Editorial & Publishing Offices :
MACMILLAN & Co., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

NATURE

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

No. 3501 SATURDAY, DECEMBER 5, 1936 Vol. 138

The Indian Institute of Science

IT required the lessons of the Great War to bring home to those engaged in industry in Great Britain the benefits which accrue from scientific research. It speaks therefore highly of the acumen of the Parsee merchant, the late Mr. J. N. Tata, that forty years ago he proposed to endow an all-India Research Institute. After a careful consideration of the schemes drawn up by Sir William Ramsay, and by Sir David Masson and Colonel Clibborn, his plan came to fruition ; and on a site at Hebbal, near Bangalore, given by the Government of Mysore, it was decided to proceed with the erection of the Institute. Unfortunately, Mr. Tata died in 1904, but his sons, the late Sir D. J. Tata and Sir R. J. Tata, gave effect to his wishes, and in 1906 the first director, Dr. Morris W. Travers, was appointed.

At the time when the scheme was first adumbrated, scientific research in India was confined almost entirely to the Government services comprised in the Survey of India, the Geological, Botanical and Zoological Surveys, and the various agricultural departments. With a few notable exceptions, mainly in the laboratories of Sir J. C. Bose and Sir P. C. Rây, the universities contributed little to the advancement of knowledge. The new institute filled, therefore, an obvious gap in the Indian educational system, providing for the first time facilities for the training of students in the methods of scientific research. The first students were admitted in July 1911 into the department of general chemistry (Prof. M. W. Travers), applied chemistry (Prof. Rudolf), and electrical technology (Prof. A. Hay), whilst in September of the same year a department of organic chemistry, under Prof. J. J. Sudborough, was added.

The exact functions of the Institute as set forth by Mr. Tata were somewhat vague, but the underlying idea was that it should work "for the benefit of India". It was naturally anticipated that the Institute would by its researches advance the development of Indian industries. The normal working of the Institute was upset in 1914 by the resignation of its first director, who was succeeded by Sir Alfred Bourne, and by the outbreak of the Great War, which naturally diverted its activities. On the retirement of Sir Alfred Bourne in 1919, it was felt that a clearer demarcation of the activities of the Institute was required, more especially since the Indian universities themselves were now active centres of research. In 1921 a committee, of which Sir William Pope was chairman, submitted a valuable report which recommended certain important changes. With the appointment of Dr. (now Sir) M. O. Forster as director, the Institute entered upon a fresh era, and although, as was perhaps natural, criticisms were heard, the period of his directorship, thanks to his great administrative ability and tact, was one of continued progress, numerous contributions of both scientific and industrial importance being made.

One of the recommendations of the Pope committee was that a reviewing committee should be appointed quinquennially to report on the working of the Institute, and a committee, of which Lieut.-Colonel Sewell was chairman, recommended in 1931 that greater attention should be paid in future to investigations likely to benefit Indian industries, since this appeared to be the desire of the founder. There has in the past been much criticism of the Institute, mainly in our opinion unfounded, on the grounds that the work carried out there was of purely scientific interest.

On the retirement in 1933 of Sir Martin Forster, the distinguished Indian physicist, Sir Venkata Raman, was appointed director. Sir Venkata was already well acquainted with the problems of the Institute since, not only had he been a member of the Pope committee, but he had served also on the council of the Institute. Since his appointment followed so soon after the report of the Sewell committee, it was naturally anticipated that he would endeavour to implement its recommendations and encourage industrial research. This has, however, proved far from being the case. As a physicist he has perhaps not unnaturally taken advantage of a recommendation of the Pope committee and developed a department of physics of which he himself is the head. Whilst this in itself was unobjectionable and a very necessary adjunct to a live department of physical chemistry, he would appear to have developed it at the expense of the existing departments, more especially those of general and organic chemistry. Simultaneously, considerable friction arose between the professorial staff and the director, resulting two years ago in the resignation of Profs. Watson and Mowdawalla.

We have now before us the report of the second quinquennial committee, presided over by Sir James Irvine, which was submitted to the Visitor (H.E. the Viceroy) last March and the recommendations of which have, we understand, been accepted in principle by the Council of the Institute. The committee found the internal affairs of the Institute to be in a most alarming condition, and to quote the report "the future of the Institute is evidently precarious". Brilliant as have been the contributions made by the director to physical science during the past four years, there is undoubted evidence that he has proved a signal failure as a director. Unlike his predecessors, he would appear to have interfered to an unwarrantable degree in the working of the various departments and rendered conditions so difficult that the resignations referred to above are readily understood. Further, he has seriously jeopardized the financial position, so that the budget can now only be balanced by drawing heavily upon reserves. It might be suggested that the Senate has been weak in allowing the continuance of the state of affairs now revealed, but it is doubtful if the protests, which it obviously made, were ever allowed to come before Council. Furthermore, the fact that two of the most important chairs, those of general and organic chemistry, were vacant, weakened its authority. If the present position had been allowed to proceed unchecked, there seems to be little doubt that practically the whole of the Institute's resources would have been devoted to the furtherance of research in pure physics, which, as the report remarks, would have been "a complete departure from the aims of the Founder".

Deeply impressed by the deplorable conditions now prevailing in the Institute, the Irvine committee makes far-reaching recommendations, some of which we print on page 981. These will, if adopted, make a complete change in the administration of the Institute, which is in many respects unnecessarily complex. Two outstanding features of the recommendations are (i) that the routine duties of administration, now in the hands of the director, should be entrusted to a registrar and (ii) that the Senate should have a direct representation on the Council. It is suggested that the registrar, who would be seconded from one of the civil services, should be secretary to the Council, Senate and Finance Committee and be responsible also for dealing with the correspondence of the Institute. This would eliminate the possibility, which at present exists, of the Senate's recommendations not being considered by the Council. Prior to the Pope committee, all heads of departments were members of the Council, and it is unfortunate that the direct representation of the Senate on the Council, a general feature in most British universities, should have been discontinued. The Council will be further strengthened, if the committee's recommendations are adopted, by the presence of a representative of the old students. This again is in accord with university practice in Great Britain.

A further recommendation of the committee is that staff appointments, in place of being for a limited number of years, should, after a probationary period, be continued until the age of retirement fixed by the Council. This once more is a reversion to the former custom, and should not only allow of a wider field of choice in making future appointments, but also enable present members of the staff to stand up for their rights and privileges.

The present unhappy position at the Institute has arisen largely from the defective administration of the director, and it is therefore natural that the Irvine report deals at length with methods for overcoming the present difficulties and preventing their recurrence. It discusses, however, the general working of the various departments in the Institute

and it suggests certain economies which should result in the balancing of the budget. Whilst not desiring in any way to limit purely scientific activities, which are regarded as fundamental, the committee suggests how it should prove possible to develop research on industrial problems. The recommendation that an organic chemist of standing should be in charge of the departments of general and organic chemistry, with four assistant professors for various branches of the science, will meet with general approval. The committee comments severely, and in our opinion with reason, on the recommendation made by an economy committee that physical chemistry should be merged in the department of physics. In view of the fundamental and growing importance of physical chemistry to the chemical industries, it is amazing that such a recommendation should ever have been made. It is anticipated that, as funds become available, the various assistant professorships will be raised to the status of full professors.

We feel convinced that if the admirable recommendations of the Irvine committee are implemented, the happy spirit, which formerly prevailed at the Institute, will be restored. There is no doubt that, with a few desirable changes of organization, a competent director could lead the Institute to notable success; if, however, the director has not the confidence and trust of the staff, the Institute must fail of its essential purpose, however perfect the organization may be. Last July was the silver jubilee of the Institute: when the time comes to celebrate its golden jubilee we do not doubt that it will have justified the desire of its founder and will have worked "for the benefit of India".

European Civilization and the African

(1) Native Policies in Africa
By Dr. L. P. Mair. Pp. xi+312. (London: George Routledge and Sons, Ltd., 1936.) 12*s*. 6*d*. net.

(2) Reaction to Conquest:
Effects of Contact with Europeans on the Pondo of South Africa. By Dr. Monica Hunter. (Published, with the assistance of a Grant from the Carnegie Corporation through the Research Grant Board, Union of South Africa, for the International Institute of African Languages and Cultures.) Pp. xx+582+28 plates. (London: Oxford University Press, 1936.) 30*s*. net.

(3) Ten Africans
Edited by Margery Perham. Pp. 356+16 plates. (London: Faber and Faber, Ltd., 1936.) 15*s*. net.

IN affairs concerning native Africa the anthropologist is no longer, as a generation ago, a voice crying in the wilderness. An ever increasing literature offers studies of the problem of the native in a varying range and from various points of view; but the authors in the main are at one in making scientific investigation of native life and conditions the essential principle of argument in theory and practice. A further difference to be noted—and this is of no little importance in view of much misunderstanding—is that these scientifically trained students of native Africa argue with detachment. Unlike their predecessors, they neither play upon the strings of philanthropy, nor as anthropologists enter unqualified protests against the modification of custom, arguing that if preserved it might serve as material for scientific investigation. Recognizing that Africa cannot be kept as a museum piece, they accept the inevitability of change, and record the facts and appraise tendencies in relation to native institutions as social and economic phenomena *per se*. It follows, almost as a matter of course, that they are aloof from political prepossessions.

Of the three books under notice each serves to illustrate a distinct line of approach to the investigation of the effects of the impact of European civilization upon the character, the institutions and the mode of life of native Africa. Dr. Lucy Mair deals with the machinery of administration and the policies which have inspired its organization; Dr. Monica Hunter, following a more general convention, records and analyses the custom of an existing group, contrasting it with the conditions of an earlier period, as well as with the conditions of the urban population and dwellers on European farms; and Miss Margery Perham, in a series of autobiographies of individuals from contrasted environments in varying degrees of sophistication, exhibits in the round, the actual product of changing conditions at almost every stage between a 'savage' and a member (feminine) of the University of Oxford.

(1) Over Dr. Mair's book it is unnecessary to linger. Its scope and method call for little comment, while to discuss its subject matter adequately would call for no less space than the volume itself.

The policies, administrative methods and problems of the European powers in Africa are concisely summarized and discussed. British territory, as the most extensive and the most varied in method, naturally receives the most attention. Direct rule, segregation, the dual system and indirect rule, each is analysed in its environmental setting in turn and subjected to a criterion in which native well-being, native rights and native needs are the essential elements. Dr. Mair's book is an indispensable aid to anyone who seeks to understand the extremely complex question of native development and administration in Africa.

(2) The group selected by Dr. Hunter for investigation, the Pondo of South Africa, was not annexed to British rule until 1895. For the investigator they possess the advantage that not only have they suffered less change than most indigenous peoples of South Africa, but also there still survives among them a number of elders who remember ancient custom. Missionary effort, though of long standing and preceding annexation, has had less effect than the trader, also active before the coming of white administration. The vast majority of the Pondo are still pagan. The most potent influence, however, in bringing about change has been the demand for labour in the Union on farms, in the mines, and in other forms of industry. As natives now go, they are fairly prosperous ; and the land question has not become acute as elsewhere. Conditions on the Pondoland reserve are contrasted with urban conditions in East London, S.A., where municipal regulations and conditions of employment have virtually eliminated native custom, especially in so far as cattle holding is impossible. On the European farms such institutions and customs as persist have, as a rule, suffered a radical modification.

Apart from its specific direction as a study of cultural modification, Dr. Hunter's book is a valuable contribution to the anthropological literature of South Africa. Her life-long acquaintance with the South African Bantu—she is herself a South African and was brought up at Lovedale—has been of the greatest service in admitting her to an understanding of the finer shades of meaning in custom and belief, which so frequently escape the no less highly trained, but less experienced observer.

(3) Miss Perham has added a few notes, but otherwise has scarcely touched the documents, which make up "Ten Africans". Her task has been that of selection, and the lives of the ten individuals here included have either been written by the subjects themselves, or have been reported verbatim. Not only are the narratives intensely entertaining in themselves, but for the social anthropologist they are also valuable raw material for judgment of the effects, psychological and other, of European contacts on the individual. The first life-history given here, for example, in which an aged member of the Babemba, who was brought up at the royal court, contrasts former conditions with those of to-day, incidentally affords a clue to weaknesses in the present system of administration, which sometimes has retained the form of native institutions, but has unwittingly destroyed the spirit which was its integrating force.

A Norse Settlement of the Viking Age in Greenland

Viking Settlers in Greenland : and their Descendants during Five Hundred Years. By Dr. Poul Nørlund. Pp. 160. (London : Cambridge University Press ; Copenhagen : G. E. C. Gads Forlag, 1936.) 7*s*. 6*d*. net.

FOR many years the attention of Danish archæologists has been directed to Greenland, not only by reason of the romantic history of the Norse settlement in that remote land, but also by the numerous remains of buildings—the farmsteads of the settlers, and their churches.

Brattahlid, believed to be the ruins of the homestead of Erik the Red, the first immigrant to go to Greenland from Iceland, in or about the year A.D. 985, was excavated and reported on by Dr. Nörlund and Dr. Marten Stenberger in 1934, and since then research has been carried on by Dr. Aage Roussell, whose account of his work under the title of "Sandnes and the Neighbouring Farms" has just been published.

Dr. Nörlund, in the volume under notice, has clothed with flesh and blood the dry bones of archæology, and told the story of the colonization of Greenland, and of the hard lives of the settlers in their valiant efforts to maintain themselves in an inhospitable land, utterly neglected by the Danish kings who claimed supremacy over this outpost of civilization. It is a sad tale of how the very monarchs who should have fostered and maintained the colony strangled its trade in the exercise of a monopoly, depriving the settlers of the necessities of their existence, and eventually bringing about the extinction of the colony. Dr. Nörlund estimates that in the 280 farms which there are said to have been, there must have been

no fewer than three thousand inhabitants, and probably more when the settlement was flourishing. By the fourteenth century, privations were telling on the physique of the people, and they were being pressed by the Scraelings, as they termed the Esquimaux. In the fifteenth century, official communication with the mother land had entirely ceased. Neither the prelate, who bore the title of Bishop of Garda, nor merchants went thither, and by the commencement of the sixteenth century, the medieval Norse culture must have been entirely eradicated.

Dr. Nörlund's book is a fascinating tale, the record of a great adventure viewed from all its various aspects. It provides an admirable illustration of the life of a Norwegian settlement of the Viking age, when that robust people were the strongest sea-power in northern Europe, and the first navigators to reach the American continent, known to them as 'Vinland'.

Not the least interesting results of the research in Greenland was the discovery of numerous well-preserved garments in the frozen ground of an ancient cemetery, which was being gradually eroded by the sea. The dead had been shrouded in the clothes they wore when in life. The relics recovered by the explorers from the site filled twelve large cases. These garments, preserved in the National Museum at Copenhagen, form a unique collection of the everyday clothes of the ordinary folk of the Middle Ages.

To those interested in the recent discovery of Viking settlements in Orkney and Shetland, this book will be valuable as furnishing plans of contemporary houses and farm buildings, and by enabling them to realize to some extent how those Norse settlers lived, trading in furs of seal and otter, the produce of the islands, and cultivating their farms. It will help to eradicate the impression that the early Norse settlers on the shores of Britain were merely ruthless sea-rovers.

The book is fully illustrated, containing *inter alia* a series of illustrations of the Herjolfnes garments. The translation from the Danish has been well done, and the text is singularly free from typographical errors.

Modern Perfumes and Essences

(1) Perfumes, Cosmetics and Soaps: with Especial Reference to Synthetics. By William A. Poucher. Vol. 2: Being a Treatise on the Production, Manufacture and Application of Perfumes of all Types. Fifth edition. Pp. xiii+426+63 plates. 25*s*. net. Vol. 3: Being a Treatise on Modern Cosmetics. Fifth edition. Pp. xi+228. 21*s*. net. (London: Chapman and Hall, Ltd., 1936.)

(2) Flavours and Essences: a Handbook of Formulæ. By M. H. Gazan. Pp. vii+115. (London: Chapman and Hall, Ltd., 1936.) 25*s*. net.

(1) THERE can be scarcely any fashion so changeable and so demanding variation as that of modern cosmetics and perfumes. The last twenty years have seen bewildering progress, and manufacturers have been forced, time and again, to drastic revision of their products and to keen experimentation. Moreover, the future seems to offer no limits to this variety, and their manufacture now demands a deep knowledge and practical experience, for much of it has an empirical basis. The author's previous editions on these subjects are well known in the perfumery and cosmetic world, and have always been accepted as authoritative. The new edition is most comprehensive and, like the previous ones, gives a very practical account of the production, manufacture and application of perfumes and cosmetics. On account of the inclusion of much new matter, the author has made the wise decision to divide the work into two volumes, one dealing with perfumery (vol. 2) and the other with cosmetics and soaps (vol. 3).

Revision has been thorough, and much new matter has been included. Probably the most interesting revision is the section dealing with otto of roses which, although one of the oldest of perfumes, has from its beginning presented a most difficult problem to the would-be buyer. In spite of the great developments in our knowledge of the essential oils, and the application of this knowledge to their evaluation, the chemist has undoubtedly failed in his attempts to detect sophistication, except in very crude form, in this perfume, or to devise constants for its purity. The problem is most controversial, and the author's contribution is of exceptional value as it is a result of a personal visit to Bulgaria, where he was afforded every opportunity for investigation and where he personally conducted the distillation of a large batch of otto. He states that variation in genuine otto must be expected because of the varied methods of production and the varied types of flowers used, and concludes that, after full consideration, the only reliable method of evaluation

of the oil must be an olfactic one. He moreover claims that this is also the opinion of the leading perfumery houses on the Continent. Such a conclusion contains little comfort to the would-be buyer, for the olfactic test, of which full details are given, appears to demand exceptional experience. It is, however, this type of information which makes the book so valuable to those whose business it is to handle the products.

The matter dealing with cosmetics (now included in vol. 3) has also been thoroughly revised, and in many instances rewritten. New chapters are given on such modern developments as sunburn preparations, the use of sulphonated alcohols in shampoos, and eye cosmetics. Exact details of preparation have been given, and the difficulties discussed in a manner which reflects the wide practical experience of the author. The work has been well done.

(2) The extensive use of both artificial and natural flavours and essences in confectionery, foods, soft drinks, ice cream, etc., has increased their value and made a study of their production and properties of great importance to the manufacturer.

Unfortunately, in the average book dealing with this subject, it is generally a matter of great difficulty to interpret the meaning of the ingredients specified in the 'recipe', as standards of strength and purity are often omitted. Thus a specified quantity of essence of vanilla is meaningless unless the strength and method of preparation and quality of the vanilla are laid down. The book under review, however, is not open to this objection, for it is devised on the lines of a pharmacopœia wherein all basic materials are of a standard quality, none of them of a proprietary nature, and the strength and method of each preparation are carefully defined. Workers should experience no difficulty in compounding.

An appendix gives simple methods for ascertaining physical constants to control the purity of all ingredients, and simple monographs on the various synthetic flavouring materials such as amyl acetate, phenylethyl acetate, etc. Some three hundred formulæ are given, all of which are woven into a scheme whereby a series of relatively simple basic preparations are first prepared, and then used for the more complicated preparations such as liqueurs and cordials. The author claims that all the preparations are stable during storage for several years. The methods of preparation are very simple, and distillation is rarely required.

A book of this type has long been needed by manufacturers concerned with these products.

H. BERRY.

Comparative Morphology of Plants

Vergleichende Morphologie der höheren Pflanzen Von Prof. Dr. Wilhelm Troll. Band 1: Vegetationsorgane. Lieferung 1. Pp. vii+172. (Berlin: Gebrüder Borntraeger, 1935.) 11.50 gold marks.

THE appearance of a new and, what appears to be, an outstanding work on the comparative morphology of plants is quite refreshing, and may we hope that it will prove to be the herald of a reawakening interest in this most important branch of botanical science.

In his foreword, the author states its scope and object:

"It differs from other works of this kind in that it resumes once again the tradition of the comparative treatment of form which was lost sight of in the course of the last century, and takes for its guiding principle the idea of the type, that is, the typological unity of the higher plant-kingdom. It is the problem of the archetype [*Urpflanze*] which is here placed in the forefront and centre of morphology."

Morphology has for long been split up into a number of departments which, however useful for affording a knowledge of formative relationships, have missed the inner unifying link. The author's thesis is to restore them to the framework of comparative morphology.

"Only comparisons founded on the concept of the *type* can demonstrate that the multiplicity of organs or groups of organs is solely conditioned by quantitative differences and divergences around a type as the dominating principle of construction. Morphology thus attains the character of an exact science.

"The slackening of creative output in morphology in the last decades is due, not to the exhaustion of the problems to be solved, but to a failure to see these problems owing to a too intensive investigation of detail and an overestimation of microscopic analysis which has blurred the vision for the perception of the organism and its organs as a whole."

The real cause of the downward grade of morphology lies in the domination of mechanistic thought over that of "independently-existing life [*Eigenständiges Leben*]". The process of thought from which morphology has degenerated had its

origin in the genius of Goethe. Since his day the gradual lapse of morphology into the vogue of considering organic forms entirely from the mechanistic point of view is to-day exemplified by such works as those of Hofmeister and Goebel.

"A true rebirth of morphology is only possible on the assumption that the mechanistic mode of thought is conquered, and replaced by a deeply founded view rooted in a Platonic–Goethian and German mode of envisaging nature", namely, by the recognition of the principle of *unity* of the "*type*", which "type" cannot be analysed or demonstrated, but revealed only to the intuitional eye ; it is derived from an idea, the "*ewig Eine*" of Goethe, manifesting in its multiplicity. More concretely put, "the type must be come at by means of the comparison of organisms in order to discover what is common to them all, this common factor appearing as a *virtual picture* behind the concrete individual forms, and representing the central idea embracing all particular objects". Latter day morphologists, in dealing with the structure of the Ophioglossaceous fertile leaf, to take one example, "instead of basing their study on the typologically true comprehension of the peculiarity, have been content with the external impression of a splitting of the leaf, elevating that into the principle of explanation ; such erroneous paths can only be pursued by those morphologists who cannot distinguish between typological and external resemblance".

Under the heading "Morphology and Development", the author states that there has been a one-sided estimation of developmental history, due to lack of typological insight, and cites as instances of this Grégoire's view of the carpel, A. Foster on the nature of the bud-scale, and Goebel's view of the sympodial inflorescence of Boraginaceæ. Goebel never recognized the typological method, against which he always remained prejudiced. Under "Organography", the author analyses and acutely criticizes Goebel's method and objective, allowing that there are hints at the comparative method here and there in his work, "but that throughout it there exists the attempt to derive the particular form of organs, not from the type, but from the function-principle or the life-conditions".

So much for the introductory section.

In Chapter i, entitled "Form-Relationships of the Higher Plants as Portrayed by Particular Examples", Prof. Troll comes to the main task of the work. After stating that "the fundamental thesis running through the whole of morphology is the problem of the archetype [*Urpflanze*]" (Goethe's original idea) and that it "would be a great mistake to connect this problem with propositions of descent-theories", the archetype in the phylogenetic sense being unknown, he begins the descriptive work dealing with the vegetative organs. "Seed Structure and Embryo", "Comparative Analysis of the Fruits of the Horse- and Sweet Chestnut", "Monopodial and Sympodial Branching", "The Bulb of the Snowdrop", "Turnip-rooted Plants and Geophytes", are a few of the headings which will give an idea of the subject-matter of this section of the book. The descriptions are original and perspicuous, and every subject is illustrated by admirable diagrams, drawings or photographs.

We heartily endorse the views of the author as set forth in the introductory section, being convinced that the position he assumes is the correct one for facing the problems of comparative morphology. Others, however, may not so readily accept this position. As regards the main, descriptive portion of this first part of the first volume, we feel sure that it will be of indispensable utility to the student of morphology. Moreover, we venture to prophesy that, when completed, this book will be, to judge by its first instalment, one of the best treatises of plant morphology extant.

W. C. WORSDELL.

The Science of Highway Engineering

Road Aggregates:
Their Uses and Testing. By Dr. Bernard H. Knight. (The Roadmakers' Library, Vol. 3.) Pp. x+264. (London : Edward Arnold and Co., 1935.) 21*s*. net.

UNDER the pressure of modern conditions, the art of road-making has of necessity become the science of highway engineering, in the process beginning to borrow freely from those older branches of applied science—chemistry, physics, geology and engineering.

The literature which is rapidly growing up to serve the new purpose expresses the need of freedom from restraint and the necessity of treating certain sections of this field from the basic and more scientific aspect. The process can indeed be reciprocal, as when there is produced from actual practice some new matter to add to the sum of knowledge in the parent science.

The present volume is an excellent example of these principles. The petrology of rocks has been exhaustively studied in the past, and those general

principles are here given a special emphasis by an author who has established a position of authority on the structure of rocks with special regard to road stone and aggregates, which forms one of the most important industrial applications of that knowledge.

Road-making to-day consists as to 99 per cent of various processes for the combination of road aggregates with a binding agent into a homogeneous structure. The binding agent and therefore the product respond to certain physical laws, but the value of the aggregate has to be appraised in terms of size, shape, toughness, proportions, texture and ability to amalgamate with binder, etc.

A fuller appreciation of these important and related factors is becoming increasingly more widely recognized, and the present volume is a most timely addition to the literature at a period when road policy and expenditure has attained a breadth and sweep never before exceeded. The subject has been carefully prepared, both in scope and treatment, by one who plainly embodies his own knowledge and practice, and the discussion and orderly presentation of the material at his disposal will make the volume of special use and acceptability to highway engineers.

The author has clearly set out a technique for the estimation and measurement of quality in these materials required to form the rock framework of modern road structures, whether assembled as concrete, asphalt, tarmacadam or just stone, and the structural considerations of rocks and the tests of their properties is well emphasized.

The work therefore merits the highest praise, that is to say, it will be of real service and guidance to all engineers responsible for expenditure on those works which have to be created to sustain the stress of modern road traffic.

R. G. H. CLEMENTS.

Heat for Advanced Students

By the late Edwin Edser. Revised edition by N. M. Bligh. Pp. x+487. (London : Macmillan and Co., Ltd., 1936.) 6*s*.

EDSER'S "Heat for Advanced Students" has been familiar to successive student generations in schools and colleges since it was first published in 1899. The essential character of the book is retained in this revised edition, prepared by Mr. N. M. Bligh after the death of Mr. Edwin Edser in 1932. The methods of the calculus have now been introduced, resulting in more concise treatment, and the term calorie, in conformity with present usage, replaces the therm previously used in the same sense. Recent developments of the subject have been described, and the chapter on radiation has been rewritten so that it now includes a simple introduction to the quantum theory. In its revised form, the book should make a fresh appeal to teachers and students.

Sacrifice to Attis :

a Study of Sex and Civilisation. By Dr. William A. Brend. Pp. v+350. (London : William Heinemann, Ltd., 1936.) 10*s*. 6*d*. net.

THE author directs attention to the menace of the falling birth-rate in Britain, and laments it. He refers to an article of his written in 1915 in which he says that "we may eventually see the Slav races increased relatively in such enormous proportion that they may come to dominate all Europe". Obviously the race of armament is of no matter ; we must start a fierce race to have the highest birth-rate in Europe and so swamp the Slavs by sheer numbers ! The author would include many of the psychoses and epilepsy as explainable on the grounds of repression and other psycho-analytic mechanisms. We would be interested to hear the results of treatment of these conditions on psycho-analytic lines. We have seen little good result in these psychoses. It is easy to advance theories but so difficult to convince scientifically minded people.

Essential Traits of Mental Life

By Truman L. Kelley. (Harvard Studies in Education, Vol. 26.) Pp. viii+145. (Cambridge, Mass. : Harvard University Press ; London : Oxford University Press, 1935.) 11*s*. 6*d*. net.

PROF. KELLEY gives as the sub-title of the little book under notice, "the Purposes and Principles underlying the Selection and the Measurement of Independent Mental Factors, together with Computational Tables". He presents a new method of factorization which certainly appears simpler than that of Hotelling's method of analysis. He compares the work of Brown and Stephenson, of Tyner, of Godfrey Thomson, with Spearman. We cannot agree with the statement that "the line of argument . . . is so simple that the meaning of what is accomplished should be clear to the student familiar with the most elementary mathematics". The mathematics involved are by no means elementary. The author provides us with an analysis of the vocational groups in the United States.

An Elementary Survey of Modern Physics

By Prof. G. F. Hull. Pp. xxiv+457. (New York : The Macmillan Co., 1936.) 20*s*. net.

PROF. HULL has written a most interesting volume giving an account of modern physics suitable for an American college student in his second year. He has been successful in providing a book of an elementary character which may be recommended to other readers wishing for an up-to-date account of recent marvellous developments. It is not a 'popular' book in the sense that mathematical operations have been avoided altogether, but the mathematical difficulties have been reduced to a minimum. The properties of atoms, electrons and photons, and the relations between them are described in a stimulating way. Such subjects as cosmic rays and transmutation of the elements, and even such abstruse questions as the Schrödinger equation and the uncertainty principle are dealt with.

Progress in the Technique of Crystal Analysis*

By Sir William Bragg, K.B.E., O.M., F.R.S.

THREE years ago, Sir Gowland Hopkins in his presidential address spoke with admiration of the work of the organic chemist and in particular of the "emergence of power to grasp the architecture of complex invisible entities such as organic molecules and the ability to construct them at will". He told how under modern methods of investigation the picture which the chemist had formed of the invisible molecule had actually taken shape. His picture-making had been amply justified. His stereometry was not, as some thinkers had maintained, to be swept away in favour of a mathematical symbolism.

This anticipation has been fully realized during the last few years, mainly through the remarkable increase in the accuracy with which the structure of molecules, molecular aggregates and solid bodies in general can be determined. For this the methods of X-ray analysis of crystalline structure have been largely responsible. Moreover, other methods have been greatly strengthened by the example set by X-ray analysis and by its reactions upon themselves. Optical, electrical, magnetic and other properties have been successfully studied with the same great purpose, namely, the correlation between the properties of a substance and the spatial arrangements of its components.

While the X-ray methods have been mainly useful in describing the arrangement of the atoms in assemblages surrounded by others of like nature and conditions, the methods of electron-diffraction are giving a remarkable insight into the modifications of arrangement that are to be found on surfaces. The extraordinary interest of such knowledge arises from the fact that natural processes so largely depend on surface actions.

For many years after its inception, the X-ray analysis was, as might be expected, engaged in trying its own powers and learning how to apply them. It cleared up many structural problems on which older methods had little to say that was definite, as for example the distinction between ionic, metallic, adamantine, and molecular compounds. Many crystalline structures were determined, and the results, as is well known, have been serviceable in a wide field of scientific research, and in many industrial processes. The methods of analysis, the technique and the interpretation of results have been greatly improved, as might be expected, by the researches of many hundreds of workers. The increase in accuracy is so great that new possibilities of usefulness come into view.

The improvement appears in two ways. In the first of the two, the measurements of the dimensions of the unit of pattern of a structure can now be made to one part in several thousand. Consequently, the determination of the electron charge e, made by the X-ray method, can stand beside the older determinations of the oil-drop method. There is a persistent discrepancy of about one part in two hundred, the former giving the value $4{\cdot}80 \times 10^{-10}$, the latter $4{\cdot}77 \times 10^{-10}$; but it is clear that the larger value is at least as near the true value as the smaller. A full discussion of the X-ray method is given by Compton and Allison in their recent book on "X-rays in Theory and Experiment", and a critical examination of some outstanding points is made by du Mond and Bollman (*Phys. Rev.*, Sept. 1936).

Again, as has been observed by Bernal, the use of high-precision determinations of the lattice constants of metals will soon become the most reliable gauge of purity of a metallic element. Accuracy has here been pushed to one or two parts in forty thousand. The phase boundaries of an alloy also can be very closely and conveniently defined by observations of such a character. Accuracy has been of great importance to the well-known work of Hume-Rothery on alloy structures, and to the curious and very important relations between order and disorder in alloys which have been specially studied at Manchester.

The accuracy with which the position of each atom in the unit cell can be measured is of quite a different order. Thanks in particular to the use of Fourier analyses by J. M. Robertson and others, the distances separating the atoms, centre to centre, can be found to about 1 per cent, even when the complicated molecules of organic crystals are under examination. This is a great advance on the possibilities of even a few years ago, and it has important consequences. In particular, fresh light is thrown upon the problem of the chemical bond. At one time, single, double, and triple bonds were considered to be distinct and definite phenomena. The tetravalency of carbon, for example, was described as an assemblage of four equal powers of combination, of which one or more might be exercised in the same direction. When the diamond structure was found by the X-ray methods, it was no matter of surprise that

* From the presidential address to the Royal Society, delivered on November 30.

the four separate single bonds were displayed in the attachment of each carbon to four neighbours. In the structure assigned by the chemist to benzene, the fact that each atom had but three neighbours presented difficulties ; various theories have been suggested in explanation, mostly little more than different ways of drawing diagrams, in which four single bonds were made to act somehow. In recent years, it has been more usual to propose that bonds may alternate between single and double, and that the tetravalency of carbon in the benzene ring is satisfied because three of the six links are double and three single, the two kinds alternating both in time and in order round the ring. The conception can be extended to cases much more complicated provided that the two forms between which alternation occurs do not differ much either in form or energy. The effect is described as one of 'resonance', a term due to Hund but applied to organic chemistry mainly by Pauling and his collaborators. Its bearing on structural chemistry was discussed by Sidgwick a few months ago in a presidential address to the Chemical Society.

When substances in which this 'resonance' is supposed to occur are examined by the X-rays, it is found that the actual centre to centre distance of two atoms connected by a link alternating between single and double is characteristic of neither of the two extremes. These last two are definite quantities, and the length of the varying link lies between them. An actual link is rarely a pure single or double or triple link. Pauling and Sidgwick both discuss a number of cases in which the centre to centre distances can be correlated with a probable or possible amount of resonance. An excellent example is furnished by oxalic acid, which was examined by Zachariasen in 1934, but has just been remeasured by Robertson, using the powerful Fourier method of analysing the observations. The distance between the carbon atoms is 1·43 A. The length of the single link of diamond is 1·54 A. The length of a double bond is very nearly 1·33 A. It might seem that in oxalic acid the link is actually more nearly double than single ; but this is not so. A small proportion of double linking seems to shorten the distance considerably. For example, each link in the hexagonal network of graphite must be two-thirds single and one-third double, yet its length is 1·41 A. In benzene, the half and half arrangement (following Kekulé) is correlated with a length of 1·39 A. or 1·40 A. Thus the actual length of a bond may prove to be a safe indication of its nature. Robertson points out that the oxalic acid molecule is always planar, which may be accounted for on the ground that rotation is restricted round a link which is even partially of a double character.

It has recently been shown by Bernal and Megaw (*Proc. Roy. Soc.*, A, **151**, 384 ; 1935) that in all probability there are two types of bond linking oxygen atoms through intermediary hydrogens. One is the 'hydrogen bond' ; it is found, for example, in acids, and it corresponds to a separation distance, oxygen to oxygen, of 2·55 A. The other is the hydroxyl bond ; it is found in a number of hydroxides, and its length is about 2·8 A. By the use of this conception it has been found possible to locate the positions of the hydrogen atoms in several hydroxide structures, particularly in the clayey mineral hydrargillite. The oxalic structure of Robertson seems to supply a new and interesting example of the difference between the two kinds of bond. One of the oxygens at each end of the oxalic acid molecule is bound to a water molecule in the crystal by a link 2·87 A., the other by a link 2·52 A.

It has been pointed out (Fricke, *Koll. Z.*, **69**, 312 ; 1934) that the linking up of hydroxyl bonds explains the properties of the gels that are formed by neutral hydroxides.

These few examples may serve to show how improvements in the technique of X-ray analysis are sharpening a tool which has already been of assistance to research in many directions and now seems to be acquiring a new usefulness.

The chemist has already shown that the properties of the molecule depend on the internal disposition of its atoms. The characteristics of the solid state depend also on spatial relations, and in a manner which is even more complicated, much more complicated than in the case of the independent molecule. Accurate measurement of the spatial arrangements lays a firm foundation for the study of the properties of a substance in relation to its structure and its composition. The problems to be solved are, of course, extremely complex, but it is surprising how much can be done towards the examination of intricate molecular associations when the spatial relations between the most commonly occurring atoms are known. This applies, for example, to the study of the proteins, which has already gone far ; to the clays, and to the glasses and other extended structures. At one time it seemed hopeless to expect to learn much of the structure of bodies which were so irregular as to give no sign of crystallinity. But it is now possible to work from the regularity in occurrence of a few definite separation distances, even when regularity in orientation does not exist : and methods have been devised by which these distances can be determined by the X-ray methods.

It is clear that the stereometry which the chemist has developed so successfully is acquiring new powers which will have the widest applications.

Nature and Control of Potato Virus Diseases

By Prof. Paul A. Murphy

THE discussion on September 15 in Section M (Agriculture) of the British Association on "Scientific Aspects of Potato Growing" proved useful and timely. Inevitably the discussion was entirely pathological, ranging from virus diseases to potato sickness caused by the eelworm, *Heterodera Schachtii*, which may reduce the value of potato land from £2 to 10*s*. per acre. Most of it, however, concerned virus diseases and the raising of healthy seed potatoes. The magnitude of the question is shown by the fact that there are half a million acres of potatoes in England and Wales, and of these some 120,000 acres are planted with Scottish or Irish seed potatoes annually. The balance is planted with local seed, and it is a question to what extent this could be profitably replaced, for fresh seed is estimated to increase yields by one ton per acre. Much also could be done, as has been shown by Bryan at Ormskirk, to maintain the health of the imported seed so as to make it last longer.

The best way to improve the potato crop as a whole, however, is to increase the vigour of the imported seed stocks. It should now be possible to guarantee the entire absence of leaf roll, which is the principal cause of degeneration. This disease depends on the aphis, *Myzus persicæ*, for its spread, and Davies has shown that its prevalence depends on such simple physical factors as temperature, humidity, wind, and system of cropping. It hibernates on Brassicas and migrates to potatoes from May on, whenever the temperature rises above 55° F. (optimum 70°–80° F.), the humidity is 70 per cent or less, and the wind does not exceed 5–6 m.p.h. This knowledge enables one to avoid the indifferent districts, but not to turn them into good ones. It also explains why the best seed is to be found in exposed, wet and windy places, particularly near the sea, where farming is mainly pastoral and potato fields isolated. The connexion of good seed with islands is proverbial.

The potato mosaic question has been in danger of becoming a mystery, but the time has come at last when a clarification is possible. Some of the difficulties have been artificial ones. In the laboratory a single virus can be made to produce mottling, streaking, or no symptoms, by choice of the proper variety, but the general rule in Nature is that the virus is either carried or expresses itself as a mottle only. In other words, those varieties in which a virus causes streak, as virus *X* does in Arran Crest or virus *A* in British Queen, are free from that infection, for the virus either kills the plant and tubers, or kills itself while localized in the necrotic spots. Virus *Y*, which is the usual cause of streak, is sometimes an exception, but the general rule holds good : one virus, one disease. This is an enormous simplification.

It is probable that no virus is entirely harmless, although in some cases no natural spread or effect on yield has been demonstrated. Omitting such, it is found that the principal potato mosaics are caused by the four viruses *X*, *F*, *Y* and *A*, alone or in combination, and these form the types of three natural groups, viruses *Y* and *A*, though distinct, being at present placed together on account of the occurrence of intermediate forms. These groups are very shortly characterized as follows :

Group 1. *X*-type viruses. Mottle on *Datura* and tobacco ; pass *L*3 filter ; vector unknown (not *Myzus persicæ*) ; typical disease, simple mosaic.

Group 2. *F*-type viruses. Spots on *Solanum nodiflorum* and *Capsicum annuum* ; carried by tobacco and *Datura* ; held by *L*3 filter ; vector, *Myzus persicæ* under certain conditions ; typical disease, yellow or aucuba mosaic.

Group 3. *Y*-type viruses (including virus *A* and vein-banding virus). Vein-banding on tobacco ; not inoculable to *Datura* ; held by *L*3 filter ; vector, *Myzus persicæ* ; typical disease, veinal mosaic or leaf-drop streak.

The four viruses mentioned, together with their four combinations, produce eight diseases as follows, though complexes of more than two terms also occur :

1. X = simple mosaic.
2. F = yellow mosaic.
3. A = veinal mosaic.
4. Y = { veinal mosaic. / leaf-drop streak.
5. $X + F$ = interveinal mosaic.
6. $X + A$ = crinkle.
7. $X + Y$ = { rugose mosaic. / leaf-drop streak.
8. $A + F$ = double virus aucuba.

The first three diseases are normally passed over in the field, the eighth is not very common, and the remainder make up the mosaic of the practical man. These, as will be seen, are caused by a virus transmitted by *Myzus persicæ*, either alone or in combination with *X*. This, therefore, reduces the mosaic problem to two dimensions : the control of *Myzus persicæ*, which is only the leaf roll problem over again with the additional complication of carriers, and the control of virus *X*. The latter is still an enigma, for though it spreads so

freely as to be almost ubiquitous, occurring for example throughout the variety Up-to-Date, and in all American commercial potatoes without exception, its vector is unknown. It infiltrates rapidly into virus-free stocks even when grown in isolation in the best districts, and is not entirely unknown in experimental glasshouses. As part of the basis of all the severe mosaics it is an active danger, but the question still awaits answer whether it is economically possible or necessary to control it as well as the aphis-borne viruses.

The viruses mentioned are not uniformly distributed throughout Great Britain and Ireland. In the best districts, leaf roll is absent, *Y* is rare, *A* is more common and *X* is nearly universal, while in the south-east leaf roll and virus *Y* become comparatively common. The useful life of a variety depends on its reaction to the local viruses, and the moderate reactors suffer most and last shortest, a good example being Arran Chief. The carriers and strong reactors escape best. Outstanding varieties, such as the famous Up-to-Date and British Queen, are intolerant of *A* and probably resist infection with it as well. Up-to-Date tolerates *X* and British Queen resists it. It appears to be the reaction to these two viruses which determines the survival of a variety in Great Britain. If it tolerates *Y* as well so much the better, but our best potatoes lack this quality, a fact which explains the failure of Up-to-Date in the interior of the United States and Canada, as probably also in Central Europe. The control of virus *Y* at home depends on the use of Scottish and Irish seed potatoes.

Dental Caries and Diet

IN spite of the facts that there are more dental clinics, that many more people brush their teeth and that more dental treatment is practised to-day than ever in the world before, dental disease seems to be as prevalent as it has ever been, especially among civilized peoples. The experimental work of Mrs. Mellanby has shown that there is an intimate relationship between the diet and the structure of the teeth in both animals and man, and that there is similarly a close relationship between structure and liability to caries in man. It remained to be proved that the incidence and progress of the disease could be influenced by alterations or additions to the diet.

The results obtained in the first stages of the investigations carried out with this object have already been referred to in these columns (NATURE, 129, 83; 1932: 133, 820; 1934). The final report* of the Committee for the Investigation of Dental Disease describes the influence of diet upon caries in children's teeth and shows that the teeth, like other organs of the body, are strongly influenced by nutritional factors brought to bear upon them, whether through their blood supply or the saliva. The dental decay that developed in the children receiving an addition of vitamin D to their diet was definitely less than in the control children not receiving extra vitamin, and its influence in inhibiting the initiation and spread of caries was especially impressive when the addition was made during the period of development and before full eruption of the teeth.

* Medical Research Council. Special Report Series, No. 211: The Influence of Diet on Caries in Children's Teeth (Final Report). By the Committee for the Investigation of Dental Disease (assisted by Alan Deverall and Mabel Reynolds). Pp. ii+137. (London: H.M. Stationery Office, 1936.) 2*s*. net.

The investigations were made in three similar institutions in the neighbourhood of Birmingham, maintained on the Cottage Home System, under the Poor Law authority and later under the local education authority. It was at first hoped to divide the children in each institution into three groups, each receiving a different supplement, so as to avoid the possible influence of slightly differing conditions in the homes affecting the results, but administrative difficulties prevented this and all the children in one home were given the same addition. Analysis of the basal diets showed that they were fairly similar in the three institutions: the variations, described in the report, probably did not affect the general conclusions drawn from the results obtained. Three experiments were carried out. In the first, the three institutions had daily additions to the diet of treacle (28–42 gm.), olive oil (14–21 c.c.) and cod liver oil (14–21 c.c.; 50–100 units of vitamin D per c.c.) respectively. In the second, carried out in one institution only, one group of children received the olive oil and the other vitamin D in olive oil (625 units per c.c.: 14–21 c.c.). In the third, the children were younger (2–5 years old) instead of 5–14 years old, and the additions were treacle, vitamin D in olive oil and cod liver oil in daily doses of 7 gm. or 7 c.c., in three different institutions. Although about 1,600 children were under observation for varying lengths of time, the number who received the special additions for the full period of three years was much less.

Six-monthly examinations were made of the mouth and of the general physical condition with

special reference to the bones. The surface structure of the teeth, their arrangement in the jaws, the number of carious teeth and the extent of caries in each, as well as the condition of the gums and the general physical state were noted at the beginning of the investigation and at each subsequent examination. The differences between the findings at the first and final inspections in each diet group were then compared.

This investigation has shown again that there is a definite direct association between the structure of the teeth and the amount of caries present in a mouth: this relationship was found in the case of both the original and newly erupted permanent teeth in the olive oil group. Although no definite evidence was obtained that diet had an effect upon the structure of the permanent teeth, there were indications that the addition of vitamin D during the period of development tends to improve the structure of the first permanent molars. On the other hand, it was proved conclusively that a high vitamin D intake before the full eruption of the permanent teeth significantly diminishes the incidence of caries in such teeth after eruption: this protective effect was especially striking in the case of the premolars and second permanent molars, which erupt later than the first permanent molars. As regards the deciduous teeth, only in the case of the youngest children could any effect of the additions to the diet be expected; evidence was obtained that caries was less progressive in the vitamin groups than in that receiving treacle.

It is of interest to note that although the incidence of fresh caries in the permanent teeth present at the beginning of the investigation was the same in the two control groups, yet the spread and degree of softening were significantly greater in the olive oil group: in the case of the deciduous teeth, however, there was a greater increase in the percentage of carious teeth in the treacle than in the olive oil group.

Summing up the results of these extensive experiments, it may be concluded that a relatively high intake of vitamin D can do much to diminish the incidence of caries if the vitamin is given during the period of development of the teeth: that a beneficial effect may be obtained if it is given at a fairly late stage of development; and that even when it is given after the eruption of the teeth, the onset and spread of caries are delayed.

Problems of Plantation Economy

IN choosing the subject of "Plantation Economy" for his presidential address to Section F (Economics and Statistical Science) of the British Association, delivered at Blackpool on September 11, Dr. C. R. Fay rightly directed attention to a neglected corner of knowledge which has lessons of much interest to the sociologist as well as the economist, to the historian, the geographer and the administrator as well as the agriculturist. Dr. Fay was clearly inspired by a recent tour in the East, and dealt mainly with the tea plantations of India. He contented himself with a straightforward account of the industry, and refrained, perhaps wisely, from comment on the wider issues.

The Royal Commission on Labour in India (1931) pointed out the similarity between a plantation and a factory—both employing a considerable number of persons under the control of a manager. The chief difference is that the work in one case is essentially agricultural and is not concentrated in a large building. The analogy is important; until regulated by factory acts, 'exploitation' of labour too often characterized the growing manufacturing industry just as exploitation of labour—including slavery—characterized the early plantation industry. Tobacco in the south-eastern United States, and sugar in the West Indies a hundred or more years ago, ought to be thought of in comparison with the Lancashire cotton mills of the same period. It is scarcely possible to contemplate the modern world without a factory system, yet the corresponding plantation system is not only less important than formerly, but also may be described as 'suspect'. To-day, India, Further India and the East Indies are the home of the greatest plantation industries, tea and rubber, and this is considered by Dr. Fay to be due in considerable measure to Government opposition to the system in Africa. Dr. Fay quotes figures in his opening paragraph to show that, despite a relatively small area, plantation products (mainly tea) account for nearly a fifth by value of the agricultural exports of India. This statement has little meaning—what one would like to know is the relative productivity of a given area of land under plantation organization and under unregulated native cultivation, and the relative cost per unit of production, having due regard to quality.

Since the bulk of the world's tea is produced in plantations, it will be of interest to detect the reasons for the persistence of plantation economy in the case of this commodity. In the first place, tea is in large demand among the white races, yet is the product of a tropical or sub-tropical shrub growing under conditions unsuited to white manual labour. Here is the essential basis for the old plantation industry in sugar, cotton, tobacco and indigo, and the modern industry in rubber. In the second place, rigid adherence to a daily time-table is essential—tea leaves must be plucked exactly when they are ready ; the 'flush' must be dealt with immediately at the factory, withering must go on until almost exactly 42 per cent of the moisture is lost—after about eighteen hours. This all means adequate organization and supervision, or the quality of the resulting tea will suffer. There would be no market for the output of a factory which did not maintain an even standard. So much so is this the case that most factories consider it unwise to use supplies from other than their own plantations. Herein lies an important difference from other plantation industries—cotton can be bought according to quality from the small-holder ; sugar cane can be brought to the sugar 'central' and does not deteriorate so rapidly. With tea the deterioration after plucking is so marked that 'lorry tea' (that is, brought in by the quickest method of transport) is regarded as superior.

Dr. Fay points out that, in the early European settlement of the New World, 'plantation' and 'colony' were virtually synonymous ; the plantation was the economic instrument whereby colonies were established. Conditions of life were difficult for employee and manager alike. To be sent to the plantations was equivalent to disciplinary banishment for the turbulent younger sons. The negro States and the West Indies owe their population—and many of their present-day problems—to the system. It is curious that the present home of the plantation—the East—was, with its existing large population, at this earlier date recognized as a field for trade rather than colonization. Thus India and the East Indies had trading posts and forts to guard them, but not plantations. Since tea and rubber planting began there much later, its history has been happier. The tea-gardens of Assam attracted to that pleasant province labourers from overcrowded Bihar who, after their term of work was finished, settled down to work the land under conditions far superior to those in their home areas. Four fifths of the people of Assam are 'foreigners' by birth or origin—the tea-gardens have enabled this important migration to take place and have done much to relieve one of the pressing population problems of India. To a less degree the rubber plantations of Malaya have had the same effect, with the difference that the Indian coolies have not been encouraged to settle. But rubber has given Malaya and the Dutch East Indies fine roads and railways and a vastly improved standard of living for the people.

The plantation system, under modern humane supervision, may thus confer great benefits on a world the agriculture of which is in a state of chaos. Not only may it provide diverse parts of the earth with commodities otherwise unobtainable—a good example is the highly organized banana industry—but it may also prove the way to development and settlement of tracts to which the individual settler without capital neither could nor would be attracted. Our economists and sociologists would be doing a great service by studying dispassionately the application of a modern plantation economy in Africa, Australia and other sparsely populated parts of the world.

L. DUDLEY STAMP.

The Hexlet*

HOWEVER ill-assorted in girth three spheres may be
Each one can kiss the other two and simultaneously
A ring of six about them all kissing serially.

Though any necklet of graded beads
May fit in general the she-sex,
This Hexlet of mine of novel design
Caresses not one but three necks.
However it's worn it alters its grade
To suit its tri-spherical prison,
Plays kiss-in-the-ring and merry-go-round
Whilst hugging three necks with precision.
Like bubbles that blow and dwindle and go
It holds up to light-hearted derision
The terrible muddle mathematical fuddle
Makes of the pure circumflex
And its pet aversion is the mental inversion
That will have 'It's $1/x$'.

All saints and sages throughout the ages
From one doxy never have swerved,
To hold fast unto what in change changes not
And ferret out what is conserved.
Now these beads without flaw obey this first law
For the aggregate sum of their bends.
As each in the tunnel slims through the funnel
Its *vis-à-vis* grossly distends.
But the mean of the bends of each opposite pair
Is the sum of the three of the thoroughfare.

FREDERICK SODDY.

Nov. 7, 1936.

* *vide* "The Kiss Precise" (NATURE, **137**, 1021, June 20, 1936).

Obituary

Prof. W. J. Sollas, F.R.S.

IN the death on October 26, at the age of eighty-seven years, of William Johnson Sollas, the University of Oxford and the science of geology have lost an outstanding personality. To a liberal culture, especially on the scientific side, he added a wide and ever-increasing knowledge of his own subject, a genius for research which extended to all its chief branches, and a philosophical point of view which always penetrated to the deeper and more theoretical bearing of the subjects with which he dealt.

Born at Birmingham in 1849, Sollas was educated at the City of London School, where chemistry was the chief subject of his interest, and at the College of Chemistry in Oxford Street, London, where he worked in Frankland's laboratory. He passed with a scholarship to the Royal School of Mines, obtained the A.R.S.M., and finally, with two of his brilliant contemporaries, Liversidge and Garnett, obtained a scholarship at Cambridge, he and Garnett being admitted to St. John's College. Here T. G. Bonney was not only his tutor, but was also acting as deputy professor of geology in Sedgwick's declining days. His influence turned Sollas towards geology as his principal subject, and he graduated with first class honours in the Natural Sciences Tripos in 1873. He was a fellow of his college in 1882–84.

Sollas's first appointment was on the University Extension, where his lectures were most successful and bore traces of the influence of Huxley and Tyndall in their clarity and attractiveness, and of Ramsay in their imagination and enthusiasm. In 1879 he was appointed professor of geology and zoology at University College, Bristol, a post he held until 1883, when he passed to Trinity College, Dublin, as professor of geology and mineralogy. Finally, in 1897, he became professor of geology and palæontology at Oxford, a chair he occupied until the end of his life, thirty-nine years, having been also elected a fellow of University College in 1901.

The anomalous "Cambridge Greensand", which inspired the early work of so many students of the Cambridge school, had its influence on Sollas, in the direction taken by his work on fossil sponges, on which he published more than thirty papers before 1890. This stage culminated in a new classification of the Spongida, articles in Cassel's "Natural History" and the "Encyclopædia Britannica", and a monograph on the Tetractinellidæ collected by H.M.S. *Challenger*. In his work he was interested not only in the systematic and anatomical results, but also in the physical principles involved in the development of the skeleton, and in the chemical interchanges of silica and carbonate of lime in their formation. The latter led him directly to study the origin of flint and chert, on which he evolved a theory that has stood the test of time. To help his work on minute organisms he devised a new use for heavy liquids, arranging them in a 'diffusion column', in which the specific gravity of such bodies could be determined by the depth to which they sank. This method he later applied to minerals and rocks, and to such fluids as blood.

Sollas's palæontological work was extended to brachiopods, echinoderms, Foraminifera, and to *Oldhamia* and its allies; he also described a new species of *Plesiosaurus* and worked out the geographical range of this genus. But perhaps his most outstanding work on organisms other than sponges was his application of the method of serial sections to the study of fossils. The ordinary zoological method was impracticable because of the intervals lost in grinding down successive slices. Sollas, therefore, worked out a mechanism and technique for grinding down specimens by stages, and, at intervals of a fraction of a millimetre, photographing and drawing in reflected light the surfaces thus obtained. Models of each section in gelatine or other medium could then be made and the organism built up at any desired magnification on successive contours, yielding a restoration of all the detail that it had preserved. A remarkable early success was obtained with *Monograptus*, and this was followed by work on a Silurian brittle-star, a Devonian fish, the skull of *Ichthyosaurus*, and, with the co-operation of his daughter Miss Igerna Sollas, a dicynodont skull. It may fairly be said that nothing has done more to advance knowledge as to the intimate anatomy, and even physiology, of extinct animals than this technique in the hands of its inventor and his successors.

When he had rounded off his sponge work, Sollas turned eagerly to petrology, and his researches on the Wicklow granite and the Carlingford complex were the most elaborate investigations undertaken up to their date. In one case he saw that the pleochroic haloes must be attributed to a new element, since identified by Joly as radium, and in the other he did much on the mixture, hybridism and metamorphism of rocks. Acting for a few years as petrographer to the Geological Survey of Ireland, he put out other work on rocks, and also assembled the evidence collected by the Survey for the issue of a map of the glacial esker system of the country. Work upon minerals was confined to a couple of papers on zinnwaldite and riebeckite, but he made a strenuous endeavour to discover the molecular structure of crystals, a subject which had awakened his interest when he first learnt at the School of Mines of Haüy's contributions to crystallography, and when Garnett advised him to test his early speculations by the atomic volumes. The data at his disposal were inadequate to carry him so far as X-ray investigation has taken Laue and the Braggs and their successors, but a series of papers published by the Royal Society indicates that he was on the right track.

The chief researches conducted by Sollas in later years were concerned with early man. He definitely assigned the Gibraltar skull to Neanderthal man, explored the Paviland Cave with its relics of Cro-Magnon man, dealt with *Pithecanthropus* and *Eoanthropus*, and applied the use of sagittal sections of the skull to a critical study of most of the Palæolithic skulls that have attracted recent attention.

Wide as is the range of work thus briefly outlined, Sollas's many activities included others of which only the barest mention is possible. Such are his application of the idea of evolution in place of uniformitarianism to geological history, his study of the geology of Bristol, Dublin, Oxford, and the Silurian Inlier of Rhymney near Cardiff, his ingenious method of studying tidal movements and their effect on the estuarine sediments of the Severn, his philosophical explanation of the origin of freshwater faunas, his study of a bog-flow in Kerry, his attempt to bore through a coral reef in the Ellice Islands, afterwards carried to success by Edgeworth David and his colleagues, his addresses and books on the age of the earth and on ancient hunters in comparison with those of to-day, and the fostering care with which he watched the translation by Miss Hertha Sollas of Suess's great work "Das Antlitz der Erde", a remarkable service to British geology for which we are deeply indebted to both father and daughter.

Sollas was awarded the Bigsby Medal and the Wollaston Medal by the Geological Society, of which he became president in 1908, a Royal Medal by the Royal Society, and the Huxley Medal by the Royal Anthropological Institute. He was made an honorary fellow of the Imperial College, and received honorary doctorates from the Universities of Bristol, Dublin, Christiania and Adelaide. His death leaves, with his associates, pupils and successors, the memory of a lovable and constant friend, a gallant and doughty foe, a sprightly debater and formidable controversialist, a daring climber and diver, an omnivorous reader, a writer of clarity, vigour and humour, an investigator of untiring energy and unimpeachable accuracy, and, whether as host or guest, a genial and most courteous gentleman.

W. W. WATTS.

An anthropological correspondent writes as follows :

Although Sollas entered upon active study of the problems of early man late in life, he rapidly became an outstanding authority. His training and experience as geologist and palæontologist inspired confidence in his balanced judgment in the discussion of chronological and morphological problems relating to early man ; while his originality and constructively critical attitude of mind, which refused to be dominated by traditional methods or accepted opinion, found ample opportunity for exercise in his studies of the various types of fossil man, in which his development of the method of craniological investigation by sagittal sections showed a remarkable grasp of the morphological and metrical problems involved in comparative study.

One of Sollas's earliest archæological investigations to attract widespread interest was his exploration of the Aurignacian site in the Paviland cave of the Peninsula of Gower, South Wales, in which a prehistoric skeleton, known as the "Lady of Paviland", was found. Here Sollas discovered painting in red on the wall, which, notwithstanding counter-argument —to be anticipated in the circumstances—that it was the recent work of a fisherman, remains the only example of cave-painting in Great Britain for which the claim of palæolithic age makes any showing.

Sollas published in scientific periodicals a number of papers on early man, which are of permanent value ; but his most considerable contribution to the literature of the subject is—and will continue to be notwithstanding later discovery and development in method and classification—his "Ancient Hunters" (third edition, 1924). Sollas had been much impressed by the Bushman tribes he had seen in the Kalahari, when the British Association visited South Africa in 1905. The influence of that experience is to be seen in the degree to which he made use of the cultural complexes of modern hunting peoples in the interpretation of the archæological evidence bearing upon the cultures of the hunting peoples of the Old Stone Age. As a general principle the method was not new to archæology, but Sollas gave it scientific precision. His references to Bushman art and associated custom and belief in certain respects anticipated later studies and discovery ; while in his comparisons of Magdalenian culture with that of the Eskimo he directed attention once more to matters from which interest had been diverted. It was in this connexion that he entered into one of the most strenuous controversies of his later life when he produced his study of the late Palæolithic Chancelade skull and affirmed its affinities to that of the modern Eskimo.

We regret to announce the following deaths :

Prof. J. T. Cash, F.R.S., emeritus regius professor of materia medica in the University of Aberdeen, on November 30, aged eighty-two years.

Sir Edwin Deller, principal of the University of London since 1929, as the result of an accident, on November 30, aged fifty-three years.

Prof. E. H. Kettle, F.R.S., professor of pathology, British Postgraduate Medical School, University of London, and consulting pathologist to St. Bartholomew's Hospital, on December 1, aged fifty-four years.

Mr. W. H. Macaulay, fellow of King's College, Cambridge, author of "The Laws of Thermodynamics" and "Solid Geometry", on November 28, aged eighty-three years.

Lady Ramsay, widow of Sir William Ramsay and affectionately associated with many friends at University College, London, and other scientific circles, on November 26, aged eighty-two years.

Prof. Wilhelm Schmidt, professor of physiography in the University, and director of the Central Institute for Meteorology, Vienna, on November 27, aged fifty-four years.

Dr. Lilian Veley, an original woman fellow of the Linnean Society of London, known for her work in entomology and microscopy, on November 27, aged seventy-five years.

News and Views

An Institute of Chemotherapy

THE malaria epidemic in Ceylon in 1934–35 directed attention anew to the importance of chemotherapy, particularly in relation to malaria, and the subject received full discussion at a joint meeting of Sections B (Chemistry) and E (Geography) of the British Association at the Norwich meeting. Last July, the Royal Society decided upon a scheme for research on malaria, and, as part of it, Lieut.-Colonel J. A. Sinton was appointed for a period of five years to work at the Malariatherapy Centre at Horton, where he would be able to include chemo-therapeutic testing and experimentation in his investigations. Hitherto, little work has been done in Great Britain on this subject, in spite of the fact that the British Empire includes vast malarious areas in Africa, India and the Far East. In the British Association discussion referred to above, Colonel S. P. James stated that of the 3½ million deaths annually from malaria, the great majority occur in the British Empire, and that the Empire spends £450,000 annually on quinine for combating malaria. It is now announced that Great Britain is to have an institute of chemotherapy, and at the annual dinner of the Royal Society, Mr. Neville Chamberlain stated that, as Chancellor of the Exchequer, he had just consented to give a grant of £30,000 a year towards the establishment of such an institute. It is difficult to foresee, he said, all the possibilities of the new institute, but the fact that the grant has been made is evidence that the Government is not indifferent to the duty of one generation to carry on investigations which may benefit only the generations to come.

Royal Society Research Funds

ACCORDING to the annual report for 1936 of the Council of the Royal Society, Mr. H. B. Gordon Warren, who died in 1932, directed that the income of his residuary estate should be used for the promotion of scientific and industrial research, and in particular to advance knowledge in metallurgy, engineering, physics and chemistry. The trustee of the estate, Williams Deacon's Bank, Ltd., has agreed that the trust shall be administered by a committee consisting of two members appointed by the Bank and eight others appointed by the Royal Society. It is understood that the fund will be slightly in excess of £200,000. The Society has also received the residuary estate of the late Sir Joseph Petavel, which amounts to about £40,000. During the past year, the Society applied to H.M. Treasury for an increase of £1,000 annually for the grant-in-aid for scientific investigations, and an increase of £500 annually for international research associations and scientific congresses. These applications have been approved by Parliament, so that the annual grants for 1936–37 for scientific investigations and for international and other congresses will be £7,000 and £2,500 respectively. From the Parliamentary grants-in-aid, a sum of £6,000 has been allotted to scientific investigations, and a sum of £1,775 to scientific publications of institutions other than the Royal Society. The Council has also decided unanimously to propose to the Society that the number of annual elections to fellowships should be increased from seventeen to twenty.

Charles Frederick Chandler, 1836–1925

ON December 6, the centenary occurs of the birth of the distinguished American chemist, Charles Frederick Chandler, who in 1899–1900 served as president of the Society of Chemical Industry. He was brought up in New Bedford, Mass., being the son of a draper. As a schoolboy he contracted with his father to sweep out and open his shop every morning for a dollar a week, in order to buy chemicals and apparatus. From school he passed to Harvard and the Lawrence Scientific School, afterwards studying chemistry under Wöhler at Göttingen. On returning home, he obtained a post as janitor under Prof. Joy at Schenectady, becoming successively instructor first in mineralogy, then in geology and eventually professor of chemistry. It was at Schenectady that he began his lifelong efforts to bring chemistry into daily life and into industry. In 1864, when the School of Mines was organized as part of Columbia College, he was invited to occupy the chair of chemistry, and thus began his great career as a teacher in New York. He was a founder and sometime president of the New York College of Pharmacy, served as president of the American Chemical Society and president of the Metropolitan Board of Health. For many years he edited *The Chemical News*. He died on August 25, 1925, at the age of eighty-eight years.

Destruction of the Crystal Palace

THE destruction by fire of the greater part of the Crystal Palace on the night of November 30–December 1 will be widely regretted, for, although its general form and architecture have often made it the subject of good-humoured ridicule, sometimes of derision, it held a unique position and was one of the most famous landmarks of London. As is well-known, it originated from the Great Exhibition of 1851 in Hyde Park, where the Crystal Palace was constructed by Sir Joseph Paxton. When the Exhibition was closed, this "blazing arch of lucid glass" was removed to Sydenham. There it was extended, and finally opened by Queen Victoria and the Prince Consort in 1854. Through public subscription, the grounds became public property in 1913. Though fantastic in appearance, the Palace has for many years been symbolic, and apart from this sentimental loss, its destruction is to be regretted since it had become a centre for music, chiefly choral

and orchestral, and for various types of exhibitions. The fire affected the Research Laboratories of Baird Television, Ltd., situated at the Palace, but the part of the building leased by the Baird Company for the production of receiver sets and their testing fortunately was sufficiently remote from the main building not to be damaged in any way. While, therefore, a great amount of research apparatus was destroyed, the delivery of Baird receiving sets will not be seriously affected. Immediate measures are being taken to find alternative accommodation for the Baird Company's large number of research workers and for the re-equipment of the laboratories, and it is not considered that the research programme of the Company will be seriously prejudiced. The fire at the Crystal Palace does not affect the B.B.C. television programmes being broadcast from the Alexandra Palace by the Baird system and by the Marconi E.M.I. system.

Television in the London Area

THE issue of *Television and Short Wave World* of December makes some critical comments on the programmes that have been transmitted from the Alexandra Palace. Complaints are made that intervals, sometimes totalling more than fifteen minutes, occur in a programme of an hour. These intervals are usually filled up by gramophone records, but the owner of the set feels that it is extravagant to run about twenty valves together with a cathode ray tube merely to hear these records. It is unfair to be too critical in the early stages of development, but it looks as if more should be spent on the programmes. Television receivers are being advertised for immediate delivery at prices ranging from 85 to 135 guineas, the picture size being about 12 in. by 9 in. Free demonstrations are given by various manufacturers in London. The Science Museum is still giving demonstrations, and the Southern Railway is giving demonstrations at Waterloo Station to railway ticket holders. Carrington House, a large block of flats in Mayfair, has been equipped for 'bulk reception' of television signals and of ordinary broadcast programmes. The building contains seventy-three flats each of which is fitted with plug points for both kinds of services. The residents of any of these flats can purchase a television or a radio set or both with confidence that the programmes will be produced without interference. It is possible that the actual Coronation ceremony in Westminster Abbey may be televized. The two great difficulties are relaying the signals to the Alexandra Palace and the provision of the necessary bright light.

Derbyshire Caves Exhibition

ON behalf of the Derbyshire Caves Exploration Committee appointed by the British Association, Mr. Leslie Armstrong has excavated Pin Hole, a cave in Creswell Crags inhabited in Upper Palæolithic times and exceptionally rich in prehistoric remains. A preliminary report was published in the *Transactions of the Hunter Archaeological Society*, **4**, part 2, with a diagram showing the brick-earth, red above and yellow below, which underlay the present stalagmitic floor, with layers of slabs fallen from the roof marking periods of exceptional cold. The palæolithic cultures represented are Le Moustier and Aurignac, the latter persisting through the glaciation associated elsewhere with La Madeleine ; and the fauna shows severe and temperate conditions alternating. There are chipped pebbles of quartzite, and flint implements of excellent workmanship, nearly all with white patina ; also slight engravings on bone, a bone blade regarded as a bull-roarer, as well as a cowrie shell and piece of mother-of-pearl. Mr. Armstrong has also excavated Mother Grundy's Parlour in the same valley, and published an account in the *Journal of the Royal Anthropological Institute*, **55**, Jan.–June 1925, with eight pages of careful drawings of the stone implements mostly of Aurignac types, but with a microlithic industry in the uppermost layer, and chipped quartzite at the base. The cave-earth of the Parlour has large stones from the roof incorporated throughout, not at intervals, and shows the same difference in colour as Pin Hole. Engravings of animals on bone in the Aurignac style and the best of the finds from both sites are now exhibited in the Department of British and Mediaeval Antiquities at the British Museum, near the top of the main staircase, and will, by the kindness of Mr. Armstrong, remain there for the rest of the year.

Romano-British Pottery Kiln from Berkshire

A ROMANO-BRITISH pottery kiln removed intact to the Science Museum, South Kensington, from its original site in Berkshire was exhibited to the public for the first time on December 1. The kiln, now shown with a reproduction of its original surroundings painted by Mr. E. M. Dinkel as a background, is one of two discovered through the introduction of the tractor-drawn plough in the cultivation of a field overlooking the dried-up bed of the River Pang on Woodrows Farm, Compton, near Aldworth, Berks. The deeper ploughing in soil only a few inches deep on chalk turned up a darker earth mixed with potsherds, which on investigation by General W. K. Hardy proved to be due to the presence of two pottery kilns. Of these, one was found to be intact, while the other had been broken up by the ancient potter. The kilns had been constructed by digging an oval hole in the chalk about four feet deep. One half of this was taken up by a rough oven of clay with a front wall of clay and stones, in which was a stoke-hole. A floor of clay, supported by a wall from centre to back, an inch or two below the level of the chalk, served as the stand on which were placed the 'green' pots for firing, heat from the fire passing through holes in the floor. Over the pots had been a dome-shaped cover of clay, which had to be broken at each firing, but of which fragments were found nearby. Pots reconstructed from the numerous sherds collected, as well as coins associated with the find, give a date not later than the beginning of the fourth century A.D. The removal intact of the undamaged kiln entailed not a little skill and ingenuity, as with reinforcement it weighed nearly

five tons. Recent archæological discovery, notably in Yorkshire, at Colchester and most recently at Lincoln, have made familiar the kiln and mode of firing employed by the Romano-British potter; but as a rule the conditions of discovery have precluded preservation for general inspection. The kiln now on view at the Science Museum is the only example of the period exhibited in Great Britain.

Exhibition of Kinematography

THE fourth Exhibition of Kinematography, arranged by the Royal Photographic Society, was opened at the Society's premises, 35 Russell Square, London, on November 28 and will remain open until December 19. A large selection of still pictures illustrates the ever-widening scope of kinematography, and includes examples of the work of many producing companies and amateur societies, and of films—scientific, instructional and for purposes of entertainment and publicity. Much recent apparatus, standard and sub-standard, is on view, this section including exhibits by most of the leading manufacturers. A Vinten gyroscopic tripod for 16-mm. work is particularly worthy of note. Stock manufacturers are also to the fore. Kodachrome is being exhibited in 16-mm. and 8-mm. sizes, the smaller size being not yet on the market in Great Britain. On this stand, too, Messrs. Kodak show samples of 16-mm. work with Pola screens. Messrs. Ilford have staged an exhibit with photographs illustrating the manufacture and testing of Cine products. Examples of their various products, including Dufaycolor, are on view. A comprehensive programme of lectures has been arranged on subjects varying from sound recording to the making of cartoon films. No charge is made for admission to the Exhibition, to the meetings, or for reserving seats.

Dr. E. Bausch and the Optical Industry of America

THE American Society of Mechanical Engineers made its annual awards for distinguished service in engineering and science, and "for great and unique acts of an engineering nature that have accomplished a great and timely benefit to the public" on December 1 to Dr. Edward Bausch and Mr. Henry Ford, when Dr. Bausch received the A.S.M.E. Medal and Mr. Ford the Holley Medal, the former established in 1920 and the latter in 1923. The A.S.M.E. Medal is awarded once a year, "and that only for inventions and improvements of great merit in the technical and public sense". Among the previous recipients have been H. G. Carlson, Dr. Robert A. Millikan, Dr. Ambrose Swasey, and other distinguished contributors to the progress of engineering. In his long and notable career, which began with the construction of his first microscope in 1872, Dr. Bausch has been a constant contributor to engineering progress. At eighty-three years of age, he is still at work, and recently, with other members of the Bausch and Lomb Optical Co., has designed the contour measuring projector. This new instrument is proving itself a valuable inspection device in many types of industry. It is both a microscope and a projection apparatus of the highest quality and great accuracy with which a highly magnified profile of such parts as screw threads, gears, dies, gauges and shapers may be thrown upon a screen or chart for study and comparison.

DR. BAUSCH entered his company's service sixty-two years ago, immediately upon leaving Cornell University. As assistant to his father, John J. Bausch, he is credited with the great expansion of the industry in the United States through the introduction of new technical methods and machine processes to compete with the cheaper hand labour of Europe. Dr. Bausch has for many years been a fellow of the Royal Microscopical Society, and has a wide acquaintance with workers in this field both in Europe and the United States. Not content with his own efforts in building up the optical industry, Dr. Bausch has been conscious of the necessity of educational work to perpetuate his labours. This explains his interest in the establishment of the Institute of Optics, as a part of the Physics Department of the University of Rochester, and the construction of the Bausch and Lomb Physics Building at the University in honour of his father and Captain Henry Lomb, founders of the Bausch and Lomb Optical Co.

Research on Atmospheric Pollution

THIRTY-THREE representatives of local authorities and other organizations co-operating with the Department of Scientific and Industrial Research met at the Fuel Research Station of the Department at East Greenwich on November 30 to discuss the investigation of atmospheric pollution. Dr. G. M. B. Dobson, chairman of the Atmospheric Pollution Research Committee, presented a report on the progress of the investigations carried out under the auspices of the Committee. The Conference noted especially that arrangements are well in hand for the intensive survey of pollution in and around Leicester. After the meeting, the representatives were shown the work of interest to them which is in progress at the Fuel Research Station. Broadly speaking, there are two fundamental and closely related factors involved in the reduction of atmospheric pollution by coal burning—the nature of the fuel and the appliance in which it is burned. The former of these leads to the selection from the varieties available of fuel most suitable for a given purpose. The preparation of coal for the market, by cleaning and grading, assists materially in the reduction of pollution; the cleaning yields a coal of lower ash content, thus decreasing the potential emission of ash in the form of grit, while grading the coal according to size reduces the content of small particles which may be blown from the fuel bed by the draught. The aim in coal-burning appliances is towards greater control over the combustion. This is obtained by uniform air distribution to the fuel and the regulation of air supply, thereby promoting efficient combustion and a reduction of the unburned products passing into the atmosphere. In the domestic field attention has been devoted mainly to the production from coal of a

free-burning smokeless fuel, by removing the greater part of the volatile matter which is responsible for most of the smoke nuisance. Appliances have been designed for the burning of such smokeless fuel. Efforts are also being made to test and modify domestic appliances so that raw coal may be burned more efficiently and with a substantial reduction of pollution.

Domestic Cokes

THE Institute of Fuel and the Manchester Association of Gas Engineers held a symposium on domestic cokes in Manchester on November 18. Arnold Marsh examined the question from the point of view of smoke reduction and, discussing the scope of the different smokeless fuels, concluded that all forms of coke would be required. E. C. Evans, on the other hand, fears that an increase in the use of oven coke for domestic purposes would be disadvantageous to the economic production of pig iron. Even now there is a shortage of suitable blast furnace coke. H. J. Hodsman, discussing the relation between the properties of a coke and its behaviour in the grate, emphasized that shallow modern grates cannot be justified on the ground of efficiency on consuming any fuel—whether raw coal or coke. The deeper fuel bed is more rational and this is being recognized by the consumer, for E. W. L. Nicol pointed out that 70,000 such grates convenient for burning coke are sold annually. A. Blackie described two suitable designs of grate which have proved satisfactory. Emphasis was laid on the possibility of activating high-temperature cokes with soda. Prof. J. W. Cobb described how in 1925 it was observed that the reactivity of coke to carbon dioxide is enormously increased by treatment with soda. The chance of industrial use of this has been increased by P. J. Askey's observations that in presence of lime, the addition of even so little as 0·5 per cent sodium carbonate to a coke may produce an adequate increase in the reactivity. R. A. Mott described experiments made with H. H. Thomas in Liverpool Gas Works on alkali activation made under coke oven conditions. These leave little doubt that high-temperature cokes can be made to burn more actively as a result of alkali treatment; but the economic future of the process will depend on other factors. Many existing gas works would find it difficult to introduce a process of pretreating coal into their routine.

Acquisitions at the British Museum (Natural History)

MR. W. FALCONER has recently presented to the Department of Zoology males and females of eighty-four British species of spiders all new to the collection. This valuable gift makes the collection of British spiders in the Museum almost complete. Another interesting accession comprises nine spiders' webs mounted between sheets of glass, the webs being made visible by a black background and the judicious application of baby powder. Prof. G. H. F. Nuttall has presented to the Department of Entomology the whole of the material upon which he based his well-known studies on the human louse. His results, published in *Parasitology* (1917–30), include a very full summary of its relation to typhus, relapsing and trench fever, and other diseases which it carries, and a detailed account of methods of combating lousiness. Among other things Prof. Nuttall demonstrated that the head louse and body louse are not distinct species, but only varieties, possibly showing slight biological differences, of a single species. Recent accessions to the Department of Geology include an extensive series of petrified cones and wood of Araucarian conifers from Patagonia, collected and presented by Dr. F. Mansfield. Many of the specimens have been cut and polished, and the preservation, in chalcedony of various colours, is very good. These fossils were found in the Cerro Alto and Cerro Cuadrado region of Santa Cruz, which has been described as one of the world's most marvellous petrified forests; the material has not yet been fully studied, and the geological age is still uncertain, though it is probably at least as old as early Tertiary. Several hundred invertebrates, mainly corals, from the Palæozoic of Germany and Bohemia, have been collected and presented by Dr. Stanley Smith. The Mineral Department has received by exchange with the Mineralogical Museum, Moscow, an interesting series of specimens from Kola Peninsula and various localities in Central Asia. Lord Ilchester has given a series of pebbles from carefully defined points on the Chesil Beach, which is probably the most remarkable bank of shingle in the world.

Exhibit of the Biology of Water-Supply

A NEW exhibit which has been installed in the Central Hall of the British Museum (Natural History) illustrating the biology of water-supply shows, more fully than its predecessor, the influence of plants and animals on the purification of water for human use. It shows how river-water is purified by storage in reservoirs, followed by filtration through sand. Some of the organisms living in the water of a river find the conditions in waterworks more favourable, and multiply greatly. Thus great swarms of minute plants, and the animals that feed on them, arise in reservoirs. This is sometimes to the advantage of the water engineer, and sometimes greatly to his disadvantage. The beneficial effects include oxygenation of the water by the plants, and the formation of a natural filtering film, more efficient than any artificial film, in stopping the passage of bacteria. This living film, which consists chiefly of microscopic plants, forms on the surface of the sand and gravel of the filter-bed. Trouble arises if the living things in the reservoirs become so numerous as to choke the filters, or are of such a kind as to give an unpleasant flavour to the water. These points are illustrated by specimens, photographs and diagrams. History has shown that, without sand-filtration, mains and supply-pipes are apt to become seriously blocked with animal growths. This is illustrated in the exhibit, which also shows how the excessive growth of microscopic plants can be checked, how wells and springs come to give good or bad water, how sudden and severe outbreaks of

iron-bacteria have been known to occur, and the importance of taking drinking water direct from the main, and of keeping household cisterns covered. The Museum is indebted to the staff of the Water Examination Department of the Metropolitan Water Board for help in the preparation of this exhibit.

The Aquarium of the New York Zoological Society

THE fortieth annual report of the New York Zoological Society (June 1936) contains a report on the aquarium, written by the assistant director, Mr. Charles M. Breder, jun. There has been much activity both in improving equipment and collecting fishes and invertebrates for the aquarium. Besides this, many fishes have been hatched, including whitefish, Chinook salmon, rainbow trout and muskallunge, and the young handed over to the New York City Water Department for distribution in public waters. Studies on the nature of electrical energy discharged by such fishes as the electric eel were continued by Mr. Coates. After many experiments, it was found that the electricity discharged by an eel could be made to light a neon tube, and this led to a daily demonstration for the benefit of the public. Mr. Breder himself is studying details of reproductive habits of fishes, including five species of sunfish, the stickleback, *Apeltes quadracus*, and the catfish, *Villarius catus*, and has published several papers on this subject. Besides work by the staff, a number of visitors have made use of the aquarium facilities during the year.

The Parliamentary Science Committee

THE annual general meeting of the Parliamentary Science Committee was held at the House of Commons on November 26, the Earl of Dudley presiding. The officers elected for the ensuing year were : *President*, The Earl of Dudley ; *Chairman*, Sir Arnold Wilson ; *Vice-Chairman*, Prof. B. W. Holman ; and *Hon. Secretary* and *Treasurer*, Mr. H. W. J. Stone. According to the annual report, four more institutions were affiliated to the Committee during 1936, and others have the subject under consideration. The total aggregate membership of the affiliated institutions now exceeds 100,000. During the last session, the Committee was active in approaching Government departments, and in promoting questions in Parliament on a variety of topics. The outstanding feature of the year's work has been the consideration of a memorandum how best to finance and develop scientific and industrial research. The investigations into this subject have not yet been completed. During the past year the following members of parliament have joined the Committee : Lord Melchett, Prof. J. Graham Kerr, Mr. Andrew MacLaren and Sir Philip Dawson.

Bright Fireball of November 14

AT about 8.45 p.m. on November 14, a very bright fireball was seen by a number of people in different parts of Ireland. All the accounts agree in describing it as extremely brilliant, showing lights of various colours—white, blue, and red—and moving fairly slowly earthwards. Some of those who saw it allege that it lighted up the country, a road being visible for half a mile ahead, or the earth being as bright as day. Many people were terrified by the apparition, and one girl collapsed with fright. Most of the accounts come from Dublin and Wicklow, but it was also seen in Co. Tipperary, and a correspondent there describes it in terms almost similar to those used by others in eastern Ireland, namely, "it seemed very close at hand and lighted the whole place up". A report from Co. Armagh, Northern Ireland, asserts that three minutes after its disappearance a dull rumbling noise like distant thunder was heard. No one has given its position at beginning or ending with reference to the stars ; indeed it does not appear that any stars were visible, at least for the observers in eastern Ireland. For this reason it is quite impossible to compute its path. Judging by the vague descriptions of its direction, it was probably falling nearly vertically somewhere about the middle of Ireland, probably a little towards the west.

Three Large Sunspots

A CONSPICUOUS feature of present solar activity is the appearance on the disk at the same time of three large sunspots, each being visible to the naked eye. Foggy weather in London and elsewhere on November 28 provided almost ideal conditions for direct observation without a telescope, and a number of people, who were previously quite unaware of the existence of the spots, discovered them independently for themselves. From a photograph obtained at the Royal Observatory, Greenwich, on November 27, the following data are derived :

Date on Disk	Central Meridian Passage	Latitude	Area
Nov. 23–Dec. 5	Nov. 29·3	17° N.	1400
Nov. 23–Dec. 5	Nov. 29·4	11° S.	1000
Nov. 25–Dec. 8	Dec. 2·2	14° S.	1400

Areas are corrected for foreshortening and are given in millionths of the sun's visible hemisphere.

Under favourable conditions, a single spot of area 500 millionths may be detected without a telescope. Including the three present spots, nineteen naked-eye spots have already been recorded this year. Since the frequency curve of these large spots approximates closely to the more representative curve given by all spots or by their mean daily area, an even greater number of large spots may be expected in 1937–38, the epoch of the anticipated maximum of the present 11-year cycle.

The Night Sky in December

ON December $22^d\ 0^h$ the sun enters, at the winter solstice, the sign Capricornus ; in the latitude of London the nights are then $16\frac{1}{4}$ hours in duration. The moon is new on December 13 at $23\frac{1}{2}^h$ and full on December $28^d\ 4^h$ U.T. At new moon an annular eclipse of the sun is visible in the antipodes (local time December 14)—the central line, along which the duration of annularity is $5\frac{1}{2}$–$7\frac{1}{2}$ min., crossing

Australia and the North Island of New Zealand. Among the seven lunar occultations visible at Greenwich, the disappearance of *A* Tauri (mag. 4·5) may be noted on December 25 at $20^h\ 0{\cdot}9^m$ at 120° from the north point of the moon's disk. Of the planets visible, Venus is a conspicuous object (mag. −3·6 to −3·7) setting about $19^h\ 0^m$ in mid-December. On December $17^d\ 17^h$ the planet is in conjunction with the moon, below which it will be situated 6°. Mercury is not very accessible to observation, but may be seen during the last week of the year near the south-west horizon at 17^h. Mars rising after midnight is in Virgo; on December 21 it passes 3° north of the bright star, Spica. Saturn, in Aquarius, sets about 23^h in mid-December; on Dec. $20^d\ 19^h$ the planet is in conjunction with the moon, and on December 28 the sun will be in the plane of the rings, the minor axis of which is now about 2″. In addition to the planets, the skies offer at any time during a fine night in December an attractive field for observation. At 22^h in the middle of the month, the constellations of Cassiopeia, Perseus, Andromeda, Taurus and Aries are near the meridian, whilst the stars of Orion, Sirius, Procyon, Castor and Pollux are south-east and eastwards. The Geminid meteor shower should be looked for on or about December 11, the radiant point being at R.A. $7^h\ 12^m$: Dec. 33° N. The light variations of Algol may be observed at about December $1^d\ 0^h$: $3^d\ 21^h$: $6^d\ 18^h$: $18^d\ 5^h$: $21^d\ 2^h$: $23^d\ 23^h$: $26^d\ 20^h$ and $29^d\ 17^h$.

Announcements

THE Buchan Prize of the Royal Meteorological Society for 1937 has been awarded to Mr. C. S. Durst, for papers contributed to the *Quarterly Journal* of the Society during the years 1931–35.

THE Mozelle Sassoon High Voltage X-Ray Therapy Department of St. Bartholomew's Hospital, London, will be opened by Mrs. Meyer Sassoon on December 10 at 2.30 p.m., when Lord Rutherford and Lord Horder will speak. A memorial plaque to Dr. R. G. Canti, late clinical pathologist to the Hospital, will be unveiled by Dr. Malcolm Donaldson, director of the Cancer Department.

MESSRS. W. WATSON & SONS, LTD., of 313 High Holborn, London, W.C., are holding their fourth Annual Exhibition of Microscopes in the Central Hall, Westminster, on December 7–11. In connexion with the Exhibition, several cinematograph films will be shown, and the following lectures will be given: "Science and Vinegar Brewing" (Mr. Sarson); "The Romance of Shell Life" (Mr. F. Martin Duncan); "Old Instrument-makers" (Mr. R. S. Whipple).

DR. FRICK, the German Home Office Minister, has ordered that specimens of blood should be examined for the presence of alcohol according to Widmark's method in the case of persons apparently under the influence of drink when involved in motor accidents.

ACCORDING to the Soviet Union Year Book Press Service, the large Soviet Medical Encyclopædia has now been completed. It consists of 35 volumes, containing 6,396 articles and 80,000 terms used in medicine and allied sciences; 20 academicians, 692 professors and 1,006 other scientific workers have taken part in the production of the Encyclopædia under the editorship of Prof. N. A. Semashko.

THE Leningrad branch of the All-Union Institute of Experimental Medicine is collecting documents relating to the life and work of the late Prof. I. P. Pavlov. The documents are to be added to the collection already in existence at the Pavlov Museum founded by the Leningrad branch. A commission is approaching men of science and scientific institutions abroad for gifts of any material they may have in their possession relating to Pavlov.

WE are informed that the price of Osborn's "Monograph of the Proboscidea" is 20 dollars (NATURE, Oct. 31, Supp. p. viii, and Nov. 21, p. 860).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

Lecturer in mechanical engineering in the St. Helens Municipal Technical School—The Director of Education, Education Office, St. Helens (December 8).

Lecturer in mechanical engineering and lecturer in electrical engineering in the Norwich Technical College—The Principal (December 9).

Lecturer in mechanical engineering in the West Hartlepool Technical College—The Secretary for Education, Education Offices, West Hartlepool (December 9).

Temporary assistant engineers, engineering assistants and junior engineering assistants to the Ministry of Transport—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (December 11).

Junior research chemist for work on fuel problems at the Bone Research and Development Association, Ltd.—Prof. W. A. Bone, Imperial College of Science, S.W.7 (December 11).

Research physicist to the Printing and Allied Trades Research Association—The Director of Research, 10 Robin Hood Court, Shoe Lane, London, E.C.4 (December 21).

Chief mining engineer to the Safety in Mines Research Board—The Establishment Officer, Mines Department, Dean Stanley Street, S.W.1 (December 31).

Imperial economic botanist at the Imperial Agricultural Research Institute, New Delhi—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (January 2).

Professor of animal pathology in the University of Cambridge—The Vice-Chancellor (January 12).

Research physicist to the British Cotton Industry Research Association—The Director of Research, Shirley Institute, Didsbury, Manchester.

Principal of the Kadoorie Agricultural School, Mount Tabor, Palestine—The Chief Secretary to the Government of Palestine, Jerusalem.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 976.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Mechanism of Thermal Change in Gaseous Organic Compounds

INVESTIGATIONS in this laboratory have shown that thermal change in gaseous organic compounds commonly leads to the formation of paired products through a single chemical process, so that, although the rate of change in the reactant is determined solely by initial concentration and temperature, the relative rates of formation of the products may be determined by other conditions. In such cases the initial rates of reaction show acceleration, the $x - t$ graphs being linear, or curved towards the x-axis; but after a relatively short period the slopes of the graphs suddenly diminish. Further, the main process seems generally to be associated with a primary or *background process*, represented by,

$$A \rightleftharpoons B\ (+ C),$$

leading to equilibrium in the system A, B, (C).

The main process seems to be initiated by binary collisions AB, collisions AA, and generally also BB, leading only to change in the equilibrium system. The main process may be represented by,

$$\begin{array}{ccccccc} a & & b & & c & & d & & e \\ & & & & & & & & C \\ A + B & \rightarrow & A'B' & \rightarrow & A'B' & \rightarrow & A'B' & \nearrow\searrow & D \\ \text{Molecules} & & \text{activated state} & & \text{complex} & & \text{unstable intermediate} & & \text{paired products} \end{array}$$

The change $c \rightarrow d$ is such that the probability of reversal is very small, and it is the rate of this process which we generally measure. Since the products which are formed simultaneously may be, on one hand, products of condensation, and on the other, products of disruption of the reacting molecules, it is suggested that these survive as entities to the *unstable intermediate* stage, and that free radicals are not accountable for the processes involved.

Re-investigation of the data obtained by Dr. Hockin, Dr. Pearce and myself from the study of the thermal decomposition (550°–630°) of ethane, and of ethane – ethylene – hydrogen equilibrium mixtures, has thrown some light on the whole problem of the thermal changes in simple organic compounds. In both cases methane and condensation products are formed, but in the background of the processes which give rise to these products is the equilibrium reaction represented by,

$$C_2H_6 \rightleftharpoons C_2H_4 + H_2.$$

However, in this case the background reaction can be studied independently, and a great deal is known about it. Also, by working with ethane – ethylene – hydrogen equilibrium mixtures, we can virtually eliminate the disturbing effect introduced by the operation of the background reaction when working with pure ethane. It is possible to make up an unlimited number of mixtures in which the ratio $(C_2H_4)(H_2)/(C_2H_6)$ corresponds to equilibrium conditions at the temperature of the experiment, and using the computative method described in one of our papers[1], I have found that the rate of formation of the products, expressed in terms of the rate of disappearance of 2-carbon hydrocarbon, conforms to the expression,

$$d(CH_4 + R)/dt = K(C_2H_6)(C_2H_4),$$

with reasonable exactitude in the case of about a hundred experiments.

Starting with pure ethane, it is found that the initial rate of reaction is accelerated. This may be accounted for qualitatively by the fact that the ethylene concentration is increasing from the commencement. However, the acceleration is greater than can be accounted for in this way, and the fact that the break does not occur in the $x - t$ graph until some little time after the ethylene concentration has reached a maximum suggests that the acceleration may be partially due to some chain mechanism arising from the background reaction. After the break, the rate of reaction seems to conform to the bimolecular equation. The ratio $(CH_4)/(CH_4 + R)$ seems to vary between limits 0·5 and unity with the hydrogen concentration, but no quantitative relationship has been worked out. The bimolecular reaction involving ethane alone results only in the formation of ethylene and hydrogen, and the bimolecular condensation of ethylene, as studied by Pearce, seems to be a heterogeneous process.

The work carried out by Dr. Seddon and myself on acetaldehyde was that in which it was shown originally that the *paired products* may result from a single chemical process. They are methane and carbon monoxide, which constitute the main product when the reaction is conducted in an empty tube, and propylene, carbon monoxide, and water, which may constitute the main product when the tube is packed. The thermal decomposition process is accelerated initially; and, from analogy with the case just considered, it seems fair to associate this process with the development of a system represented by,

$$CH_3.CHO \rightleftharpoons CH_2{:}CHOH,$$

in the background. The constituents of the system are known, though nothing is known about their equilibrium relations.

The thermal decomposition of methyl nitrite has been studied by Mr. A. G. Carter and myself. Contrary to the conclusion of Steacie and Shaw, we find that the decomposition process shows strong initial acceleration, and that paired products result, the processes being represented by,

$$2\,CH_3NO_2 = 2\,NO + CH_2O + CH_4O, \text{ or}$$
$$N_2O + 2\,CH_2O + H_2O.$$

There is evidence here that the process must be bimolecular. However, though there is plenty of evidence to show that methyl nitrite does not behave like a normal ester, there is no evidence as to the nature of a background process, should such exist. The thermal decomposition of methylamine has been studied by Messrs. Bosanquet, Carter, Wilshire and myself, in continuation of the work of Emeléus and Jolley. Their work suggested that the two methods of decomposition represented by,

$$CH_3NH_2 = HCN + 2\,H_2, \quad \text{and}$$
$$CH_3NH_2 + H_2 = CH_4 + NH_3,$$

are related. We find further evidence in support of this view, and also that the processes are initially accelerated. The process represented by the first equation is definitely reversible, and it can be supposed that a background reaction operates in this case, though its nature is again unknown.

A similar mechanism must operate in the case of other gaseous reactions to which I have made reference in recent letters to NATURE.

We have also studied the thermal decomposition of certain 3-carbon compounds, but detailed analysis shows that the processes are extremely complex. One can, in such cases, express the rates of decomposition, if measured by observing increase in pressure at constant volume, by means of an equation analogous to that representing unimolecular change. Taking the two sets of results together, however, it seems to me that such procedure is likely to be much more misleading than helpful.

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Oct. 30.

[1] *J. Soc. Chem. Ind.*, **53**, 323 (1934).

Action of Co-zymase as the Specific Co-enzyme of Lactic Dehydrogenase from Heart Muscle

EARLIER work on the mechanism of enzymatic dehydrogenation has shown that, in presence of a thermolabile apo-dehydrogenase of protein character, co-zymase takes up hydrogen from a substrate and is thereby reduced to a dihydro-form[1]; the dehydrogenation of alcohol may be represented by the equation

$$\text{alcohol} + D^A\text{-}Co^{I} \rightleftharpoons \text{aldehyde} + D^A\text{-}Co_1H_2 \qquad (1)$$

where D^A is the specific alcohol apo-dehydrogenase and Co^I co-zymase. The apo-dehydrogenases are specific with respect to substrates and to one or other of the two known co-dehydrogenases, co-zymase (Co^I) or Warburg's co-ferment (Co^{II})[2]. Recently, we showed that lactic apo-dehydrogenase from heart muscle and alcohol apo-dehydrogenase from yeast are not identical, but both form active holo-dehydrogenases only with Co^I and not with Co^{II} [3].

Green and Brosteaux[4] have just confirmed our result that lactic dehydrogenase is not activated by Co^{II}, but have not decided whether the necessary co-dehydrogenase is identical with Co^I. Our earlier proof of the identity of lactic co-dehydrogenase with co-zymase, based on parallelism between fermentative and co-dehydrogenase activity, is confirmed conclusively by the following experiments, which show that alcohol co-dehydrogenase and lactic co-dehydrogenase are completely interchangeable. The identity of the former with co-zymase is quite certain.

(1) 2·0 ml. $M/2$ sodium lactate, 1·4 ml. $M/2$ disodium hydrogen phosphate and 0·1 ml. lactic dehydrogenase (D^L) from heart muscle (clear solution) were mixed in an absorption cell and the extinction (ε) at $\lambda = 334$ mμ was measured photo-electrically. After addition of 0·4 mgm. co-zymase, the extinction increased rapidly, corresponding with the formation of reduced co-enzyme (Fig. 1). Equilibrium was

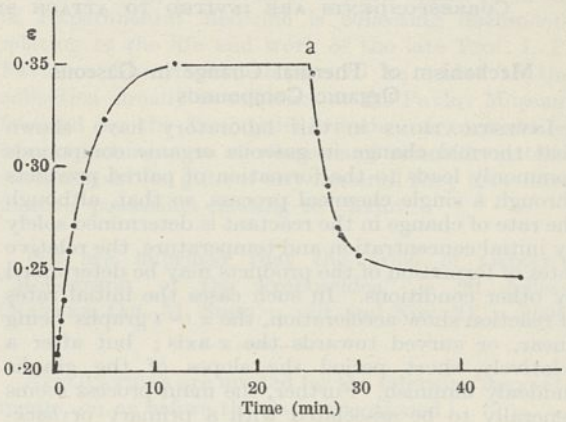

FIG. 1.

reached after 10 minutes. After a further 15 minutes, 0·1 ml. $M/10$ sodium pyruvate was added (a) which caused the extinction to fall rapidly to a value representing the absorption of the excess of pyruvic acid. This experiment indicates the reversibility of the process

$$CH_3.CHOH.COOH + D^L\text{-}Co \rightleftharpoons CH_3.CO.COOH + D^L\text{-}CoH_2 \quad . \quad . \quad . \quad . \quad (2)$$

The effect of pH and temperature on this equilibrium is being further investigated.

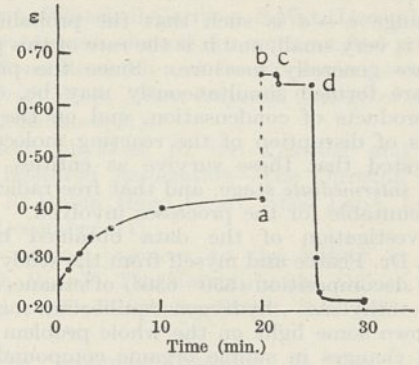

FIG. 2.

(2) In a similar experiment (Fig. 2), after production of the reduced co-enzyme, the mixture was heated (a) for 5 minutes at 75°, thus destroying the lactic apo-dehydrogenase. After filtration, the extinction of the clear filtrate was again measured (b). The increase is due to a displacement of the equilibrium by rise of temperature in favour of the reduced co-enzyme prior to destruction of the enzyme. No reaction occurred on addition of 0·1 ml. $M/100$ acetaldehyde (c), but on subsequent addition of 0·1 ml. alcohol apo-dehydrogenase from yeast (d),

the extinction fell immediately to the initial value. This action of acetaldehyde in presence of alcohol apo-dehydrogenase indicates that the reduced co-enzyme was identical with dihydro-co-zymase.

(3) In a mixture of 0·2 mgm. co-zymase, 0·3 ml. *M*/2 phosphate buffer *p*H=7·6, 0·1 ml. alcohol apo-dehydrogenase, 0·2 ml. absolute alcohol and 3·5 ml. water, dihydro-co-zymase was produced and recognized by its characteristic absorption at 334 mμ (Fig. 3). After attainment of equilibrium, the apo-

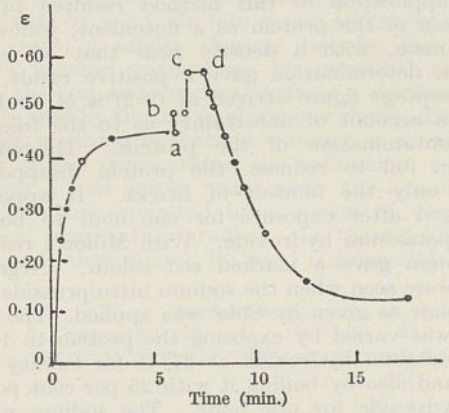

FIG. 3.

dehydrogenase was destroyed by heating (*a*); the extinction rose to (*b*) owing to a slight turbidity. Addition of 0·1 ml. *M*/10 pyruvate caused an immediate increase to (*c*), due to the pyruvate itself, but on further addition of 0·1 ml. lactic apo-dehydrogenase (*d*), the extinction fell by an amount representing the reoxidation of the dihydro-co-zymase. It follows that dihydro-co-zymase can act as the prosthetic group of lactic dehydrogenase in the reduction of pyruvic acid to lactic acid.

These three experiments show that the co-enzyme of lactic dehydrogenase is identical with that of alcohol dehydrogenase and therefore with co-zymase. The reduction of pyruvic acid to lactic acid in muscle glycolysis probably involves dihydro-co-zymase. Further details will be given elsewhere.

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H. v. EULER.
H. HELLSTRÖM.

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Oct. 23.

[1] Euler, Adler and Hellström, *Z. physiol. Chem.*, **241**, 239 (1936).
[2] Euler and Adler, *Z. physiol. Chem.*, **238**, 233 (1936).
[3] Adler and Michaelis, *Z. physiol. Chem.*, **238**, 261 (1936).
[4] Green and Brosteaux, *Biochem. J.*, **30**, 1489 (1936).

The Sterckfontein Ape

IN NATURE of September 19, Dr. R. Broom, of Pretoria, has given an account of the important discovery of a Pleistocene anthropoid skull at Sterckfontein, near Johannesburg, Transvaal, and has supplemented it simultaneously by a series of excellent photographs both of the site and specimen which have appeared in the *Illustrated London News*. In NATURE of October 24, p. 719, he has given a figure and description of the teeth. He maintains that the Sterckfontein specimen belongs to the same genus *Australopithecus*, although to another species, as the Taungs ape, and that both are hominoid, and not nearly related to any of the existing species of anthropoids.

In examining the cast of the Taungs specimen in the British Museum, and the photographs of the teeth published by various authors, notably by W. Abel[1], the conclusion could not be avoided that these teeth are not human at all but are more like those of the gorilla. As regards the skull of the baby specimen from Taungs, it shows features which are decidedly gorilloid. The concave profile of the face (taken to be chimpanzoid by Dart) can easily be explained by deformation, proof of which is the crack at the root of the nasals. The nasals themselves are fairly big, but appear smaller than they really are, because the lower end is broken off, and the nasal aperture therefore distorted. Other features which the skull has in common with the gorilla are the length of the brain case, and the fact that the suture between the maxillary and the zygomatic runs medially to the masseteric knob, whereas in the chimpanzee, for example, it runs laterally. The size of the Taungs ape is smaller than that of any recent gorilla of corresponding age. The Sterckfontein skull is that of an adult animal. Its size again is smaller than that of the existing gorilla. But this reduction in size is on about the same level as in the Taungs ape. The teeth figured by Dr. Broom are quite unlike those of man or of the chimpanzee. In both of these they are roundish in outline, and the heel of the last molar is shortened and the individual cusps more or less fused into a ridge. In the Sterckfontein skull, and in the gorilla, the cheek teeth are more rectangular in cross-section, and the last molar has a well-developed heel with two distinct cusps (and a postero-external style). The structure of this tooth in Dr. Broom's specimen can be matched by that found in a female gorilla from the Okuni district, South Nigeria (Brit. Mus. No. 7.1.8.4).

Dr. Broom has maintained that one of the most important features proving the affinity of *Australopithecus* and man was the fact that the lateral incisors of the upper jaw and the canines meet, a feature which he thinks does not occur in apes. This may be true in normal chimpanzees and gorillas. But it is not quite true in the pigmy chimpanzee (*Pan satyrus paniscus*) found south of the Congo, where the space between these two teeth has become very small indeed. This animal, as has been pointed out before, presents a case homologous to *Australopithecus*[2]. The small size, the dome-shaped forehead, the shortness of the face which is responsible for the crowding together of the teeth, are the same in both. It is, therefore, very probable that *Australopithecus* was a pigmy gorilla. From the relative size of the two specimens known and the smallness of the canine teeth, it appears that both were females.

The fact that Dr. Broom's specimen does not represent an ancestral form of the hominoid line does not detract from the extreme value of the discovery. It is to be hoped that he will be able to continue his researches, and to elucidate the history of anthropoids in Africa, an undertaking quite as important and interesting as that of the ancestors of man himself.

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Oct. 27.

[1] *Morphol. Jahrb.*, **65**, 539–640 (1931).
[2] *Ann. Mag. Nat. Hist.* (10), **13**, 583 (1934).

Enamel Protein

HUMAN dental enamel contains about one per cent organic matter[1], and it is well established on histological evidence that the structure of enamel consists of a mesh-work of organic matter in which inorganic salts (mainly calcium phosphate) are deposited in an orderly arrangement, resembling prisms. It is to be noted that newly formed enamel is covered with a layer of organic matter (Nasmyth's membrane), and also[2] that there is more organic matter in enamel near the junction with the underlying tissue, the dentine, than in that portion equidistant from the dentine and the surface of the tooth.

Fifty years ago Thompson[3], in describing human dental enamel, referred to "an organic matrix of horny matter, keratine", and it may be said that the organic matter associated with enamel has always been regarded as keratin. Most authorities agree in referring to keratins as proteins with a high sulphur content, although Block and Vickery[4] do not regard "a high proportion of cystine as necessarily characteristic of keratins". It has been stated that "the linkages binding sulphur into the protein molecule are uncertain"[5]; this uncertainty may be said to extend to organic substances containing sulphur, of which two new examples have recently been described by Mueller[6] and Baernstein[7]. It will be seen below that the presence of sulphur can readily be demonstrated in some keratins, but it may be said that the demonstration is incomplete so far as enamel protein is concerned. Rosebury[8], who recently published a detailed study of enamel protein, described it as "showing the chemical characteristics of keratin". In this work he used the lead test for labile sulphur, which, he says, "at best is not a delicate reaction".

In separating the organic material in enamel from the inorganic part, one of the difficulties with which I met was the scarcity of suitable human material. It was considered that biochemical methods of examination into the nature of this protein offered advantages over methods involving the use of stains and microscopy. One method of separation of the inorganic matter from the organic consists of reducing whole teeth to powder, then suspending the mass in a liquid of which the relative density is midway between that of the inorganic and the organic portions. This method was not continued as it was found that the density of the organic matter in dentine was too near that of the organic matter in enamel.

I took advantage of the fact that the inorganic salts of enamel are soluble in acetic acid, while the organic part appears to be insoluble. While this means of separating organic matter from inorganic has been found convenient, it is realized that the acid may have some action on the protein. For the purposes of the present work, it has been assumed that acetic acid does not dissolve organic matter from the dentine. This assumption is supported by histological evidence.

In an attempt to elucidate the nature of enamel protein, the following method was used: sound (non-carious) human teeth were scraped clean, dipped in 20 per cent nitric acid for a few seconds to remove surface contamination, and washed in distilled water. The roots were cut off and discarded, and any remaining pulp-tissue removed. The crowns were next exposed to the action of 10 per cent acetic acid as a decalcifying agent and agitated mechanically for twelve days. In this way the greater part of the enamel was removed from the dentine and appeared in the acid as a white powder, separation being aided by shaking with glass beads. The pieces of dentine were removed, and the white powder allowed to settle for 24 hours, when the bulk of the fluid was poured off and tested for protein with picric acid and with sulpho-salicylic acid, both with negative results. The powdery mass was next shaken up with distilled water and a few drops of nitric acid added. The enamel protein was thrown out by centrifuging, then washed and centrifuged several times until the washings appeared neutral to B.D.H. universal indicator.

The application of this method resulted in the separation of the protein as a flocculent, yellowish-brown mass, with a density near that of water. Nitrogen determination gave a positive result, but the percentage figure arrived at (9·2) is of doubtful value on account of uncertainty as to the freedom from contamination of the protein. Heated on platinum foil to redness, the protein disappeared leaving only the faintest of marks. It appeared unchanged after exposure for one hour to boiling strong potassium hydroxide. With Millon's reagent the protein gave a marked red colour. Negative results were seen when the sodium nitro-prusside test for sulphur as given by Cole[9] was applied. The procedure was varied by exposing the protein to 1 per cent potassium hydroxide at 37° C. for twenty-four hours, and also by boiling it with 25 per cent potassium hydroxide for one hour. The sodium nitroprusside test gave a negative result after both these forms of treatment. As controls, fragments of human nail, sheep's wool and horse hoof were exposed to acetic acid for ten days and then tested for sulphur by the nitro-prusside method, with a positive result in each case. Other reducing agents were used in attempts to reduce any cystine present to cysteine: tin exposed to hydrochloric acid, also zinc exposed to cadmium chloride then to hydrochloric acid. Both these reducing agents were used in place of potassium cyanide, but gave negative results. It was noticed, however, that when potassium cyanide was used as a reducing agent, the protein went into solution.

It is thought that it should be possible to get the protein in a pure form by the use of potassium cyanide followed by the use of dialysis. The observation that the action of potassium cyanide is to dissolve this protein may be contrasted with the negative results observed with the nitro-prusside method. It is thought that neither the acetic acid used to decalcify the teeth, nor the presence of calcium salts from the enamel or the dentine affected the result. Preliminary examination of the protein by Mr. W. T. Astbury using X-ray spectrography has suggested that the X-ray picture differs from that given by some keratins.

The organic material appears to be a protein containing tyrosin and resembling reticulin, and further work to determine its nature is in progress.

The work was carried out with the aid of a grant from the Medical Research Council, for which grateful acknowledgement is made.

PAUL PINCUS.

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[1] Bowes and Murray, *Biochem. J.*, **29**, 12, 2721 (1935).
[2] C. F. Bodecker, *J. Dent. Res.*, **6**, 2, 117 (1923).
[3] A. H. Thompson, *Amer. J. Dent. Soc.*, **20**, 433 (1887).
[4] Block and Vickery, *J. Biol. Chem.*, **93**, 1, 113 (1931).
[5] D. Jordan Lloyd, "Chemistry of Proteins" (London, 1926).
[6] J. H. Mueller, *J. Biol. Chem.*, **56**, 157 (1923).
[7] H. Baernstein, *J. Biol. Chem.*, **115**, No. 1, p. 25 (1936).
[8] T. Rosebury, *J. Dent. Res.*, **10**, 187 (1930).
[9] S. W. Cole, "Pract. Physiol. Chem." (Cambridge, 1933).

Thermal Stratification in Lakes

EARLY in this century, Thienemann[1] and Naumann[2] described the physical conditions in deep freshwater lakes in the temperate zone. They found a yearly cycle of events which depended on the thermal stratification of the water. Their findings, and the conclusions they drew from them, can be summarized briefly, as follows. In winter and early spring, the temperature and density of the water mass is almost uniform from the surface of the lake to the bottom, so that the viscosity of the water is the only hindrance to mixing by wind. In late spring and early summer this state of affairs changes because the surface layers become warmed up by increased radiation from the sun and conduction from a warmer atmosphere, and by the inflow of warmer rivers. The result of this warming is that, in summer, a warm upper layer of less dense water, the epilimnion, comes to lie over a cold deeper water mass, the hypolimnion. The two are separated by a region of very steep vertical temperature gradient, the thermocline, with the result that mixing by wind is impossible.

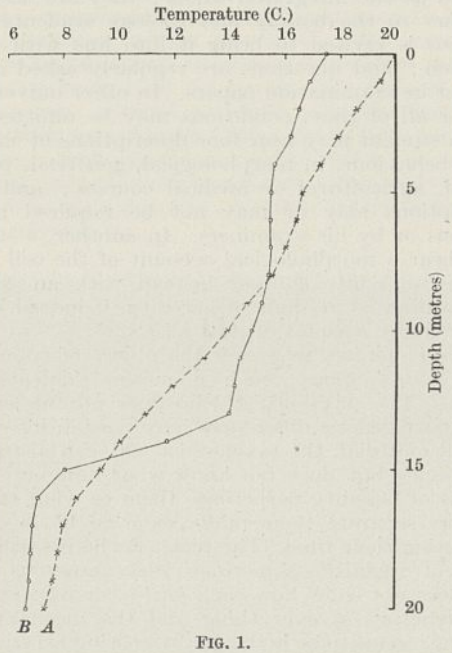

FIG. 1.

Since photosynthesis can only take place in the upper layers of the water, that is to say in the epilimnion, the available supply of salts for the planktonic algæ must be that which is dissolved in the water above the thermocline. Thus the continuous existence of the thermocline, with the consequent separation of the epilimnion from the hypolimnion, has important biological consequences, namely, the restriction of algal growth by limiting the salt supply. Thienemann and Naumann suppose that this state of separation exists continuously for the whole summer and well into the autumn, in fact throughout the period of maximal solar radiation. Consequently, the salt supply of the upper layers of water can first be renewed in late autumn, when the thermocline breaks down owing to the cooling of the epilimnion. Then free circulation is again possible, and water richer in salts from greater depths can reach the surface.

We have taken regular temperature observations in the north basin of Windermere extending over several months during the spring and summer of 1936. Our findings do not agree with those of the Continental workers, for the thermocline in Windermere, in this year at any rate, can be very unstable. It can appear and disappear in the course of a few days. Sometimes the state of affairs postulated as permanent by Thienemann and Naumann was found, but at other times there was a uniform temperature gradient from the surface to a depth of 20 metres without any trace of a thermocline. The presence or absence of a thermocline can be correlated with the weather. When it is calm there is no thermocline at all, but windy weather is always followed by the appearance of a region of sharp temperature gradient. The depth at which the thermocline appears depends on the strength of the wind; the stronger the wind the greater the depth. It can occur at any depth in Windermere from just below the surface down to 15 metres. After a thermocline has been formed during a period of active mixing by wind, it disappears again within two days if the weather becomes quiet.

In Fig. 1 the curve *A* represents the state of affairs during the period August 25–29, 1936, when the weather was uniformly fine and windless. Curve *B* obtained on August 31, 1936, at the same place, shows that a thermocline had been formed at a depth of 13–15 metres by a strong wind blowing on the intervening day, August 30.

Some of the factors which lead to the formation of the thermocline are not yet clear, and nearly all those concerned with its disappearance are still obscure. But the biologically important fact remains, that the thermocline is not a continuous feature of the summer conditions in temperate lakes. Sometimes it is not there at all, and when it appears the depth at which it occurs varies greatly. This must lead inevitably to a re-orientation of ideas about the biological productivity and the heat budgets of temperate lakes.

PHILIP ULLYOTT.
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Windermere.

[1] A. Thienemann, *Verh. naturhist. Ver. preuss. Rheinl.*, **70** (1913).
[2] E. Naumann, *Handl. K. Svensk. Vetenskapakad.*, **56** (1917).

The Half-Drill Strip System Agricultural Experiments

PROF. R. A. FISHER and Dr. Barbacki have recently published a paper in the *Annals of Eugenics* entitled "A Test of the Supposed Precision of Systematic Arrangements"[1]. There is a good deal in the paper with which I am not in agreement and with which I hope to deal elsewhere, but a letter from a friend of mine in Australia, who had heard at second-hand that Fisher's "results showed not only that the half-drill strip failed to give a valid estimate of error but was less accurate", shows that it would be better not to let such rumours get a start, for they are quite unfounded.

In the paper, the crop on a uniformly treated field was assigned to two imagined treatments *A* and *B* on a systematic plan in which eight strips of the width of a half-drill were assigned to *A*, and eight to *B*, in the usual arrangement of an eight

comparison half-drill strip experiment. Apart from the fact that one should have at least ten comparisons—in Beaven's original paper[2] there were 26—the representation is a fair one.

The authors, for the purpose of ascertaining the degree of precision which is obtainable from the systematic arrangement in question, have taken the weights of grain, not from the total area of each of the 16 strips, but from 12 sections of each strip, and have treated these 192 sections as if they were independent half-drill strips—in fact they have called them half-drill strips—and from the 96 comparisons they have calculated a standard error to represent the precision which they suppose an advocate of systematic arrangements would attribute to the method. But, of course, the sections of a half-drill strip are not in fact independent, and in this case are markedly correlated, so that the figure which they obtain is much too small to account for the observed difference between the *A*'s and the *B*'s—and they draw conclusions adverse to the systematic arrangement and not to their own method of calculation.

The procedure adopted, of dividing up the long strips, is that which Dr. Beaven[2] originally proposed in 1922, namely, weighing the sheaves off equal segments of his half-drill strips and calculating the error from these weights; but so early as 1923, I pointed out[3] that this method would probably give a fallaciously small value, and since then it has been customary to regard the whole length of the strip as the unit in the calculation.

Had Prof. Fisher and Dr. Barbacki calculated the error on that basis[4,5], they would have found a standard error of 2·37 per cent of the average yield, while the actual difference between the *A*'s and *B*'s amounts to 1·75 per cent; that is, the difference between two things which should be the same within the error of random sampling is in fact no more than 0·75 times the standard error.

The authors' practical demonstration of the correctness of my *a priori* reasoning is, of course, very gratifying to me, but I must nevertheless insist that their paper has no bearing whatever on the error of present-day half-drill strip experiments.

"STUDENT."

[1] Barbacki and Fisher, "A Test of the Supposed Precision of Systematic Arrangements". *Annals of Eugenics*, **7**, Part 2 (1936).
[2] Beaven, "Trials of New Varieties of Cereals", *J. Min. Agric.*, **29**, Nos. 4 and 5 (1922).
[3] "Student", "On Testing Varieties of Cereals", *Biometrika*, **15**, 286, 287 (1923).
[4] "Student", "Yield Trials". Baillère's "Encyc. Sci. Agric.", vol. 2 (1931).
[5] "Student", "Co-operation in Large Scale Experiments". *J. Roy. Stat. Soc.*, Supplement (1936).

Genetics in the Universities

THERE are two technically distinct branches of experimental biology: physiology and genetics. The first is concerned with the processes by which life is maintained and developed, the second with the determinants of these processes which are identifiable in heredity. The distinction between the two methods of analysis is convenient, but not of course rigorous; experimental embryology attempts to connect them. Across this subdivision cuts the much older one between botany and zoology. However difficult it may be to draw the line between plants and animals, in descriptive work it is clearly necessary to draw a line somewhere. But in experimental analysis it is not merely unnecessary; it is often destructive. This is perhaps not so true in physiology as in genetics, since there is a bifurcation in the method of development of plants and animals and even in the molecular structures used in their development. But this bifurcation begins outside the cell nucleus. Within the nucleus the distinction between plants and animals in structures both molecular and super-molecular to a great extent breaks down. Nuclear division and sexual heredity are the same in principle in the fly and the flowering plant.

This view of the unity of living things in their genetical aspects is so clear and important that it has been recognized by the British Association through the appointment of a committee to co-ordinate genetics and cytology in the different sections, and it is to be hoped that the confusion of the past will be remedied in this way. But it is in teaching that failure to recognize the unity of biology leads to the most serious confusion and failure of adjustment to modern changes. The universities present a surprising spectacle of variation in their methods of teaching genetics and cytology. In a few, the processes of heredity and their underlying mechanism are described as one integrated whole; they are described together to the botany and zoology students; the syllabus is revised to bring it into line with recent research; and questions are regularly asked on the subject in examination papers. In other universities, any or all of these conditions may be omitted. In one, a student may hear four descriptions of chromosome behaviour, in morphological, genetical, physiological, agricultural or medical courses; and these descriptions may or may not be required by his syllabus or by his examiners. In another, a student may hear a morphological account of the cell which he has to relate as best he can with an entirely unco-ordinated account of heredity, if indeed he has received any account of it at all.

In our opinion, whatever the object of training in botany or zoology, such a method defeats that object. The physiologist who does not understand what part genetic differences may play in his experimental material, the taxonomist who can distinguish his species but does not know what different mechanisms of heredity perpetuate them or what sterility barriers separate them, alike seem to be in danger of wasting their time. The teacher who describes the types of organism (sometimes very numerous types) and does not show how each varies, or who explains the structure of everything and the mechanism of nothing, seems to be in danger of wasting his students' time. Above all, he is likely to deter the most intelligent students from continuing their studies in what may appear to be a purely scholastic inquiry.

Teaching how meiosis works without ever arriving at its results in crossing-over and segregation, teaching *Drosophila* genetics without mentioning how the spores of fungi show the properties inferred in the sperm of *Drosophila*: throwing away, in a word, the glorious opportunity that genetics now offers us of uniting the sciences, seems to be the consequence merely of lack of co-ordination. Departmental independence in the universities should be accompanied by departmental co-operation. Uniformity between the universities is the last thing we want, but the student surely has a right to expect internal consistency. Is it too much to hope that the Boards of Studies which all over Great Britain will soon be considering their university courses should ask themselves, first whether their syllabuses represent the fundamentals that recent research can offer to the

intelligent student; secondly, whether the teaching of genetics and cytology is satisfactorily co-ordinated between the botanical and zoological sides; and thirdly, whether the questions set in examinations adequately cover the newer parts of the syllabus.

ERIC ASHBY, Bristol.
F. A. E. CREW, Edinburgh.
C. D. DARLINGTON, Merton.
E. B. FORD, Oxford.
J. B. S. HALDANE, London.
E. J. SALISBURY, London.
W. B. TURRILL, Kew.
C. H. WADDINGTON, Cambridge.

Nov. 9.

Vernalization of Winter Rye during Ripening

VERNALIZATION of winter rye by chilling, which normally is carried out during the germination of ripe grain, has been successfully applied during ripening while the ears remained attached to the parent plant. To this end each ear was placed in a boiling tube inserted in the neck of a vacuum flask containing ice. Thus the ear was not in direct contact with the ice and a fairly even temperature of 1°–1·5° C. was maintained within the tube. The ears were selected for treatment at various times after anthesis, and, after being kept for twenty-four days at a low temperature, allowed to finish ripening normally. Ears which were selected from the middle period of ripening alone produced grain which on spring planting proved to be vernalized. The control grain came from ears kept for a similar period in vacuum flasks without ice.

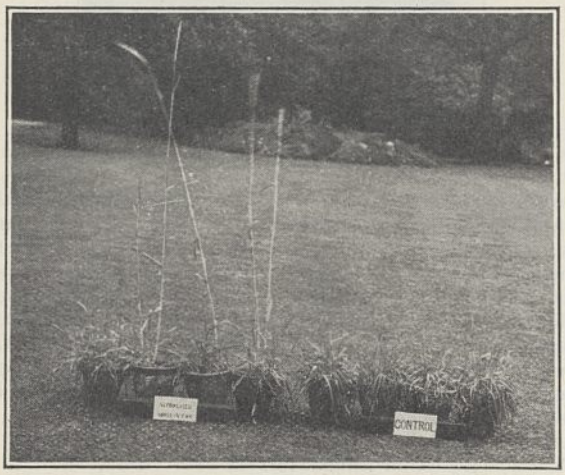

FIG. 1.

Ripening ears with stems and green leaves were also successfully vernalized after being detached from the plant. They were placed in water, and chilling carried out in a refrigerator at 1° C. for a period of six weeks. Control ears were ripened in a dark room at 17°–18° C. A photograph of plants grown from grain of chilled and unchilled ears is shown (Fig. 1).

Experiments are now in progress to find at which stage in the development of the embryo the application of cold is most effective.

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Sparking Potential of Mercury Vapour

THE sparking potential of mercury vapour between parallel electrodes previously degassed at about 750° C. has recently been measured in this laboratory throughout a large range of vapour densities, and the influence of the material of the cathode on the sparking potential has also been examined.

When the density of the vapour is expressed in terms of the corresponding pressure, p mm. of mercury, of a permanent gas at 17° C., and d is the distance in cm. between the electrodes, the sparking potential was found to be almost a linear function of the spark parameter pd from about 500 to 5,000 volts. The value of pd at the minimum sparking potential was 1, while at the highest vapour density used pd was 85 and the sparking potential was 5,000 volts.

The minimum sparking potential V_m was measured for a number of different cathode surfaces, and the values obtained are given in the accompanying table, where φ is, approximately, the work function of the cathode.

Cathode.	φ	V_m in volts.
Clean nickel	5	400
Clean 'Staybrite' steel	4·7	380
Nickel coated with a mercury film	4·4	305
Steel „ „ „ „	4·4	305

It is seen that large changes in the value of V_m were produced by small changes in the work function of the cathode surface.

A corresponding variation of the normal cathode fall with the work function of the cathode material has previously been noted[1]. With the highest values of pd, however, the sparking potential was practically independent of the nature of the cathode surface, and this result is in accordance with the general theory of the spark discharge[2]. At these high vapour densities, also, the spark time lag was very pronounced.

The large variation of V_m with the nature of the cathode surface affords strong evidence in support of the view that the cathode plays an important part as a source of electrons under the impact of positive ions; and that in mercury vapour this mechanism is of predominating importance in the production of the spark and in the maintenance of the discharge. In this respect mercury vapour differs from a typical diatomic gas like hydrogen[3]. However, this result does not necessarily exclude the possibility of the existence of the process of ionization by positive ions in collision with the molecules of mercury vapour which in fact has been detected[4] with ions of energies of about 700 electron volts, but it would appear that this process does not predominate over the electrode effect, especially at those densities which correspond to the minimum sparking potential.

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Department of Physics,
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[1] F. Köppen, *Z. Phys.*, **75**, 650 (1932).

[2] J. S. Townsend, "Electricity in Gases", Chap. ix and xi (1915); also L. B. Loeb, *Rev. Mod. Phys.*, **8**, 267 (1936).

[3] J. S. Townsend and F. Llewellyn Jones, NATURE, **130**, 397 (1932); and *Phil. Mag.*, **15**, 282 (1933).

[4] R. M. Chaudhri, *Proc. Roy. Soc.*, A, **141**, 389 (1933).

Auroral Phenomena and the Behaviour of the Ionosphere during a Total Solar Eclipse

FROM the appearance of very long auroral rays in the middle of the night, as described for the auroral display at Oslo of October 16 [see NATURE, Nov. 28, p. 930], it follows that the density of matter also during the night may decrease very slowly upwards.

This state is essentially due to the large number of free electrons present. On account of the high mobility of the electrons, the coronal structure of the upper atmosphere[1] produced on the day side will spread (diffuse) into the night region. This spreading process will counteract the night contraction and support the maintenance of 'a coronal distribution' on the night side of the earth.

In this way we may also account for the fact, shown by radio-echo measurements, that the reflecting layers maintain their conductivity and reflecting power during a total solar eclipse[2].

Thus the distribution of matter and the corresponding electrical state on the night side of the upper atmosphere which is revealed by auroral investigations enable us to understand certain essential features regarding the behaviour of the ionosphere during a total solar eclipse.

The spreading or diffusion process essentially effected by free electrons has also to be taken into account in any estimate of the rate of recombination from changes of ion concentration derived from radio-echo measurements.

L. VEGARD.

Physical Institute, Oslo.
Oct. 28.

[1] L. Vegard, "Die Korona der Erde und Sonne, etc.", *Gerlands Beiträge zur Geophys.*, **32**, 288 (1931).
[2] Cf. L. V. Berkner and H. W. Wells, "Report on Ionospheric Observations during Solar Eclipse of June 19, 1936". Presented to the Edinburgh Congress of the International Union of Geodesy and Geophysics.

Demonstration of Phosphorescence

THIS letter describes an interesting lecture experiment in connexion with phosphorescence. It provides a striking demonstration with apparatus of a simple character, and makes available a 'permanent' source of 'cold' light.

It is well known that most, if not all, materials that phosphoresce as a result of exposure to light are also fluorescent. This fact, coupled with the initial rapid decay of phosphorescence characteristic of phosphors, renders it difficult to appreciate visually the extent to which phosphorescence may be excited. Luminescent powders are commercially available which exhibit marked phosphorescence when illuminated by wave-lengths of three thousand to four thousand Ångström units, and the modern electric discharge lamp, in which a discharge passes through mercury vapour at approximately atmospheric pressure, provides a convenient source of these wave-lengths.

Phosphorescence resulting from irradiating the selected powder can be observed at a constant value, if it is continually re-excited and viewed for a short period while the radiation is discontinued. If it is observed immediately after irradiation, then the phosphorescence will have suffered little decay and will be near a maximum.

This effect can be secured very conveniently by rotating an opaque cylinder coated with phosphorescent material in front of a lamp radiating suitable wave-lengths. The side of the cylinder remote from the lamp is then a source of 'cold' light of quite high brilliancy.

The apparatus that has been constructed is illustrated in Fig. 1, and it consists of a Mercra 400 watt lamp provided with a special outer bulb functioning as a filter to pass only ultra-violet radiation between 3,000 A. and 4,000 A. Chances No. 14 is a good example of a suitable filter. The cylinder may be rotated at various speeds and may have a surface

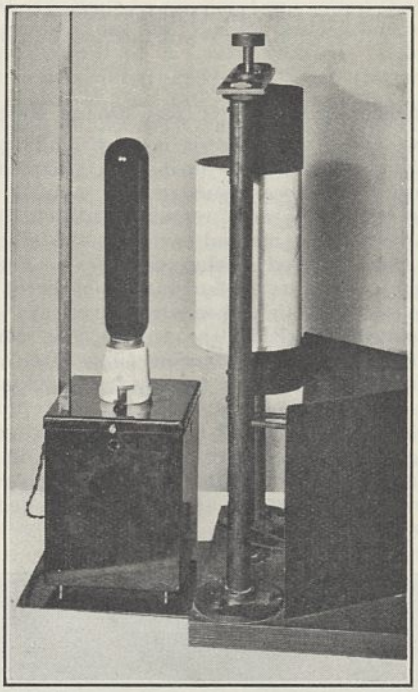

FIG. 1.

brightness of 10 equivalent foot-candles, and a total luminous output equivalent to that of a 1–1/2 watt tungsten filament lamp. In this connexion it is of interest to note that a road surface with a brightness of 0·5 equivalent foot-candles is considered to be illuminated to a fairly high standard, and one once again realizes the attractiveness of the (at present) impracticable suggestion to employ phosphorescent materials, excited during the daytime, on our road surfaces or surroundings.

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Diamagnetism of Mixtures of Organic Liquids

CERTAIN measurements of the magnetic susceptibility of binary mixtures of organic liquids made by us[1], which are at variance with the determinations of several investigators and which we have agreed are in error for reasons stated[2], are still being quoted in text-books and the literature.

We have now completed the remeasurement of the susceptibility of the binary mixtures under discussion, namely, acetone-chloroform, acetone-trichloroethylene, chloroform-ether, by the Gouy method[3] and find that the deviations of these

mixtures from the mixture law do not exceed 2–3 per cent except in the case of acetone-chloroform, where a maximum deviation of about 4 per cent is obtained : results which are substantially in agreement with those of our critics.

Since our new apparatus came into use, full details have been published for the mixtures of acetone and trichloroethylene[4]. Details of other binary mixtures of organic liquids are to be found in the same paper and in a further paper[5]. The general conclusions to be drawn from the values obtained for about fifteen series of binary organic mixtures of substances of varying chemical type are that, in common with other physical properties, (i) the magnetic susceptibility exhibits slight deviations from the mixture law for most binary mixtures of organic substances ; (ii) where the constitution and molecular weight of the constituents of the mixtures are similar the deviations are very small, rarely exceeding 0·5 per cent ; and (iii) where there is considerable difference in chemical constitution or mass the deviations are slightly larger, about 1–4 per cent. When, however, molecular susceptibilities are compared, the deviations are much smaller, rarely exceeding 0·1 per cent, and thus come into line with the deviations of other physical properties from the mixture law.

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V. C. G. TREW.

Physical Chemistry Laboratory,
Bedford College, N.W.1.
Oct. 31.

[1] *Proc. Roy. Soc.*, A, **131**, 209 (1931).
[2] NATURE, (Jan. 16, 1932).
[3] Trew and Watkins, *Trans. Far. Soc.*, **30**, 1310 (1933).
[4] Trew and Watkins, *loc. cit.*
[5] Trew and Spencer, *Trans. Far. Soc.*, **32**, 701 (1936).

Centrifuging in Rotating Hollow Cylinders

PROBLEMS in particle size analysis in disperse systems may be divided in general into two classes, namely, those involving the determination of the size or molecular weight of particles comprising the disperse phase of a monodisperse system, and those involving the determination of the particle size distribution function for the disperse phase of a polydisperse system.

Dr. M. Schlesinger has described[1] a most ingenious method for determining the molecular weight of units of the disperse phase in presumably monodisperse systems. The method employs the Sharples super-centrifuge run with a 'closed bowl'. Using the Sharples super-centrifuge with a continuous flow or separator bowl, we have been able to obtain sufficient data for the calculation of the particle size distribution curve in such polydisperse systems as colloidal clays, all particles of which have equivalent spherical diameters substantially below 500 mμ.

Our method, which was presented before the thirteenth Annual Colloid Symposium in St. Louis, on June 11, 1936, involves feeding at a constant rate a suspension of known concentration and temperature into the centrifuge bowl, which rotates at constant speed. As the suspension flows through the bowl, there is a partial sedimentation of the particles of the disperse phase on to a removable celluloid liner flush with the walls of the bowl. After a suitable amount of suspension has flowed through the bowl, the operation is discontinued and the liner containing the sediment withdrawn. At definite distances along the liner, the sediment is quantitatively removed and weighed. From this data the particle size distribution curve may be calculated. As it is unnecessary to settle out the disperse phase completely, the effluent liquid, while reduced in concentration in disperse phase, may still contain some disperse phase, depending on the rate at which the suspension is fed into the bowl during the run.

This method, which will be published in detail in the volume reporting papers at the 1936 Colloid Symposium, as well as in a forthcoming issue of the *Journal of Physical Chemistry*, is particularly useful when it is desired to make a particle size fractionation of some polydisperse system ; for example, when it is contemplated studying the influence of the particle size variable upon other properties of the colloidal sol. We have developed it in particular for use in determining the influence of particle size on thixotropy and rheopexy of suspensions of the colloidal clay bentonite.

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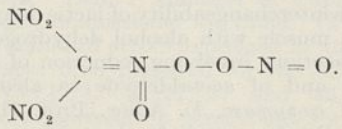
Oct. 20.

[1] NATURE, **137**, 549 (Sept. 26, 1936).

Constitution of Tetranitromethane

IN a "Research Item" in NATURE of November 7, p. 807, attention is directed to the question of the constitution of tetranitromethane. Instead of the usual symmetrical formula, it is suggested that the substance is to be represented by the expression :



The arguments[1] have been reproduced so recently in NATURE that it is unnecessary to repeat them, but they appear to be fallacious for the following reasons : It is said that the symmetrical formula does not explain the oxidizing properties of the substance, but this statement fails to take into account the strong inductive effect of the nitroxyl groups. The molecule as a whole must be powerfully cationoid and electron-accepting, as indeed is shown by the colorations produced when tetranitromethane is dissolved in anionoid solvents without decomposition. But furthermore, the $C(NO_2)_3$ group must be that substituted methyl group with the greatest general electrical effect (electron-attracting) and it will excel in this respect even the groups CF_3 and CCl_3. It is therefore not at all surprising that the compound $C(NO_2)_3.NO_2$ simulates peroxidic character and is very readily reduced.

A perfectly analogous case is that of carbon tetraiodide, which is very readily reduced to iodoform, and in this case a special constitution would be difficult to devise. Again, it is said that one of the nitro groups of tetranitromethane is markedly different from the others in its reactions, but it should be remembered that when this first nitro group has been removed, the substance is no longer tetranitromethane. It has acquired the hydrogen atom necessary for

transition into the *iso*nitro form. The final and conclusive argument in favour of the formula $C(NO_2)_4$ and against the proposed revision is provided by the fact that tetranitromethane has a very small dipole moment[2].

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[1] C. Krauz and J. N. Stěpánek, *Chem. Obzor.*, **11**, 153 and 177 (1936).
[2] J. W. Williams, *Phys. Z.*, **29**, 204 (1928); E. Bretscher, *Helv. phys. Acta*, **1**, 355 (1928); A. Weissberger and R. Sängewald, *Ber.*, **65**, 701 (1932).

Nicotine Inhibition of Oxidation and Fermentation

IN a recent letter to NATURE[1], I have reported some observations on the more powerful inhibition of various oxidations in micro-organisms by *dl*-nicotine as compared with the *l*-form. Such results are regularly obtained when *dl*-nicotine prepared according to the method of Pictet and Rotschy is used; this preparation is relatively more efficient than the natural form. But optically pure *d*-nicotine later prepared by us lacked these properties. It was therefore concluded that some active principle always present in the racemic preparation is responsible for the observed effect. This principle has been isolated and identified as hydronicotine. Further, when we hydrogenized nicotine in two different ways and tested these preparations, we actually observed much stronger inhibition of oxidation in micro-organisms, as compared with nicotine, but no specific effect on fermentation processes. It is therefore concluded that hydronicotine and not the *d*-form is responsible for the biological effects described in my previous communication. Investigations along this line are in progress.

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Zoological Institute,
University, Moscow.
Oct. 28.

[1] NATURE, **138**, 245 (1936).

Points from Foregoing Letters

To explain the mechanism of certain thermal reactions in gaseous organic compounds, Prof. M. W. Travers assumes a series of transformations: molecules → activated state → complex → unstable intermediates → paired products, and states that the rate of reaction usually measured is determined by the transformation complex → unstable intermediates. He discusses the thermal decomposition of ethane and of ethane-ethylene-hydrogen equilibrium mixtures, and refers to the thermal decomposition of acetaldehyde, methyl nitrite and methylamine.

From the interchangeability of lactic dehydrogenase from heart muscle with alcohol dehydrogenase from yeast, in reactions involving reduction of pyruvic to lactic acid and of acetaldehyde to alcohol *in the presence of co-zymase*, E. Adler, Prof. H. v. Euler and H. Hellström conclude that co-zymase is the active co-enzyme for both those specific oxidation-reduction agents.

From an examination of the cast of the Taungs ape in the British Museum (Natural History) and of the photographs of the skull and diagrams of the teeth of the Sterckfontein ape recently described by Dr. R. Broom, Dr. E. Schwarz concludes that the animals to which they belonged were not in the direct ancestral line of man but were more nearly related to the gorilla.

Preliminary results of an investigation into the nature of the protein by Dr. Geo. Pincus in the enamel of teeth indicate that it contains no sulphur, though it has hitherto been believed to be a keratin. Its X-ray picture also differs from that of some keratins, and it appears to contain tyrosin.

Graphs showing temperature gradients in the north basin of Windermere during calm and in windy weather, in spring and summer, are submitted by P. Ullyott and P. Holmes. Unlike the conditions described by other investigators for lakes in the temperate zone, the authors find no *permanent* region of sharp temperature change (thermocline) separating an upper warm layer from a lower cool one; they find the thermocline only during windy weather, and then it may occur at any depth down to 15 metres.

Following an inquiry into the split-drill method of testing cereal varieties applied to data obtained by Wiebe on the yields of wheat, Barbacki and Fisher concluded that "the arrangements randomizing either pairs or sandwiches of half-drill strips give smaller errors than the systematic arrangement" advocated by "Student". Commenting upon this, "Student" considers the criticism unwarranted and states that although Barbacki and Fisher's arrangement is a fair example of half-drill experiment, their method of calculating the error was one which he had expressly rejected in 1923.

A group of leading workers in experimental biology discusses the teaching of genetics in the universities, and advocates greater co-ordination of genetics and cytology on the botanical and zoological sides than at present exists.

Prof. F. G. Gregory and O. N. Purvis report that they have successfully 'vernalized' winter rye by keeping the ears of the rye at a low temperature (1°–1·5° C.) for twenty-four days during the ripening of the parent plants.

The sparking potential of mercury vapour is found by Dr. F. Llewellyn Jones and W. R. Galloway to be almost directly proportional to the 'spark parameter' (pressure × distance), over a wide range of vapour densities. The authors give the minimum sparking potential at different cathode surfaces (nickel and steel, clean and mercury coated) and discuss the process of formation of ions.

A simple apparatus for the demonstration of phosphorescence is described by H. Warren. It consists of a rotating cylinder coated with the phosphorescent substance and exposed on one side to exciting radiation.

As a correction to some of their previous findings, Prof. J. F. Spencer and Dr. V. C. G. Trew state that they have redetermined the magnetic susceptibilities of mixtures of acetone-chloroform, acetone-trichloroethylene, and chloroform ether and find that the maximum deviations from the mixture law is about 4 per cent.

Research Items

Origins of Speech and the Orang-Utan

DR. CORNELIUS J. CONNOLLY, professor of physical anthropology in the Catholic University of America, as the result of a study of the brains of fifty species of primates from the lemur to man in the primate brain collection of the Smithsonian Institution, Washington, D.C., claims to have found in the cerebral cortex of the orang-utan the first rudiments of the brain structures of speech (*J. Physical Anthrop.*, Oct. 1936). It is believed by neurologists that the associative process, which with the power of making articulate sounds constitutes the essential element in human speech, is centred in that part of the cerebral cortex known as Broca's area, found in both frontal lobes of the brain, and set off from the rest of the brain by well-marked depressions, the inferior frontal sulci. This area is now found to appear first among the primates in the orang. Absent in the gibbon, it is more emphatically marked in chimpanzee and gorilla. The sulcus subdividing the inferior frontal region, on the other hand, is exclusively and constantly human, never appearing in the anthropoids; but there is evidence of it in *Pithecanthropus* and Neanderthal man. It is possible that the exclusively human *V*-shaped area of the cortex enclosed by this sulcus may be that in which the association between sound and objects, making symbolism possible, takes place. So far as surface pattern of the cortex is concerned, the orang and two higher apes appear to have stopped on the threshold of speech. A second point emerges from the study of thirty-five orang brains of both sexes and various ages. This shows that while the principal sulci are present in all from birth and are standardized, there is greater variability in the pattern of the secondary channels in the orang than there is in either of the other great apes. As the sulci divide functional areas of the cortex, it would seem that the brain of the orang is possibly capable of further development.

Roding of the Woodcock

THE habit of the woodcock of flying over definite tracks at dusk and in the morning during the breeding season has been investigated by T. Warwick and V. D. van Someren (*Scot. Nat.*, 1936, p. 165). A particular pair of birds developed four roding circuits, varying in length from one to three miles and used with different frequencies. The flights, which took place irrespective of the kind of weather, lasted for almost an hour beginning about 9 p.m. and might include so many as thirteen circuits. Both birds occasionally flew together, but most often the male was unaccompanied. The rate of flight was approximately twenty miles an hour, and it was noticeable that as darkness fell the length of time taken to complete a particular circuit increased. The purpose of the roding habit is obscure: each circuit followed a line on which one or more marshy feeding places occurred, and when another woodcock was encountered the roding flight was interrupted while the interloper was driven off. The authors accordingly regard roding, since the woodcock is not a song-bird, as having an aggressive basis and as delimiting the territory by regular patrolling. It is unfortunate that the position of the nest relative to the system of roding flights was not definitely determined.

Resistance of Fish to Supercooling

EXPERIMENTS on the effect of low temperatures on live fish have so far shown that death follows cooling to about − 1° C. It was not clear whether death was due to the conversion of body fluids into a solid state, or whether the low temperature by itself had a fatal effect on living cells. To decide this question, P. J. Schmidt and his collaborators have investigated the result of keeping fish in supercooled water (*C.R. Acad. Sci., U.S.S.R.*, 3, No. 6; 1936). The authors succeeded in supercooling the body fluids, for a prolonged period, to a temperature more than 2° below their normal freezing point. The experiments proved that fish can stand supercooling even to − 3·06° C. if no crystallization of the surrounding water or of the body fluid occurs. This suggests that fish perish mainly from the effects of ice forming within the body, and not from the effects of low temperature. Such powers of resistance to supercooling should be of biological significance for fishes, since cases of supercooling of water occur in natural conditions. The phenomenon can be interpreted as a true anabiosis, if the latter is defined as a depression of life by the elimination of water from living matter, so that a complete cessation of life-processes results.

Standard Errors of Mendelian Ratios

TABLES of standard errors of Mendelian ratios have been worked out by Messrs. S. S. Purewal and P. K. Rao (Misc. Bull. No. 11, Imperial Council of Agric. Research, 1936. Delhi: Manager of Publications; London: High Commissioner for India. 12 annas or 1*s.* 3*d.*) The standard errors expressed in numbers of individuals have been prepared for the ratios 1 : 1, 3 : 1, 9 : 7, 15 : 1, 13 : 3, 27 : 37 and 63 : 1, and standard errors expressed in percentages for the 1 : 1 ratio. The tables give the standard errors for values of n from 5 to 1,000 and can be used for numbers up to 100,000. A deviation greater than twice the standard error is considered significant. These tables should be useful for geneticists and plant breeders.

The Temperature Scale

WHILE the final standard scale of temperature is Kelvin's thermodynamic scale, independent of the properties of any particular substance, it is on the properties of gases that we have to depend for the practical realization of the scale in certain low and certain high temperature ranges. An examination of the properties of hydrogen, nitrogen and carbonic acid then available led Daniel Berthelot in 1907 to conclude that the coefficients of expansion and of pressure of a perfect gas and of actual gases at very small densities were 0·0036618, from which it follows that the temperature of freezing water on the Kelvin scale is 273·09° K. Much accurate work on helium and the above gases has been done in the last thirty years, and from a consideration of it Prof. Keesom and Dr. W. Tuyn, in a communication from the Kamerlingh Laboratory of Leyden (Supplement No. 78), come to the conclusion that a more accurate value of the coefficient is 0·0036611, from which it follows that the freezing point of water is 273·14° K.

Velocity of Radio Waves

MOST of the measurements being made at the present time on the ionosphere are based on the assumption that radio waves travel with the velocity of light. The paper by R. C. Colwell, N. L. Hall and L. R. Hill, which appears in the *Journal of the Franklin Institute* of November, on the experimental determination of the velocity of radio waves, is therefore a timely one. The experiments were made between West Virginia University and Fairmont State College, which are 20 kilometres apart. A continuous train of very short radio pulses from the sending station travel to a receiving station, where their phase is adjusted so that a pulse starts back the instant it is received. Synchronization between the transmitting and sending station is automatically obtained, as they are both supplied from the same 60-cycle power network. The observations so far obtained indicate that the velocity of the ground waves varies between one half and two thirds the velocity of light. The experiments give no indication of the velocity of sky waves. To obtain measurements of these, it would have been necessary to have a second radio station on a stratosphere balloon. It is concluded that the velocity with which radio waves travel along the ground is considerably less than that of light. This reduction in the velocity is attributed to the influence of the conductivity and dielectric constant of the earth and to the ionization of a certain layer of the atmosphere. The authors also conclude that the velocity of ground waves is not constant, and that the strength of ground waves varies during periods of atmospheric disturbance. On one occasion, the received signal was four times normal strength, and during this period the measured velocity was a minimum.

'Lumophor' Glass for Tubes containing Luminous Gases

RECENT researches on 'lumophor' glass, that is, glass for use in making the tubes containing luminous gases, has led to the discovery of much more effective materials for making these tubes. A brochure recently published by Glaswerk Gust. Fischer, Ilmenau, Thuringia, gives many technical calculations and measurements on the efficiency of various types of lumophor glasses. An abstract of it is given in the November number of *Helios*, the electrical export trade journal published in Leipzig. It is found that the brightness of the tube increases very appreciably with the current taken by it, but the luminosity in lumens per watt shows its maximum value with a small tube current. The characteristics shown by the various types of lumophor glasses are all of a similar nature. Interesting data are given on the influence of external temperatures from − 60° to + 220° C. on the light intensity. It is known that luminous tubes for blue light burn differently according to the external temperature even when filled with a mixture of rarefied gases having high resistance powers against cold. This dependence is more pronounced when lumophor glasses are used. In this case, the luminous colour results from the radiation from the mercury vapour and the radiation of the luminescence of the glass walls. The experiments made with a photo-cell and the measurements show that the light intensity throughout the medium temperature range, which coincides with the surface temperature range, has the maximum value. At temperatures exceeding 220° C., No. 1 lumophor glass loses its pure white colour and assumes a greyish-white tint. At 0° C. the colour becomes duller as the pressure of the mercury vapour decreases. The light blue tube No. 2 shows a violet colour at − 40° and above 135° becomes a greyish-white. Owing to 'fatigue' of the glass, the light emitted falls 30 per cent in the first two hours and then remains constant, even after the lapse of 3,400 hours. Switching the tubes off invariably leads, on relighting, to an increase in luminescence.

A Co-ordinated Cuprous Complex

IN the most stable derivatives of cuprous copper, the co-ordination number appears to be 4, for example, in $K_3[Cu(CN)_4]$. It is found (F. G. Mann, D. Purdie and A. F. Wells, *J. Chem. Soc.*, 1503 ; 1936) that cuprous and silver iodides form compounds with tertiary phosphines and arsines analogous to the well-known non-ionic aurous chloride derivatives $[R_3P(As) \rightarrow AuCl]$. The cuprous compound would be expected (for 4-co-ordinate copper) to be $[(PR_3)_3CuI]$, analogous with $K_3[CuI_4]$. In this compound the copper is joined by three co-ordinate and one covalent link, giving the 7 electrons which the copper requires to attain the electronic structure of krypton. This suggests that the 2-co-ordination compound, $[R_3P \rightarrow CuI]$, should be very unstable, whilst actually many members of the phosphine and arsine series are very stable. X-ray analysis of the arsine compound shows that the true molecule actually consists of four simple units, $[Et_3As \rightarrow CuI]_4$. In this molecule, the four cuprous atoms are arranged at the apices of a regular tetrahedron : the four iodine atoms lie each at the centre, but above the plane of, one face of the tetrahedron. Beyond each cuprous atom is an arsenic atom lying on the elongation of the axis joining the centre of the tetrahedron to the copper : the three ethyl groups are then joined to each arsenic atom so that the tetrahedral angle is subtended both at the arsenic and at the first carbon atom of the ethyl groups. The stability is conferred by each iodine atom, in addition to being covalently linked to its original copper atom, also becoming joined by co-ordinate links to the other two copper atoms of the same tetrahedral face. Each copper atom acquires 7 electrons and is identical, in both co-ordination number and electronic structure, with that in $K_3[Cu(CN)_4]$. Interesting derivatives with $\alpha\alpha'$-dipyridyl were also prepared.

Orionid Meteors

MOHD. A. R. KHAN, of the Osmania University, Hyderabad, Deccan, observed the Orionids from October 18 until 21, a total of 124 being recorded in the four nights. He has deduced a radiant at 93·7° + 14° by combining the observations over the period. It would have been better, if possible, to have used the results for each night separately, as the radiant moves eastward from night to night. Mr. J. P. M. Prentice discusses this matter in *Memoirs of the British Astronomical Association* (Report of the Meteor Section), May 1936. He concludes, after careful study of this shower, that the radiation comes from three sharply defined centres situated at close intervals in declination + 15°, and that these three centres move approximately 1·3° (small circle) each day.

Anniversary Meeting of the Royal Society

SIR WILLIAM BRAGG delivered his presidential address to the Royal Society on November 30, opening with the customary record of the losses by death of the Society during the past year. These have been unusually heavy, for they have included the Society's patron, H.M. King George V, two foreign members and no less than twenty-one fellows. Reference was made to recent gifts for research to the Universities of Oxford and Cambridge, and to the fact that the Society has undertaken a principal share in the administration of £200,000 bequeathed by the late Mr. H. B. Gordon Warren, the interest of which is to be applied to the encouragement of research in metallurgy, engineering, physics and chemistry. The capital value of the funds administered by the Society, including the Warren bequest and also the bequest of about £40,000 by the late Sir Joseph Petavel, is now approximately a million sterling. Surveying some developments of the past few years in the light of the research which has made them possible, Sir William said: "From this point of view the suggestion sometimes made that scientific workers might take a holiday looks more ridiculous than ever. No nation could afford such an intellectual disarmament in the face of the world; nor could the world itself in face of the evils that are to be overcome." There is the danger, however, that research funds may inadvertently lead a man into a blind alley so far as useful occupation is concerned; it should be the business of bodies administering such trusts to see that the highly qualified men they utilize are not wasted when their active research has ended. The address concluded with a discussion of recent developments in the field of the X-ray analysis of crystalline structure (see p. 953).

Sir William Bragg then presented the medals for 1935; extracts from his remarks are printed below.

PRESENTATION OF MEDALS

Copley Medal: Sir Arthur Evans, F.R.S.

Sir Arthur Evans is awarded the Copley Medal. He is the leading British authority in classical archæological studies: from his father he inherited a predilection for numismatics, a subject to which, in his earlier years, he made contributions of outstanding importance. His researches in Crete from 1893 onwards resulted in the discovery of the remains of a civilization which he named Minoan after the sea-king, Minos. He traced the development of the Minoan civilization from approximately 3200 to 1400 B.C., from the late Neolithic through the Bronze Age. His Cretan work, published in six volumes, "The Palace of Minos", has revolutionized our knowledge of the ancient history of the Near East.

Rumford Medal: Prof. E. G. Coker, F.R.S.

The Rumford Medal is awarded to Prof. Ernest George Coker, who has devoted a lifetime to the investigation of stresses in solids by means of polarized light. The original effect was discovered by Brewster in 1815, and Brewster himself suggested that the effect might be used for the direct exploration of stress. But although many physicists since Brewster's time investigated the effect, no one, until Coker came, developed a practical method enabling stresses in a model to be actually traced. Coker not only applied to such researches a material, celluloid, not hitherto employed, and capable of being cut to any shape, but he was also the first to devise a reliable instrument (the lateral extensometer) for measuring at any point the sum of the principal stresses, which is not directly given by the optical results. In many other ways, he made very important improvements in methods of observation, and he has, in fact, created a new technique and given the engineer a new instrument of discovery. His work is only now beginning to be recognized and taken up by the engineer.

Coker's first paper on this subject dates from 1910; since then he has published, either alone or with pupils and colleagues, some fifty or sixty papers, in which he has applied the method to almost every important engineering problem which can be approximated to on two-dimensional lines. In the course of his work, not only has he cleared up a vast number of problems and difficulties, but he has also rendered a great service to applied mathematics, by demonstrating to the engineer the substantial accuracy of the results of the mathematical theory of elasticity.

Coker's work fulfils admirably the condition laid down for the Rumford Medal which says that the discoveries for which it is awarded should be such as "tend most to promote the good of mankind". The results obtained by photo-elasticity in such subjects as the stability of dams and the strength of aeroplane frameworks will certainly be the means of saving many lives. Moreover, Coker has created a world-wide school: to his inspiration is largely due the modern development of photo-elastic laboratories in Japan, the United States, Belgium, Switzerland and Russia.

A Royal Medal: Prof. R. H. Fowler, O.B.E., F.R.S.

A Royal Medal is awarded to Prof. Ralph Howard Fowler. His general theory of statistical mechanics, his later applications of it to the equilibrium of mixed crystals and to a theory of semi-conductors, are of outstanding importance. His paper on dense stellar matter contains the first working out of the properties of a degenerate electron gas, and those on the internal conversion of γ-rays and on thermionic emission and stray field emission of electrons from metals were fundamental. His work on the theory of the photo-electric effect, especially as a function of temperature, led to a rational means of analysing emission frequency curves, which enables one to determine the true threshold frequencies. His work on the quantum theory of energy exchange between gases and solids broke new ground. Further, he has made notable contributions to the theory of the photo-electric current in semi-conductors, and has made notable contributions in recent years by his adaptation of wave mechanics, as it has been developed, to the solution of problems actually under investigation by groups of experimentalists working in close association with him.

A Royal Medal: Prof. E. S. Goodrich, F.R.S.

A Royal Medal is awarded to Prof. Edwin Stephen Goodrich. He is distinguished for his long series of researches on the comparative anatomy, embryology and palæontology of invertebrates and vertebrates, which have thrown light on some of the most fundamental problems of animal morphology. His work on the excretory organs of annelids and of *Amphioxus* resulted in a new conception of the nephridia and their relation to the cœlom and cœlomoducts. His memoirs on scales of fishes and on the median and paired fins threw fresh light on the classification and phylogeny of fishes and on the evolution of the vertebrate skeleton. His contributions to our knowledge of the segmentation of the vertebrate head are recognized as of the first importance. His volume on cyclostomes and fishes in Ray Lankester's "Treatise on Zoology" and his more recent book, "Studies on the Structure and Development of Vertebrates", are masterly and original contributions to the subject of comparative anatomy. In the opinion of many he is the outstanding morphologist of our time.

Davy Medal: Prof. W. A. Bone, F.R.S.

The Davy Medal is awarded to Prof. William Arthur Bone, who has had a wide and varied experience in the main branches of chemical science. His early work on the alkyl substituted succinic acids and allied substances, which furnished a valuable chapter in synthetic organic chemistry, was speedily followed by more fundamental researches on the thermal decomposition of hydrocarbons and their oxidation products and by quantitative studies of hydrocarbon combustion. The evidence collected during these prolonged and systematic investigations, devised to include a great variety of experimental conditions of slow combustion and detonation, was overwhelmingly in favour of the hydroxylation theory of the combustion of hydrocarbons. His study of the direct union of carbon and hydrogen led to a synthesis of methane from its elements.

The closely related problem of flame movements in mixtures of burning or exploding gas has been submitted by him to exhaustive examination with improved methods, which made it possible to observe for the first time some striking characteristics of this phenomenon.

On the subject of catalysis, Prof. Bone's contributions are of especial interest and importance. Thus he has recently demonstrated by a variety of convincing experiments that carbonic oxide and oxygen will unite in the gaseous phase in the absence of moisture.

In collaboration with many colleagues and students, Bone has investigated the difficult problem of the chemistry of coal and has applied new physical and chemical methods of identifying the constituents of this complex material. The benzenoid constitution of coals of widely different geological ages and maturity was demonstrated by oxidation experiments which furnished a complete series of the polycarboxylic acids of benzene. In this field of chemical research, Bone will always be regarded as a pioneer.

Darwin Medal: Dr. E. J. Allen, F.R.S.

The Darwin Medal is awarded to Dr. Edgar James Allen, who for the past forty-two years has been director of the Laboratory of the Marine Biological Association at Plymouth.

Allen has made many notable additions to our knowledge of marine biology, dealing with such diverse subjects as the nervous system of the lobster, faunistic studies of estuarine and other areas, systematic work on the Polychæta, the genetics of *Gammarus*, and contributions to fishery science. He initiated exact work on the association of bottom faunas with the nature of the deposits and has published valuable papers on the artificial culture of phytoplankton, in which he was one of the earliest to obtain successful results. Many years ago he followed the chain of events leading from sunshine and inorganic constituents of sea-water, through phytoplankton and zooplankton to food fishes, making some of the first contributions to a subject which has since shown striking developments.

When the international fishery investigations began, Allen undertook the English share of the work, which was then based on laboratories at Plymouth and Lowestoft: after the Great War the Lowestoft laboratory branched off and became the Government centre for economic fisheries investigations. He has been closely associated with the International Council for the Exploration of the Sea from its earliest beginnings. The organization of the work on water pollution, carried out by the River Tees Survey Committee, owes much to his initiative, and he is a member of the Committee dealing with similar problems in the River Mersey.

Much of Allen's work has been directed to the study of evolution. The Hooker lecture, which he delivered to the Linnean Society in 1929, deals with the origin of adaptations, and his presidential address to Section D (Zoology) of the British Association in 1922 is again concerned with the evolution of life in the sea.

Throughout his long term of office at Plymouth, Allen has been the inspiration of the workers at the Laboratory, and the success of his labours is shown by the high quality of the research which has been carried out under his direction.

Hughes Medal: Dr. W. Schottky

The Hughes Medal is awarded to Dr. Walter Schottky of the Central Laboratory of Siemens and Halske, Berlin. He is best known by his contributions to the fundamental theory of thermionic emission. One of his investigations led in 1914 to the formulation of a theory of the effect of an electric field at the surface of a hot conductor upon the emission of electrons; another led to the discovery of the "Schrot" effect, which attributes certain variations in a thermionic discharge to random emission of individual electrons. He also discovered the so-called 'temperature effect' in ordinary conductors of electricity, which he traced to the thermal agitation of the molecules. Further, he made valuable contributions to the theory of space charge in vacuum tubes in the early days of the subject.

Apart from these mathematical contributions to our knowledge of principles, Schottky has added very greatly to engineering progress in wireless telegraphy. In particular, he invented the screening grid valve which has everywhere superseded the triode valve in the high-frequency amplifiers employed in receiving broadcast signals. He is also the inventor of the method of super-heterodyne reception wherein the currents of intermediate frequency are amplified. These are two of the most important wireless inventions of the past twenty years.

The Indian Institute of Science

QUINQUENNIAL REVIEWING COMMITTEE

THE report of the second quinquennial reviewing committee of the Indian Institute of Science, Bangalore, presented to the secretary of the Government of India toward the end of March last, has now been published (Bangalore : Mysore Residency Press). The committee was appointed by H.E. the Viceroy of India two months earlier, and its members were : Sir James Irvine, principal and vice-chancellor, University of St. Andrews (chairman) ; the late Dr. A. H. Mackenzie, pro-vice-chancellor, Osmania University, Hyderabad ; and Dr. S. S. Bhatnagar, professor of chemistry in the Punjab University, with Mr. F. F. C. Edmonds, inspector of schools, Coorg and Bangalore (secretary).

The terms of reference to the Committee were :

"To review the working of the Institute with special reference to the purposes for which it was founded and, if any changes are considered desirable in the organization or activities of the Institute for the better achievement of these purposes, to make recommendations accordingly, but with due regard to the Institute's actual or reasonably augmentable financial resources."

The subjoined extracts are from the report of the Committee :

We have felt compelled to consider the whole question of the aims and objects of the Institute as, during a period of unusually rapid change, it is more than ever necessary to secure that the policy pursued is consistent with the wishes of the Founder and of the contributing bodies. We may at once express the view that, as a first consideration, the province and purpose of the Institute must be defined in more precise terms than at present, and that such a definition should be adopted officially both by the Council of the Institute and by the Government of India. Only in this way can the aims and objects of the Institute be placed beyond individual and fluctuating interpretations ; in the absence of such definition, no continuous policy can be developed.

It may be admitted that the purposes for which the Institute was created have never been clearly defined, but this is in no sense a reflection on those who founded it or who have since administered its affairs. The Founder, the late Mr. J. N. Tata, was a public-spirited and enlightened benefactor who initially envisaged a scheme for creating an Imperial Teaching University the activities of which were to be focused in three main departments, viz., a Scientific and Technical Department, a Medical Department, and a Philosophical and Educational Department. Even with the generous support offered by Mr. Tata, so comprehensive a project was beyond realization, and the idea eventually took shape that the new foundation should be a Research Institute rather than a University.

Later the Government of India, with the concurrence of the heirs and executors of Mr. J. N. Tata, defined the Scheme for the Administration of the Institute as follows :

"The object of the Institute shall be to establish Chairs and Lectureships in Science and Arts especially with a view to the promotion of original investigations in all branches of knowledge and their utilization for the benefit of India, and to provide and to assist in the provision of suitable libraries, laboratories, and all necessary appliances."

No doubt with the laudable intention of securing a measure of elasticity and reasonable freedom to meet changing conditions, the above statement of purposes was drawn up in general terms, but nevertheless the intention is clearly revealed. According to the scheme as approved, the main objective of the Institute is to promote original scientific investigations and to facilitate the utilization of knowledge "for the benefit of India". Professorships and lectureships, offices traditionally associated with University teaching, are certainly envisaged, but in this case these offices are provided for a specific purpose, viz., the equipping of students for research.

In our opinion, the phrase "the benefit of India" strikes the keynote of the policy to be followed by the Institute. Admittedly there are many ways in which a research institution may operate for the benefit of a country and it is owing to the varying interpretations placed on this critical phrase that differences of opinion have since arisen. It may be argued with good reason that the prosecution in India of research of high merit is a benefit to the country through the prestige it confers ; similarly the provision of a steady succession of young men whose minds have been developed through the discipline of research in pure science is another result which comes within the compass of the phrase "the benefit of India". But, whilst in full agreement with such arguments, we believe that the initial conception of the founder was that the activities of the Institute should be devoted primarily to securing for India the material benefits expected to follow from the close association of scientific research with the industries of the country.

We are fully alive to the advantages and the cultural and material benefits which accrue from fundamental scientific work ; equally we recognize that there is no conflict between pure and applied research which can be, and ought to be, prosecuted side by side to their mutual advantage. We are chiefly concerned with the problem as to which of these complementary activities should carry the greater emphasis, and we hold strongly the opinion that, in accordance with the wishes of the Founder, this emphasis should be laid on the applications of scientific research to industry. Accordingly, our first recommendation is that Clause 3 in the Regulations be amended to read as follows :

"The object of the Institute shall be to establish Chairs in Science and Arts for the purpose of providing advanced instruction and conducting original investigations in all branches of knowledge and particularly in such branches of knowledge as are likely to promote the material and industrial welfare of India ; to provide suitable libraries, laboratories, and equipment ; and to co-operate as far as possible with such recognized institutions as exist or are founded in future for cognate objects in India."

The adoption of the above regulation will remove ambiguity as to the purposes of the Institute, will enable a continuous policy to be followed, and will inspire confidence in the bodies which assist its finances. As will appear later in this Report, we do not recommend the curtailment of fundamental scientific research or the abolition of teaching; but in terms of the regulation now proposed, teaching (except in the case of electrical technology which stands in a special position) should be confined to preparing workers as investigators, and, while research in pure science should continue to be an approved purpose, the major part of the resources of the Institute should be applied to those investigations which are likely to be of direct benefit to industry in India.

The evidence before us shows that in some quarters it is tacitly assumed that the Institute should be capable of searching for and selecting industrial problems, of solving these problems in the laboratory, and finally of applying the results on a technical scale. Such an attitude of mind is by no means confined to India, and so long as it is maintained, the Institute will remain the target of uninformed criticism. It must be remembered that, judged by the standards of modern research organizations in Europe and America, the Institute is small and has to work within a comparatively narrow income. But even the largest and best endowed research organizations can provide only a limited service to industry, in the sense that while they may succeed in winning the new knowledge necessary to solve an industrial problem, they are rarely capable of translating laboratory results into terms of technical practice. Different types of mind and experience as well as different equipment are necessary to bridge the gap between theory and practice. In short, the correlation of science and industry demands, as a rule, three types of men, viz., (a) those who find the problem, (b) those who unfold the new knowledge necessary to solve it, and (c) those who apply the results. The corresponding qualities and knowledge are rarely combined in the same types of individual or in the same institution.

Taking into account the restrictions imposed on the Institute by its size, its income, and its geographical situation, it is essential to relieve the staff of the sole responsibility for finding industrial problems for investigation. These problems should be submitted to the Institute by some responsible body capable of collecting proposals from India as a whole, and of sifting them so as to exclude merely routine inquiries (for which other agencies are available) and suggestions which are too unwieldy to be handled by the comparatively small number of workers available at Bangalore. The initiation of problems might well be undertaken by such bodies as—

The Industrial Intelligence and Research Bureau,
The Imperial Council of Agricultural Research, and
Departments of Industries.

Co-operation with bodies such as those mentioned above will enable the Institute to keep in constant touch with the industrial needs of India.

Suggestions for research initiated in the above way would be received in the ordinary course of business by the Registrar and would be submitted by him to the Senate which, in turn, would allocate the problem to the appropriate department or departments. In this way, each inquiry would receive the benefit of several expert opinions, a team spirit would be fostered, and the departments of the Institute would stand in less danger than at present of intellectual isolation. To make this proposal effective will demand something more than merely formal acquiescence on the part of all concerned. The active prosecution of applied research should be regarded as a duty, willingly undertaken with the certain knowledge that the more energetically this duty is fulfilled, the less scientific prominence becomes attached to the workers themselves. Few publications are likely to result from such research work, but this need not be deplored if in the end the Institute is made to play the part for which it was created. Above all, it will be necessary to develop in members of the Institute the idea that there is no loss of scientific dignity in directing scientific research to the service of man.

Conclusion

Throughout our inquiry and in compiling our Report we have been actuated by more than a desire to rectify an unhappy situation. It has been our earnest endeavour to make suggestions, conceived in a spirit of impartiality, which may help the Institute to attain a position where, without challenge, it will operate for "the benefit of India". Within the framework of our scheme and free from the distractions of routine administration, the Director may devote his full powers to fundamental researches in Physics which must redound to the fame of the Institute as a home of intellectual effort. Equally, the Professors in other departments are placed in a position which will enable them to bring their best energies to bear on research problems affecting the industrial welfare of India, and to equipping students to play their part in the application of such work. With improved status, a greater security of tenure, and a clearer prescription of their duty, there is every reason to believe that the Professors will render this service in a happier and more helpful atmosphere.

As we foresee the effect of our proposals, the Institute in the future may be regarded as divisible into three sections each with its special sphere of activity, viz., (a) Physical and Mathematical Sciences in which the research work will continue to be primarily of a fundamental nature with an allegiance to the intellectual rather than to the industrial aspects of life, (b) Chemical Sciences which will be called upon to carry the main responsibility for applied research while not neglecting original work of a more academic type, and (c) Engineering Sciences where the duties for the time being will be in part instructional and in part investigatory. We have suggested that these sections be granted a reasonable measure of autonomy, but they will not be isolated units, for they will find a common meeting place in the reconstituted Senate, where their efforts to serve science and to serve India will become in the best sense co-operative.

It may be the case that our proposals are a compromise, forced upon us by circumstances, but nevertheless we believe that they represent a workable solution of existing difficulties. If given a fair trial and if operated in the right spirit, they will enable the Institute to begin its second semi-Jubilee period with renewed hope. If our scheme fails, it can only be through the clash of personalities beyond the remedy of any powers possessed by a Reviewing Committee. Some of our proposals are far-reaching in their effect. Their full significance will be apparent only by a study of the complete text of our Report.

Educational Topics and Events

BIRMINGHAM.—The Huxley Lecture is to be delivered on December 10 at 5.30 p.m. in the Medical Theatre of the University, by Prof. A. M. Carr-Saunders, professor of social science in the University of Liverpool, who has chosen as his subject "The Population Problem in Great Britain".

CAMBRIDGE.—The Vice-Chancellor gives notice that the professorship of animal pathology is vacant by the resignation of Prof. J. B. Buxton. A meeting of the electors will be held on January 19. The Council of the Senate has determined that at this election preference shall be given to a candidate whose experience and interests lie chiefly in scientific investigation rather than in veterinary practice, and that a professional veterinary qualification, though undoubtedly advantageous, shall not be regarded as essential.

EDUCATIONAL films have been produced in such numbers and variety and are in such wide demand as to justify the publication by the Central Information Bureau for Educational Films (103 Kingsway, London, W.C.2) of a "National Encyclopædia" and of bi-monthly bulletins, entitled *Film Progress*, for keeping it up to date. Bulletin No. 4, issued in September, reviews the work of the Bureau from 1932, the year in which it was formed. It published in the following year a "Guide", which was brought up to date and re-issued as the "National Encyclopædia" a year ago. Through the medium of *Film Progress* it keeps in touch with schools in all parts of the Empire and in many foreign countries, including China, Chile, Holland, Latvia, Rumania, the U.S.A., and the U.S.S.R. It has advocated the formation of a school and parents film society to aid in the installation of projectors in schools, an object which is also attainable through the formation of local branches of the British Film Institute. The current issue of *Film Progress* includes several reviews of books, descriptive lists of new films and detailed practical suggestions on how to train members of the school staff and selected students in the handling of projectors. Very many of the new films described appear to be admirably suited for inclusion in cinema entertainment programmes but for the supposed prejudice of cinema-goers against everything admittedly educational. Among them is "Citizens of the Future", a survey of public education claiming to show how the schools are fitting children to employ their leisure time in useful occupations and preparing them to take their proper place in a world demanding high standards.

PROFESSORS of "Things in General" are needed to cope with the undergraduate situation in American universities to-day. This is one of a number of interesting conclusions reached by Prof. H. G. Merriam of Montana in a recent address on "The Liberal Arts College in State-supported Universities". The ancient ideal of making a scholar and gentleman as the aim of a university education was long ago given up, but the idea of making scholars continues to influence university instruction. Now it is recognized that among the myriads that pass on from high school to college, very few have the stuff from which scholars can be made, and a vast amount of instruction, lacking the integrating power of a clearly defined goal, is a futile hodge-podge. The primary function of instruction during their first two years in college should be, in State-supported, if not in all institutions, to train the students for worthy citizenship. Real problems of the individual and of society must be dealt with realistically and frankly, even when this involves breaking away from the American tradition that a college professor should avoid themes of popular contemporary interest lest he should be quoted in newspapers. The youth of to-day are impatient of theory except as manifestly applicable to live issues. The content and technique of instruction must be based on a consideration of such questions as: "What does the individual need to know about the fundamentals of the good life; about what good reasoning is and what its value; about the uses of emotion and the control of it; about society, its composition and working; about what factors in politics can be and should be controlled?"; and developed in the light of the conception of education as a gradual slow lifting of the people of a democracy to as high a level of thinking and feeling as possible.

Science News a Century Ago

Electric Currents in Metalliferous Veins

WRITING from 4 Clarence Street, Penzance, on December 6, 1836, to William Sturgeon, W. J. Henwood, the Assay Master of Tin in the Duchy of Cornwall, dealt with the subject of "Electric Currents observed in some Metalliferous Veins". In his communication he described briefly the geology of Cornwall and the methods of making his experiments, discussed the results obtained, and examined the various theories which had been put forward to explain the phenomena. Experiments were made by pressing plates of sheet copper 12–20 inches long and 3–4 inches wide closely against such portions of the metallic contents of the veins as were thought proper for examination. Copper wires 0·05 inches in diameter were connected to the plates and to a galvanometer. In some cases, 600 feet of wire were required. Copper, pyrites, vitreous copper ore, black copper ore, galena and blende were among the contents of the veins, but it was only from the metallic parts of the veins that currents were obtained. Henwood had assisted Robert Were Fox in the first experiments of the kind made, and he had then extended them to mines in all parts of Cornwall (*Sturgeon's Annals*, 1, 124).

Graham's Work on the Constitution of Salts

AT a meeting of the Royal Society held on December 8, 1836, Frances Baily being in the chair, the second part of a paper by Thomas Graham was read. It was entitled "Inquiries respecting the Constitution of Salts of Oxalates, Nitrates, Phosphates, Sulphates and Chlorides". "In the third section," said the report on the paper, "he discusses the constitution of the phosphates. Phosphoric acid, he observes, is quite peculiar in being capable of combining with bases in three different proportions; forming besides the usual class of monobasic salts, containing one atom of acid to one atom of protoxide as base, two other anormal classes of salts, in which two or three atoms of base are united to one atom of acid, namely

the pyrophosphates and the common phosphates, as they are usually denominated, but which the author proposes to designate by the terms *bibasic* and *tribasic* phosphates. Arsenic acid forms only one class of salts; but that class is anormal; every member of it containing three atoms of base to one atom of acid like the common, or tribasic, phosphates. These anormal classes of phosphates and arseniates are the only known salts to which the ordinary idea of a subsalt is truly applicable: all other reputed subsalts being probably neutral in composition, as has been shown by the author in the case of the subnitrate of copper; for they all bear an analogy to this salt in their small solubility and other properties, while they exhibit little resemblance to those classes of phosphates and arseniates which really possess more than one atom of base."

The Gresham Lecturers

ON December 9, 1836, the Court of Common Council of the City of London considered a report which had been presented on the question of transferring the Gresham Lectures from the small incommodious room at the Royal Exchange to the City of London School. In its report of the proceedings, *The Times* said: "There are seven lecturers under the will of Sir Thomas Gresham, each of whom is paid a liberal salary for occasionally lecturing upon scientific and other topics, in an obscure apartment in the Royal Exchange, and the very spacious and commodious school endowed by the Corporation being almost finished, a committee was appointed to consider and report the best means of deriving some public advantage from the employment of the lecturers. The Corporation have been for some time endeavouring to obtain the consent of the gentlemen who derive the pecuniary emolument from these appointments to transfer their exertions to some more enlarged sphere of action in the city; but hitherto all attempts to induce them to leave the old station, whose walls have so long witnessed their abortive labours, have been ineffectual."

The lecturers, with one exception, objected, maintaining among other things that the removal of the lectures to the School "would not be advantageous to the public, but on the contrary would be injurious to the foundation of the Gresham institution, by attaching it to the school and destroying its independence". *The Times* of December 13 contained a letter from one of the lecturers and a copy of the resolutions passed by himself and the others on November 17. One of these ran "That, in the opinion of the lecturers, there can be no want of funds to maintain or carry out the Gresham lectures according to the founder's intentions, it appearing from the report of the Charity Commissioners of 1821 that the yearly income of the Gresham estates then amounted to £6,080, while the yearly payments, on account of the trusts, only amounted to £1,113 4s."

The Gresham professorships of "divynitye, astronomy, musicke, geometry, law, physicke and rethoricke" date from 1595, Henry Briggs being the first professor of geometry. From 1597 until 1768, the lectures were given in Gresham's house in Bishopsgate Street. They were then given in the Royal Exchange until that building was destroyed by fire in 1838. In 1843 a special building was erected in Gresham Street, this being replaced in 1913 by the present College. The chairs of geometry and astronomy are the oldest in Great Britain.

Societies and Academies

Dublin

Royal Irish Academy, November 9.

NORMAN HARRIS: Petrological study of the Portrush sill and its veins. The Portrush sill has been mapped on the 25-in. scale, particular attention being paid to variations within the sill itself, and to the different types of veins and their relationship with the hornfelsed lias of the roof. The bulk of the intrusion is coarsely mottled olivine-dolerite; then passes marginally into a fine-grained intergranular type. Micrometric analyses show that the proportion of olivine and iron-ore increases with depth. Chemically the average rock corresponds to the Hebridean Plateau-Magma-Type. Various types of hornfels and their mineral developments are described. Several occurrences have been found of veins of mobilized hornfels which pass downwards into the sill from the roof. Other veins and sheets within the sill are shown to comprise metasomatized hornfels and also a variety of synthetic rocks which are referred to the action of the magma and its emanations on included rafts of hornfels. The absence of veins in the Lias roof and the capacity of the hornfels to inject the olivine-dolerite indicate that the hornfels was under internal compression, presumably due to expansion, while the upper part of the sill was contracting and under internal tension. A later hydrothermal stage is represented by widely distributed calcite-chlorite-zeolite veins. Five types of pyroxene have been recognized in the rocks investigated. Analyses are given of two of the pyroxenes: common augite and pigeonite.

Paris

Academy of Sciences, November 9 (*C.R.*, **203**, 901–960).

ALFRED LACROIX: The meteorites (æroliths) found in the Tanezrouft (Western Sahara). The two fragments found appear to have fallen at the same time, very recently. From the mineralogical and chemical examination, these meteorites are pliosideriferous chondrites.

JEAN CABANNES and JEAN DUFAY: Regularities in the spectrum of cometary nuclei.

MARC KRASNER: Multiplicative representation in the body of $\mathfrak{p}$-adic numbers relatively Galoisian.

FRÉDÉRIC ROGER: Taylor's formula and the differential geometry of ensembles.

CASIMIR KURATOWSKI: Projective ensembles and the operation (A).

P. ERDÖS and ERWIN FELDHEIM: The mode of convergence for the Lagrange interpolation.

RENÉ LAGRANGE: The theorems of addition of Legendre functions.

BOHUSLAV HOSTINSKY: The superposition of two sinusoids.

DANIEL BARBIER: The emission of electrons by the sun and its relation with terrestrial magnetic phenomena.

LÉOPOLD ESCANDE and GEORGES SABATHE: Errors produced by the inclination of the trajectories in calibrations carried out by means of hydrometric screws with counting gear. If the axis of the rotating screw is not in the same direction as the moving water, serious errors are produced. For an inclination of 20° the error is ten per cent, and this error increases rapidly with the angle.

JEAN LOUIS DESTOUCHES : The generalization of the Lorentz transformation for a system of corpuscles.

JACQUES SOLOMON : Diffusion of light by neutrons.

MLLE. SUZANNE VEIL : Electrometric potential and constitution of electrolytes.

PIERRE BARCHEWITZ : Study of the absorption spectra of benzene and its derivatives in the near infra-red (6000–9500 A.). A table of results for ten compounds is given : the figures confirm the views of R. Freymann on the influence of certain groups on the position of the bands (CH=).

MLADEN PAIĆ : Absorption spectra in the ultra-violet of coproporphyrin and of some of its metallic complex compounds.

LÉON JACQUÉ : Mechanical properties of steels treated with hot hydrogen under pressure. Ordinary steels under this treatment are decarbonized and show a loss in mechanical strength. But steels with 3–6 per cent of chromium, 0·5 per cent of molybdenum, no nickel and low carbon retain their mechanical properties and hence are suitable for work at high temperatures under pressure of hydrogen.

JEAN WYART : The crystalline network and macles of leucite.

GILBERT MATHIEU : The principal bands of phtanite of the Brinoverian of Vendée.

MARCEL THORAL : Age and fauna of the Ordovician schists of Cabrières (Herault) known as 'Asaphus schists'.

ALEXIS LAMBERT : Presence of the Senonian in the Djurjura chain.

JEAN LACOSTE : Remarks on some structural characters and on certain aspects of petroleum geology, in two analogous regions, the Subcarpathians and the Sud-Rif regions.

CHARLES BOIS : The importance of the long waves and the depth of focus in earthquakes.

MARIUS CHADEFAUD : The chondriosomes and plastids of *Caulerpa* (Green Algæ).

A. and R. SARTORY and J. MEYER : Influence of a partial or high vacuum on the growth and morphology of some lower fungi.

MAX LAFON : Weight evolution of the organs in mice deprived of lysine.

PAUL DURAND, PAUL GIROUD, EDOUARD LARRIVE and ANDRÉ MESTRALLET : Susceptibility of animals to the virus of the *maladie des porchers*.

Geneva

Society of Physics and Natural History, October 22.

F. CHODAT and G. CARRISSON : The effect of sodium mono-iodoacetate on the respiration of the yellow *Staphylococcus*. The authors give measurements of the inhibitive action of sodium mono-iodoacetate on the respiration of *Staphylococcus aureus*. This is already apparent at a concentration of $M/50{,}000$ of the reagent, and is reduced to one half at a concentration of $M/1{,}000$.

P. ROSSIER : (1) The approximate expression of the colour index as a linear function of the inverse of the effective temperature of stars. A development, in series, of an expression obtained in a general theory of the index, gives sufficient expressions in some cases where the accuracy of the observations is not very great. (2) Observations of the 1936 comet. Photographic observations of July 19 and 23, 1936. Spectrographic observation of July 23. (3) Spectrographic observations of Novæ Herculis, 1934 and Aquilæ, 1936. The loss of brightness of Nova Herculis appears to have influenced the continuous spectrum and most of the emission lines, excluding those of ionized oxygen. The spectrum of Nova Aquilæ, 1936, shows the hydrogen line and the line at 4640 A. characteristic of novæ in the form of wide emission lines.

B. HOCHREUTINER : Announcing the republication of the "Flora orientali" of Edmond Boissier, of vol. 6 of de Candolle and the issue of a new periodical, *Le Boissiera*, Part 1.

Moscow

Academy of Sciences (*C.R.*, 3, No. 4, 1936).

E. VORONOVSKY : A minimum problem in the theory of sequence of moments, and the evaluation of the polynome (2).

S. M. RYTOV : Diffraction of light by ultra-sound.

V. V. WEREDNIKOV : Influence of soil capillarity on the oozing of water with free surface.

P. P. BUDNIKOV and E. I. KREČ : Evolution of sulphur oxides from calcium sulphate by means of chlorine, in the presence of catalysts, for simultaneous production of hydrochloric and sulphuric acids (2). Behaviour of different modifications of silica towards chlorine at high temperatures.

V. S. SADIKOV and A. G. PESINA : Autoclave splitting of the non-extractable portion of beef by means of an aqueous solution of lithium carbonate.

T. T. DEMIDENKO, A. A. KULKES and V. P. POPOV : Colloids in beef correlated with soil liming.

A. SCHWARTZ and S. F. KUZMIN : The potato in its genetic aspect. (2) Variability of the protein content in the interspecific hybrids *Solanum phureja* × *S. rybinii*.

I. A. FILIPPENKO : Physiological characteristics of vernalized and non-vernalized winter wheat.

N. BEZBORODKO : The Tchernigov-Donetz Basin zone of volcanism, and the geochemical province connected with it.

(*C.R.*, 3, No. 5, 1936).

M. JALTUNOVSKAJA : A problem of interpolation.

N. S. SMIRNOV : Existence theorem of non-linear integral equations.

B. V. NUMEROV : Compilation of a fundamental catalogue of right ascensions.

G. DUBOŠIN : One particular case of motion in the resisting medium with a variable mass.

V. FABRIKANT : Contribution to the problem of the disappearance of spectral lines in strong electrical fields.

L. G. GINDIN, I. I. TORSUJEV and W. A. KAZAKOVA : Behaviour of sulphur solutions, and of a series of organic compounds of sulphur in saturated carbohydrates towards metals.

M. P. VOLAROVIČ and A. A. LEONTJEVA : An investigation of the elasticity of some molten rocks.

J. V. RAKITIN : Controlling the ripening of the Japanese persimmon.

M. I. SALTYKOVSKIJ : Cold resistance of the first generation of wheat hybrids.

A. N. DRUŽININ : The problem of structure and the evolution of the elbow joint of Mammalia.

Forthcoming Events

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

Monday, December 7

ROYAL GEOGRAPHICAL SOCIETY, at 5.—J. A. Steers: "Coral Islands of the Great Barrier Reefs".

UNIVERSITY OF LEEDS, at 5.15.—Prof. E. A. Owen: "The Application of X-Rays to the Study of Alloys".*

GUY'S HOSPITAL MEDICAL SCHOOL, at 5.30.—Prof. George W. Corner: "The Ovarian Hormones" (succeeding lectures on December 8 and 9).*

Tuesday, December 8

SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL, at 8—(at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, W.1).—Dr. Marie Stopes: "Some Biological and Physiological Details of Fertility".

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, at 8.30.—Prof. Allan Ferguson: "Splashes and what they Teach".

Wednesday, December 9

ROYAL SOCIETY OF ARTS, at 8.—H. V. Potter: "Artificial Resins".

BIRKBECK COLLEGE, at 8.15.—Anniversary celebration to be held in the College Theatre.

Sir Frederick Gowland Hopkins, F.R.S.: Foundation Oration.*

CHADWICK PUBLIC LECTURE, at 8.15—(in Manson House, 26 Portland Place, W.1).—Sir Weldon Dalrymple-Champneys: "Modern Views on Infection and Disinfection".*

Thursday, December 10

ROYAL COLLEGE OF SURGEONS, at 5.—Prof. George W. Corner: "Salernitan Surgery in the Twelfth Century" (Vicary Lecture).

CHEMICAL SOCIETY, at 5.30—(at the Institution of Mechanical Engineers, Storey's Gate, S.W.1).—Prof. E. Paneth: "Study of Transmutation in the Chemical Laboratory" (Liversidge Lecture).*

UNIVERSITY OF BIRMINGHAM, at 5.30.—Prof. A. M. Carr-Saunders: "The Population Problem in Great Britain" (Huxley Lecture).*

Friday, December 11

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. J. S. Owens: "The Smoke of Cities".

ROYAL INSTITUTION, at 9.—Dr. H. Spencer Jones, F.R.S.: "Large Telescopes, including the 200-inch Reflector".

Official Publications Received

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 3, No. 29: *Botryococcus* and the Algal Coals. Part 1: A Reinvestigation of the Alga *Botryococcus Braunii* Kützing, by Dr. Kathleen B. Blackburn; Part 2: The Boghead Controversy and the Morphology of the Boghead Larvæ, by Dr. B. N. Temperley. Pp. 841–868+2 plates. 4*s.* 3*d.* Vol. 58, Part 3, No. 30: A Contribution to the Geology of the Faeroes. By Dr. Frederick Walker and Charles F. Davidson. Pp. 869–897+3 plates. 4*s.* 9*d.* (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [1311

Committee of the Privy Council for the Organisation and Development of Agricultural Research. Report of the Agricultural Research Council for the Period October 1933–September 1935. (Cmd. 5293.) Pp. iv+130. (London: H.M. Stationery Office.) 2*s.* net. [1611

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1935–36. Pp. 39. (Aberdeen: North of Scotland College of Agriculture.) [1811

Board of Trade. Statistical Abstract for the British Empire for each of the Ten Years 1926 to 1935. Sixty-fifth Number. (Cmd. 5298.) Pp. xviii+331. (London: H.M. Stationery Office.) 5*s.* net. [1911

British Empire Cancer Campaign. Thirteenth Annual Report of the Grand Council presented at the Meeting held at the House of Lords 23.11.36. Edited by J. P. Lockhart-Mummery. Pp. xxviii+338. (London: British Empire Cancer Campaign.) [1911

Hannah Dairy Research Institute. Bulletin No. 7: An Inquiry into the Drinking Habits of Children of School Age, with Special Reference to Milk Drinking. By Dr. Norman C. Wright. Pp. 50. (Kirkhill, Ayr: Hannah Dairy Research Institute.) 2*s.* [2011

Fifth Quinquennial Congress of the Universities of the British Empire, 1936. Report of Proceedings. (Published for the Universities Bureau of the British Empire.) Pp. viii+262. (London: G. Bell and Sons, Ltd.) [2111

University of Cambridge: Solar Physics Observatory. Twenty-fourth Annual Report of the Director of the Solar Physics Observatory to the Solar Physics Committee, 1935 August 1–1936 July 31. Pp. 4. (Cambridge: Solar Physics Observatory.) [2111

East African Agricultural Research Station, Amani. Eighth Annual Report, 1935–36. (Colonial No. 119.) Pp. 41. (London: H.M. Stationery Office.) 1*s.* net. [2111

Public Social Services (Total Expenditure under certain Acts of Parliament.) Pp. 20. (Cmd. 5310.) Pp. 20. (London: H.M. Stationery Office.) 4*d.* net. [2111

Research Association of British Paint, Colour and Varnish Manufacturers. Bulletin 16: The Preservation of Iron and Steel by means of Paint. By Dr. L. A. Jordan and Dr. L. Whitby. Pp. 68. (Teddington: Paint Research Station.) 2*s.* 6*d.* [2311

Rothamsted Conferences, 22: Diseases of Bees; being a Report of a Conference held at Rothamsted on September 26th, 1936, under the Chairmanship of Sir E. J. Russell. With Contributions by Sir E. J. Russell, Dr. H. L. A. Tarr, Dr. G. D. Morison, Dr. Otto Morgenthaler, Jas. I. Hambleton, and others. Pp. 43. (Harpenden: Rothamsted Experimental Station.) 1*s.* 6*d.* [2411

Other Countries

Dominion of Canada: National Research Council. Report No. 29: The Comparative Feeding Values for Poultry of Barley, Oats, Wheat, Rye and Corn; a Review and Analysis of Published Data. Prepared by Earle W. Crampton. Pp. 50. (Ottawa: King's Printer.) 25 cents. [1411

Memoirs of the Geological Survey of India. Vol. 70, Part 2, No. 1: An Attempt at the Correlation of the Ancient Schistose Formations of Peninsula India. By Sir Lewis Leigh Fermor. Pp. iv+53–217. (Calcutta: Geological Survey of India.) 2.4 rupees; 4*s.* [1611

Proceedings of the United States National Museum. Vol. 83, No. 2990: A Revision of the Chalcid Flies of the Genus *Perilampus latreille* occurring in America North of Mexico. By M. T. Smulyan. Pp. 369–412. Vol. 83, No. 2996: New Tertiary Foraminifera of the Genera *Operculina* and *Operculinoides* from North America and the West Indies. By Thomas Wayland Vaughan and W. Storrs Cole. Pp. 487–496+plates 35–38. Vol. 84, No. 2999: The Ichneumon-Flies of the Genus *Brachycyrtus* Kriechbaumer. By R. A. Cushman. Pp. 17–24. Vol. 84, No. 3000: New Cottid Fishes from Japan and Bering Sea. By Rolf L. Bolin. Pp. 25–38. (Washington, D.C.: Government Printing Office.) [1711

Smithsonian Miscellaneous Collections. Vol. 73, No. 8: Opinions rendered by the International Commission on Zoological Nomenclature. Opinions 124 to 133. (Publication 3395.) Pp. ii+44. (Washington, D.C.: Smithsonian Institution.) [1711

U.S. Department of Agriculture. Farmers' Bulletin No. 1766: Game Laws for the Season 1936–37; a Summary of the Provisions of Federal, State and Provincial Statutes. By H. P. Sheldon and Frank G. Grimes. Pp. ii+38. (Washington, D.C.: Government Printing Office.) 5 cents. [1711

U.S. Department of the Interior: Office of Education. Bulletin, 1936, No. 16: A Step Forward for Adult Education. Pp. 28. 10 cents. Leaflet No. 36: Educational Law; Selected References. Compiled by Ward W. Keesecker. Pp. 15. 5 cents. (Washington, D.C.: Government Printing Office.) [1711

U.S. Department of Agriculture. Technical Bulletin No. 518: A Second Revision of the Chalcid Flies of the Genus *Harmolita* (Isosoma) of America North of Mexico, with Descriptions of 20 New Species. By W. J. Phillips. Pp. 26+10 plates. 5 cents. Technical Bulletin No. 532: The Comparative Moisture-Absorbing and Moisture-Retaining Capacities of Peat and Soil Mixtures. By I. C. Feustel and H. G. Byers. Pp. 26. 5 cents. (Washington, D.C.: Government Printing Office.) [1811

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 157: Pollination and Selection in *Anona Squamosa* and *Anona Cherimolia*. By M. S. Ahmed. Pp. iv+29+8 plates. 5 P.T. Bulletin No. 164: The Spacing of Sugar Cane in Egypt and Elsewhere. By Arthur H. Rosenfeld. Pp. iii+47+5 plates. 7 P.T. Bulletin No. 178: Preparation and Method of Application of the Zinc Phosphide Bait employed in the Control of the Mole-cricket *Gryllotalpa*. By A. Kassab. Pp. ii+12+8 plates. 3 P.T. (Cairo: Government Press.) [1911

Punjab Irrigation Research Institute. Research Publication, Vol. 2, No. 13: Uplift Pressures under a Depressed Floor. By Dr. N. K. Bose and Harbons Lal Uppal. Pp. 12+10 plates. 7 annas; 8*d.* Research Publication, Vol. 2, No. 15: Punjab Practice in Silt Observations. Pp. 13+6 plates. 6 annas: 7*d.* Research Publication, Vol. 5, No. 6: Pressure under Weirs—Depressed Floors with and without Sheet Piles. By Dr. V. I. Vaidhianathan, Gurdas Ram and Dr. E. McKenzie Taylor. Pp. 4+10 plates. 5 annas; 6d. (Lahore: Punjab Irrigation Research Institute.) [2311

Commonwealth of Australia. Report of the Seventh Australian Cancer Conference, held at Melbourne, 4th–8th May 1936. Pp. 72. (Canberra: Government Printer.) [2311

Indian Forest Records (New Series). Vol. 1, No. 4: A Note on Protecting Indian Structural Timbers against Fire, Termites, Borers and Fungi (Rot). By S. Kamesam. Pp. ii+93–113. (Delhi: Manager of Publications.) 7 annas; 9*d.* [2311

Gold Coast. Report of the Forestry Department for the Year 1935–36. Pp. ii+13. (Accra: Government Printing Department; London: Crown Agents for the Colonies.) 1*s.* [2411

Recent Scientific and Technical Books

Volumes marked with an asterisk (*) have been received at "NATURE" Office

Mathematics : Mechanics : Physics

Allen, Edward S. Plane Trigonometry. Ex. Cr. 8vo. Pp. xii +156. (New York and London : McGraw-Hill Book Co., Inc., 1936.) 12*s.* 6*d.**

Bailey, J. H. Shackleton. Elementary Analytical Conics. Cr. 8vo. Pp. v +378. (London : Oxford University Press, 1936.) 7*s.* 6*d.**

Ballard, P. B., and **Hamilton, E. R.** Fundamental Geometry. Ex. Cr. 8vo. Second Series, Pupil's Book 2. Pp. 48. (London : University of London Press, Ltd., 1936.) Paper, 10*d.* ; limp cloth, 1*s.*

Blaschke, W. Vorlesungen über Integralgeometrie. Heft 1. (Hamburger mathem. Einzelschriften, Heft 20.) Zweite erweiterte Auflage. Roy. 8vo. Pp. 59. (Leipzig und Berlin : B. G. Teubner, 1936.) 5 gold marks.

Cranz, C., Herausgegeben von. Lehrbuch der Ballistik. Ergänzungs-Band. Roy. 8vo. Pp. xii +292. (Berlin : Julius Springer, 1936.) 36 gold marks.

Deodhar, G. B. Introduction to Optics. Roy. 8vo. Pp. xii +614 +21 plates. (Allahabad : The Indian Press, Ltd., 1936.)*

Eddington, Sir Arthur. Relativity Theory of Protons and Electrons. Sup. Roy. 8vo. Pp. viii +336. (Cambridge : At the University Press, 1936.) 21*s.* net.*

Fisher, R. A. Statistical Methods for Research Workers. (Biological Monographs and Manuals.) Sixth edition, revised and enlarged. Demy 8vo. Pp. xiv +339. (Edinburgh and London : Oliver and Boyd, 1936.) 15*s.* net.*

Föppl, O. Aufschaukelung und Dämpfung von Schwingungen. (Grundzuge der technischen Schwingungslehre, Band 2.) 8vo. Pp. 121. (Berlin : Julius Springer, 1936.) 6.90 gold marks.

Fröhlich, Herbert. Elektronentheorie der Metalle. (Struktur und Eigenschaften der Materie : eine Monographiensammlung, herausgegeben von F. Hund und H. Mark, Band 18.) Ex. Cr. 8vo. Pp. vii +386. (Berlin : Julius Springer, 1936.) 28.80 gold marks.*

Gale, W. J. A First Book of General Science. (New General Science Series.) Part 1 : Mainly about Matter. Cr. 8vo. Pp. xvi +131. (London : University of London Press, Ltd., 1936.) 2*s.* 3*d.*

Haberland, G. Mechanik. Unter Mitwirkung von F. Haberland. (Bibliothek der gesamte Technik, Band 322.) Vierte neubearbeitete Auflage. 8vo. Pp. 228. (Leipzig : Max Jänecke, 1936.) 3.60 gold marks.

Hogben, Lancelot. Mathematics for the Million : a Popular Self Educator. Med. 8vo. Pp. 647. (London : George Allen and Unwin, Ltd., 1936.) 12*s.* 6*d.* net.

Hutchinson, Joseph G. Arithmetic for the Business Office. Imp. 16mo. Pp. 160. (London and New York : Gregg Publishing Co., Ltd., 1936.) 1*s.* 6*d.*

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Eshbach, Ovid W., Prepared by a Staff of Specialists under the editorship of. Handbook of Engineering Fundamentals. (Wiley Engineering Handbook Series, Vol. 1.) Demy 8vo. Pp. xii +1036 +50. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 25*s.* net.*

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Congrès International de Philosophie scientifique, Sorbonne, Paris, 1935, Actes du. 1: Philosophie scientifique et empirisme logique. Roy. 8vo. Pp. 81. 12 francs. 2: Unité de la science. Roy. 8vo. Pp. 77. 12 francs. 3: Langage et pseudo-problèmes. Roy. 8vo. Pp. 60. 10 francs. 4: Induction et probabilité. Roy. 8vo. Pp. 65. 10 francs. 5: Logique et expérience. Roy. 8vo. Pp. 80. 12 francs. 6: Philosophie des mathématiques. Roy. 8vo. Pp. 85. 12 francs. 7: Logique. Roy. 8vo. Pp. 73. 10 francs. 8: Histoire de la logique et de la philosophie scientifique. Roy. 8vo. Pp. 92. 12 francs. (Actualités scientifiques et industrielles, 388–395.) (Paris: Hermann et Cie., 1936.)*

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