, he concludes, can be rationalised only by a process of self-understanding, self-education, and, if need be, self-sacrifice on the part of all.

Roman Mining in Britain

IN a paper on Roman mining in Britain, read before the Newcomen Society on March 30, Mr. G. C. Whittick gave a review of the mining operations during the whole of the Roman occupation. Though the Roman invasion cannot be ascribed chiefly to the desire to gain possession of the country's mineral wealth, after the initial seizure of the south-east of the island, there followed the inevitable accompaniment of the exploitation of minerals, particularly lead. After referring to the mining methods, to the treatment of ores, and to the question of organisation, Mr. Whittick dealt with the mining of coal, gold, copper, lead, iron, and tin. During the first century and a half of the Roman occupation, lead was the most important product of Britain. Lead mining in the Mendips was apparently begun so early as A.D. 49, and production rose rapidly during the reigns of Nero (A.D. 54-68) and Vespasian (A.D. 69-79). The centre of Roman activity in the district was in the valley of the Blackmoor, just south of Blackdown. The ore was obtained from surface workings, and from the waste heaps of the workings many pigs of Roman lead have been recovered. Lead was also

mined in Flintshire, Derbyshire, Yorkshire, and Shropshire. Most of the pigs which have been found bear inscriptions, and some have been officially stamped showing that they had been desilverised. The iron-workings of the Roman period were concentrated in the Weald and in the Forest of Dean, and tin mining was carried out to a small extent in Cornwall.

Velocity of Light

MR. M. E. J. GHEURY DE BRAY, 40 Westmount Road, Eltham Park, London, S.E.9, has published, in the form of a pamphlet entitled "La vitesse de la lumière", a critical and documented discussion of the chief experiments made to determine this constant, from the pioneer work of Römer and of Bradley, down to the latest experiment devised by Michelson. The experiments are carefully analysed, and the accounts contain discussions of certain errors, obscurities, and irrelevancies which disfigure the presentation of the subject in many of the texts. The description of the observations of Römer and of Bradley is specially useful. The author presents a table which shows the results of some twenty-one experiments, beginning with that of Fizeau in 1849 and concluding with the recent work of Michelson. Of these experiments he decides, after critical consideration, that seven give trustworthy results. He divides these into two groups—experiments carried out on a short base line and those carried out on a long base line. The results are summarised as follows:

(1) Bases courtes ; inférieures à 4 Km.		
1879-5	Michelson	299-910
1882-7	Newcomb	299-860
1882-8	Michelson	299-853
(2) Bases longues ; 23 Km. et plus.		
1874-8	Cornu-Helmert	299-990
1902-4	Perrotin	299-901
1924-6	Michelson	299-802
1926-0	Michelson	299-796

The conclusion reached is that "un fait très remarquable est tout de suite révélé par cette classification : dans les deux groupes, la vitesse de la lumière diminue progressivement avec le temps, et le changement de vitesse est approximativement proportionnel à l'intervalle de temps correspondant". However this may be, there is no question that Mr. Gheury de Bray has provided a useful résumé of the literature dealing with a very difficult experimental problem.

Ocean Newspapers

SINCE the first issue of the *Transatlantic Times*, which appeared in the form of a leaflet on the s.s. *St. Paul* on Nov. 15, 1899, maritime journalism has made great progress. All newspapers issued on British ships are now published by an organisation known as the Wireless Press. In the first place, it supplies ships with copies of the journals prepared in such a way that the news can be printed on board ship as it is received by the ship's radio operator. Rugby Radio, the G.P.O. wireless station, daily transmits three news bulletins—in the early morning, at midday,

and during the evening. It also transmits a Saturday night message giving the League football results. This message is in keen demand among the crews on cargo boats all over the world. In the case of general elections, big races, and other events of world-wide interest, it often happens that a passenger in mid-Atlantic is reading the results before they have been distributed on land. The special bulletins, broadcast throughout the day, are exhibited prominently for the passengers to read. Foreign stations also bombard the ship with news. The ship's purser has the task of sub-editing the newspaper. In an interesting paper on maritime journalism, by E. C. Thomson, in the *Wireless World* for March 23, it is stated that there are indications that the 'wireless news' will give place, possibly at no distant date, to a replica of a journal printed on land. This could be achieved without much difficulty by means of facsimile telegraphy. A complete page printed on land could be reproduced on board ship in a shorter time than would be required to carry the actual newspaper from one end of Fleet Street to the other.

Archæological Exploration in Macedonia

THE recently issued *Annual of the British School at Athens*, No. 30, covers the sessions 1928-29 and 1929-1930 (London: Macmillan and Co., Ltd., £3, 3s.). In addition to the annual report and financial statement, it includes the usual complement of papers by members of the School. The excavations in Macedonia have been continued, and although the account of the work carried out by Mr. W. A. Heurtley and others at Saratse provides no sensational discovery, it demonstrates the relation of cultural development in an interesting strip of country to that of the Vardar valley and the area immediately around Salonika. A Troadic site at Thermi in Lesbos was excavated by Miss W. Lamb, who describes the five successive cities of an Anatolian colony which was finally abandoned some time before the sack of Troy II. The excavations are still incomplete after two seasons' work. Messrs. J. D. and H. W. Pendlebury describe two extensive and elaborate protopalatial houses at Knossos, found at the bottom of walled pits in the west court. It is unfortunate that owing to their position they cannot be excavated, but a somewhat hazardous feat of exploration has revealed their character to a considerable extent. The first instalment of a study of the morning hymns of the Emperor Leo by Prof. H. J. W. Tillyard provides evidence on medieval methods of musical notation of considerable interest to students of early music. Mr. J. D. Beazley's "A Dancing Maenad" is a study of the grouping and meaning of figures on a Nolan amphora from Woburn Abbey. Nearly half the volume is devoted to the continuation of the final report on the School's important excavations at Sparta in 1924-28 by the former director, Mr. A. M. Woodward.

Animals Playing at being Hunted

A HAND-REARED female of the prongbuck, or American antelope, owned by Mr. L. T. Murray at Mertzon in Texas, displayed a most remarkable

originality in getting itself hunted, as related by its owner in the *Journal of Mammalogy* for February, p. 41. Its habit, as it was allowed complete liberty, was to go to the main street of the little town and entice dogs to pursue it; the resulting hunt might last as long as three-quarters of an hour, at the discretion of the doe, which had so much the advantage of her pursuers in speed and intelligence that she did as she liked with them, fleeing in pretended fear, circling and waiting for them to come up, and then darting off in the opposite direction, until at last she left the pack behind and went home. It is satisfactory to learn that she came to no harm and was ultimately sent to a park and bore twins; but it would be interesting to know if playing at being hunted is a recreation indulged in by animals we usually regard as food for others, when they live in the natural state. That the hunters may play at hunting we know from what has been observed of the puma and the peregrine falcon.

Excavations in Texas Caves

THE Smithsonian Institution, it is announced through Science Service, of Washington, D.C., is sending an expedition to the caves of western Texas in charge of Mr. Frank M. Setzler, staff archaeologist. The object of the expedition is to obtain evidence of the culture of the early cave dwellers of this area, and if possible to ascertain their relation to the basket makers who preceded the Pueblo-Indians of the south-western states. Traces of the basket-makers' culture have already been found in Texas caves, but there is also evidence, in spear points of stone associated with the bones of extinct animals at some depth below the earliest basket-maker relics, of an earlier people.

Modern Aids to Teaching

A QUARTERLY review of modern aids to teaching, entitled *Sight and Sound*, has been published under the auspices of the British Institute of Adult Education. The first issue contains thirty pages, and is illustrated. It is edited by a committee appointed by the Institute, and its purpose is to promote interest in the use of modern scientific inventions, such as the film, gramophone, wireless, and television, in schools and colleges and in general cultural work. The gramophone and wireless have already shown their usefulness in the teaching of languages and music; one of the articles in the issue maintains that the teaching film should be planned, made, and used in the school.

New Physical Apparatus

IN their new catalogue, No. 115X, of forty pages, Messrs. Griffin and Tatlock, Ltd., give an account of some new models of physical apparatus designed for use in the teaching of physics. Under the name Microid Physical Series some twenty new designs have been produced, based for the most part on modern research methods. Each apparatus is described in a 'specification', and this is followed by 'experimental notes' which will be useful to the teacher and the student, especially as in many cases numerical results from an actual experiment are

quoted. As indicating the type of apparatus included, mention may be made of the microcel thermopile, the thermo-magnet illustrating the heavy currents obtainable from thermo-elements under suitable conditions, the magnetic potentiometer (Chattock), and the moment of inertia apparatus with rotating table. Experiments are also included on light, such as the parallel plate refractometer, and heat, such as the micrometer expansion apparatus, to mention only a few of the methods described. References are given to the textbooks of Pohl, Searle, and Worsnop and Flint. Teachers of physics will find here many suggestive hints for experimental work.

Announcements

DR. DUKINFIELD H. SCOTT, F.R.S., the eminent palaeobotanist, has been elected a corresponding member of the Prussian Academy of Sciences.

THE Faraday Medal of the Institution of Electrical Engineers will be presented to Sir Oliver Lodge at the ordinary meeting of the Institution to be held on April 21 at 6 P.M. The presentation will precede the twenty-third Kelvin Lecture, which will be delivered by Dr. W. E. Sumpner, on "The Work of Oliver Heaviside".

UNDER the auspices of the British Science Guild, Prof. S. Chapman, professor of mathematics at the Imperial College of Science and Technology, will deliver a popular lecture on "Polar Lights", on Wednesday, May 25, at 5 P.M. The lecture will be at the Royal Society of Arts, John Street, Adelphi, W.C.2. Tickets, for which no charge is made, can be obtained on application to the Secretary, British Science Guild, 6 John Street, Adelphi, W.C.2.

THE Dyers' Company Gold Research Medal for the period 1930-31 has been awarded to Prof. F. M. Rowe, professor of colour chemistry and dyeing in the University of Leeds, for a series of three papers on the chemical and physical effects of kier boiling on insoluble azo colours on the fibre. This is the third occasion on which Prof. Rowe has received this medal, the earlier awards being made for the periods 1924-25 and 1926-27 for his investigations of other aspects of the chemistry of azo colouring matters.

PROF. W. L. BRAGG, F.R.S., professor of physics, Victoria University of Manchester; the Rev. Canon H. Maynard Smith, Canon Residentiary of Gloucester; and the Right Hon. J. H. Whitley, chairman of the British Broadcasting Corporation, formerly Speaker of the House of Commons, have been elected members of the Athenæum under the provisions of Rule II. of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

THE following appointments to the Colonial Agricultural Service have recently been made by the Secretary of State: Mr. W. E. Bassett, formerly assistant superintendent, Victoria Botanic Gardens, Nigeria, to be assistant agricultural officer, Dominica; Mr. T. R. Hayes, superintendent of agriculture, Gambia, to be agricultural officer, Uganda; Mr. F. L. Squibbs, assistant agricultural officer, Leeward

Islands, to be assistant director of agriculture, Seychelles; and Mr. I. G. C. Squire, assistant manager, Oil Palm Plantations, Sierra Leone, to be manager, Government Plantations, Zanzibar.

THE American Association for the Advancement of Science will hold its second summer meeting at Syracuse, New York, on June 20-25. The third summer meeting will be held at Chicago in connexion with the Century of Progress World's Fair on June 19-30, 1933. The centre of this meeting at the World's Fair will be the Hall of Science, in which nearly ten acres of floor space will be devoted to science exhibits. Seventy-five European men of science will be invited to attend this meeting as guests of the American Association.

THE twenty-second annual May lecture of the Institute of Metals will be delivered by Dr. F. Körber, director of the Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf, on Wednesday, May 11, at 8 P.M., at the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, S.W.1, the subject of the lecture being "The Plastic Deformation of Metals". Cards of invitation may be obtained from Mr. G. Shaw Scott, 36 Victoria Street, S.W.1.

THE amalgamation of the Optical Society and the Physical Society of London has been under consideration for some time. It has now been decided to proceed with the amalgamation. Certain alterations are to be made in the articles of association of the Physical Society, and, in due course, a general meeting of the Optical Society will be held to wind up the Society.

FARMERS' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies, and other bodies interested in agriculture or market gardening are invited to inspect the Rothamsted and Woburn Experimental Plots during the coming summer. Mr. H. V. Garner and Capt. E. H. Gregory will be available to demonstrate the plots. All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

THE autumn meeting of the Iron and Steel Institute will be held in London on Sept. 13-15, concurrently with that of the Institute of Metals. It has been provisionally decided that at least one joint session shall be held at which papers of interest to the members of both Institutes shall be presented and discussed. Other sessions will be held separately but concurrently.

AT the recent annual meeting of the Institution of Automobile Engineers, Major C. G. Nevatt was elected president of the Institution for the session 1932-33. The summer visit of the members of the Institution will this year take the form of a four days' trip up the Thames to Oxford on June 8-11, including visits to Morris Motors, Ltd., and the Pressed Steel Works of Great Britain.

ANOTHER of the valuable catalogues (No. 456) of Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, has reached us. It deals with nearly 1500 works on zoology, geology, and palæontology, and should be

of interest to students of these branches of science and to librarians.

MESSRS. Bowes and Bowes, 1 Trinity Street, Cambridge, have just published a catalogue (No. 461) entitled "Old-time Literature (a third Catalogue), principally of XVIIth and XVIIIth centuries", containing particulars of nearly 1700 second-hand books on a variety of subjects, several of which relate to scientific matters.

THE following books are announced for early publication by Messrs. Longmans and Co., Ltd.: "The Causes of Evolution", Prof. J. B. S. Haldane; "A Manual of the Flowering Plants and Ferns of the Transvaal, with Swaziland, South Africa", Dr. J. Burt Davy—Part 2, "Malvaceæ to Umbellifera" (completing the Archichlamydeæ); "Modern Methods in Quantitative Chemical Analysis", Drs. A. D. Mitchell and A. M. Ward; "Modern Practice in Mining", Sir Richard Redmayne—Vol. 5, "Colliery Machinery and its Application"; "Steam Engine Theory and Practice", Prof. W. Ripper, new and revised edition, edited by Prof. W. J. Goudie; "Elements of Steam Power Engineering", Dr. O. Sneed, and "Graphical Geometry", E. N. Digweed.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Male laboratory assistants, Grade II., at the Royal Arsenal—The War Department Chemist, B.47, Royal Arsenal, Woolwich, S.E.18 (April 23). A veterinary assistant at the Veterinary Laboratory of the Ministry of Agriculture and Fisheries, New Haw, Weybridge—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (April 25). An assistant master at the Mining and Technical Institute and Junior Technical Day School, Neath, with a degree in engineering and works experience in engineering—The Director of Education, County Hall, Cardiff (April 25). A woman demonstrator in inorganic and physical chemistry at the Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (April 30). A lecturer in botany at the Wigan and District Mining and Technical College—The Principal, Wigan and District Mining and Technical College, Wigan (May 2). An intelligence officer in the Engineering and Metals Section of the Department of Overseas Trade—The Chief Establishment Officer, Department of Overseas Trade, 35 Old Queen Street, Westminster, S.W.1 (May 5). Assistant civil engineers in the Civil Engineer-in-Chief's Department, Admiralty, and H.M. naval establishments at home and abroad—The Civil Engineer-in-Chief, Admiralty, S.W.1 (May 14). An assistant master at the Leyton Technical College, with a degree in engineering or its equivalent and experience in teaching—R. J. Geldart, 280 High Road, Leyton, E.10. An assistant chemist under the Research Association of British Paint, Colour, and Varnish Manufacturers—The Paint Research Station, Teddington, Middlesex. A laboratory steward in the Department of Physics of St. Thomas's Hospital Medical School—Dr. J. H. Brinkworth, Physics Department, Medical School, St. Thomas's Hospital, S.E.1.

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.]

Hexuronic Acid as the Antiscorbutic Factor

EXPERIMENTS are being carried out in order to decide whether 'hexuronic acid' is the antiscorbutic factor. So far as is known, the distribution of this acid in plants follows closely the distribution of vitamin C. In the animal body it can also be found in relatively high concentration in the suprarenal cortex. Its chemical properties closely agree with the known properties of the vitamin. It was discovered and isolated several years ago at the Biochemical Laboratory, Cambridge.¹

The hexuronic acid used in the present series was prepared in crystalline form from beef suprarenal glands two years ago at the Chemical Department of the Mayo Clinic.² As is known, 1.5 c.c. of lemon juice is the minimum protective dose for guinea-pigs against scurvy. This quantity of lemon juice contains approximately 0.5 mgm. of hexuronic acid. 1 mgm. of the acid has been given to our test animals daily, since, owing to the long exposure to air, some of our hexuronic acid preparation may have been decomposed.

The general procedure used in studying the antiscorbutic activity of hexuronic acid was that recommended by Sherman and co-workers.³

The test period in the first experiment consisted of 56 days. At the end of that time the guinea-pigs which had been receiving hexuronic acid, as well as the positive controls which received 1 c.c. of lemon juice, were chloroformed. The positive controls showed mild scurvy on autopsy, while the animals receiving hexuronic acid showed no symptoms of scurvy at all. The negative controls, which received the basal diet only, had an average survival of 26 days and had typical symptoms of scurvy. In this experiment, however, only a small number of animals were used, and the animals receiving hexuronic acid, as well as the positive controls, were losing weight continually because the basal diet employed at that time contained no milk powder (it consisted of rolled oats, bran, butter fat, and salt). For this reason we decided to repeat the experiment.

In the test which is in progress at the present time the defects mentioned above have been remedied. A large number of animals has been used, and skimmed milk powder has been added to the basal diet.

The test was composed of the following groups: (1) Negative controls receiving the basal diet only, 9 animals. (2) Positive controls, receiving 1 c.c. of lemon juice daily, 8 animals. (3) Test animals receiving the basal diet and 1 mgm. of hexuronic acid daily, 10 animals. (4) Controls receiving mixed diet, 10 animals.

The negative controls all died between the time limit of 20-34 days, with an average survival of 26 days, after a continuous and big drop of weight. They all had symptoms of severe scurvy.

At the end of 55 days all the animals receiving hexuronic acid, as well as the positive controls with lemon juice or mixed diet, were living apparently in good health and were gaining weight consistently. At this time three animals which received hexuronic acid and two animals which received lemon juice were chloroformed. Mild symptoms of scurvy were present

in the positive controls with lemon juice, but no signs of scurvy in the animals receiving hexuronic acid.

The test will be continued until the ninety-day period is over, and full details will be published later.

This research was supported by the Ella Sachs Plotz Foundation.

J. L. SVIRBELY.*

A. SZENT-GYÖRGYI.

Institute of Medical Chemistry,
University Szeged, Hungary.

* Holder of an American-Hungarian Exchange Fellowship, 1931-32, from the Institute of International Education, New York.

¹ Szent-Györgyi, A., NATURE, May 28, 1927: *Biochem. J.*, **22**, 1387; 1928.

² Szent-Györgyi, A., *J. Biol. Chem.*, **90**, 385: 1931.
³ Sherman, H. C., La Mer, H. K., Campbell, H. L., *J. Am. Chem. Soc.*, **44**, 165; 1922.

At the wish and by the courtesy of Prof. A. Szent-Györgyi, I arranged to examine in my laboratory the 'hexuronic acid' which he isolated while working in the Biochemical Laboratory, Cambridge. At the end of 1929 he sent me 10 grams of the substance, which had been prepared in the chemical laboratory of the Mayo Clinic, Rochester, U.S.A. Owing to the value and scarcity of this material, it has been necessary to carry out each experiment with very small quantities, and to establish with much deliberation and care the experimental conditions and controls. This work is still in progress and is being directed to the elucidation of the constitution and the achievement of the synthesis of the substance; this has involved the study of its chemical properties, and the formation of a crystalline derivative. The preliminary results now communicated show that the hexuronic acid is most probably the 6-carboxylic acid of a keto-hexose, which does not appear to be related either to *d*-fructose or to the ketose corresponding to *d*-galactose. This work has been conducted by my colleague Dr. E. L. Hirst, assisted by Mr. R. J. W. Reynolds, whose report is given in the accompanying note.

W. N. HAWORTH.

University of Birmingham,
March 28.

THE 'hexuronic acid' prepared from suprarenal glands by Prof. Szent-Györgyi was a cream-coloured micro-crystalline powder, m.p. 184°-187° (decomp.). On recrystallisation from methyl alcohol-ether the substance was obtained in irregular aggregates of rectangular crystals, which were almost colourless. No change in m.p., analysis, or other properties was observed even after several successive crystallisations. The crystals showed brilliant colours when observed between crossed nicols in a polarising microscope. Before and after recrystallisation the same analytical figures were obtained (Found: C, 41.0; H, 4.7. C₆H₅O₆ requires C, 40.9; H, 4.5 per cent). Neither nitrogen nor methoxyl was present. In aqueous solution the rotation $[\alpha]_D^{20} + 23^\circ$ (c. 1.1) increased slowly to $+31^\circ$ (3 days) and then decreased to zero (11 days).

The hexuronic acid reduced Fehling's solution, neutral silver nitrate, and neutral potassium permanganate in the cold. It gave the Molisch test and the orcinol reaction, but failed to show the naphtoresorcin colour test characteristic of glycuronic acid.

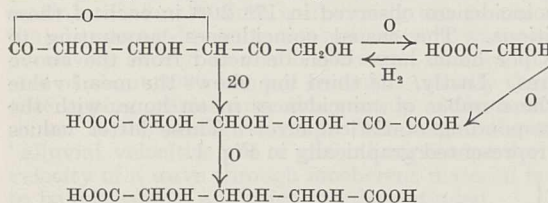
The hexuronic acid was monobasic (40 mgm. of sodium hydroxide neutralised 172 mgm. of substance—calc. for C₆H₅O₆, 176).

Oxidation by atmospheric oxygen in slightly alkaline solution, with a trace of copper as catalyst, introduced one carboxyl group in place of a primary alcohol

group and the product reduced Fehling's solution. Oxidation to the same stage occurred with remarkable rapidity when the hexuronic acid reacted with neutral, acid, or slightly alkaline potassium permanganate. The reaction, which required two atoms of oxygen per molecule of the substance, was thereafter much less rapid but proceeded regularly in the cold until one further atom of oxygen per molecule had been absorbed. The product was now non-reducing.

When heated with phenylhydrazine in dilute acetic acid, the hexuronic acid gave intractable, dark-coloured, amorphous products which could not be purified. The action of *p*-bromophenylhydrazine in dilute acetic acid on the barium salt of the hexuronic acid (compare Goldschmiedt and Zerner, *Monatsh.*, **33**, 1217, 1912) gave a dark red micro-crystalline powder which, after recrystallisation from alcohol, had m.p. 230°-235° (decomp.). Analysis showed it to be the *p*-bromophenylosazone of a hexose-uronic acid (Found: C, 40.8; H, 3.5; N, 11.1; Br, 30.3. $C_{18}H_{18}O_5N_4Br_2$ required C, 40.7; H, 3.4; N, 10.6; Br, 30.2 per cent). Control experiments with glycuronic acid and galacturonic acid failed to give the above substance. With glycuronic acid Goldschmiedt and Zerner's barium salt of the *p*-bromophenylosazone of glycuronic acid was obtained, whilst the galacturonic acid gave a yellow powder which appeared to be mainly the barium salt of the corresponding galacturonic acid derivative.

The above reactions, together with Prof. Szent-Györgyi's observation that oxidation by iodine in the cold removes two atoms of hydrogen, which are easily replaced by mild reducing agents, can be understood most readily on the following basis:



Inasmuch as the configuration and ring-structure of the lactone of the hexuronic acid have not yet been established, the structural formulæ are given above in the open chain form, although the sugar-ring is most probably that of a keto-furanose.

E. L. HIRST.
R. J. W. REYNOLDS.

Chemistry Department,
University of Birmingham,
March 28.

Biological Estimation of the Quality of Sewage Effluents

It is known that certain motile Protozoa and Bacteria gather near the surface film in water containing organic matter. *Polytoma uella*, Ehr. (Fig. 1), one of the Phytoflagellata, in narrow upright tubes rests in a stable zone about 4 mm. below the meniscus, and this reaction may be utilised in detecting organic impurities in water and estimating the biochemical oxygen demand of sewage and sewage effluents.

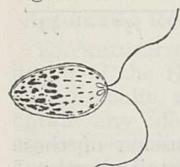


Fig. 1. — *Polytoma uella*, Ehr. $\times 550$, in Dobell's Iodine.

This organism abounds in the final settlement tanks at the Leeds Sewage Works. Cultures are obtained by aerating the humus from these tanks, *Polytoma* increasing in the supernatant fluid as the humus clarifies. Sub-culture is done in tubes of one-inch diameter. Equal parts of humus and bacteria

bed effluent are placed in these and partially sterilised in a water bath for an hour at 80° C. Boiling destroys the colloidal nature of the medium. The tubes are then inoculated from the previous culture, are kept at room temperature, and are not closed.

The working of the test depends partly on capillarity and is carried out in tubes of 4 mm. bore. These are graduated 5 mm. from the bottom and 40 mm. above

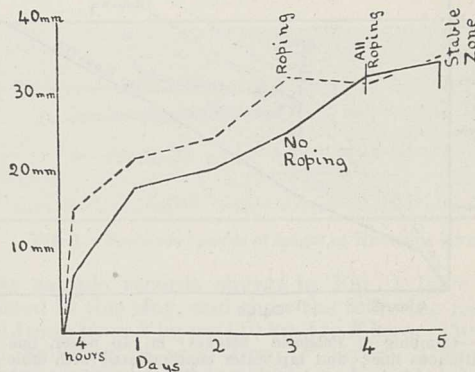


Fig. 2.—Climbing of *Polytoma* 'blanket' in tap water, mean of four tubes, continuous line; and in deoxygenated tap water, one tube, broken line. Tests start simultaneously. Temp. range 49°-55° F. Deviation from mean is shown where scale permits.

this mark. The supernatant fluid of a culture is placed in the tube to the lower mark by means of a fine pipette provided with a long glass bead near the orifice to protect against fouling the sides. The water to be tested is run gently on to this to the upper mark by an ordinary fine pipette. Inoculum and water lie distinct, and the exact distance to the meniscus

is measured. The *Polytoma* gather at the junction in a formation which is called a 'blanket' on account of its characteristic appearance. This blanket mounts the tube at a speed which bears a close relationship to the purity of the water. The order of the movement is illustrated in the charts. In Fig. 1 the rate of rise in ordinary and deoxygenated tap water is contrasted. In Fig. 2 the manner in which the *Polytoma* detects slight contamination of the water is shown.

When the oxygen in solution is below one part in 100,000 parts of water, the blanket is sensitive to very slight differences; the less oxygen present, the more rapid the rise. When an excess of oxygen is present, the blanket is by so much depressed into the depths of the inoculum. Light and darkness and variations in the pH of the water are of no account, and the reaction proceeds steadily at all ordinary room temperatures. The presence of nitrates and nitrites in the water in amounts such as occur in sewage effluents retards the rate of rising.

In crude sewage or other highly polluted waters, the blanket disperses and regathers at the meniscus in less than an hour. Heavy roping is usual from this position in bad water. In tap water, the upward progress is steady, and in a few days the blanket reaches its stable zone well below the meniscus, and there remains. Between these wide differences in behaviour, all intermediate conditions have been observed. It is thus possible to refer waters to a series of grades in contrast to tap water, controls of which are included in every series. Five grades can be defined at present from readings made at the end of one hour and of four hours respectively. Subdivisions of the worst grade are rendered possible by suitable dilution of the fluid tested with tap water.

Spirillum is present in the cultures and possibly plays some part in the reaction. In young cultures, it accompanies the *Polytoma* in its climb, and may form

a conspicuous layer in the blanket. Cultures from 3 to 8 days old react best when *Spirillum* is not too abundant. With older ones, the *Polytoma* becomes sluggish, and its rise may be delayed for a day, except in foul waters. In a reaction thus delayed, *Spirillum* may leave the inoculum first, and the *Polytoma*

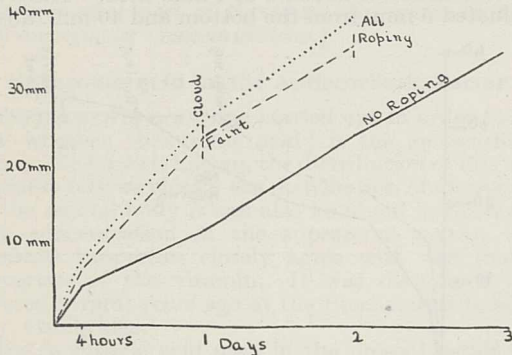


FIG. 3.—Climbing of *Polytoma* 'blanket' in tap water, one tube, continuous line; and tap water contaminated with stale urine at start of test; 1 per cent urine, dotted line; 0.5 per cent urine, broken line; mean from two tubes of each; deviations from mean are shown where scale permits. Temp. range, 49°-57° F., 63° on second day for 2 hours.

blanket follow later and absorb its aggregation. Confusion may thus arise.

Through the courtesy of Mr. J. T. Thompson, manager of the Leeds Sewage Works, I have been able to begin the study of this reaction under practical conditions. I have had the benefit of his expert knowledge of the processes of sewage purification, and access to the record of the analyses of the sewages and effluents tested, as done by Mr. H. Watson. The reaction has been demonstrated to the Royal Society of Tropical Medicine and Hygiene.

LL. LLOYD.

Zoology Department,
University, Leeds.

The Variation of Penetrating Radiation with Zenith Distance

FROM the few investigations¹ so far made of the angular distribution from the zenith of penetrating radiation, the only definite result which emerges is that the intensity is much greater in the vertical direction than in any other. Very recently Mr. Medicus has published² the results of observations made by a method similar to mine described below. But the number of coincidences registered in the different directions is perhaps insufficient for a definite deduction. There is therefore a great need for a trustworthy series of measurements, made with an apparatus having sufficient resolving power to allow the true distribution to be deduced. An exact knowledge of this distribution is of no little importance. In the first place, it is a necessary element in the exact discussion of many other experiments. Secondly, it is interesting to see whether the observed zenithal distribution can be due to the absorption by the atmosphere of a radiation which was originally isotropic.

With these considerations in view, I have attempted a thorough investigation of the problem. I wish to express my sincere thanks to Prof. B. Rossi for suggesting this problem and for his advice and help.

The measurements were made in a wooden hut, the walls and roof of which were 3.5 cm. thick, especially built for the purpose on a terrace of the Physical Laboratory of Arcetri, which is so located that its

horizon is unobstructed, except partially towards the east by the hill of Arcetri.

For the purpose of observing only the rays coming from a relatively small solid angle, I used the coincidence method between the impulses of two Geiger-Müller tube counters. These had a diameter of 3 cm. and an effective length of 20 cm. The coincidences were registered by Rossi's method.³ The axes of the two counters were placed horizontally at a distance of 18 cm. apart.

The two tube counters were mounted so that the plane containing the axes of the two tubes could be rotated round a horizontal axis (the latter being exactly in the north and south direction), so as to make a varying inclination with the vertical. The observations were made with the inclination towards the west.

To eliminate the softer component of the penetrating radiation, a block of lead 5 cm. thick was interposed between the two counters at a distance of 0.7 cm. from the lower one. This precaution seemed advisable both because this softer radiation may very probably be partly of secondary origin and because the walls of the hut are likely to have an influence only on this softer radiation. The results are as follows:

ϕ	0	20	40	60	75
Coincidences in 17 ^h 20 ^m	1616	1441	1018	404	181
No. per hour	93.2 ± 2.5	83.2 ± 2.5	58.4 ± 2.2	23.3 ± 1.7	10.5 ± 1.4

In the first line are shown the values of the angle ϕ between the vertical and the plane containing the axes of the counters; in the second the total number of coincidences observed in 17^h 20^m in each of these positions. The casual coincidences, amounting to 13.8 per hour, have been deducted from the above figures. Lastly, the third line shows the mean value of the number of coincidences in an hour, with the corresponding statistical error. These latter values are represented graphically in Fig. 1.

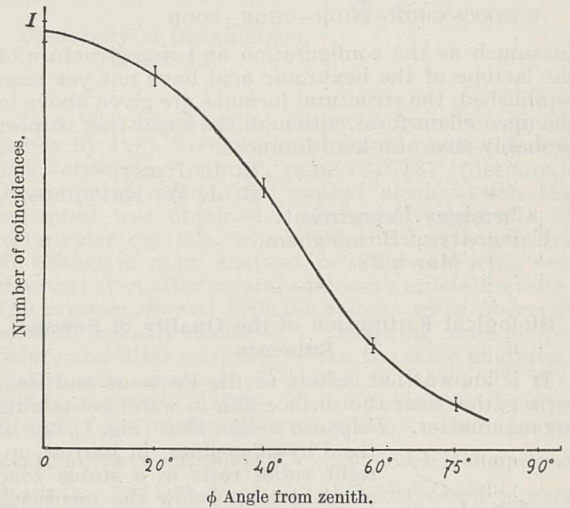


FIG. 1.

Without entering into a full discussion of these results, which will be described in detail shortly, I note that the intensity curve, as a function of the zenithal angle, seems to be somewhat sharper than would be expected from absorption by the atmosphere.

Finally, I wish to express my thanks to Mr. L. Emo for the friendly help given me during part of these investigations, and to the Consiglio Nazionale

delle Ricerche, which has supplied the funds necessary to carry out a group of researches on the penetrating radiation.

GILBERTO BERNARDINI.

Laboratorio di Fisica della R. Università,
Arcetri, Firenze,
March 5.

¹ Tuwim, *Sitz. Preuss. Akad.*, p. 91; 1931. Skobeltzyn, *C.R.*, 194, 110; 1932.

² Medicus, *Z. Phys.*, 74, 350; 1932.

³ NATURE, 125, 636; 1930.

Geophysical Prospecting

MAY I, as one of the editors of "The Principles and Practice of Geophysical Prospecting" (Cambridge University Press, 1931), ask NATURE to publish the following correction? It is made at the request of Mr. E. H. Booth, one of the contributors to the chapter on seismic methods, and it has the approval of Sir Edgeworth David.

An error has crept into the discussion of field tests at Tallong, N. S. Wales, given on p. 229. In Fig. 176 the east and west indicators have been accidentally interchanged. The same figure indicating the interpretation placed on the geophysical work shows the existence of a mass of alluvium over a mile wide and upwards of 200 feet deep. In the geological map of the Tallong area, reproduced on p. 228, no such deposit of anything approaching to this extent and thickness is shown, though the omission of a geologist to indicate such a mass of material would be very serious. As a matter of fact, the deposit is mostly decomposed granite in situ. The mistake in representing this as alluvium is obviously due to the fact that decomposed granite transmits seismic waves comparatively slowly, as would alluvium, namely, at the rate of about 3000 feet per second. Actually there is outcropping granite over this portion of the area, as shown in the geological map. The use of the term 'alluvial velocities' as a general expression for the velocity of a wave through incoherent material is apt to be misleading, and might be discontinued.

In fairness to the geologists who surveyed this area years ago, it must be admitted that the geophysical interpretation, while accurately classifying the material according to the velocities of the transmitted waves, was inaccurate in its presentation of the geological structures of the Tallong area. It is regretted that through an oversight no reference was made to the fact that the geological map of Tallong, reproduced in Fig. 175, is almost entirely the work of Dr. W. G. Woolnough, geological adviser to the Commonwealth Government of Australia. The accuracy of this map has been amply verified by later observers.

T. H. LABY.

Natural Philosophy Laboratory,
University of Melbourne,
Feb. 4.

Automatic Recording of Heaviside Layer Heights

EXPERIMENTS made to determine the effective height of the Heaviside layer have shown extremely varied results, and it has been clear that, in order to obtain any idea of the normal state of the upper atmospheric ionisation, it is unsatisfactory to take observations at widely spaced intervals of time. Continuous automatic records of effective height are required.

Gilliland and Kenrick have recently published a preliminary account of a method of obtaining such records.¹ I have independently developed a method which differs in several important respects from that of Gilliland and Kenrick. The 'echo' method of

Breit and Tuve is used. A transmitter is caused to emit short 'pulse' signals with a constant interval by being driven from the A.C. mains. The signals, together with any echoes, are then arranged to give a stationary pattern on a cathode ray oscillograph screen at the receiver.² The tips of the peaks representing the signal and echoes are photographed on a film moving at about three inches per hour.

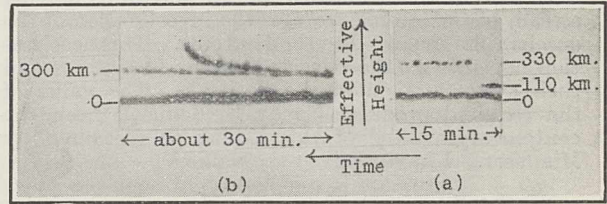


FIG. 1.—Specimen records of height of Heaviside layer.

The sample records shown in Fig. 1 have been obtained in this way, and show the following results:

- (a) Jump from *E* layer (110 km.) to *F* layer (330 km.).
- (b) Splitting of echo from *F* layer. The upper component apparently vanishes due to electron limitation, while the lower component persists.

It is hoped to publish further details of the method in the near future.

ERIC L. C. WHITE.

Cavendish Laboratory,
Cambridge,
March 5.

¹ Bureau of Standards *J. Research*, Nov. 1931, 783.

² E. L. C. White, "Method of continuous observation of the Heaviside Layer", *Proc. Camb. Phil. Soc.*, 27, 445; 1931.

Photo-Conductivity of Diamonds

SINCE reporting that we had found a diamond transparent at 8μ in the infra-red and so far as $\lambda 2300$ in the ultra-violet region of the spectrum,¹ whereas most diamonds have an intense infra-red absorption band at 8μ and no longer transmit beyond $\lambda 3000$, we have come across four more diamonds of that type transparent in both regions. Some of these diamonds respond to radiation in a manner which is striking and, we believe, hitherto unrecorded.

Gudden and Pohl,² and also Miss Levi,³ succeeded in obtaining a current when certain diamonds were illuminated with ultra-violet light from a mercury arc, provided at the same time a considerable voltage were applied to surfaces of the diamond.

This we can repeat with all the diamonds of the transparent character, but most of them on illumination without the application of any voltage produce a current. In one case this is as much as is equivalent to a galvanometer throw of 1×10^{-7} ampere, while a back E.M.F. of about 0.6 volt is required to bring the galvanometer back to zero. This effect was obtained with contacts of brass, lead, or graphite.

Exploration of the activating region by means of the large monochromator of King's College, London (kindly put at our disposal by Prof. Allmand), showed that the most effective wave-length for photo-conductivity in the transparent diamonds is about $\lambda 2300$.

R. ROBERTSON.
J. J. FOX.
A. E. MARTIN.

Government Laboratory,
London, W.C.2,
March 24.

¹ Robertson and Fox, NATURE, 126, 279; 1930.

² *Z. Phys.*, 3, 125; 1920; 6, 249; 1921; 7, 65; 1921.

³ *Trans. R. S. Can.*, 16, 241; 1922.

The Hydrogen Chromosphere

THE slow decrease of the density of hydrogen with increasing height in the solar atmosphere requires a consideration of the force opposing gravity. As is well known, radiation pressure is insufficient for this purpose, at least if the radiation-intensity is not wholly different from the value derived by extrapolation from the solar spectrum in the visible region.

However, the existence of an outward moving stream of Ca^+ atoms requires the investigation of the acceleration imparted to the H-atoms. This acceleration depends on the density ρ of the Ca^+ atoms and their systematic outward velocity v . The value of the required product ρv may be deduced from the contour-asymmetry of the K-line, as measured by Minnaert. I have derived the value¹

$$\rho v = 0.8 \times 10^{-12};$$

however, owing to the circumstances of the problem, this value has a large degree of uncertainty and requires revision in the future.

Combining the determination of ρv with a classical computation² of the effect of the collisions on the hydrogen atoms, I have deduced the ratio of the acceleration imparted to a hydrogen ion at rest to the acceleration of gravity. The resulting value of this ratio is 1.1. The value for a hydrogen atom would be much smaller on account of the shielding effected by the bound electron.

Though inconclusive at present on account of uncertainties in the values involved, this computation induces me to adopt as a working hypothesis the convection of the hydrogen atoms by the outward moving Ca^+ atoms.

The fact that the motive force of the Ca^+ ions only is present at comparatively great heights in the solar atmosphere concentrates its action especially on hydrogen.

A more detailed analysis of the motion of hydrogen will be published elsewhere.

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¹ B.A.N., 182.

² B.A.N., 213.

Polarisation of Raman Scattering

THE use of an improved technique has enabled us to obtain more precise measurements than formerly of the polarisation of the lines in Raman spectra. A systematic study has now been made with many liquids. An important result obtained is that no line has a depolarisation greater than 6/7, and that earlier reports by various workers indicating a larger depolarisation in certain cases are not correct. The limiting value of 6/7 is obtained in many instances, especially in all cases of a rotational scattering, whether by gases or by liquids. Many vibration lines also exhibit this high degree of depolarisation, as, for example, the frequencies 605, 1584, and 1605 of benzene, the two bands at 189 and 1398 in formic acid, the line at 750 in thiophene, the frequencies 106, 131, and 403 in tin tetrachloride, and the corresponding lines given by the tetrachlorides of carbon, silicon, and titanium. In all these cases, the explanation suggested in the last paragraph of Bhagavantam's note in NATURE of Jan. 30, 1932 (p. 167), is evidently applicable.

A careful determination has been made with the intense 992 line of benzene and it is found that it exhibits a genuine depolarisation of 7 per cent. The tetrachlorides of carbon, silicon, titanium, and tin exhibit an interesting progression in the behaviour of their strongest lines: the lines 459, 426, 382, and 367 given respectively by these compounds exhibiting

depolarisations of 4, 11, 12, and 16 per cent. That these lines, which correspond to a symmetric oscillation of the tetrahedral molecules, exhibit a genuine depolarisation is not surprising in view of the well-attested optical anisotropy of these molecules. It is found that the Rayleigh scattering by all the tetrachlorides is accompanied by a rotational Raman scattering and is depolarised to an appreciable extent, which increases with increasing atomic number of the central atom.

S. BHAGAVANTAM.

S. VENKATESWARAN.

210 Bowbazar Street,
Calcutta, India, Feb. 28.

Constitution of the Keratin Molecule

IN a note which appeared recently in these columns, Speakman and Hirst¹ recorded comparisons of the work necessary to stretch wool fibres in water, in acids, and after treatment with nitrous acid. The conclusion they reached was that acids disrupt a linkage of the type $\text{R}_1 - \text{COO} - \text{NH}_3 - \text{R}_2$ in the keratin molecule formed from acidic and basic units in adjacent polypeptide chains. Taking the figures quoted by Marston² for the amino-acid composition of wool, it was shown that the dibasic aspartic and glutamic acids were collectively present in quantity roughly proportional to that required on the assumption that they entered into a linkage of the type postulated with the ϵ -amino group of lysine and the guanidine group of arginine.

The suggestion put forward by Speakman and Hirst is worthy of consideration in explaining the properties of wool fibres, although they have neglected in their calculations one factor which makes the agreement or correspondence between the quantities not so close as would appear from their figures. They have assumed that every molecule of glutamic or aspartic acid has one carboxyl group free to enter into salt formation with an amino group. Wool yields upon hydrolysis 1.2 per cent of 'ammonia'- or 'amide'-nitrogen. Now, the general opinion among protein chemists is that this ammonia exists in the protein in the form of acid-amide linkages with one or other of the dibasic amino acids.^{3, 4, 5}

Osborne⁶ was one of the first to point out the parallelism between the yields of ammonia and of dicarboxylic acids from various proteins, and although hydroxyglutamic acid was only discovered afterwards,⁷ it will be recalled that Luck⁸ succeeded in isolating a complex from caseinogen, representing at least one-third of its ammonia nitrogen, in which a peptide of lysine glutamic acid amide was the principal constituent. Alternative theories as to the origin of ammonia nitrogen, for example, ureide linkages,⁹ which have at one time or another been proposed, have all had eventually to be abandoned.

Speakman and Hirst must therefore deduct 12.6 per cent by weight of glutamic acid from the 12.9 per cent contained in wool, since this is presumably in combination with the 1.2 per cent of ammonia nitrogen, leaving 0.3 per cent of glutamic acid and 2.3 per cent of aspartic acid (say 2.6 per cent in all) free to enter into the type of union they postulate with the basic amino acids. As they state, "Using Marston's data, the arginine and lysine are together equivalent to an amount of glutamic acid equal to 11.4 per cent by weight of the wool". Even if the more recent figures of Vickery and Block,¹⁰ independently confirmed by Stewart and me,¹¹ of 8.6 per cent arginine instead of 10.2 per cent and 2.3 per cent lysine instead of 2.8 per cent, be taken, these bases, for complete combination, would require 9.57 per cent of glutamic acid—nearly four times the amount actually available.

So far, no systematic search has been made for

hydroxyglutamic acid or for hydroxylysine in wool, and the above considerations are naturally confined to existing data.

A second point in the communication under consideration raises the question whether hydroxylysine may not be a constituent of wool. Speakman and Hirst found 0.94-1.11 per cent of amino nitrogen in the wool they examined; the ϵ -amino groups of 2.8 per cent lysine would account, however, for only 0.27 per cent. They included 0.82 per cent as being derived from 10.2 per cent of arginine, making 1.09 per cent in all, in agreement with their experimental findings. The guanidine group of arginine does *not*, however, yield nitrogen with nitrous acid under the usual conditions.

Van Slyke and Birchard¹² have shown that in most proteins the free amino nitrogen corresponds very closely to one-half of the lysine nitrogen, and in the present case it may be concluded that wool probably contains hydroxylysine or other diamino acid in addition to lysine.

Our uncertainty as to the composition of the keratin molecule (only one complete analysis is upon record, that of Abderhalden and Voitovici¹³ in 1907) makes it imperative that trustworthy quantitative chemical evidence should be available to test the newer physical theories of keratin structure now being advanced.

CLAUDE RIMINGTON.

Understepoort Veterinary Research Laboratory,
Pretoria, South Africa, Feb. 1.

¹ Speakman and Hirst, *NATURE*, **128**, 1073, Dec. 26, 1931.

² Marston, Council of Sci. and Ind. Res., Commonwealth of Australia, *Bulletin*, **33**, 1928.

³ Fischer, "Untersuchungen über Aminosäuren, Polypeptide und Proteine", **1**, 1899-1906; **2**, 1907-1919: Springer, Berlin.

⁴ Osborne, *J. Amer. Chem. Soc.*, **24**, 140; 1902.

⁵ Osborne and Gilbert, *Amer. J. Physiol.*, **15**, 333, 1905-1906.

⁶ Osborne, Leavenworth and Brautlecht, *Amer. J. Physiol.*, **23**, 180; 1908-1909.

⁷ Dakin, *Biochem. J.*, **12**, 290; 1918.

⁸ Luck, *Biochem. J.*, **13**, 679; 1924.

⁹ Andersen and Röd-Müller, *Biochem. Z.*, **70**, 442; 1915.

¹⁰ Vickery and Block, *J. Biol. Chem.*, **86**, 107; 1930.

¹¹ Stewart and Rimington, forthcoming publication in *Biochem. J.*

¹² Van Slyke and Birchard, *J. Biol. Chem.*, **16**, 539; 1913-1914.

¹³ Abderhalden and Voitovici, *Z. physiol. Chem.*, **52**, 368; 1907.

Preparation of Anhydrous Chlorides and Metallic Couples

DURING investigations involving the Grignard reagent it was noticed that, when the magnesium was in contact with lead chloride under ether, bubbles of gas were evolved, which were found to arise from traces of water in the ether.

This led to the investigation of the action of water on a metallic salt (chloride, sulphate, nitrate, etc.) when mixed with a metal lower in the electro-potential series than the metal of the salt.

It was found, especially in the case of the chloride, that reaction in many cases occurred with explosive violence, the more electro-positive metal replacing the less electro-positive metal of the salt. Typical cases of such violent reactions were given by zinc and aluminium respectively when in contact with (a) HgCl_2 , (b) PbCl_2 , (c) Cu_2Cl_2 , etc. Such mixtures are very effective for detecting the presence of traces of water in organic liquids.

These observations led to heating the mixtures to ascertain whether in cases of volatile chlorides a simple method of preparation were possible, and it was found that when excess of aluminium was heated with lead chloride a quantitative yield of aluminium chloride was obtained. When excess of aluminium is not taken, a yellow crystalline substance (probably a double chloride of lead and aluminium) is formed along with the aluminium chloride. The reaction takes place very readily and can be carried out in a

soft glass test-tube. Aluminium and cuprous chloride, also aluminium and silver chloride, react easily to give aluminium chloride. For syntheses by the Friedal Crafts' reaction, the aluminium chloride can be quantitatively distilled over by connecting the test-tube with a bent metal tube to the reaction vessel. Instead, the mixture may be placed in the reaction vessel itself and gently warmed; the aluminium chloride condenses on the side of the flask, and the metallic residue can be shaken out of the vessel. The chloride is then washed down the side of the vessel with the organic solvent, or dislodged by means of a glass rod.

Zinc and stannic chlorides are readily prepared by the action of (a) zinc on cuprous chloride, (b) tin on cupric oxychloride. The cupric oxychloride is prepared by fusing ordinary hydrated cupric chloride on a tray, the fused mass being ground up in a mortar and transferred to a distillation flask. Powdered tin is dropped into the flask, the neck being closed by a cork wrapped in tin-foil. On gently heating, anhydrous stannic chloride distils over and is collected in a test-tube placed on the side arm. In this way anhydrous stannic chloride in excellent yield can be very quickly prepared.

Zinc and cuprous chloride when left on a filter paper react, causing the paper to ignite. When magnesium and cuprous chloride were heated together an explosion occurred; the flask was shattered and coated with copper.

Another point of interest is that effective couples can be made in this way. For example, in the preparation of diphenyl methane,¹ instead of adding aluminium mercury couple, an effective nascent couple is obtained by adding a little aluminium and mercuric chloride. The yield was quite as good as that obtained by the usual method, with the further advantage that the couple prepared *in situ* is always effective, and is more certain in its action than the ordinary couple.

Observations indicate that oxychlorides may in some cases be better than normal chlorides, for the use of the former involves the possibility of a thermite as well as a displacement reaction.

At present the application of the above facts for widening the scope of reactions is being investigated.

S. D. NICHOLAS.

Chemical Department,
University of Birmingham,
Edgbaston, Feb. 23.

¹ Cohen, Hirst, *Trans. Chem. Soc.*, **67**, 826; 1897.

Degree of Weathering of Soils

IN the modern study of soils, there is an urgent need for methods of analysis which will express quantitatively the fundamental properties and genetic relationships of the material examined. We are venturing to suggest a provisional method whereby an approximate estimate may be obtained of the extent to which chemical weathering has proceeded in a given soil.

Assuming that the clay fraction separated in mechanical analysis represents that portion of the soil which has resulted from processes of chemical weathering—the so-called weathering complex—and that the remainder of the soil consists of unweathered minerals, such as feldspars, and unweatherable minerals, such as quartz, the proportion of the total alumina of the soil present in the clay fraction should give a rough measure of the degree to which chemical weathering has proceeded. Since the principal clay-forming minerals are complex aluminosilicates, a soil which has reached the end-point of weathering

will contain no alumina in its non-clay fraction. On the other hand, a soil in the early stages of chemical weathering will contain considerable amounts of alumina as unweathered aluminosilicates in the non-clay fraction. We therefore propose, as a measure of the degree of weathering, the amount of alumina in the clay fraction, calculated as a percentage of the total alumina of the soil. For example, if a certain soil contains 20.5 per cent of alumina, of which 16.4 per cent is in the clay fraction, the degree of weathering is 80 per cent. A parallel estimate may be obtained from the percentage of the total ferric oxide of the soil present in the clay fraction, but in many cases, particularly in tropical soils, there are considerable proportions of secondary ferric oxide in the non-clay fraction. Indeed, with lateritic soils, the partition of alumina is equally untrustworthy as a measure of the degree of weathering.

We have divided the soils examined by this method into two categories, namely, (1) soils derived by primary weathering from crystalline rocks, and (2) soils derived from materials such as alluvium and marine sediments which have already undergone one or more cycles of weathering. In Category 1, we may distinguish (a) soils such as those in Britain, in which chemical weathering has only proceeded to a moderate extent, and (b) soils of the humid tropics, in which chemical weathering is far advanced.

We have examined five soils in Category 1 (a), six soils in Category 1 (b), and seven soils in Category 2. Our results are shown in the following table, which gives the average degree of weathering calculated from the alumina and from the ferric oxide data respectively.

	Degree of Weathering calculated from	
	Al ₂ O ₃	Fe ₂ O ₃
Category 1 (a) .	33.0 (18.6-40.3)	32.1 (15.5-43.1)
Category 1 (b) .	76.5 (58.4-89.7)	66.1 (58.6-94.3)
Category 2 .	82.9 (70.5-93.4)	64.5 (48.5-84.3)

It will be seen that the figures obtained are in good agreement with expectation, for the tropical soils and the soils of secondary origin show much higher degrees of weathering than the relatively immature soils derived by primary weathering under British conditions. The degrees of weathering calculated from the ferric oxide data are in the same order as those calculated from the alumina, but are rather lower, partly on account of the presence of ferric oxide of secondary origin in the non-clay fraction, and partly on account of the presence, in some cases, of unweatherable minerals of the magnetite group.

Though only approximate in character, the proposed method may serve as a simple procedure for obtaining an estimate of the relative maturity of soils, and may, therefore, aid in the sub-classification of the major soil groups. It may also find an application in the study of regolithic materials.

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MINNIE RICHARDSON.

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Bangor, March 3.

Function of the Spiracles of Insects

IN carrying out investigations on the respiration of insects, with particular reference to the action of the spiracles and the factors which control their activity, one is struck by the divergence of the results recorded by previous workers. It appears that they have tended to look upon the spiracles only in connexion with gaseous exchange (oxygen and carbon dioxide). Respiration, however, also entails a water metabolism.

Feeling that the tracheal system may have an importance hitherto overlooked in the water balance of the insect, both in respiration and temperature control, efforts have been made to assess the various avenues of water exchange, using larvæ and pupæ of *Galeria mellonella* (Lepidoptera). Preliminary experiments show that a large part (a first approximation gives 50 per cent of total) of the water exchange occurs via the trachea and spiracles.¹

The results obtained may help to explain the different observations upon spiracular behaviour at increased temperature. Thus, while at one time the spiracle may be opening to deal with an increased gas exchange at increased temperature, it may later begin to close to avoid injurious desiccation.

The problem is complicated by the increase in the rate of gaseous diffusion at high temperatures, which tends to overcome the need of spiracular opening. The experiments performed, however, give generally concordant results and uphold the idea put forward very well. The technique is simple and allows of concurrent observations on the localisation of carbon dioxide exchange, and it is hoped to shortly publish a full account of the results.

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¹ Buxton, 1930. *Proc. Roy. Soc. Lond.*, B, 106.

Preparation and Mounting of Deliquescent Substances

CERTAIN deliquescent crystals were required for structural investigations. The following method of preparation and mounting was found satisfactory.

A tube 1.5 cm. in diameter was drawn down at one end to a short tube 0.75 cm. across, and at the other to a capillary. The apparatus was warmed and a stream of dry carbon dioxide was passed through from the capillary end. When the apparatus was dry, the substance to be sublimed was introduced, the gas flow stopped, and the end of the narrow tube sealed. The capillary was then attached to a 'Hyvac' pump, the apparatus evacuated and sealed off.

The tube was heated in an air oven until good crystals were obtained. When cool, a scratch was made at the base of the narrow tube, and a piece of thin rubber tubing was slipped over it until it gripped the wide tube. The rubber tubing was connected to the supply of dry carbon dioxide. The tube was then broken at the scratch, thus filling the apparatus with dry gas. The broken glass was pushed down the rubber tubing until a sufficient length was free to be clipped. The end was then cut off, and a piece of lithium glass tube, drawn down to a capillary at one end, was inserted, carbon dioxide being passed meanwhile. The capillary was then sealed and the clip removed. A piece of stout wire was pushed through the rubber and used to dislodge the crystals, one at a time. After dropping into the capillary tube, they were sealed off separately. The crystals are liable to move unless the tube tapers.

Slight changes in technique enabled crystals grown from solution or fusion to be mounted in the same way.

When optical measurements were to be made, the crystal was dropped into a small spherical bulb blown on the end of a short tube. A fine glass rod dipped into tap fat was passed through the hole in the rubber, and the crystal, suitably oriented, was picked up on the end of this. The rod was then melted into the side of the tube, and the whole sealed off.

NORA WOOSTER.

A. J. P. MARTIN.

The Mineralogical Laboratory,
The Museums, Cambridge, Feb. 23.

Research Items

The Campas Indians, East Peru.—Some notes on the culture of the Campas Indians of eastern Peru are given by Prof. Morris G. Caldwell and Mr. John Calhoun in the *Scientific Monthly* for March. An area covering several thousand square miles of jungle and mountainous land and intersected by several tributaries of the upper Amazon is characterised by a common culture sufficiently uniform to justify the name of 'the Campas Culture-area'. It extends from the Pachitea River south to the Mantaro, and from the Ucanali westward to a line from Jauja to Huanaco. The Indians possess a well-developed culture, though it appears to be retarded. They use bamboo arrows three feet long, tipped with a sharpened palmwood head sixteen inches long. Four small prongs encircle the point to catch in the flesh. Blunt hardwood heads are used for killing small birds. Fish arrows have three prongs. The bow is of palmwood five feet long. A hunting axe of dull porous stone hafted on a two-foot wooden handle is used. The principal means of transportation is by canoe—a dugout about thirty-five feet long and five feet wide. It is made from palmwood by the use of axe and fire. Pottery jars are made from the yellow river clay; they are used for carrying water, fruit berries, etc. Garments are made from cotton which grows wild, and are often decorated with feathers, bunches of bone, seeds, nuts, toes of small animals, and bones of small birds and monkeys. The dress is a slip-over garment without sleeves and a poncho. They chew coca leaf and have an intoxicating liquor made from yucca root chewed by the old women.

Egyptian Magic.—An Egyptian bilingual papyrus, long in the British Museum but unknown to scholars, has been translated and edited by H. I. Bell, A. D. Nock, and Herbert Thompson (*Proc. Brit. Acad.*, vol. 17). It gives a number of short magical formulæ current in Egypt, presumably at the date of writing, which is placed at somewhere towards the end of the third century A.D. The procedure is usually to invoke a god or some higher power and compel him to assist the invoker in procuring what he wishes. In the present collection the Demotic text includes an invocation to Thoth for aid, a method to discover a thief, spells for reputation, and an amatory spell. The Greek texts are mainly concerned with the last named. In a spell to obtain an answer to a dream, a laurel leaf is placed under the head when the invoker goes to sleep. On it are written seven invocations, that is, seven strange forms of the names of Horus and Thoth, to which *kh* has been added, possibly representing some peculiarity in pronunciation of the divine name. In "the way of finding a thief", the head of a drowned man is used, a stalk of flax grown from the ground under which it has been buried for the purpose, being used to tie the magical knot which binds the thief. In a charm to win a woman's love, a figure of Osiris in wax, wound in ram's wool, is buried with the bone of a lizard under her threshold, while a spell is chanted to Isis at the rising of the moon. The influence of the lizard is seen again in a charm in the Greek text, of which the object appears to be to secure the woman's love by ensuring her separation from her husband. Numerous examples of the use of the lizard in medicine and erotic magic are collected in the editorial notes.

Flocking Habits of Birds.—The use of bird-ringing (or banding, as it is called in America) in conjunction with bird traps has brought to light some interesting features regarding the grouping of birds during the

winter or non-breeding season. On the campus at Stanford University, California, flocks of golden-crowned and white-crowned sparrows (*Zonotrichia coronata* and *Leucophrys pugetensis*) arrive on autumn migration or stay over the winter until the return in April and May. To supplement the ringing method, which entails the handling of birds for identification, some feathers of the birds were distinctively stained so that the individuals could be recognised in the field. The results, recorded by John B. Price (*Condor*, 1931, p. 238), show a constant return of the same bird to the same area and even the same trap. The author concludes that both species spend the winter in definite flocks, each with its own range of 15-20 acres. Between the flocks there is very little interchange of individual birds, and the memory of the territory seems to persist from year to year, for in most cases an individual bird was found to return to its original flock territory after migration.

Classification of the Gulf-Weeds.—On British coasts' the most conspicuous of the brown seaweeds are members of the group *Fucales*, represented by a few genera, each with one or only few species, the commonest being *Fucus* spp. In warmer seas, the group is also prolific, but represented by other genera, of which one of the more important is *Sargassum*. Unlike *Fucus*, *Sargassum* is represented by a large number—probably more than three hundred—of species, and a wide field is still open to systematists to bring the classification of this genus into a satisfactory condition. Problems are presented not only by the large number of species, but also by variations in form due to environment and to the fact that some of the species are dioecious, with morphological differences between plants of the two sexes. Dr. Setchell of California has given an account (*Hong Kong Naturalist*, vol. 2, No. 4; 1931) of the existing schemes of classification and the main features of the five subgenera, based on the system of J. C. Agardh (1848-1889). He adds also a tentative artificial key for the identification of species occurring in the Hong Kong region, where the genus is well represented. This should prove of great assistance to any who have opportunities of studying the genus further.

Maize Hybrids with *Tripsacum*.—Induced parthenogenesis is a possible method of obtaining homozygous strains instead of prolonged inbreeding. Mangelsdorf and Reeves (*J. Her.*, vol. 22, No. 11) attempted to produce such seeds in maize by pollinating it with a related grass, *Tripsacum dactyloides*. This species extends from the Atlantic to Texas, the Texas form used having narrower leaves and $2n=36$ chromosomes, while the Connecticut form has $2n=72$. Crossing with the Texas type was obtained by shortening the maize silks or stigmas to about two inches. By double pollination it was found that hybrid seeds develop better adjacent to normal seeds. No parthenogenetic embryos were obtained, but the hybrid seeds usually showed 38 chromosomes. In maize $n=10$, so with double fertilisation an endosperm containing $10+10+18$ chromosomes should be found. The embryos of these seeds usually had 28 chromosomes. When pollen from the tetraploid *Tripsacum* was used, seedlings were obtained with 46 chromosomes in their root tips, as expected. Most of the seeds in these crosses were abortive and shrivelled, but could be germinated on agar. From some 185,000 silks exposed to pollination, only 84 seeds matured. Certain maize varieties crossed more

readily than others, and curiously enough the tetraploid *Tripsacum* was more successful than the diploid as pollinator. The hybrids more nearly resemble the male parent, especially when the tetraploid form is used. Some plants from this cross which matured are sterile in pollen and seeds. Meiosis shows 18 bivalents, presumably the *Tripsacum* chromosomes pairing with each other, and 10 lagging maize chromosomes. Numerous small nuclei are formed, resulting in aborted pollen. The reciprocal cross, *Tripsacum* × maize, has never succeeded. These results differ in some respects from earlier work of Collins and Kempton.

Magnetic Distribution in China and Tibet.—In *Veröffentlichungen d. Preuss. Meteorolog. Inst.*, No. 379 (Abh. Bd. 9, No. 7), Berlin, 1931, O. Venske gives a reduction and discussion of the terrestrial magnetic observations made by W. Filchner on his expedition through China and Tibet in 1926–28. Prior to this journey, very little was known about the magnetic distribution in Tibet. Filchner measured the declination, dip, and horizontal force at about 150 stations, about 50 km. apart, using a magnetic theodolite, the dip being measured with the aid of soft iron induction bars. The stations lay on two routes, each lying roughly in the east-west direction; the northern one was from Tashkent (41° N., 69° E.) by Tihua (44° N., 88° E.) and on to Lussar (36° N., 102° E.), and the southern one from Lussar to Leh (34° N., 78° E.) over the Tangla Pass, 15,000 ft. above sea-level. Despite many difficulties and privations, due to ill-health and Tibetan hostility, Filchner's measurements, according to Venske, are of satisfactory accuracy. The declination nowhere differed much from 0°, confirming that the agonic line runs east-west in Tibet; local disturbances are small and suggest (in agreement with gravity data) that the non-magnetic surface rocks reach down to great depths.

Spitsbergen Geology.—D. Sokolov and W. Bodylevsky (*Skrifter om Svalbard og Ishavet*, 35, pp. 151, pls. 14; 1931) describe the Jurassic and Lower Cretaceous faunas of the west coast of Spitsbergen and discuss their stratigraphical relationships. The horizons which have been recognised from palaeontological evidence range from Upper Callovian to Lower Aptian. Lower Callovian and Albian may also possibly be present in Spitsbergen. The Lower Aptian does not appear to have been previously recognised in the Arctic region. Typical Oxfordian is not present. The abundance of *Aucella*, of which about thirty species are described in this memoir, gives a characteristic aspect to the Upper Jurassic and Lower Cretaceous faunas and recalls that of Petschora-land. Continental conditions are indicated by the occurrence of *Gingko* and other plants in beds above the undoubted Valanginian and below the Criocerat beds of the Lower Aptian.

Atmospheric Ozone.—The main conclusion reached by D. Chalonge in his paper (*J. Phys.*, January) on the vertical distribution of ozone in the air, is that little is known about this, and that the present methods of investigation based on ultra-violet spectrophotometry are unsatisfactory. In particular, he shows that it is misleading to refer to an absorbing layer at 50 km., if this is taken to mean that the region where absorption occurs is restricted, or even that the centre of gravity of the ozone is defined by it. Ozone is, on the contrary, present in considerable quantity so low as 20 km., and, probably with a concentration increasing with height, up to 80 km., which is not much below the Heaviside layer. What appears to be most urgent is some entirely new

experimental method, if this can be devised, and, until this is forthcoming, ambiguity is likely to attach to the results obtained with current methods, including the one which makes use of ozone absorption in the yellow, which has recently been described by O. R. Wulf (*Smithsonian Misc. Coll.*, vol. 85, No. 9).

Optical Glasses.—As the result of an examination of the properties of a large number of optical glasses as given in a manufacturer's catalogue—that of the Parsons' Optical Glass Company—Mr. T. Smith, of the Optics Department of the National Physical Laboratory, has come to the conclusion that a knowledge of the refractive indices of a glass for light of three wave-lengths is sufficient to enable the index for any other wave-length within the visible spectrum to be calculated. The refractive index for any wave-length can be expressed in the form $a + bw^n$ where a , b , and n are constants for each glass and w is the wave number, that is, the reciprocal of the wave-length. From this it follows that between the indices and wave numbers for three lines we have $(\mu_1 - \mu_3)/(\mu_2 - \mu_3) = (w_1^n - w_3^n)/(w_2^n - w_3^n)$, and if n is found so that the equation is satisfied for three lines for which the μ 's are observed the μ of any other line of known w may be calculated. It is therefore more convenient to define the reciprocal dispersion or constringence ν as $(\mu_F - 1)/(\mu_F - \mu_C)$ where F and C are the blue and red hydrogen lines, and in comparing glasses it is more useful to the computer of optical systems if $\log \nu$ instead of ν is plotted against μ , and Mr. Smith hopes glass makers will publish diagrams of this kind on an agreed uniform scale in their catalogues. He considers that at present a larger variety of glasses is produced than is necessary for optical purposes. His conclusions were well received at a meeting of the Optical Society in February, 1931, and his paper and the discussion on it appear in part 3 of vol. 32 of the *Transactions of the Society*.

Crystal Structure of Benzene.—It is somewhat surprising that although benzene is one of the simplest of organic compounds, yet its crystal structure has never been at all fully worked out. It is true that the dimensions of the unit cell have been determined consistently in two different investigations, and that the space group and the number of molecules to the cell are known, but there are various technical difficulties which make it difficult to proceed further. Some account of these, and of the way in which they have been partially overcome, has been published by E. G. Cox (*Proc. Roy. Soc.*, March). One of the major difficulties is the high vapour pressure of benzene, which is five times that of ice at 0° C., and makes it impossible to keep the solid in the open for long. To overcome this, the crystal was enclosed in a gelatin capsule; this was reasonably transparent to X-rays, and sufficiently impervious to benzene vapour when lightly coated with shellac for the crystal to be kept for several days. It was, however, still impracticable to work with an ionisation spectrometer, and hence the rotating crystal method, with a special cooled camera, had to be employed. Even so, it was not considered worth while to make other than eye estimates of intensity. The main result which emerges is that the experimental results are strongly in favour of a flat-ring molecule; a puckered ring would exaggerate some of the discrepancies observed, and would not agree with the absence of cleavage of the crystals and their considerable hardness. Beyond this, little more can be said than that the ring structure is loosely knit; the average distance from centre to centre of carbon atoms in neighbouring molecules is

about 3.8 Å., compared with 3.5 Å., which is the distance most usually found to occur in organic substances.

Reactivity of Metals with Water.—We have received from Mr. Binayendra Nath Sen, of 57 Patutola Lane, Calcutta, a communication in which he advances a rule that only those metals react with water at the ordinary temperature in which the distance of closest approach of the atoms is not smaller than 3.00 Å. The list includes lithium, sodium, potassium, calcium, bismuth, magnesium, cerium, and lead. Mr. Sen states that other metals are not acted upon by water at the ordinary temperature, and in them the distance of closest approach is less than 3.00 Å., with one or two exceptions.

Oxidation of Phosphorus.—A number of new observations on the oxidation of phosphorus vapour at low pressure, which bring out the fact that this can occur in more than one way, have been described by H. W. Melville and E. B. Ludlam (*Proc. Roy. Soc., March*). They are concerned with the manner in which the reaction takes place in the presence of tungsten and platinum when the pressure is too low for an explosion, but in order to avoid the difficulties which arise in applying the usual methods for measuring low pressures in this instance, the explosion limit was made use of for this purpose by determining how much additional oxygen was required to pass to the critical value for explosion to occur. When platinum was put in the reaction chamber, the rate of reaction could be measured conveniently with it at 200° C.; no glow could be seen during the reaction, and it

probably occurred at the platinum surface. With a tungsten filament, on the contrary, it was necessary to go to 500° C., and the reaction was accompanied by a green glow; from this, and from other evidence, it was concluded that the change started at the metal surface, but was propagated through the gas, and finally ended on the walls of the tube. Gold, silver, and molybdenum, although not studied in detail, appeared to behave similarly to tungsten.

Pressure on Retaining Walls.—A paper was read before the Institution of Civil Engineers on Feb. 23 by Prof. C. F. Jenkin on "The Pressure on Retaining Walls". Researches on this subject were begun by the author in the Engineering Laboratories at Oxford in 1926, and during the last two years have been continued at the Building Research Station. An account of the work up to last year was given by Prof. Jenkin to the Royal Society; but the present paper describes the latest type of experimental apparatus and gives the results of tests on the pressure exerted by sand on walls of many types. The tests include measurements of the forces on the wall (in magnitude, direction, and position) and also the determination of the planes of rupture and the nature of the motion of the sand down the back of the wall. Approximate formulæ have been developed and their application is summarised in practical working rules. The errors in many of the old forms of wedge theory are pointed out, the reaction of the wall on the sand is discussed, and the author expresses the hope that others may be saved from the pitfalls into which he himself has fallen.

Astronomical Topics

New Comet.—Two telegrams and circular No. 361 from the I.A.U. Bureau, Copenhagen, announce the discovery of a comet of the ninth magnitude by Mr. H. E. Houghton (presumably at Pretoria) on April 1. It was observed at the Cape observatory as follows: April—2^d 18^h 0^m U.T., R.A. 13^h 39^m 16^s, S. Decl. 75° 50'; daily motion, - 6^m 0^s, N. 1° 26'. No orbit is to hand, but the rapid northward motion may bring it into the view of European astronomers before very long. Actually the U.T. of the above observation was given as 6^h, but as there was daylight at the Cape at that time, it is presumed that 18^h was meant.

There is some doubt as to the letter that should be assigned to this comet. Nothing more has been heard of the object reported by Prof. van Biesbroeck on March 6; also, the status of the Delporte object of March 12 is still in doubt—it may be either a comet or a planet.

The comet Grigg-Skjellerup should now be within reach of moderate telescopes; the following ephemeris for 0 h. is from *B.A.A. Circular*, No. 111:

April 15 . . .	R.A. 6 ^h 23 ^m 6 ^s	N. Decl. 2° 10'
" 20 . . .	6 33 54	4 5
" 25 . . .	6 46 0	6 17
" 30 . . .	6 59 42	8 52

The comet is likely to be large and diffused.

Brazilian Tide Tables for 1932.—These tide tables were calculated at the Observatory of Rio de Janeiro, with the aid of a Kelvin tide-predictor, and are published by the Brazilian Ministry of Education. They give the times of every high and low water throughout the year for the fifteen principal ports of Brazil; also the height of water above the zero marks on the tide gauges at the ports. The marked differences between the heights of the tides at the different ports are of interest. The range appears to be smallest at Rio de Janeiro, where the range at the highest springs

scarcely exceeds a metre. The port of St. Luiz is at the other extreme; on April 21, which is the highest tide of the year, the range from high to low water is 5.8 metres. Some of the ports show a considerable diurnal term, by comparison between the two high waters twelve hours apart. There is much in the book that will interest students of the tides; their astronomical interest has increased since it was shown by Taylor and Jeffreys that tidal friction is probably sufficient to explain the excess of the moon's acceleration over that arising from astronomical causes.

The Delporte Object.—The determination of an elliptical orbit for this object from the early observations presented difficulties, owing to the object being nearly in opposition to the sun. It is unlikely that the orbit is really parabolic, but the following parabola, by S. Arend of Uccle, represents the observations with fair accuracy up to the end of March; the observed declination is then 3' north of the predicted one.

<i>T</i>	1932, April 4-0284 U.T.
ω	= 25.662°
Ω	= 171.694
<i>i</i>	= 20.137
<i>q</i>	= 1.16335

The following recent observations made at Uccle are published in *R.I. Circ.* 584:

	R.A. 1932.0.	N. Decl.
March 23-812165	13 ^h 26 ^m 7.16 ^s	20° 55' 27.8"
" 26-976600	13 53 42.37	25 32 6.1
" 28-914416	14 10 32.39	28 0 28.6

Uccle positions of March 23, 24, and 25, previously published, were erroneous, belonging to a different object. The Delporte object was photographed at Heidelberg on March 26, the magnitude being 14. It was noted as doubtful, but is confirmed by the Uccle observation.

The Wheat Problem

THE Twentieth Report of the Imperial Economic Committee, originally intended for presentation at the Ottawa Conference in 1931, which was eventually postponed, has been issued in the form of a survey,* without recommendations, of the present wheat position, with an analysis of the chief causes—economic, technical, social, and political—contributing thereto, together with indications as to which are in all probability temporary and which of a more permanent character. The fact that over vast areas of land the growing of wheat, the primary foodstuff of the world, does not repay the cost of production is a problem of the first magnitude for the Empire and for the world in general, and it is evident that such a situation has been brought about by the interaction of a number of complex causes.

In the report a statistical treatment is made of the changes in price, production, acreage, yield, and international trade that have taken place since 1920, special attention being paid to the later years of the period. Figures for Russia are excluded on account of their uncertainty and the exceptional position occupied by Great Britain during the years under consideration.

Since 1921 the trends of prices of wheat and general commodities have been very similar; this suggests that the changes in wheat prices are not solely attributable to causes peculiar to wheat production or marketing. Production, although in excess of effective demand in recent years, is actually lower than that normally expected from the pre-War trend, so that the term 'over-production' is a relative one only. The re-entry of Russia into the export trade, however, has done much to intensify the disparity between supply and demand. As a result, at the end of the crop year 1930-31, curtailment in wheat production was taking place in all the principal

exporting countries except Canada and Russia. The expansion which had occurred during the previous nine years was due to an increase in area harvested, rather than to any changes in the average yield per acre, which for the world as a whole has not shown much variation. Biological and, particularly, mechanical improvements in the methods of wheat production during the post-War period have had far-reaching economic consequences, for the result has been an increased output at a lower cost of production of a commodity for which a corresponding increase in consumption was not obtained.

Comparison is made between the policies adopted by certain important exporting and importing countries, and, almost throughout Europe, State action has been taken with the view of raising internal wheat prices in the interest of local producers. The most significant and, at the same time, the most uncertain feature of the present situation, however, is Russia. The existence of a wheat-producing country and potential exporter of the magnitude of Russia, the policy of which is not directly related to the international level of wheat prices, introduces completely new economic considerations into the question and complicates the task of assessing the world's situation.

The outlook for the season 1931-32, as summarised by the International Institute of Agriculture, indicates that the total world's production, including Russia, is, on the whole, insufficient to cover the requirements of consumption, so that it will be necessary to draw upon the accumulated stocks which continue to depress the market, but, nevertheless, it is estimated that they will still remain heavy at the end of the current crop year.

The wheat problem is, however, fundamentally a general problem, and the removal of the obstacles which to-day impede the recovery of industrial life would go a long way towards bringing about an improvement in the wheat situation.

* Reports of the Imperial Economic Conference. Twentieth Report: The Wheat Situation, 1931. Pp. 121. (London: H.M. Stationery Office, 1932.) 6d. net.

Recent Excavations in British Honduras

THE report of the first and second Marshall Field Archaeological Expeditions to British Honduras* serves to point the moral that, in archaeological investigation, it by no means follows that the outstanding site or the sensational discovery in the long run makes the most illuminating contribution to knowledge of the culture of the people under investigation.

The settlements explored by these expeditions in 1928 and 1929 were situated in a peripheral area of Maya culture, in which neither exceptional development nor an advanced standard in the arts of life could be expected; while in themselves they were not of sufficient importance to justify inclusion even in the rank of fourth class sites. Yet, being in part residential, they give a truer view of the life and customs of the people than do more imposing ceremonial centres. The material they have yielded will constitute a considerable contribution toward what is much needed, namely, the formulation of an ordered sequence of pottery types and styles within a defined cultural area, which will serve as a basis for systematic and intensive study of the cultural history of circumjacent regions in an ever-widening circle. Toward this a beginning has now been made in the investigations undertaken, or projected, by the Carnegie Institu-

tion of Washington at Uaxactun (Guatemala) and the Field Museum of Chicago in north-central Honduras.

The sites investigated by the two expeditions, of which Mr. Eric Thompson was the leader, are situated in the Cayo district of British Honduras, on the western frontier, where it borders on Guatemala. The actual site of the excavations was twenty-five miles south-east of the town of El Cayo in the neighbourhood of the Mountain Cow Water Hole. Except for a scarcity of water, the site was admirably adapted to Maya settlement, having an abundance of game and a salubrious air owing to its height. In fact, these settlements are the highest cities in the 'Old Empire' area, Hatzcap Ceel, described in this report, being probably as much as 2250 ft. above sea-level. The country being very broken, the inhabitants were practically cut off from cities to the south, such as Pusilha and Lubaantun, though only forty miles away. To the west and north-west—to Ixkun, about thirty-three miles, and Ucanal, twenty-seven miles away—the country was easily traversed. Although it is not known with certainty which tribes inhabited this area when the Spaniards came, it is probable either that they were Mopans, who are known to have occupied the country immediately to the west, or were closely allied to that people. It is suggested tentatively that in ancient times these Mountain Cow Water Hole area cities were inhabited by Chol-speaking Mayas.

* "Archaeological Investigations in the Southern Cayo District, British Honduras." By J. Eric Thompson. Field Museum of Natural History, Publication 301. Anthropological Series, vol. 17, No. 3.

Four groups of sites within a two-mile radius of the Mountain Cow Water Hole area were excavated. Of these, two, Hatzcap Ceel and Cahal Pichik, were ceremonial centres and two, Tzimin Kax and Cahal Cunil, were residential sites.

The two ceremonial centres flourished at the close of Cycle 9 and the beginning of Cycle 10 in Maya dating. Evidence for this is afforded by two dated monuments, of which the dates correspond to A.D. 835 and A.D. 910. There is evidence also of a succession of construction periods in the superposition of buildings, though not all these must be taken to represent distinct culture phases. The pyramids were found to be in a collapsed condition. Each of the ceremonial sites possibly had a ball court between two pyramids. Most of the pyramids of the temple type yielded votive caches. The contents of these caches were generally uniform in character, seven of the ten found containing characteristic small figurines of jade, slate, or shell. Other offerings were jade and small objects, including a worked flint of eccentric form with three arms, or points, two lobster-claw-shaped and one tau-shaped. In five of the seven caches containing figurines were containers in the form of a barrel-shaped cylindrical urn. One of the offerings is a mask which is undoubtedly the finest jade object yet found in British Honduras. It is now in the British Museum. A mirror of iron pyrites was found at Hatzcap Ceel, but the remains of what was probably a second were too far corroded to permit of certain identification.

The evidence of the pottery showed that these two sites belong to the same general cultural area as Holmul, Yalloch, and Uaxactun—an area in which art, as exemplified in stone carving on altar and stelæ, did not fall far short of that of the larger cities of the Peten region in what is now Guatemala; but architecture and the ability to erect large carved stone monuments did not penetrate here until late in the Old Empire period. It would appear that the art of erecting large multiple vaulted buildings never reached the Mountain Cow Water Hole region.

The two residential sites, Tzimin Kax and Cahal Cunil, consist of a number of scattered plazas of small size, constructed on the tops of natural hillocks enlarged by piling around them masses of stone and rubble up to a height of three or four feet above the

natural summit. The whole was then levelled up, and pyramidal square and low oblong mounds erected at the edge of the platform thus constructed. The platforms average twenty-five metres in each direction and are orientated within three or four degrees of true north. The outside walls were made of blocks of stone roughly faced but unsquared. The fill is of large limestone boulders and a small amount of rubble, but is loose. There is evidence that the platforms were reconstructed on several occasions.

A number of burials was associated with most of the plazuelas. This would be fully in accord with what we know of Maya practice. Bishop Landa says that it was customary for the people of Yucatan to bury their dead under the house, and among the modern Maya, children are buried under the floors of the huts. It is to be noted that in a burial at Tzimin Kax a number of small crude pots were found in pairs, one being placed mouth downwards over the other. Three of these contained bones: in one the first, second, and third dactyls of a human hand, judging by its size, of a woman or adolescent; and in a second a single bone, which proved to be the second dactyl of a small adult's hand. Dr. Gann also records the finding of the terminal phalanx of "a Maya lady's little finger" from a burial near Progreso. The skeletal remains were in a bad state of preservation, but Prof. Elliot Smith reported on two skulls as showing marked antero-posterior deformation.

The two residential sites were evidently occupied for a longer period than the ceremonial centres. Reference to the classification made by Dr. Vaillant at Holmul shows that all four sites were occupied in the period Holmul V., while the earlier period of Holmul I. is represented in burials at both the residential sites. At Cahal Cunil there is certain evidence which points to a still earlier period of 'pre-Holmul'. Pottery of the same type has been found at Uaxactun in conditions which point to its being earlier than Holmul I. It must be remembered that although this correspondence with Holmul is established in the Mountain Cow Water Hole area, it does not necessarily follow that in absolute dating the two are contemporary; the latter being a peripheral area, Holmul pottery may have reached it at a later date. It is clear that the sites were not occupied after the introduction of metal.

Forecasts of Fisheries

A REPORT of the activities of the various area committees of the International Council for the Exploration of the Sea has recently been published.* In small compass, it may be said to place before the public of the different nations represented in the Council the aims and present achievements of marine investigation. Amongst a wealth of valuable and interesting material, the report of the Northern North Sea Committee deserves special mention, as recording a notable landmark in the history of fishery research.

In the work of this Committee, most attention is being given to the herring and the haddock—the two most important commercial fishes of the northern North Sea. As a result of this concentration of effort, there is being built up, slowly but surely, a very definite knowledge of the composition of the stocks of these two species which is of immediate value for an understanding of the fluctuations in the practical fisheries. Much still remains to be accomplished,

more particularly with regard to the correlation of these fluctuations in the year classes of fish entering the marketable stocks with the successive changes in hydrographical and biological conditions in the sea.

Nevertheless, the work on the haddock has reached a stage when the yield of the North Sea haddock fisheries for eighteen months or two years ahead can be anticipated with great accuracy. Definite forecasts, made only experimentally as yet, have proved most satisfactory. For example, the general success of a forecast made in April 1929 at the scientific meeting of the International Fisheries Conference in London is cited. At that meeting it was stated that the fairly successful 1926 brood should, for most of its fourth year (1929), serve to provide catches just above normal. By the end of the autumn of that year, however, this brood should have made the greater part of its contribution to the catches. The 1927 brood had proved a failure, so catches would therefore be expected to sink below normal from late autumn 1929 to well on in 1930. But about August of the latter year there should take place a marked increase in the catches owing to the upgrowth of the highly successful 1928

* Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 74: Procès-verbaux (Mars 1931). Pp. 203. (Copenhagen: Andr. Fred. Høst et fils, 1931.) 7.75 kr.

brood. In 1931 still greater catches should accrue. The course of events in the commercial fishery agreed very closely with the above prediction.

In the report now before us forecasts are made for an ensuing period as far forward as the middle of 1933. After the autumn of 1931, when most of the 1928 brood has been fished out, a sharp drop in the catches is predicted, owing to paucity of the 1929 and 1930 broods. Landings will continue below normal throughout 1932 and during at least the first half of 1933. The result of the 1931 spawning is not known at present, but a good brood is hoped for in order to relieve the depression which always follows when two successive years produce numerically unsatisfactory broods.

G. A. S.

Mobilities of Atmospheric Large Ions

A RECENT paper by R. K. Boylan entitled "The Mobilities of Atmospheric Large Ions"* is of obvious importance in the subject of atmospheric electricity, which has engaged the attention of many meteorologists since Elster and Geitel's pioneer researches many years ago. Of the two classes of ion present in atmospheric air, the large ions of small mobility discovered by Langevin are normally the most numerous, and there is general agreement in fixing their mobility at 0.00033 cm./sec./volt/cm. These appear to be the principal nuclei of condensation for water vapour, and to be the result of small ions attaching themselves to uncharged particles of dust.

It is pointed out by Boylan that whereas McClelland and P. J. Nolan have found ions of smaller mobility in air treated in various artificial ways, such as bubbling through alcohol or passage over flames, it is generally believed that ions larger than the Langevin ions, that is, ions of smaller mobility, are absent from untreated air. Experiments conducted by Boylan on air in a well-ventilated room in Dublin gave strong reason for disbelieving this conclusion. Experiments were made on the usual lines, air being drawn at measured speeds between two lengths of concentric brass tubing, between which high tension electric fields of various known strengths were maintained, the current being measured by an electrometer. Since ions tend to group themselves around certain mobilities, these groups can be detected by looking for discontinuities in the curve obtained by plotting current against voltage; at such points all the ions of a given mobility are just collected on the inner electrode during the passage of the air through the tube. Boylan used both the McClelland and Zeleny methods of working with this apparatus, and tried many variations of air speed.

Curves derived by both methods agreed in showing clear evidence of the presence of several groups of large ions of mobilities higher and lower than that of the Langevin ions. So far from indicating 'saturation', that is, complete removal of ions, at a voltage corresponding with the mobility of the Langevin ion, the ionisation measured increased by amounts varying from 28 to 200 per cent when sufficient voltage to produce saturation was applied.

The difficulties of accurate measurement of the mobility of each group were very great; for the use of very high voltage or very slow speed, or some compromise between the two, is essential when dealing with such low mobilities, and each gives rise to its particular source of error or uncertainty. For this reason, Boylan does not claim to give a complete or accurate catalogue of the larger ions. Among the principal groups more mobile than the Langevin ions

may be mentioned those of mobility 0.0008 and 0.0006, and among the less mobile groups those of mobility 0.0009 and 0.00006. There was striking general agreement with many of the artificially produced groups observed by J. J. Nolan and by McClelland and P. J. Nolan. It is considered that very few of these ions would be found in the air of country districts.

E. V. N.

University and Educational Intelligence

APPLICATIONS for Ramsay Memorial fellowships for chemical research, one of which will be limited to candidates educated in Glasgow, will be considered by the trustees at the end of June. Particulars of the fellowships can be obtained from the Secretary, Ramsay Memorial Fellowship Trust, University College, Gower Street, W.C.1. The application forms must be received by, at latest, May 31.

THE Carnegie Trust for the Universities of Scotland has recently had under consideration the question whether, in view of the public assistance now available to the Scottish university student, the payment of class fees from funds dedicated under the Trust deed to this object should be continued. In its thirtieth annual report, the Trust's executive committee declares that the system whereby education authorities assist necessitous and deserving students has not yet reached in practice such a stage of development and uniformity as would warrant the immediate withdrawal from those eligible of the payment in part of class fees by the Trust, and that the special circumstances of the times are such as to render any such new departure inexpedient for the present. The amount spent by the Trust in this way in 1930-31 was £56,366. During the past four years, inquiry into the financial circumstances of each applicant's household has been made before admission to the benefits of the Trust, and it has been determined that in the case of all entrants to the university under twenty-one years of age the minimum standard of requirement for admission to these benefits shall be the obtaining of higher grade passes in three subjects in the Leaving Certificate Examination or in recognised equivalents. During the year, former beneficiaries have repaid a sum of £1891 voluntarily. The Trustees' scheme for the endowment of research is reported to be functioning very successfully. The awards, however, are limited to £16,000 a year, which is only half of the aggregate of the grants applied for.

"RADIO and Education" is the title of a short historical survey issued by the Office of Education, Washington, of the educational uses of wireless transmission in America. The work of amateurs is one phase of education by radio which the United States Army and Navy have in the past done much to foster. At the present time, there is a vast amount of direct instruction by broadcast lectures, one of the most important examples of which is the National Broadcasting Company's music appreciation hour directed by Walter Damrosch in connexion with the concerts of the New York Symphony Orchestra and listened to by some millions of pupils at every lecture. The 'American School of the Air' gives a half-hour period of instruction daily in historical drama, Nature study, vocational guidance, and a wide range of other topics which fit into the curricula of the public schools. Of the enterprises of State departments in this field, the Ohio School of the Air is the most extensive and thorough. Its programmes, comprising geography, rhythmic exercise, French, and other high-school subjects, are broadcast one hour each day and are

* *Proc. Royal Irish Academy*, vol. 40, Section A, No. 4.

listened to in twenty-nine States. There is a clash of interests between commercial and public institutional broadcasting, the demand for radio channels for commercial use having been so great that the right of the State to use this medium even for police purposes has been challenged. Practically all the commercial broadcasting stations devote much (in the aggregate about a tenth) of their time to 'educational' programmes. There are indications, however, that the advertising programmes are gradually displacing the educational, except at educational stations.

Calendar of Geographical Exploration

April 19, 1827.—The Niger and Timbuktu

M. Caillié, a French government official of Sierra Leone, left Kakundy, on the Nunez river, midway between Sierra Leone and the Gambia. With a small caravan of Mandingoes he crossed the region through which ran the upper tributaries of the Senegal and the Niger. He was the first European to enter the town of Jenné, on the Niger, though Park had seen it on his last journey. From Jenné he sailed down the Niger to Kabara, the port of Timbuktu, and reached that city on horseback. Caillié found the city to be a collection of mud huts, among which rose several rudely built mosques. To north-east and south of it spread vast deserts, and after a fortnight's stay, Caillié and his caravan began a march across the Sahara to Morocco. In one tract the travellers marched ten days without a drop of water; men and animals suffered severely, but ultimately Caillié won his way through Tafilet and the Atlas to Fez and Tangier. Timbuktu was first reached by a European in 1826, when Major Laing paid for his pioneer entry into the mysterious city with his life.

April 20, 1534.—Cartier and the St. Lawrence

Jaques Cartier sailed from St. Malo, in charge of an expedition to look for a north-west passage to the Orient. He reached Newfoundland on May 10, but was delayed by ice. Then began his series of explorations of the coasts of Newfoundland, Labrador, and the islands and straits off the coasts of Canada. In 1536, on a second voyage, he sailed up the St. Lawrence estuary and reached the site of the present Montreal, of the scenery around which and of the Lachine Rapids he left a vivid description. Cartier's work in charting these coasts and discovering the region of the St. Lawrence, which was later settled by the French, was of outstanding importance.

April 22, 1500.—The Coast of Brazil

Pedro Alvares Cabral sighted the coast of Brazil. He had been sent out by the Portuguese Government to follow up da Gama's discovery of an 'all sea' route to India, and da Gama had himself drawn up the sailing directions. In order to avoid the calms off the Gulf of Guinea, Cabral bore so far to the west that the coast of South America was discovered. Early in the same year the Spanish navigator, Vicente Yanez Pinson, had touched the coast of Brazil, but Cabral did not know of this.

April 22, 1898.—Cambridge Expedition to the Torres Straits

Dr. A. C. Haddon arrived at Thursday Island in charge of an expedition closely associated with the University of Cambridge. The expedition was of a unique character, for it was the first occasion on which investigations into the psychology of primitive peoples were carried out on a thoroughly scientific

basis. Dr. Haddon gathered round him for this pioneer effort a brilliant group whose names are now world-famous in psychology, including the late Dr. W. H. R. Rivers, Dr. C. S. Myers, Prof. W. McDougall, and Prof. C. G. Seligman. The scientific data gathered have been published in several volumes, which have become standard sources of inspiration for all subsequent field workers in primitive psychology and in the social and physical anthropology of native peoples. The members of the expedition visited many islands in the Torres Straits, and also studied tribes in the Central and Mekeo districts of British New Guinea and in the Baram district of Sarawak. In 1888-89, Dr. Haddon paid a visit to the Torres Straits, and became deeply interested in the life of the natives; the confidence which he then inspired in them paved the way for the friendly relations essential for the success of scientific work among these 'head-hunting' tribes.

April 22, 1908.—Stefansson in the Arctic

Vilhjamur Stefansson set out on an expedition, during which he discovered several Eskimo tribes and obtained much information about their way of life. Stefansson began his career of exploration by archaeological research in Iceland in 1904. In 1905 he turned to arctic research, and by 1928 had spent ten winters and thirteen summers in scientific work north of the Polar Circle, always living like the Eskimo and therefore travelling light. The Canadian arctic expedition under Stefansson in 1913-18 is estimated "to have withdrawn nearly 100,000 square miles from the areas of unknown seas and lands". On this expedition the ship *Karluuk*, carrying part of the group, was crushed in the ice and sank. Its crew reached Wrangel Island, where a relief ship rescued the survivors—Capt. Bartlett, commander of the *Karluuk*, having bravely walked to Siberia to bring help.

April 23, 1556.—The English on the Arctic Coast of Russia

The *Searchthrift*, commanded by Stephen Burrough, left Ratcliffe on a voyage to search for the north-east passage. Sebastian Cabot, then a very old man, came on board to wish them God-speed. Burrough met many Russian and Finnish *lodjas* (sailing boats with boards bound fast together by willows, not riveted). These fishing boats gave him much help, and were able to sail more easily and rapidly than the *Searchthrift*. Burrough, after reaching Vaygatz, returned to Kholmogory and wintered there, intending to proceed to the mouth of the Ob River next season. Instead of doing this, he turned westwards to search for Willoughby and the two vessels lost with him in the 1553 expedition. His voyage set up a new record of arctic penetration and made it clear how great were the difficulties of voyages in these very high latitudes. He brought back interesting accounts of the life and customs of the Samoyedes.

Societies and Academies

LONDON

Geological Society, Feb. 24.—G. C. A. Jackson: The geology of the N'Changa district, Northern Rhodesia. The area, which forms part of the original Rhodesian Congo Border Concession, covers approximately 800 square miles, and lies immediately to the south of the Belgian Congo border. It is a wooded penplain, underlain by four principal series of ancient metamorphosed and unfossiliferous sediments: namely, basement schists, Muva series,

Bwana M'Kubwa series, and Kundelungu series. The complex ranges from the Archaean to possibly the Lower Palaeozoic in age. Petrological descriptions were given of all the principal rock types.—G. V. Douglas: General geology of a portion of Northern Rhodesia. The climatic cycle since Tertiary times, which was first desert, changed to rain-forest conditions, and is now reverting to aridity. The evidence adduced was the deep oxidation in the mines and the presence of huge dead anthills. In the eastern part of the area, pegmatite dykes with coarse and fine crystallisation occur. The coarse texture is found on the *hanging wall*, where the dykes are inclined. Where the dykes are vertical, the coarse crystallisation is found in the centre. These dykes furnish ancient plumb lines; if the dykes are now found with the coarse crystallisation on the hanging wall, it can be inferred that the country has not been flexed since the time when these dykes were consolidated. In Northern Rhodesia this phenomenon is a means of distinguishing between the older and younger granites. The trend lines of the area run from north-east and south-west in the eastern part to north-west and south-east in the section from N'Dola to some point to the west of N'Changa; in the western part the general trend is north-east and south-west, swinging into Angola.

PARIS

Academy of Sciences, March 7.—Marcel Brillouin: The critical latitudes. A contribution to the dynamical theory of tides.—Charles Nicolle and Jean Laigret: The presence of a bacterium analogous with *Rickettsia* in the vaginal tunic of guinea-pigs and rats, inoculated by way of the peritoneum with non-virulent products. These bacteria appear to exist in the organism of the rat and guinea-pig, either normally or, more probably, habituated.—C. Camichel, L. Escande, and G. Sabathé: The similitude of barrages with lateral contractions.—Jean Baptiste Senderens: The comparative value of various catalysts in the formation of esters. Comparison of the catalytic effects of sulphuric acid, sodium bisulphate, potassium bisulphate, aluminium sulphate, and phosphoric acid in the formation of alkyl acetates.—Henri Lagatu and Louis Maume: The application of the leaf diagnosis.—Henri Villat was elected a member of the Section of Mechanics in succession to the late G. Koenigs.—Gaston Julia: A canonical conformal representation of multiply connex areas.—A. Buhl: An invariance of double integrals attached to any ordinary differential equation of the first order.—Mandelbrojt: Theorems on the convergence of Taylor's series with gaps.—T. Vijayaraghavan: The growth of functions defined by differential equations.—S. Sanielevici: Singular integral equations.—Arnaud Denjoy: The characteristics of the surface of the anchor ring.—Julius Wolff: The iteration of holomorph functions in a demi-plane.—N. Abramesco: The circle of univalence of a holomorph function $f(x)$ and the smallest distance between two zeros of an equation $f(x)=A$.—Al. Proca: The magnitudes characteristic of the Dirac electron.—J. Haag: The experimental determination of the damping couple of an oscillator.—R. Serville: The passage from the viscous to the hydraulic régime for the movement of a solid in water.—Robert Gibrat: The mathematical adjustment of the delivery curves of a water-course.—F. Bourquard: Oblique plane ballistics waves and conical waves. Application to the study of air resistance.—Dubourdieu: The electromagnetic field produced by a wire carrying a sinusoidal alternating current above a conducting layer.—A. Portevin and P. Bastien: Casting alloys. Relation with the interval of solidification.—A. Turpain and H. Sabatier:

Contribution to the experimental study of electrical induction.—J. Rabinovitch: The rotatory dispersions of benzene solutions of α -dextrorotatory pinene and β -lavorotatory pinene.—A. Kastler: The Raman effect and the dipolar moment.—R. de Malleman, L. Gabiano, and F. Suhner: The magnetic rotatory power of neon. The Verdet constant for neon is one-sixth that of hydrogen and one-eighth that of argon. In the case of the monatomic gases, there is a simple connexion between the magnetic rotation and the corresponding refraction. This is not the case with the polyatomic gases.—Constantin Salceanu: The variation of the temperature constant of magnetic double refraction and of the Havelock constant for some fused organic substances.—André Marcelin and Lew Kowarski: The measurement of the thickness of thin crystalline plates by variation of incidence.—R. Forrer: The thermal law of homopolar linkages. Law of the Curie points and the melting point law.—P. Jacquet: An electrochemical method permitting the evolution of solutions of gelatine to be followed as a function of the time.—Pierre Jolibois and Georges Fouretier: The photographic registration or reactions between electrolytes. The method is applicable to reactions which modify the electrical conductivity of the liquid medium in which the reactions take place.—Sze Shih-Yuan: The magnetic spectrum of the β -rays emitted by thorium-B.—Mme. Irène Curie and F. Joliot: The projections of atoms by the very penetrating rays excited in light nuclei.—Pierre Auger: The projection of light nuclei by ultra-penetrating radiations of excited radioactivity. Trajectories photographed by the Wilson method.—Charles Dufraisse and Daïb Nakaé: The catalysis of autoxidation: the antioxygen properties of cobalt. Observations concerning current theoretical discussions. Results of a detailed study of the action of metallic cobalt, its oxides, and salts on the oxidation of furfural. There appears to be no element which acts exclusively as an accelerator of oxidation.—T. Nanty and M. Valet: The specific inductive capacity of colloidal solutions. Aqueous solutions of various dyestuffs were examined. While some (Congo red, diamine blue, diamine black) show a marked increase in the specific inductive capacity, others gave the same figure as pure water.—G. Gire: The reduction of magnesia by silicon. A mixture of silicon and magnesia in the proportion Si:2MgO, heated in a vacuum for three hours between 1280° C. and 1320° C., gave a sublimate of metallic magnesium on the cold part of the tube. About sixty per cent of the magnesia was reduced to metal.—L. Bert and E. Ander: A new type of true acetylene compound, phenoxypropine. The reaction between the compound $C_6H_5 \cdot O \cdot CH_2 \cdot CH = CHCl$ and metallic sodium in boiling toluene gives rise to phenoxypropine, $C_6H_5 \cdot O \cdot CH_2C:CH$. This is shown to be a true acetylene derivative and the first term of a new series.—René Wurmser and Mlle. Nécicia Mayer: The reversibility of the oxidoreducing system of solutions of glucides.—Marius Badoche: Hydrocarbons isomeric with rubrene obtained by the hydrogenation of 9:11-diphenyl-9:12:10:11-diphenylene-9:11-dihydronaphthacene.—M. Grunfeld: The chemical reactivity of certain classes of amines. Measurements of the reaction velocities between ethyl malonate and six amines.—Georges Denigès: Formaldoxim, a very sensitive reagent for metals of the iron group, especially manganese. Various applications.—Jean Lacoste: The Senhadjas massif (Southern Rif).—L. Cagniard: The propagation of a shock at the interior of a homogeneous, isotropic, elastic, semi-indefinite solid, limited by a plane surface.—Henry Hubert: The air currents superposed in the dry

season above the Cape Vert peninsula.—Henri Gauthier: The cells with rods in fishes.—Raymond-hamet: The effects of adrenalin on the vessels of the paw and of the kidney.—A. Girard, G. Sandulesco, A. Fridenson, and Ir. J. J. Rutgers: A new crystalline sexual hormone extracted from the urine of pregnant mares.—Émile André and Raoul Lecoq: The reserves of vitamin A and D in some cartilaginous fishes.—G. Tanret: The glucosides of the leaves of the oleander. Nerioloside extracted from the *Nerium oleander* is distinct from the glucosides of *Strophanthus*.—E. Marchoux and V. Chorine: The culture of the invisible forms of the spirochete of fowls.—P. Durand: The dog as a reservoir of the virus of fièvre boutonneuse.

ROME

Royal National Academy of the Lincei, Nov. 15.—Gr. C. Moisil: Generalisation of conjugate functions.—M. Kourensky: Integration of equations to partial derivatives of the second order with one unknown and two independent variables.—M. Ghermanesco: *n*-Metaharmonic functions.—S. Finikoff: The transformation *T* of congruences of straight lines.—P. Barreca: A method for reducing to the equator and to the equinox the separate durations of evening and morning colorations of clouds.—G. Devoto: Investigations on the dielectric constants of liquids. (6) Aqueous solutions of sulphamide. The experimental data obtained indicate for sulphamide a polar formula,

probably, $\text{NH}:\text{SO} \begin{cases} \text{NH}_3^+ \\ \text{O}^- \end{cases}$, which is analogous to that

proposed for carbamide in aqueous solution, namely, $\text{NH}:\text{C} \begin{cases} \text{NH}_3^+ \\ \text{O}^- \end{cases}$.

—A. Ferrari and C. Colla: Chemical and crystallographic investigations on complex nitrites (1). The crystallographic analogy of potassium cobaltinitrite to the potassium-lead-nickel, potassium-lead-cobalt, and potassium-lead-copper triple nitrites has recently been demonstrated, the results obtained indicating that the water often found on analysing the cobaltinitrite is not combined directly with the molecule but is water of impregnation. Results of measurements on a further series of complex nitrites, isomorphous with the others, are now given: $\text{K}_2\text{Ca}[\text{Ni}(\text{NO}_2)_6]$, $a = 10.29 \text{ \AA}$., calculated density 2.75; $\text{K}_2\text{Sr}[\text{Ni}(\text{NO}_2)_6]$, 10.49, 2.88; $\text{K}_2\text{Ba}[\text{Ni}(\text{NO}_2)_6]$, 10.67, 3.02; $\text{K}_2\text{Ca}[\text{Co}(\text{NO}_2)_6]$, 10.17, 2.86; $\text{K}_2\text{Sr}[\text{Co}(\text{NO}_2)_6]$, 10.23, 3.10; $\text{K}_2\text{Ba}[\text{Co}(\text{NO}_2)_6]$, 10.45, 3.20. Similar compounds with copper in place of cobalt or nickel give photograms with what appear to be the lines of two isomorphous monometric lattices.—G. Mezzadrol: (1) Action of ultra-short electromagnetic waves on silkworms irradiated prior to incubation. This action produces a favourable effect throughout the whole life-cycle of the worms—hatching, growth, and spinning—and results in an increased final product.—(2) Action of Italian radioactive soils on the germination of seeds and on the growth of plants. The influence of finely ground Italian soil of radioactivity 4.2×10^{-9} per gram on plants (peas, maize) grown in the laboratory in Knopp's nutrient solution is manifested in marked increase in the length of the roots and in the development of the plants. Field experiments in which the radioactive soil was used as fertiliser result in stronger and greener plants and in yields exceeding by 20 per cent or more those of the controls.—A. Galamini: The fasting and re-nutrition curves in castrated male rats.

VIENNA

Academy of Sciences, Dec. 10.—L. Schmid and E. Kötter: (1) A trityl-ether of glycogen. (2) The dye of the mullein blossoms, *Verbascum*. The pig-

ment is a glucoside, apparently α -crocetin.—A. Jellinek: Training experiments with long-tailed monkeys, *Cercopithecus*. (1) Distinguishing objects by colour, brightness and tone. Coloured cardboard boxes were used and a reward of sugar. They learnt to distinguish yellow from violet.—(2) The monkeys learnt to distinguish a framework box containing one lump of sugar from a similar box containing two lumps of sugar, being rewarded with the sugar when they chose the one lump.—E. Murr: (1) Experimental reduction, by heat, of the time of gestation in the ferret (*Putorius furo*). Some ferrets were kept at 20° and some at 35°. Those at the lower temperature had a gestation period of about 41½ days, those at the higher temperature about 39½ days.—(2) The course of bodily temperature in mammals (*Putorius furo*) during gestation. In the first part of gestation the temperature is slightly higher than in the second half.—H. Przißram and P. Suster: Antenna and leg regeneration in phasmids.—P. M. Suster: Regeneration of antenna and of Johnston's organ in the rhinoceros beetle, *Oryctes nasicornis*.—P. M. Suster: Inheritance of enforced feeding on *Drosophila repleta*. Ten generations of the fly were fed on carrot, and afterwards, for five more generations, carrot was offered as an alternative and much more frequently chosen for egg-deposition.—K. Trinczer: The rôle of temperature and humidity in the colour-change of frogs.—K. Fritsch: Observations on flower-visiting insects in Styria, 1911.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 17, No. 12, Dec. 15).—Carl E. Seashore: The natural history of the vibrato. A study of the vibrato has been made by (1) phonophotographic recording of music and speech, and (2) psychophysical measurements of perception of vibrato produced synthetically by instruments. A definition of vibrato is offered: an artistic vibrato consists of a periodic oscillation in pitch averaging a half-tone for singers and a quarter-tone for string instruments, at an average rate of 6-7 cycles a second, usually accompanied by synchronous intensity and timbre oscillations playing a secondary rôle.—Walter R. Miles: Measures of certain human abilities throughout the life span. Manual motility and reaction speed in males show a general increase up to the 'twenties', and then a gradual decline with age. It is suggested that neural conservation mechanisms become more potent with increasing age.—George Grant MacCurdy: The use of rock crystal by palæolithic man. Seven rock crystal tools have been found by the American School of Prehistoric Research in the lower of two Mousterian levels in a rock shelter, Les Merveilles, at Castel-Merle, near Sergeac (Dordogne).—Wilder D. Bancroft, Robert S. Gutsell, and J. E. Rutzler, jr.: Reversible coagulation in living tissue (9).—Morphine addiction was induced in dogs and the symptoms on sudden withdrawal of morphine (which agglomerates nerve colloids) were relieved by sodium rhodanate (which peptises the nerve colloids).—W. V. D. Hodge: Further properties of Abelian integrals attached to algebraic varieties.—George D. Birkhoff: (1) Proof of a recurrence theorem for strongly transitive systems.—(2) Proof of the ergodic theorem.—O. Veblen and J. H. C. Whitehead: Correction to "A set of axioms for differential geometry".—H. S. Vandiver: Summary of results and proofs on Fermat's last theorem (6).—P. A. Smith: Properties of group manifolds.—A. Wintner and F. D. Murnaghan: On a polar representation of non-singular square matrices.—Joseph M. Dalla Valle: Note on the Heaviside expansion formula.—Edwin B. Wilson and Margaret M. Hilferty: The distribution of chi-square (χ^2).—H. Bateman: Relations

between confluent hypergeometric functions.—G. A. Miller: Groups involving a small number of conjugates.—Marcus M. Rhoades: Linkage values in an interchange complex in *Zea*. Evidence is given of the occurrence of reciprocal translocation (segmental interchange) in a semi-sterile maize.—P. C. Mangelsdorf: Modification of Mendelian ratios in maize by mechanical separation of gametes. Separating the pollen grains by sieves into tiny and normal showed that the genes for 'starchy' and 'sugary' are genetically associated with size of pollen grain; the tiny grains accomplish fertilisation only rarely in competition with normal grains.—Clyde E. Keeler: A probable new mutation to 'white-belly' in the house mouse, *Mus musculus*.

Forthcoming Events

FRIDAY, APRIL 15

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University Museums, Oxford), at 10.30 A.M., 2.30, and 5.30.

ROYAL ANTHROPOLOGICAL INSTITUTE (Sociological Research Committee), at 2.—J. H. Driberg: Economic Stages of Development in Africa.

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at 36 George Street, Manchester), at 7.—Annual Meeting.

SATURDAY, APRIL 16

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University Museums, Oxford), at 10 A.M. and 2.30.

MONDAY, APRIL 18

ROYAL GEOGRAPHICAL SOCIETY, at 5.—S. T. A. Mirrlees: The Weather on a Greenland Air Route: Discussion of Meteorological Results of the B.A.A.R.E.

ROYAL SOCIETY OF ARTS, at 8.—Prof. J. C. Drummond: Recent Researches in the Nature and Functions of Vitamins (Cantor Lectures) (1).

TUESDAY, APRIL 19

ROYAL SOCIETY OF MEDICINE.—Special Meeting of Fellows, at 5; General Meeting of Fellows, at 5.30.

GRESHAM COLLEGE (Basinghall Street, E.C.2), at 6.—A. R. Hinks: Celestial Objects of Peculiar Interest (Gresham Lectures). (Also on April 20, 21, and 22.)

SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.30.—Annual Meeting.

WEDNESDAY, APRIL 20

SOCIETY OF GLASS TECHNOLOGY (at Sheffield University).—Annual General Meeting, at 2; Ordinary Meeting, at 2.30.—R. A. Hacking: Recent Developments in Open Hearth Furnace Design.—Dr. G. Zotos: A New Method of Melting Glasses and Silicates.

TEXTILE INSTITUTE (at Manchester), at 3.—Annual General Meeting.

ROYAL SOCIETY OF ARTS (Dominions and Colonies Meeting), at 4.30.—J. O. P. Bland: China and the Future of our Far Eastern Trade (Lecture).—At 8.—J. G. Jarvie: Instalment Buying (Lecture).

ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.—Discussion on The Microscopy of the Filterable Viruses. Speakers: The President, J. E. Barnard, Prof. J. C. G. Ledingham, Dr. S. P. Bedson, Dr. C. C. Hurst, Prof. J. McIntosh, Capt. S. R. Douglas, Dr. W. J. Elford, Dr. G. M. Findlay, B. K. Johnson, and others.

THURSDAY, APRIL 21

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Dr. W. E. Sumpner: The Work of Oliver Heaviside (Kelvin Lecture).

FRIDAY, APRIL 22

ROYAL ANTHROPOLOGICAL INSTITUTE (Human Biology Research Committee), at 5.30.—Prof. J. B. S. Haldane: Present Knowledge concerning Blood Groups.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (Annual General Meeting) (at Waldorf Hotel, Aldwych), at 6.45, followed by dinner at 7.30.—Sir Robert Horne: Currency and Prices (Address).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. J. B. S. Haldane: Hereditary Transmission of Acquired Characters.

SATURDAY, APRIL 23

INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin).—Prof. J. K. Catterson-Smith: Everyday Uses of Electricity (Faraday Lecture).

Official Publications Received

BRITISH

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 2, March. Pp. 57-106+xxxvi. (London.)

The Quarterly Journal of the Geological, Mining and Metallurgical Society of India. Vol. 3, No. 3, November 1931. Pp. 83-151. (Calcutta.) 6 rupees.

Annals of the Royal Botanic Gardens, Peradeniya. Edited by N. D. Simpson. (Ceylon Journal of Science, Section A: Botany.) Vol. 11, Part 4, February 20th. Pp. 307-359+plates 45-52. (Peradeniya: Director of Agriculture; London: Dulau and Co., Ltd.) 3 rupees.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 56: A Soil Survey of Blocks A, B, C, D and F, Renmark Irrigation District, South Australia. By T. J. Marshall and P. D. Hooper. Pp. 23. Bulletin No. 58: The Life Cycle of *Stephanurus dentatus* Deising, 1839, the Kidney Worm of Pigs; with Observations on its Economic Importance in Australia and Suggestions for its Control. By I. Clunies Ross and G. Kausal. Pp. 80. (Melbourne: H. J. Green.)

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 3, Part 1, March. Edited by Prof. H. W. Turnbull and Dr. E. T. Copson. Pp. 76. (London: G. Bell and Sons, Ltd.)

British Honduras. Annual Report of the Forest Trust for the Year ended 31st March 1931. (Belize: Conservator of Forests.)

Proceedings of the Royal Society of Edinburgh, Session 1931-1932. Vol. 52, Part 2, No. 6: On the Definition of Spatial Distance in General Relativity. By H. S. Ruse. Pp. 183-194. 1s. Vol. 52, Part 2, No. 7: Graphical Classification of Carbonaceous Minerals; the Place of the Constituents of Common Coal. By Prof. Henry Briggs. Pp. 195-199. 9d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Research Association of British Rubber Manufacturers. Twelfth Annual Report for the Year 1931. Pp. 36. (Croydon.)
Journal of the Chemical Society. March. Pp. iv+725-988+lviii. (London: Chemical Society.)

FOREIGN

Bulletin of the Bingham Oceanographic Collection, Peabody Museum of Natural History, Yale University. Vol. 4, Art. 2: A Revision of the Genus *Gobionellus* (Family Gobionidae). By Isaac Ginsburg. Pp. 51. (New Haven, Conn.)

Science Reports of the Tokyo Bunrika Daigaku. Section A, Nos. 15-17: Barkhausen-Kurz-Effekt nach der Wellenmechanik, von Kwai Umeda; Wave-Length Shifts of certain Spectral Lines of Hg II, by Atô Imazato; A Theory of the Rotatory Dispersion, by Gentaro Araki. Pp. 167-201. (Tokyo: Maruzen Co., Ltd.) 47 sen.

Meddelelser fra Lunds Astronomiska Observatorium. Ser. 1, Nr. 129: The Effect of Change of Origin in Type A Series. By Richard A. Robb. Pp. 12. Ser. 1, Nr. 130: The Application of Type A Series to Skew Curves. By Richard A. Robb. Pp. 10. (Lund.)

Feld Museum of Natural History. Report Series, Vol. 9, No. 1: Annual Report of the Director to the Board of Trustees for the Year 1931. (Publication 306.) Pp. 287+22 plates. (Chicago.) 1 dollar.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 84. Reptiles and Amphibians from Honduras. By E. R. Dunn and John T. Emlen, Jr. Pp. 21-32. (Philadelphia.)

Contributions to American Archaeology, Vol. 1, Nos. 1-4. Excavations at Baking Pot, British Honduras, by Oliver Ricketson, Jr.; Maya Astronomy, by Dr. John E. Teeple; The Temple of the Wall Panels, Chichen Itza, by Karl Ruppert; Notes on the Metates of Chichen Itza, Yucatan, by Gustav Strömrvik. (Publication No. 403.) Pp. iii+157+49 plates. (Washington, D.C.: Carnegie Institution.)

Contributions to the Genetics of certain Chromosome Anomalies in *Drosophila melanogaster*. By A. H. Sturtevant and T. Dobzhansky. (Publication No. 421.) Pp. v+81. (Washington, D.C.: Carnegie Institution.)

Meddelelser fra Kommissionen for Danmarks Fiskeri- og Havundersøgelser, Serie Fiskeri. Bind 9, Nr. 1: Biological Investigations upon the Cod in Danish Waters. By Erik M. Poulsen. Pp. 150. 10.00 kr. Bind 9, Nr. 2: Investigations of the Plaice Stock in the Southern Horns Reef Area in the Years 1928-1930. By Aage J. C. Jensen. Pp. 32. 2.50 kr. Bind 9, Nr. 3: Fluctuations in the Stock of Cod in Icelandic Waters. By A. Vedel Tåning. Pp. 43. 3.15 kr. Bind 9, Nr. 4: On the Spawning Places of the Herring in certain parts of the North Sea, the Skagerak and the Kattegat in the Autumn of 1930 and some Earlier Years. By Erik M. Poulsen. Pp. 17. (København: C. A. Reitzels Forlag.)

CATALOGUES

Botany, Entomology, Ornithology, Zoology, etc.: Catalogue of Books at Cheap Clearance Prices. (No. 198.) Pp. 16. (London: Dulau and Co., Ltd.)

A Catalogue of Important and Rare Books on Zoology, Geology and Palaeontology. (No. 456.) Pp. 100. (London: Bernard Quaritch, Ltd.)

Old-Time Literature, principally of XVIIIth and XVIIth Centuries. (No. 461.) Pp. 80. (Cambridge: Bowes and Bowes.)

Temperature Measurement. Pp. 4. (London: Negretti and Zambra.)