NATURE

SATURDAY, OCTOBER 13, 1934

No. 3389 Vol. 134

CONTENTS

Editorial and Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number : WHITEHALL 8831
Telegraphic Address : PHUSIS, LESQUARE, LONDON

Advertisements should be addressed to
T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4
Telephone Number : City 4211

Industrial and Social Interactions

IN many of the addresses and discussions at the recent meeting of the British Association at Aberdeen, attention was given to the social and economic problems which have arisen out of the greater command of Nature placed in the hands of man by the creative ingenuity of the engineer. The advent of power production has resulted in a profound change in the character of industry, and for this reason alone scientific workers, using the term in the broadest sense, should be rightly concerned with the social consequences of scientific discovery and invention. This approach from the engineering or mechanical side, and particularly the endeavour to assess the contribution of what has been termed the engineering mind to questions of distribution and consumption as it has been applied in the field of production, tends to obscure the fact that the attention of science has been focused on social questions with almost equal power from a very different point of view.

The scientific study of the human problems of industry may be said to have commenced with the post-War period. The initial stimulus was undoubtedly derived from the success of the inquiries carried out in 1915–17 by the Health of Munition Workers Committee. The original conception of industrial fatigue was largely that of a rather simple and special study prompted by an acute national emergency. The various reports issued by the Industrial Health Research Board or the publications of the National Institute of Industrial Psychology well illustrate how the work, which began as a clearly defined problem in the supply of munitions, continued as a complex and changing study of profound importance to all industry. The committees associated with the Industrial Health Research Board cover statistics, physiology of muscular work, industrial psychology, heating and ventilation, industrial pulmonary disease, physiology of hearing, physiology of vision ; and the reports of the Board range freely over these subjects, industrial accidents, vocational guidance and selection, and the like.

The work has, however, now extended far beyond laboratory investigations, and a recent admirable study by Prof. E. Mayo, "The Human Problems of an Industrial Civilisation" (New York : The Macmillan Company, 1933), illustrates the point that it can, and is, playing its part in bringing before the scientific world some

of the larger social issues. It is not merely that there is no simple condition or fact described by the word 'fatigue', for example, and that fatigue is rather a convenient word to describe a variety of phenomena. The disuse of the word 'fatigue' in the title of the Industrial Health Research Board tokens indeed a significant admission that the problems are highly complex and that the industrial investigator must take account of many factors, some of which may lie outside the boundaries of industry proper. Investigations have revealed the existence in the works situation of difficulties and disabilities which are the direct outcome of external conditions, and can scarcely be removed by methods developed inside the works.

The question of industrial *moral* in this way becomes related directly to that of public *moral*. It is not enough to have an enlightened company policy in all staff matters and a well-planned programme of manufacture with adequate scientific and technical control, if effective human collaboration cannot be secured. Account must be taken of the real difficulties experienced by the workers in their social, as well as in their industrial, environment.

The focusing of attention on social conditions from this point of view of industrial efficiency and welfare reveals at once that some of the difficulties experienced by industry in regard to *moral* are due to the reaction of the disintegrating influence of industry itself on the social order. Changes in social habits induced by industrial demands or development, or the greater freedom conferred by new methods of communication or transport, frequently tend to diminish social control and the social understanding and support which the ordinary individual requires. Such conditions demand an accession of intelligent self-control, just when many find it difficult to formulate for themselves new attitudes or habits.

In the social disorganisation thus created—this breakdown of the social codes which formerly disciplined us to effective working together—we find the true explanation of much that is mechanical in the so-called leisure of to-day, much of the delinquency, crime, suicide and lawlessness of to-day, as well as contributory factors in the more sinister aspects of unemployment or political movements. The rapid development of the industrial civilisation, out of proportion with social and moral or ethical development, threatens what McDougall describes as world chaos and Durkheim as 'anomie'—disequilibrium or planlessness.

Thus from the human side we are faced with the same necessity for intelligent control, for wider and wiser planning, for the expansion of the area within which a rational or scientific direction functions in place of prejudice, if mankind is to avert disintegration and regain control over events. In this rapidly changing world, man cannot assign a value to his work unless there is some sort of integral social background—unless in the human and social-political sphere we can replace haphazard guess and opportunist fumbling by precise knowledge of the type and extent of social change, comparable with our knowledge and technique in the physical world.

It is not of course suggested that industry, any more than science, bears the sole responsibility for this problem of social disorganisation. A period of exceedingly rapid economic growth, defects in our educational system as well as in political institutions, have all contributed to the present state of affairs. Both science and industry, however, do carry a sufficiently large share of responsibility to warrant an increasingly close concern on the part of scientific workers and industrialists with social and political problems.

Taxonomy and Phylogeny of Monocotyledons

The Families of Flowering Plants. 2: *Monocotyledons; arranged according to a New System based on their probable Phylogeny.* By J. Hutchinson. Pp. xiii+243. (London: Macmillan and Co., Ltd., 1934.) 20*s.* net.

EIGHT years have elapsed since the publication of the first volume of "The Families of Flowering Plants", which dealt with the Dicotyledons. The author, in his preface to this his second volume, dealing with the Monocotyledons, apologises for the delay. At the time of the appearance of the former treatise, he confesses that he had then "only a cursory knowledge of the Monocotyledons as compared with that of the Dicotyledons". Perhaps if he had hastened the publication of the second volume, he might have produced a work somewhat perfunctory in character. As it is, whatever criticism may be brought against it, he cannot be charged with this. In the interval, Mr. Hutchinson has been able to exercise to the full on the Monocotyledons his flair for affinities, with the result that we have before us a work of much originality.

The book is compiled on similar lines to the previous one on the Dicotyledons, but with this amplification. Owing to the Monocotyledons being a less extensive group of plants, there is sufficient

space for the inclusion of keys to the genera of the families with the exception of the Orchidaceae and Gramineae. A serviceable key, however, to the tribes of the latter family is supplied by a colleague, Mr. C. E. Hubbard. In fact, thirty well-illustrated pages are devoted to the grasses, which happen economically to be the most important family of plants in the world and botanically one of the most difficult to master.

In the concise introduction, after reviewing and criticising the important taxonomic systems of the past as applied to the Monocotyledons, Mr. Hutchinson considers the question as to whether this subphylum should be regarded as mono- or polyphyletic, and decides strongly in favour of the former view. This is of intrinsic interest, for in his first volume he expressed the opinion that the Monocotyledons should be "placed after the Dicotyledons, from which they were derived at an early stage, the point of origin being the Ranales *and perhaps other groups*". The words now put in italics show that he has not prejudged the issue. He was then aware that a diphyletic origin had been proposed, namely, the derivation of the arum family (Araceae) and a few others from the peppers (Piperaceae) and the rest from the Ranales. After a full examination of the Monocotyledons as a whole (and it is well to bear in mind that the author has at his command the unrivalled dried and living collections of Kew), he rejects as highly improbable any direct piperaceous relationship, showing on the other hand how readily the aroids can be derived from the Liliaceæ.

There is general agreement, we think, that there is something more than mere superficial resemblance between the Ranales and the Helobiae. Hutchinson stresses this, and considers that a close relationship with the Dicotyledons is only shown at this point. For example, except for its single cotyledon and lack of endosperm, the genus *Ranalisma* of the family Alismataceae might equally well be placed in the Ranunculaceae. The Butomaceae are remarkable in sharing alone with the Cabombaceae the peculiar placentation in which the ovules are scattered over the inner surface of the free carpels instead of being confined to the margins. He does not touch on the vexed question as to the interpretation of the single cotyledon of the Monocotyledon in terms of the paired cotyledons of the Dicotyledon. He does, however, point out that some of the Ranunculaceae have only one cotyledon. Lyon, some years ago, argued for the inclusion of the Nympheaceæ in the Monocotyledons on cotyledonary grounds. Granting that the Monocotyledons had dicotyledonous ancestors, the reason for the change in the number of the seed-leaves is still obscure.

The absence of endosperm in all the Helobiae is certainly striking considering its presence in most other Monocotyledons and in nearly all the Ranales. Hutchinson comments on this and suggests that they have probably lost their endosperm through the adoption of an aquatic habit. This is not entirely convincing. The Araceae, for example, differ considerably among themselves as to the presence or absence of endosperm, but this variability cannot well be correlated with habit. Then in aquatic Dicotyledons, absence of endosperm is by no means the rule. In this connexion, it is interesting to call to mind that, in the Nympheaceæ, *Nelumbium* with the least-modified flower has an exalbuminous seed, whereas the other more advanced genera have endosperm.

The placentation of the ovules in the Butomaceae is remarkable, finding its parallel only in the Cabombaceae. This scattering of the ovules over the inner surface of the carpel is suggested as an ancient character, and so presumably as preceding the marginal position in evolution. On orthodox grounds it would be less disconcerting to regard it as derived from the marginal. Students of the carpel have singularly neglected this peculiar form of placentation.

As a basis for his new classification of the Monocotyledons, Mr. Hutchinson uses a character present in the apocarpous families which he regards of prime importance, the significance of which has hitherto escaped notice. This is the occurrence of a distinct biseriate perianth, the outer whorl of which consists of free usually green sepals and the inner of free coloured petals—in fact, a Dicotyledonous perianth except that the whorls contain usually three members each instead of five. It is of interest to note that trimerous whorls occur to some extent in the Ranales. From these apocarpous forms, three more or less distinct lines of evolution are traced. In one line through the Alismataceae reduction and sexual separation set in very early, producing an almost wholly aquatic branch, some of the forms, for example, *Zostera* and *Posidonia*, eventually adapting themselves even to marine conditions—an adaptation not yet attained by any Dicotyledon. This group of families is almost the same as those comprising Engler and Prantl's series Helobiae.

In the second line of descent, the calyx and corolla remain distinct, but the carpels are no longer free from one another. The spider-worts (Commelinaceae) come first, followed by the more-advanced Bromeliads, and as side branches from the former proceed families with a dry chaffy perianth culminating in forms with flowers in dense heads such as *Eriocaulon*. So far, this assemblage of families agrees fairly closely with

Engler and Prantl's series Farinosae. Hutchinson now places at the top the Scitamineae (bananas, cannas, gingers, etc.) which he designates as the order Zingiberales. These plants have been regarded as prototypes of the orchids on account of the reduction in the androecium being carried as far as unity, and also because in a few genera something suggestive of the orchidaceous labellum has been evolved. The author considers these resemblances to be merely parallelisms, and we are inclined to agree.

The third line of descent traced by Mr. Hutchinson is characterised by both whorls of the perianth becoming petalloid. They tend to be alike and to coalesce into a hexamerous corolla. The Liliaceae form the basic group. In this family are to be found genera with incipient syncarpy. It is here that the author makes one of his more striking departures from current taxonomy respecting the Monocotyledons. The Amaryllidaceae have for long been separated from the Liliaceae by the possession of an inferior ovary. This is an easily recognised distinction, but Hutchinson argues cogently that it is an artificial one separating forms evidently related. Instead he sees in the umbellate type of inflorescence subtended by an involucre of one or more spathaceous bracts a distinguishing character for the Amaryllidaceae, and consequently transfers from the Liliaceae to this family the tribes Agapantheae, Allieae and Gilliesieae. The onions are no longer to be associated with the lilies. The Welsh then in substituting the daffodil for the leek as their floral emblem was unconsciously obeying affinities. The hitherto somewhat unwieldy family of the Liliaceae is further restricted by the detachment of aberrant tribes to form separate families. These are named Trilliaceae, Smilacaceae and Ruscaceae. This is in keeping with the author's general practice of making the orders and families more natural and so in many instances less comprehensive, and thus easier of definition.

The absence of floral bracts in the tribe Heloniadeae is emphasised and on this account a relationship with the ebracteate Juncaginales is suggested. This tribe is considered a primitive one of the Liliaceae, but the absence of bracts, we think, must be held to be derivative through loss as in the case of the Cruciferae.

The very natural family Iridaceae is unaltered, except for the inclusion of the Tasmanian genus *Isophysis* (*Hewardia*) which has hitherto been placed in the Liliaceae on account of its superior ovary, though in all other respects it is iridaceous.

From the Liliales the other groups of Monocotyledons so far not mentioned in this review are derived. The ubiquitous and derided *Aspidistra* unexpectedly gains distinction as the connecting link between the lily and the arum families. The species of *Yucca*, *Dracœna*, *Agave* and kindred forms, largely arboreal in habit, are brought together in one order as leading up to the palms. The orchids, representing the highest floral evolution along entomophilous lines, are derived from Liliaceous stock through the Haemodoraceae, and finally, along anemophilous lines the culminating families of sedges and grasses are likewise traced from this stock through the rushes (Juncaceae).

New terms—Calyciferae and Corolliferae—are introduced for the two main divisions of Monocotyledons, based on the character of the perianth. A third division, the Glumiflorae, is then made for the rushes, sedges and grasses. Here there seems to be some inconsistency in taxonomic status. The Glumiflorae are a branch presumably of the Corolliferae and should therefore be a classificatory unit of lower rank. If raised to that of a division, then why not retain Helobiae as one too? A very natural group of orders could thereby be associated.

This book, like its predecessor, is well illustrated by excellent line drawings. Many of these are original, from the author's own clever pen, which shows to especial advantage in the floral design surrounding the dedication to Agnes Arber of Cambridge in recognition of her classical researches on Monocotyledons. In it can be traced Mr. Hutchinson's views on the phylogeny of this branch of flowering plants.

In a work of this detailed and descriptive character, complete freedom from minor errors can scarcely be expected. Printers' lapses uncorrected, however, are few, suggesting careful proof reading. A few slips in arrangement and in the keys have been noticed. For example, the troublesome water weed *Elodea* is erroneously denoted as bisexual. The Posidoniaceae are missing in the key to the families of the Juncaginales. The words "Division III Glumiflorae" should have headed page 185. We notice also the use of the word 'biphyletic' instead of the more correct 'diphyletic'.

By the completion of "The Families of Flowering Plants", Mr. Hutchinson has definitely thrown out a challenge to those botanists who uphold Engler's classification, a system which has been largely followed on the Continent and to some extent in America, but only half-heartedly in Great Britain. One wonders whether it is soon destined to be superseded. Some remarks made by Sir Arthur Hill in his brisk foreword to this volume are of interest in this connexion. He writes as follows: "The lapse of eight years since the 'Dicotyledons' appeared has on the whole been

of advantage, since it has allowed botanists time to study and digest the earlier volume and to realise that not only do they appreciate the value of his [Mr. Hutchinson's] researches, but that they are also generally in agreement with his conclusions." This is encouraging to those who think that Mr. Hutchinson, in following such theorists as Hallier, Bessey and Arber and Parkin, is taking the right course. The Ranalian, or perhaps it might be better termed the Magnolian, type of flower is believed to be the least evolved, and from some such form all other kinds of flowers are held to be derived by modification and reduction. Hutchinson's new system is based on these ideas, and thus is diametrically opposed to Engler's, which postulates the primitiveness of unisexual flowers of few parts. His Monocotyledons, for example, begin with such genera as *Typha* and *Pandanus*. Hutchinson regards the flowers of these in just the opposite way, as more or less climaxes in reduction series—in fact, great simplification in the individual flower accompanied by much complexity in the inflorescence. Engler, however, in his last discussion on the phylogeny of Angiosperms, conceded an important point in allowing the primitive flower to be bisexual though still without a perianth or only a rudimentary one. Such a position leaves the origin of the perianth very much in the air.

It is well to bear in mind that, in the present state of our knowledge, theories bearing on the evolution of the flower can be based only, or at any rate mainly, on the comparative morphology of existing forms. The rocks so far help us little, though two groups of extinct plants, the Bennettitales and the Caytoniales, are sufficiently suggestive as to allow speculation to be advanced regarding the unsolved problem of the origin of flowering plants. Until crucial fossil evidence is forthcoming, surely it is more logical, as well as more suitable for teaching, to commence a system for their classification with plants having flowers of the Ranalian type than of the kind shown by *Typha*, *Pandanus* and the catkin-bearing trees. These latter plants may not be recent geologically, but that does not necessarily debar their flowers from having been derived by reduction. A comparative survey of existing Angiosperms shows how readily an entomophilous family can evolve anemophilous forms with reduction down to complete loss of the perianth, accompanied often by separation of the sexes. This has probably proceeded repeatedly from early times in Angiospermous history. The earlier an anemophilous branch has been given off, the less easy will it be to connect its descendants with any existing entomophilous family. In this way the isolation can be accounted for of such families as the Pandanaceae and Typhaceae.

In conclusion, Mr. Hutchinson is to be heartily congratulated on the completion of his "Families of Flowering Plants". Much information of an interesting, useful and suggestive character is compressed in its pages. Maps here and there are introduced to show the geographical distribution of families when this is especially striking. We commend the work to botanists generally and to systematists in particular. It is definitely written on phylogenetic lines. Taxonomy without phylogeny may be likened to bones without flesh. At the same time, the author is careful to state in his preface that his effort "represents only the beginning of an endeavour to establish a phylogenetic system for the Monocotyledons".

Mr. H. G. Wells Reveals Himself

Experiment in Autobiography: Discoveries and Conclusions of a Very Ordinary Brain (since 1866). By H. G. Wells. Vol. 1. Pp. 414+8 plates. (London: Victor Gollancz, Ltd., and The Cresset Press, Ltd., 1934.) 10*s*. 6*d*. net.

A CURIOUS post-War phenomenon is the spate of autobiographies and "ought-not-to-biographies" issuing from the publishers. The diapason of the War resounds in these books. Silent and abashed, we stand before the cenotaph. Some dream-child whispers: "What did you do, daddy, in the Great War?" The hand gropes for the fountain-pen. Others, like Elihu, the son of Barachel, feel their bellies as wine which hath no vent, ready to burst. "I will speak that I may be refreshed." Mr. H. G. Wells's reason is akin to Elihu's—"to clear and relieve my mind". He explains that he has spent a large part of his life's energy "in a drive to make a practically applicable science out of history and sociology" (p. 26). A jewel has formed in his head and "through its crystalline clearness, a plainer vision of human possibilities, and the condition of their attainment appears" leading to "an undreamt-of fullness, freedom and happiness within reach of our species". Vast changes in the educational, economic and directive structure of society will be necessary. Details are reserved for the second volume to be published in a few weeks.

This first volume gives only hints of Mr. Wells's design for the new world he wishes to create. His life as a shop assistant, here realistically described, suggests a dream. The draper's shop. Enter a shabby old lady. "Our new model? Certainly, *Moddom*. That counter! Mr. Wells, forward." A not very impressive figure shuffles in, *our* Mr. Wells, munching the last mouthful of his bread and butter breakfast, sniffs contemptuously at

some dusty boxes labelled "Karl Marx—*Das Capital*", "Abolish the retail distributor", "Made in Russia", reaches down a box marked, let us suppose, "World-State", and with voluble dialectic succeeds in selling the new model for 1*s.* 11¾*d.*, together with a packet of pins for the odd farthing. Quite possibly the old lady will find that the pins alone serve some really useful purpose. Our post-War world is full of irony. "To the saving of the universe," says Conrad, a man of powerful judgment, "I put my faith in the power of folly." If not folly, something simple, something unsophisticated—like the heart of a child. "The perfectly efficient," writes Gerald Heard in "These Hurrying Years", "is the perfectly finished." A re-birth has to take place—"foetalisation" is the scientific word. If Mr. Wells is going to tell us that the only way to save the world is to make it a macrocosm of Geneva—but we will not indulge in anticipations, Mr. Wells's own *cuvée reservée*.

Mr. H. G. Wells was born in 1866, "blaspheming and protesting", and this first volume of his autobiography takes us to the year 1896, during which he earned £1,056 7*s.* 9*d.*, and had definitely mounted the pedestal of success. Students of the science of heredity will not find much raw material in his origin. His mother was "a little blue-eyed, pink-cheeked woman with a large, serious, innocent face", and his father's chief claim to fame before the birth of Mr. Wells—he was a professional cricketer—was having bowled four Sussex batsmen in four successive balls, a super-hat trick "not hitherto recorded in county cricket". In one of his reprinted letters (p. 400) Mr. Wells asks his parents: "If I haven't my mother to thank for my imagination and my father for skill, where did I get these qualities?" This may be a pleasing display of filial piety. Even with the help of his autobiography, Mr. Wells is not easy to explain, whether in terms of nature or of nurture.

His early education was spasmodic and was followed by apprenticeship to a draper. Emancipation came when Mr. Wells became a student of Huxley's at the Royal College of Science—then called the Normal School of Science—his training as a science teacher being subsidised by the Government with a weekly grant of one guinea. His unstinted praise of Huxley as "the acutest observer, the ablest generaliser, the great teacher, the most lucid and valiant of controversialists" confirms current opinion. After a year's course of general biology and zoology, "the most educational year of my life", the remaining two years of his course in the school were in the nature of an anti-climax. He writes with little enthusiasm of Guthrie, the professor of physics, who "maundered amidst unmarshalled facts", and with less of Judd, the professor of geology, to whom his antipathy was immediate; and he failed in his final examination in geology in 1887.

Tragedy? Not in the ordinary sense. The real tragedy was that Mr. Wells should not have continued study and research in biology under Huxley. He might have discovered the cause of human cancer, leaving to others the investigation of the cause and cure of world cancer. Academically he may appear to have been butchered to make a Juddian holiday but, with feline resuscitation, he soon took the B.Sc. degree of the University of London with first class honours in zoology and second class honours in geology, a remarkable achievement, appreciated strangely enough by no one more important than William Briggs, principal of the University Correspondence College, and of the University Tutorial College. For these institutions, Mr. Wells worked with diligence and success, until he abandoned teaching for literature, carrying away as booty one of his devoted women students, Amy Catherine Robbins, his second wife and mother of his children.

This is an interesting book—especially for those who have trodden the same Calvary without securing the same crown, undoubtedly golden in the case of Mr. Wells—warm, human and ingenuous, occasionally too ingenuous. The young man emulating Mr. Wells's colossal success who spends half a minted guinea to discover its secret will find (p. 157) that for some years Mr. Wells had two guiding principles in life: first, "If you want something sufficiently, take it and damn the consequences"; and secondly, "If life is not good enough for you, change it; never endure a way of life that is dull and dreary, because after all the worst thing that can happen to you, if you fight and go on fighting to get out, is defeat, and that is never certain to the end which is death and the end of everything". Has not the first principle created the chaotic world which Mr. Wells is obligingly going to set right? It is the *stupid* people, as Sir Walter Raleigh remarked in one of his letters, who make the work and then do it. Mr. Wells is not easy to explain. . . .

There lurks in Mr. Wells, on his own confession, "the latent 'Arry in my composition" (p. 388), exhibited in his references to religion, especially the unquotable account of his first communion (p. 189), and in the exposition of his private benevolences, including the inevitable Christmas turkey. Some lapses from Mr. Wells's high standard of scientific accuracy may be noted. The date of the great Education Act was 1870, not 1871 (pp. 84, 93, 327) and the diamond jubilee year was 1897, not 1896 (p. 403). T. Ll. H.

Progress in Biochemistry

Annual Review of Biochemistry. Edited by James Murray Luck. Vol. 3. Pp. viii+558. (Stanford University, Calif.; Stanford University Press; London: H. K. Lewis and Co., Ltd., 1934.) 5 dollars.

RESEARCH workers and others interested in biochemistry have already begun to look forward to the date of the appearance of this review of the literature of the previous year. The volume appears with commendable punctuality; it is once again international in character, the twenty-six sections being written by experts working in Europe as well as in America. There is a tendency to make the reviews more critical in nature and less like mere reports: they gain in value accordingly.

A number of new subjects are selected which might be described as topical; in some of these a good deal of confusion exists, so that a critical review helps to bring clarity; in others there is definite progress to record. A stage is being reached when more definite views as to the course of metabolism are emerging, as, for example, the series of changes during glycolysis in muscle for which a new scheme has been put forward by Embden, whose tragic death is so greatly to be deplored, and substantiated by the work in particular of Myerhof. The series of changes from glycogen and glucose to lactic acid involving the formation of hexosediphosphate, the intermediate formation of pyruvic acid among other substances, and the action of enzymes at various stages, illustrate the complexity of the fermentation process, which not so long ago was regarded as a direct simplification of the glucose molecule. Even the phosphorylation is complex, for it apparently requires a co-enzyme system of adenosinetriphosphate, magnesium and inorganic phosphate. In explaining metabolism the biochemist seems to have abandoned any hope of simplicity.

One of the most useful reviews is that of Rosenheim and King on the sterols, a subject in which brilliant progress has been made. A new cholane formula devised by these authors which consists essentially of a reduced phenanthrene ring system has satisfied all the tests applied to it, and its adoption has acted as a stimulus to other work as, for example, the constitution of the œstrogenic hormones established by Marrian and Butenandt. It is remarkable that the phenanthrene nucleus is common to such physiologically active substances as calciferol, cardiacglycosides (strophanthin), toad poison (bufotoxin), carcinogenic hydrocarbons and œstrogenic hormones.

Hormones and vitamins still attract attention, likewise the animal pigments. A novel review is that on energy metabolism in nutrition, complete with symbols *SDA* and *BMR*, which is disproportionately long. On the other hand, the summary of biochemical and nutritional studies in the field of dentistry is a welcome sign of the entry of chemistry into this important subject.

More than a word of praise should be accorded to the excellent structural formulæ and the general printing of the book. E. F. A.

Short Reviews

Geomorphologie. Von Prof. Dr. Fritz Machatschek. Zweite Auflage. Pp. iv+154. (Leipzig und Berlin: B. G. Teubner, 1934.) 4.50 gold marks.

DURING the fifteen years which have elapsed since this little book first appeared, the science of geomorphology has undergone certain marked changes both in scope and application. This is seen, not least, in the important results which have been obtained by the application of geomorphological principles to the elucidation of problems connected with the deformation of the earth's crust, especially within the belts of young fold mountains. It is an important branch of geographical as well as geological science and, for this reason, a short yet comprehensive account of modern methods and results, suitable for the student, is very desirable. The present volume provides such an elementary textbook, and forms an admirable introduction to the study of the surface morphology of the earth.

The subject is treated from the genetical point of view throughout the book. For this purpose two main methods of investigation are employed: (1) a consideration of the different forces active at the surface of the earth and their ability to produce land forms; (2) a critical analysis of existing land forms in relation to their origin and development.

The first four chapters are of a general nature and deal with the physical and chemical forces which can be regarded as active agents in the modification of the earth's crust. The remainder of the book is devoted to a critical analysis of land forms under varying climatic and structural conditions. Five main types are recognised as follow: (1) the normal cycle of erosion; (2) erosion in humid climates; (3) erosion under polar conditions; (4) erosion in arid climates; and (5) islands and coasts. Within each type the modifying influence of structure is fully discussed.

Finally, the author provides a most useful appendix in which about one hundred terms of foreign origin are defined. The concise yet comprehensive nature of this little book should recommend it as one of the most useful textbooks available for the use of the elementary student.

Thorpe's Dictionary of Applied Chemistry. Supplement. By Prof. Jocelyn Field Thorpe and Prof. M. A. Whiteley. Vol. 1: *A–M*. Pp. xxi+680. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1934.) 60*s*. net.

In order to make up the lee-way developed during a period of 7–13 years, two additional volumes are being provided as supplements to the original seven volumes of Thorpe's "Dictionary of Applied Chemistry". The present volume of about 700 pages is issued at the same price as the original volumes and covers the literature from *A* to *M*. Since the list of contributors to the new volume occupies five pages, an individual review of the articles which they have written is scarcely practicable; but the reader naturally turns at once to a 20-page supplement to the article on carbohydrates in vol. II, by Dr. E. F. Armstrong, to find the new ring-formulæ fully described and discussed. On the inorganic side, articles on hafnium and illinium are contributed by Prof. G. T. Morgan, whilst a long supplementary article on hydrogen by Prof. J. R. Partington includes ortho- and para-hydrogen, but was evidently completed at too early a date to include the isotopes discovered in 1933. Recent technical developments are represented by well-illustrated articles on coal gas and coke manufacture, on explosions and explosives and on iron and steel. A long supplementary article on analysis by Prof. G. T. Morgan is devoted mainly to the organic reagents which now play such an important part in the detection and separation of the metals, as well as of certain acid radicals. There are also many brief entries and cross-references which maintain the essential character of the dictionary as a work of reference for unfamiliar, as well as for the more familiar, names and subjects.

A very attractive feature of the new volume is provided by the use of heavy capital letters, not only for the main headings of the various entries, but also for the chemical formulæ, which are thereby rendered exceptionally clear and easy to pick out from the lighter type of the ordinary text.

The Casting of Brass Ingots. By R. Genders and G. L. Bailey. (Research Monograph No. 3.) Pp. xv+191+63 plates. (London: British Non-Ferrous Metals Research Association, 1934.) 15*s*.

The attention being paid at the present time to the production of sound ingots of all kinds is well illustrated by the remarkable reports which are being issued by the Heterogeneity Committee of the Iron and Steel Institute, and by the work done on brass by the Research Department at Woolwich for the British Non-Ferrous Metals Research Association. Since a sound ingot is the essential starting point for sound products to be produced therefrom, this type of research, slow and tedious as it may be, finds most ample justification. The book under review is, in a collected form, the reports which have been prepared for the latter of the two research programmes mentioned above. To manufacturers of brass ingots for rolling it will be essential, but its importance extends much further than this. When at length the individual links can be welded into a comprehensive theory of the solidification of metals in moulds, the present work will not be the least useful. The amount of experimental information contained is large, the work has been well and patiently done, and the authors may be congratulated on the production of a volume of real value. The fact that the separate portions of the work were made the subjects of individual reports may possibly be the explanation of the one criticism which may be made, namely that there appears to be a certain lack of cohesion. F. C. T.

The Rôle of the Deserts. By A. J. McInerny. (The Channing Useful Pocket Series, 7.) Pp. 51+6 plates. (London: The Channing Press, 1933.) 4*s*. 6*d*. net.

Mr. McInerny here develops further his theories of the part played by the great deserts in human evolution. He holds that these great arid stretches of land in the Old World, extending from North Africa to Central Asia and from the Hindu Kush to Manchuria, are zones of disinfection which, by purifying the infected air coming from the tropical zones of jungle and swamp and causing it to be then distributed in the upper air to zones of development, have been the principal, though not the sole, factor in the evolution of man from the negro of the jungle to the yellow man of sub-arid areas and then the white race. Heidelberg man and Neanderthal man and related forms of extinct man are premature escapes from the zones of development. Mr. McInerny also turns his attention to America. Here, he holds, the influence of the deserts has not been strong enough to produce races capable of an advanced civilisation. In consequence, he is dubious as to the future of the white races now living on that continent. His views in their application to the question of ethnological affinities produce some new and startling results.

Perkin and Kipping's Organic Chemistry. Entirely new edition. By Dr. F. Stanley Kipping and Dr. F. Barry Kipping. Part 3. Pp. viii+615–967+xlii. (London and Edinburgh: W. and R. Chambers, Ltd., 1934.)

This volume deals with the more advanced parts of organic chemistry in the same clear and practical manner as the first two parts. A short but adequate account of the electronic formulæ of organic compounds precedes the consideration of various types of isomerism, and the discussion of important groups of compounds such as the monosaccharides, polysaccharides, cyclic hydrocarbons, terpenes, carotinoids, pyrones, anthocyanins, organo-metallic compounds and some selected heterocyclic compounds. There are several chapters on important theoretical matters, such as optical activity, isomeric change, the structure of benzene, and steric hindrance. The book gives in a reasonable space such information as an honours student may be expected to assimilate in the field covered, and it may be warmly recommended. In future editions, the structure of pyrones should be explained on a more modern basis, since quadrivalent oxygen is no longer admitted.

Nutrition in Relation to Disease

THE symposium on nutrition in relation to disease at the Aberdeen meeting of the British Association took the form of a joint meeting of Sections I (Physiology) and M (Agriculture). In the last ten years there has been a great development of research in the nutrition of farm animals. There are now two institutions—one at Cambridge and one at Aberdeen—devoted entirely to research in this subject. The meeting served the purpose of bringing together for review, results obtained in the medical field, where conclusions are drawn from experiments on small laboratory animals and from clinical observations on human beings, and those obtained in work with the larger domestic animals. Though the papers showed that the fundamental principles and the major problems are the same in both fields, they brought out the fact, sometimes overlooked, that the requirements for adequate nutrition and the effects of deficiencies of the various food constituents are not the same in all species. Dr. H. H. Green emphasised the necessity for caution in applying directly in medical or veterinary practice, results obtained with experimental animals.

The review showed that in the last twenty years, advance in knowledge has been so great that our ideas with regard to the etiology and treatment of many diseases have been revolutionised. It looks as if the science of nutrition may prove as important in the prevention of disease as the science of bacteriology.

In the case of certain deficiency diseases such as scurvy and rickets, the connexion between nutrition and disease is now established, and the dietary factor involved clearly defined. Investigators have moved on to the study of long-continued minor degrees of malnutrition which do not produce early gross signs of disease. To what extent do animals in this condition suffer from decreased resistance to bacterial or parasitic attack, and to what extent does this condition lead to the development of chronic diseases of digestion and metabolism ?

Dr. D. Robertson gave data to prove that in the case of coccidiosis in chickens and intestinal parasites in sheep, the state of nutrition of the animal is an important factor in determining both the extent and the effect of infestation. The results of these observations are now being applied successfully in practice. In the case of bacterial infection, carefully controlled experiments have shown that, with certain micro-organisms, animals in a poor state of nutrition show lowered resistance. In other cases, however, negative results have been obtained. This is a difficult field of inquiry, in which progress must be slow, as the nature and significance of immunological reactions are still obscure.

The bearing of nutrition on chronic diseases was discussed in each of the three leading papers (Dr. J. B. Orr, Prof. J. J. R. Macleod and Prof. S. J. Cowell). In the beginning of the present century, the influence of pathological conditions on metabolism was studied usually on the assumption that the abnormal metabolism was secondary to the pathological condition. The conception that disease may arise from a faulty diet has stimulated research from the point of view that the pathological condition is the result of the disordered metabolism, which may be present long before any clinical signs are evident. Data were given showing that in minor degrees of malnutrition the composition of fluids and tissues in the body is abnormal, and that these abnormalities give rise to dysfunction. It was suggested that the continued dysfunction might ultimately give rise to chronic disease. This condition is of special importance in early life. Deficiencies of certain substances in the food in the phase of active growth may lead to imperfect development of tissues, and so predispose to disease in later life. Dr. May Mellanby's paper on teeth illustrated the importance of perfect nutrition even in the pre-natal period.

In the present stage of very limited knowledge, the most that can be said is that the observations made are suggestive. Much patient and laborious investigation, however, is needed before we can speak with any degree of assurance on the relative importance of nutrition, heredity and environmental factors in the etiology of chronic diseases of metabolism. There is reason to believe, however, that this may be a fruitful line of inquiry. The study of some of these diseases from the nutritional point of view has already led to striking results. Ascorbic acid (vitamin C) seems to be effective in curing several diseases such as purpura hæmorrhagica, pyorrhœa and certain forms of hæmorrhagic nephritis. Progressive muscular atrophy seems to yield to treatment with an amino-acid, glycine. Psoriasis, in some cases at least, is cured by eliminating cholesterol and allied fatty substances from the diet. The treatment of pernicious anæmia with liver is now a well-established practice. These are diseases for which, until recently, medicine could provide no very satisfactory treatment. It may well be that these are merely the first fruits of the modern attack from the nutritional point of view on chronic diseases of obscure etiology.

The practical bearing of this recently acquired

knowledge on the incidence of disease was discussed by several speakers, and the results of investigations on the connexion between faulty diet and disease in the community were quoted in support of the suggestion that disease due to faulty diet is prevalent. Thus, an investigation showed that about 50 per cent of women of the child-bearing age among the working classes in one of our cities were suffering from nutritional anæmia. The addition of milk to the diet of school children was followed by 20 per cent increase in rate of growth and by improvement in health. A large proportion of children are evidently not attaining their full inherited capacity for health. It was suggested that much of the disease in later life may be due to malnutrition in childhood and that this may have a bearing on the large number of rejections of recruits from the army, owing to poor physique or chronic disease.

If, indeed, disease due to faulty dietary should eventually prove to be as prevalent as these isolated and limited observations suggest, then there are obvious economic and political implications, especially at the present time, when we are moving towards a planned economic system under which the amount of certain foodstuffs coming on the market and the price at which they may be retailed, may be fixed for purely economic reasons. As a matter of fact, we have not sufficient data to warrant making an authoritative statement on the subject. Experimental observations have been far too limited in extent and too academic in nature to permit of wide generalisation. Sir Frederick Gowland Hopkins wisely counselled caution in the interpretation of the limited facts available. The urgent need of the present time is large-scale investigations over a number of years in different sections of the community in order to obtain data which may be applicable to the populace as a whole.

Pit-Head Generation of Electric Power

(FROM A CORRESPONDENT)

IN his presidential address before the Engineering Section at the recent British Association meeting at Aberdeen on "Sources of Cheap Electric Power", Prof. F. G. Baily advocates the establishment of electric generating stations at the pit-heads, his contention being that with low-grade coal and 'waste' fuel having a calorific value of 10,000 B.Th.U. per lb. available at a cost of five shillings per ton, electricity could be produced at one-twentieth of a penny per unit below the cost of production at the most modern steam stations now operating.

Prof. Baily very properly refers to the heavy burden of local rates on electricity undertakings, amounting in some cases to 0·1*d.* per unit sold, and suggests that a substantial reduction may be claimed such as a half, amounting to 0·05*d.* per unit which, with the equal saving which the pit-head station with cheap fuel can achieve, will bring about a reduction of 0·1*d.* per unit. The present cost of generation at large stations he puts at 0·25*d.* In this figure, 0·25*d.* per unit generated, rates (on the generating station alone), as Prof. Baily says, may amount to 0·06*d.* per unit, and on the whole undertaking often as much as 0·1*d.* per unit sold. This is a serious addition to the price which users of electricity have to pay. At least one undertaking selling many millions of units every year pays more in rates than it does for the coal required to generate all the electricity it sells. With the generating stations of industrial concerns de-rated, a substantial reduction in the rating of public utility stations appears to be a reasonable demand, but any reduction obtained would apply equally to the existing stations and to the proposed pit-head stations and would not affect a comparison between the two.

Prof. Baily visualises a pit-head station (perhaps many stations) having a daily output of about one million units. A saving of one-twentieth of a penny per unit would therefore be well worth striving for, and if such a saving could be effected it seems strange that nothing is being done to connect one such station to the Grid. It is only fair to say that such proposals are not new. In 1919 the Nitrogen Products Committee, with some of the most eminent engineers and other well-known scientific men of the day among its members, referring to the subject, said :

"It has often been advocated that large power stations should be situated at the collieries or even at the pit's mouth in order that the cost of coal delivered into the bunkers may be reduced to the lowest possible point. This would be perfectly sound provided the other principal requirement of a cheaply operated power station could be obtained at the same site, namely, an abundant natural supply of circulating water for condensing purposes, capable of being utilised without undue cost of pumping. In the case, for example, of a station loaded to 100,000 k.w. at least six million gallons of condensing water would be required per hour on a load factor of 95%—some 136,000,000 gallons per day. The only alternative to a large supply of cooling water is to use cooling towers with a consequent large permanent loss of water by evaporation and a considerable increase in the temperature of the condensing water leading to a serious addition to the

coal consumption of the Power Station. The constant loss by evaporation into the atmosphere amounts in practice to about 2% of the total, and as this is irrecoverable it has to be constantly made up from an outside source. In the case cited above of a 100,000 k.w. station operating on a load factor of 95% the employment of cooling towers would necessitate a daily supply of 2·72 million gallons of make up water to replace losses. . . . To sum up, the large power station at a colliery site having to rely upon cold water for condensing purposes involves an increased capital expenditure, an increased consumption of coal, a large initial supply of water for the towers and a large daily supply for make up purposes. . . . The Committee is not aware of any localities in Great Britain where natural supplies of condensing water of the magnitude indicated above can be obtained at the pit's mouth or in proximity to collieries and it is impracticable to transmit so large an amount of water over any considerable length of pipe. . . ."

In 1925 the matter was considered by the Coal Commission, which took evidence as to the practicability of having large generating stations located at the collieries. Then in 1926 the Board of Trade appointed the National Fuel and Power Committee to consider and advise upon questions connected with the economical use of fuels and their conversion into various forms of energy. This Committee made the following observation :

"The generation of electricity at the pit head is at first so very attractive that it is frequently advocated ; but consideration of all the relevant factors makes it evident that the cheapness of low grade fuel in a colliery district does not necessarily make it desirable that electricity for general public supply should be generated there. The determination of sites for future capital stations is in the hands of the Central Electricity Board, and the Electricity Commissioners and the Central Electricity Board will naturally take its supplies from the most economical stations. Where circumstances favour the erection of a station of large capacity in a colliery district there is no doubt that the saving in the transport of coal will give such a station added advantage. But the choice of a site for a generating station to supply a central network depends on a balance of considerations. The larger the capacity of the station, other things being equal, the lower is the cost of generation. The cost of transmission and distribution are also of importance and a station in the centre of a body of large consumers has an advantage in this respect. . . . It appears to us therefore that the question whether the Power Station should be at the pit or away from it or whether the colliery power station should be larger than is required to supply the colliery's own requirements or indeed whether the colliery power station is in any given case necessary at all, or whether the energy should not be taken from the national system must be decided on the merits of each particular case, having regard to local and district conditions. . . . We recommend that the possibility of the use of low grade fuel should be carefully considered when the site of any new electricity generating station is under consideration and when the plant for the station is designed and that the desirability of making any necessary adaptations of plant for the use of such fuel should be considered even for the existing stations. . . ."

It is fifteen years since the Nitrogen Products Committee issued its report, and Prof. Baily's answer to the criticism contained in it in regard to cooling towers, is that with the higher steam pressures now in use the reduction in efficiency due to the lower vacuum obtained with cooling towers is often exaggerated, and he mentioned the Hams Hall Station at Birmingham with a fuel consumption of 1·35 lb. per unit and an overall thermal efficiency of 23·34 per cent, in support of his contention. The Battersea Station on the Thames, Clarence Dock Station on the Mersey, and the Ironbridge Station on the Severn, may be mentioned as typical examples of coal-burning stations located at suitable centres. All three have a thermal efficiency exceeding 26 per cent, and no doubt this will be improved upon by the time any pit-head station is connected to the Grid.

The magnitude of the water problem may be judged by the fact that about 500 tons of water is circulated for every ton of coal burned, and last year more than 10½ million tons of coal were consumed at the stations of electricity supply authorities. There has been an improvement in recent years in the efficiency of cooling towers, but that improvement is scarcely sufficient to justify Prof. Baily's claim that "the absence of cooling water can be definitely disregarded as a disability in the use of pit-head stations".

The lower operating efficiency with cooling towers and higher capital cost, amounting to £100,000 in Prof. Baily's 100,000 k.w. station, are items which are not likely to be disregarded by those engineers who are responsible for the building of new stations or the extension of existing ones.

The suggested saving of one-twentieth of a penny per unit generated at the pit-head will suffer a further reduction when the cost of lines to connect it with the Grid are added. Prof. Baily suggests that transmission cost will be small, but sub-station equipment and duplicate lines would be necessary, and the cost in some cases considerable. The above-mentioned additional costs can, of course, be arrived at within close limits, but how is the price of 'waste' fuel having a calorific value of 10,000 B.Th.U. per lb. to be stabilised at 5*s*. a ton ? With generating stations built for the purpose of utilising this low-grade coal, it might become a main product, and with an increased demand the price would surely rise unless some agreement were made to keep it sufficiently low to enable the pit-head station to compete successfully with existing stations. In theory it is an attractive plan to use low-grade

fuel, cut out certain waste at the collieries and generally improve their efficiency, but the merits of such a scheme must rest on economic facts.

Prof. Baily bases his main comparison on stations working on a load factor of 40 per cent, but in future there will be two types of station in operation, the base load station working on a load factor of something of the order of 80 per cent and peak load stations operating on a poor load factor. Into which category are the pit-head stations to be put ?

We think there may be individual cases where a pit-head station will compare favourably with an existing selected station, but we can see no substantial evidence to justify any general scheme which would reduce the number or render redundant the existing base load stations. As soon as it can be proved that the pit-head generating station is capable of supplying energy to the Grid at a price below that of the most modern stations now connected to it we believe that : (1) capital will be found for such a station ; (2) the Central Electricity Board will be prepared to enter into a contract to purchase the whole of the station output ; and (3) the Electricity Commissioners will give their consent.

International Conference on Physics

SOME time ago, the Physical Society became convinced that results of value could be anticipated from an international conference on atomic (particularly nuclear) physics, and it was the intention of the Society to call such a conference this year. At the same time, the British National Committee for Physics—one of the constituent bodies which together form the International Union of Pure and Applied Physics—proposed to invite the Union to hold its next meeting in Great Britain.

It was a natural step to amalgamate these two functions, and the six-day meeting on October 1–6 has amply demonstrated the wisdom of that step. It was, we believe, the first occasion on which a meeting of the International Union had taken the form of a colloquium, and it brought together a most impressive array of physicists of note from many countries. The actual membership was nearly 600, of whom some 150 came from abroad. The international nature of the conference was perhaps best illustrated when an Italian, speaking in French, gave to the mainly English audience an account of recent work by a German who was unable to attend in person. The meeting was held in London in the rooms of the Royal Society and at the Royal Institution, and in addition, at the invitation of Lord Rutherford, one session was held at the Cavendish Laboratory, Cambridge.

The more formal business of the International Union included the ratification of a report on symbols and definitions, with which we hope to deal later, and the election of Prof. Niels Bohr to succeed Prof. R. A. Millikan in the presidential chair. In addition to this, the Union was responsible for the organisation of a discussion on certain problems of the solid state. In crystals, there is much evidence tending to show that, over and above the lattice regularity revealed by X-rays, there is a further definite structure, on a larger scale. The existence of such a block or mosaic structure was much debated, but assuming it to exist, it becomes a question of great interest to decide whether it is present inevitably, as a consequence of the need for the potential energy to become a minimum, or whether it is fortuitous, and due to something in the nature of flaws distributed statistically. The theoretical question involved here was discussed in one form or another at several of the meetings, and it seems likely that a solution will at least be expedited by the interplay of ideas and by consideration of the numerous suggestions made.

The most immediately obvious point about crystals is their lack of tensile strength, as compared with the value to be expected on theoretical grounds. The difference for rock-salt, for example, is about a thousand-fold, and two rival theories are in existence to account for this. One theory is that outlined above ; the other locates the weaknesses at cracks on the surface of the specimen. This crack theory receives strong support from many experiments where surface treatment alone has been found to alter the tensile strength considerably ; perhaps the most striking illustration is the discovery by Joffé and others, that the strength of rock-salt is increased twenty-five fold by merely carrying out the experiments in hot water. Of course, it must be borne in mind that a block structure might still exist, even if not needed to explain this particular fact. Much of the evidence for a block structure rests on data obtained by studies of plastic yielding, as well as on chemical facts and microscopic examination.

That part of the conference for which the Physical Society was directly responsible concerned itself with certain aspects, mainly experimental, of the recent advances in nuclear physics. It is true that fifteen years have elapsed since Lord Rutherford first succeeded in demonstrating that certain nuclei could be disintegrated by

bombardment with sufficiently swift α-particles, but at that time the products observed were always protons. We thought that nuclei were made up of protons and (negative) electrons. A few years ago, nuclear reactions were studied, using as projectiles not α-particles, but protons accelerated by means of intense electric fields produced for the purpose. This development was rapidly followed by the use of the newly discovered neutrons as bombarding particles, leading again to further nuclear reactions. Meanwhile, spectroscopy had given clear evidence of the actual existence of the hydrogen isotope of mass 2, and it was not long before this was separated, and its ions used as bombarding particles. At the same time, it was realised that the cosmic radiation with which space appears to be permeated, whether it is corpuscular or of wave-character, forms a powerful source with which Nature is continually carrying out disintegration experiments. Thus we may bombard any element with protons, deutons, neutrons, photons (including γ-rays) or α-particles, and may as a result obtain any one or more of these, either with or without ordinary negative electrons.

Even this, however, does not exhaust the list of particles. In certain reactions, the positive electron appears as a product. This is most clearly demonstrated in Wilson cloud-chamber photographs taken in magnetic fields, where the curvature of the track gives immediate evidence of the sign of the charge, whilst the nature of the track makes its electronic character evident. This particle is emitted as a product by the new radioactive elements discovered recently by M. and Mme. Joliot. These elements, which have lives varying from less than a minute to a few hours, are produced from ordinary elements by bombardment with neutrons, and there is no reason to suppose that the list of them is by any means complete. Indeed, Fermi has given reasons for supposing that, by bombarding uranium with neutrons, he has succeeded in producing a new element which is neither uranium itself, nor any of the five or six which immediately precede it in the periodic table. Consequently he suggests that it may be the element of atomic number 93 or 94, until now unknown.

As to the reactions which may occur in these various bombardments, it seems, as pointed out by Lord Rutherford, that practically any transmutation occurs (though the probabilities of the different reactions naturally differ) provided only that it is consistent with the energy laws. In this connexion, of course, a knowledge of the so-called 'mass-defects' is of primary importance, since they are so intimately related to the energy changes, in consequence of the Einstein law $E = mc^2$. Among these mass-defects, many are known with great accuracy from measurements with the mass-spectrograph or otherwise, but there is one particle, the neutron, for which the value of the mass-defect is uncertain.

This uncertainty is particularly regrettable since the values suggested lie on opposite sides of the mass of the proton, and consequently the relative stability of the two particles cannot properly be assessed. The higher of the two values put forward at the Conference depends on the assumption that, if one and the same element can be obtained as a product in two different reactions with the same initial reactants, then the energy content of that resultant is the same in both cases. Whilst the assumption is a reasonable one, yet the existence of certain isotopic isobars (isotopes with the same mass number) with different energy contents seems almost proved, when these are obtained in different reactions. If this can occur when the end-product arises from two different reactions, it may possibly turn out to be true that the isotopic isobars obtained by different mechanisms in a single reaction will also differ in energy, in which case the lower value for the mass of the neutron would hold the field.

It was suggested by Gamow at the Cambridge meeting of the Conference that the two forms of a single isotope referred to above might be explained if we could introduce another (not yet observed) particle, the negative proton, since in that case one form could contain a positive and a negative proton where the other contained two neutrons.

Even when we have added the negative proton to our list of particles, it is not complete. There is the 'neutrino', introduced by Fermi to maintain the conservation of energy, momentum and spin in β-ray emission. This particle, which is uncharged, has been discussed by several authors, all of whom conclude that its mass is much less than that of the electron.

Other papers, with which space does not permit us to deal, were concerned with the nature of the cosmic rays, which, besides being powerful agents in causing nuclear reactions, must of course be the products of such reactions, and are therefore to be studied also from that point of view.

In addition to the formal meetings, the social side was well cared for, and, further, many an informal discussion took place, which must certainly not be overlooked when we try to assess the scientific value of the Conference. All who attended seem agreed in hoping that another such meeting may be held in due course, and they will be well satisfied if it is equally successful.

J. H. A.

Obituary

Dr. Berthold Laufer

THE death is reported of Dr. Berthold Laufer, of the Anthropological Department of the Field Museum, Chicago, and one of the foremost authorities on the art and antiquities of China. Berthold Laufer was born in Cologne on October 11, 1874, and was educated at the University of Berlin and at Leipzig, where he took his Ph.D. in 1897. In 1898–99 he travelled in Siberia as a member of the Jesup Expedition to the North Pacific and in 1901–4 was in China with the expedition of the Eastern Asiatic Committee. In 1904 he joined the staff of the American Museum of Natural History, New York, where he remained until 1908, acting, from 1905 until 1907, as a lecturer in anthropology at Columbia University. After spending the two years 1908–10 in Tibet and China with the Blackstone expedition, he was appointed in 1911 a curator in the Anthropological Department of the Field Museum, Chicago, a position which he retained until his death. He continued to travel in China at intervals during this, the most fruitful period of his life, and the collections of the Field Museum benefited enormously not only from his success as a collector of objects of ancient Chinese art, but also from his unrivalled knowledge of Chinese antiquities.

One of Laufer's most successful journeys was that on which he led the Marshal Field Expedition to China in 1923. His knowledge of the history of the domesticated plants and animals of China proved invaluable to the mission sent out by the National Research Council under the U.S. Department of Agriculture. Laufer was a voluminous writer, and produced a large number of very fully illustrated monographs on Buddhist and Tibetan literature, and Chinese archæology and ethnology, of which the best known are perhaps those dealing with ancient pottery, bronzes, jades and precious stones.

Laufer was exceptionally gifted as an orientalist, and his knowledge of the Chinese language and literature was of the greatest assistance to him in his work on Chinese antiquities; but in his writings on Chinese culture, whether dealing with objects of art or with the common objects of everyday life, such as agricultural implements or domesticated plants, he showed that he had at his complete command a wide range of knowledge of the material culture of other peoples of the world. While this added to the scholarly character and the value as comparative studies of his work, it led him at times, in the view of some, to be over-bold in speculation.

Mr. H. A. Allen

Henry Attwool Allen, a former member of the staff of H.M. Geological Survey, died on October 3 at the age of seventy-nine years. Since 1919 he had been living in retirement at Eastbourne. Allen joined the Geological Survey as a temporary officer in 1875, and was attached to the Palæontological Department (then under the late Mr. E. T. Newton) in 1892, with the old title of 'assistant naturalist'. Here he was occupied with curatorial work on the fossils in the Museum at Jermyn Street, London, and he compiled several useful lists of types and figured specimens. These lists were published in successive numbers of the "Summary of Progress" of the Survey. He also took part in the identification of fossils collected during the progress of the Survey, his work in this direction being incorporated in sundry memoirs.

Before his retirement, Allen was a well-known figure on excursions of the Geologists' Association, and for some years acted as editor of the *Proceedings* of that body. He served on the Council of the Geological Society in 1911–15.

News and Views

The Retirement of Prof. A. Fowler, F.R.S.

A complimentary dinner to Prof. A. Fowler on his retirement after fifty-two years' association with the Royal College of Science, South Kensington, was held at the Imperial College Union on October 9. Dr. H. Dingle, assistant professor of astrophysics at the College, occupied the chair, and among the assembly, in addition to many old students and colleagues and the Rector of the College, Mr. H. T. Tizard, were representatives of a number of scientific societies, including Sir James Jeans, president, and Prof. W. W. Watts, president-elect, of the British Association; Prof. F. J. M. Stratton, president of the Royal Astronomical Society, Prof. H. H. Plaskett, Savilian professor of astronomy, Oxford, and Prof. Allan Ferguson, secretary of the Physical Society. In an eloquent speech proposing the toast of the guest of the evening, Dr. Dingle gave an outline of Prof. Fowler's career from the time when he entered the College as a scholarship student at the early age of fourteen and a half years to his appointment as Yarrow research professor of the Royal Society in 1923 from which he is now retiring. During almost the whole of this period, Prof. Fowler has been engaged in experimental research in spectroscopy, and his laboratory has become the chief centre of such work in the world. He is a leading authority on the identification and reproduction of celestial spectra, and his intuition and knowledge revealed in spark spectra series of lines which have fundamental significance in connexion with modern theories of the atom. In supporting the toast, Sir Richard Gregory said that metaphorically Prof. Fowler had for fifty years been listening to celestial language and music and had been successful in reproducing many of the fundamental notes, as well as analysing the over-

tones into a regular sequence. After hearing the morning stars singing together in their glory for so long, it was no wonder that they had influenced his character and made him to his many admirers only a little lower than the angels. The Rector of the College, Mr. Tizard, afterwards presented Prof. Fowler with an illuminated address, together with a writing desk, chair and a silver tea-tray from past and present colleagues.

New Science Buildings at Cambridge

FOUR important additions to the scientific laboratories at Cambridge will be available for public inspection on October 22, the occasion of H.M. the King's visit to open the new University Library. All, however, will have been in use since the commencement of the Michaelmas term, so that there will be no ceremony. These buildings, in so far as they are concerned with research, are paid for under a generous scheme agreed to with the Rockefeller Trustees, but, in addition, the University has built new teaching laboratories for the Zoological Department, the two top floors and part of the basement of its new school representing the Rockefeller contribution. The new wing for physiology is a building about 70 ft. by 50 ft. and 60 ft. high with five floors, of which the lowest is a theatre to hold 280 students. The first floor is devoted to pharmacology, and the second to chemical aspects of physiology, while the top floors represent advanced teaching and research ; this wing gives the Department a total accommodation for more than forty research workers. Botany has received a 60-ft. extension of its previous building. The addition comprises an advanced lecture room and library extension on the ground floor. Half of the first floor is devoted to palæobotany, while the remainder of this floor and the second floor form a Sub-Department of Mycology, the top floor falling to advanced physiology. Agriculture has a new building largely devoted to offices, etc., but the Rockefeller scheme here is invaluable in the assistance given to research in animal physiology, in soil research and in statistics, among other subjects. Zoology retains its old Museum wing unaltered, but otherwise has an entirely new building with novel features that are likely to cause it to be most extensively visited on October 22. Rooms have been assigned in it to fifty-seven workers engaged in research work.

The Male Sex Hormone

ORGANIC chemists are well accustomed to spectacular results from the researches of Prof. L. Ruzicka and his school. Yet the artificial production of the male sex hormone recorded in the October number of the *Helvetica Chimica Acta* by Ruzicka, Goldberg, Meyer, Brüngger and Eichenberger probably transcends in interest any previous publication from the Zurich laboratories. Adopting the hypothesis of Butenandt, who first isolated and characterised the testicular hormone, that this substance is a hydroxyketone closely related to the sterols, Ruzicka and his collaborators examined the neutral fractions arising from the chromic acid oxidation of the acetate of dihydrocholesterol and some of its stereoisomerides. The removal of the sterol side chain by such oxidations has long been used for the identification of the side chain, but previous investigators had been unable to isolate the major fragment of the molecule. This has been achieved by Ruzicka, and the hydroxyketone resulting from *epi*dihydrocholesterol proved to be completely identical with the male hormone (androsterone) isolated by Butenandt. By this simple experiment, the structure of a complex natural product has been completely elucidated and its stereochemical relationship to the sterols established. Apart from speculation, the only previous chemical knowledge of the hormone was that it was a saturated hydroxyketone of the probable formula $C_{19}H_{30}O_2$. It is unfortunate that this conversion of cholesterol into androsterone should be described by the investigators as a 'synthesis'.

THE simplest biological test for the male hormone is its effect in promoting comb-growth in capons, and in this respect the artificial substance proved as effective as the natural hormone. A remarkable feature is the specificity of the hormone. Of the four stereoisomeric hydroxyketones obtained by the oxidation of dihydrocholesterol, *epi*dihydrocholesterol, coprosterol, and *epi*coprosterol, those from the last two compounds had no influence on the comb-growth of capons in daily doses of 1000 γ ; that from dihydrocholesterol required daily doses of 500 γ for comb-growth, whereas the artificial hormone (from *epi*dihydrocholesterol) gave a response with daily doses of 70 γ.

The Chemist and Warfare

MR. J. DAVIDSON PRATT, secretary and general manager of the Association of British Chemical Manufacturers, addressing the Glasgow Section of the Society of Chemical Industry on October 5, discussed the part to be played by the chemist in schemes of national defence against attack from the air. He said that, in spite of the Geneva Protocol prohibiting the use of gas in war, it is necessary that the general public should be instructed in methods of defence, since some nations in signing the Protocol have made it clear that they would use gas if an adversary used it first. Gas used against an uninstructed civil population has a demoralising effect, but the publication of highly alarmist articles on the subject of poison gas attacks from the air by people whose knowledge of the subject is very limited is most undesirable. Mr. Pratt referred to the work which would fall to the chemist in the event of an air raid. He would have to be on the spot to identify the gas used, and would be required to decide quickly whether an area would require to be decontaminated or not, as some types of gas would be quickly swept away by the wind while other types would persist for a considerable length of time. The best method of defence for the civil population is the provision of gas-proof shelters, and every building should contain a gas-proof room. The chemist's advice would be required in selecting and fitting these rooms.

MR. PRATT then discussed the attitude of chemists to chemical warfare. He said that it has been suggested that chemists should bind themselves together and refuse to have anything to do with the manufacture of material which could be used in warfare. It has been stated that this scheme is not practicable because the chemical profession in most countries is not sufficiently organised and that it would require the co-operation of every nation, whereas the League of Nations itself has shown that it is impossible to get complete agreement on any matter of international policy. Another objection is that, in some countries, every citizen has to do as he is told, and in any event, in war, a man's first duty is to his country. In spite of these objections, Mr. Pratt insisted that the idea is worthy of further consideration because the alternative is so appalling that the chemist might well destroy the civilisation which he has been instrumental in creating, unless he insists that his inventions are not used for warlike purposes.

National Planning in Industry

THE need for sound national planning of industrial effort was emphasised in an address delivered before the Birmingham Group of the Institute of Industrial Administration on October 4, by Mr. Harold Macmillan, M.P., president of the Institute. Mr. Macmillan said that we have moved into a new economic society. The conditions of the nineteenth century world have passed away. In the old world Great Britain had great advantages. It was a pioneer nation and the workshop of the world, and on the whole the system was very satisfactory for the greater part of the nineteenth century. In the period preceding the War Great Britain exported capital to foreign countries, financed the market for its own exports and very largely developed the world. That system was very satisfactory while it lasted, but it has largely changed and to-day's problems have arisen almost entirely as the result of that change. The War quickened the pace, and the world has largely industrialised itself, economic nationalism prevails, and the balance of the world has been overthrown. The potential capacity to produce has increased at a rate far more rapid than the market to absorb.

AFTER referring to directions in which the War impeded British industry, Mr. Macmillan said that we have to face realities, and must not be content any longer to try to return to the past. We have to consider on what prosperity depends. It is the maintenance of certain balances—the balance between production and demand, and the monetary balance between the rate of saving and the rate at which savings re-enter a market in the form of investments. He does not think industrialists should be content to go on as industrialists in the same way as they did in the last two or three generations. Industrialists then did not bother themselves very much about monetary standards, but the last ten years have taught them how deeply concerned they are. National self-sufficiency is everywhere increasing. International trade barriers have to be overcome if the standard of living is not to fall. Unco-ordinated competition among ourselves for the home market weakens resources for obtaining export trade. Capital must contribute by acquiescence in a planned industry, and by demanding high professional standards from management. Management has to contribute by the more efficient co-ordination of functional activities and the elimination of waste in every form, and labour has to contribute by full co-operation resulting from a greater confidence in an industry so planned and conducted.

Friedrich Tietjen, 1834-95

THE centenary occurs on October 15 of the birth of the German astronomer Friedrich Tietjen who, in 1881, with Tisserand, E. C. Pickering, Tempel and Gylden, was made a foreign associate of the Royal Astronomical Society. Born in a village in the duchy of Oldenburg, Tietjen left school at the age of fifteen years to work on his father's farm, but some years later, having relinquished his right to the farm, he was able to attend the Universities of Göttingen and Berlin, and in 1862 at twenty-eight years of age became an assistant under Encke at the Berlin Observatory. Three years later, he became first assistant to Foerster, Encke's successor, and this post he held until 1874. In 1866 he discovered a minor planet, and in the same year, with Albrecht, carried out geodetic operations in connexion with the Mid-European Survey. In 1868 he went to the East Indies with Spörer and Engelman to observe the solar eclipse of August 18. An indefatigable worker and a remarkably facile computer, in 1874 he was made editor of the "Berlin Jahrbuch" and four years later succeeded Bremiker as editor of the "Nautisches Jahrbuch". With Foerster he also managed a school of instruction in scientific computation. He died at the age of sixty years on June 21, 1895, having suffered from ill-health for several years.

Nazi Philosophy and Truth

IT would be difficult to find a more complete and cynical indifference to freedom of thought and intellectual expression than appears in the speech, as reported in the *Times* of October 6, delivered by Dr. Frank, the Reich Commissar for Justice, on October 4 to the joint meeting of the Association of German Jurists, the Foreign Political Department of the Nazi Party and the teachers of economics in universities and other places of higher education. Dr. Frank is reported to have said: "as the pursuit of knowledge is the service of truth it must necessarily be service to National-Socialism. We insist that the unity of the philosophy which lies at the basis of National-Socialism must not be challenged by anybody." The exclusive and inviolable identification of philosophic truth with the principles and ideas of a dominant political faction, has a familiar ring which would have provoked no surprise had it come from the mouth of a politician, but its uncompromising terms are startling when uttered by a commissar for justice, who has been responsible for the recent reorganisation of jurists throughout Germany. More was to follow. Dr. Frank went on to say, "Our aim

must not be originality or novelty in books, but the promotion of national welfare, of national safety, of national wealth and national solidarity. There must be no more battles of theory among you." He goes on to bid the teachers of law and economics show the way to German intellectual life by their good example. By a strange perversion of logic, policy dictated by political expediency is made the touchstone of truth and teaching, research and speculative thought are to be conditioned by predetermined conclusions, outside the terms of which they may not stray. The restrictions placed on the study of race and the history of culture are evidently now to be extended to jurisprudence and economics.

Clinical Research at Guy's Hospital

THE governors of Guy's Hospital and the governors of Guy's Hospital Medical School have accepted an invitation from the Medical Research Council to co-operate in the establishment of a new 'unit' for scientific research work in clinical medicine. It has been agreed that the Council will provide the salary of a whole-time director and of his assistants, with the cost of all apparatus and research material used by the unit. For its part, the Hospital will provide suitable laboratory accommodation free of charge, and will place and maintain beds at the disposal of the director: the latter is to be *ex officio* a member of the visiting staff, with a seat on the Medical Committee and the committees of the Medical School. These arrangements are to be effective for a period of five years in the first instance. Dr. Ronald T. Grant, hitherto working in the service of the Council in the Department of Clinical Research at University College Hospital, London, has been appointed director of the new unit. The invitation was issued to Guy's Hospital by the Medical Research Council in accordance with its general policy of improving the facilities available in Great Britain for the scientific study of disease in the human subject, and with this end in view of increasing the number of higher appointments for whole-time workers in this field. The financial resources which the Council is able to apply to the purpose are those which were released when the senior post formerly maintained by the Council at University College Hospital, and held by Sir Thomas Lewis, received permanent endowment through the generous action of the Rockefeller Foundation.

Electrical Launching Gear for Lifeboats on the *Queen Mary*

THE electrical generators of the *Queen Mary* have a total capacity of about 10,000 kilowatts. There are in addition two 75 kilowatt generating sets driven by Parsons oil engines, which can be used for emergencies. Messrs. Samuel Taylor and Sons, Ltd., of Brierly Hill, Staffs, are supplying all the launching gear for the lifeboats. It includes twenty-four sets of gravity davits and winches. These davits run down inclined trackways carrying the boat with them until they finally reach their outboard position, when the boat is lowered from the davit head into the sea; the whole operation is done without stopping, the motive power being gravity. The cradle holding the boat is made in two portions, the carriage and the arm. The two portions run down the track bodily, after which the arm swings out of the carriage until the boat attains the outboard position and the lowering begins. There is no jerk anywhere, the motion being continuous. The movement of the davit is controlled by an electric winch mounted on a deck house. The winches are fitted with patent speed-sustaining brakes which limit the lowering speed of the lifeboats to one foot per second. For raising the lifeboats, after they have been lowered for any reason, such as lifeboat drill, the electric motors are used. Limit switches are provided which check the movement when the davits reach their inboard position and the interlocks make it impossible for the operator to make a mistake.

Mining in Great Britain

THE thirteenth annual report of the Secretary for Mines for the year 1933 from the Mines Department, which includes as usual the annual report of the Chief Inspector of Mines, has recently been issued (London: H.M. Stationery Office, 1934. 3*s*. 6*d*. net). The most important statement in this report is to be found in a review of the British coal-mining industry, which states that "Signs of an improvement in the position of the British coal-mining industry were evident in the latter part of 1933". This is a very satisfactory statement as showing that the coal production of the country is at last recovering from the serious slump that has affected it for so long. It must not, however, be supposed that all the difficulties have been overcome, because the report goes on to state that work at the pits was most irregular and that the prices of British coal were slightly lower than in the previous year. It is shown that various trade agreements made with different Governments of Europe have resulted upon the whole in an advantage to the coal trade of Great Britain. It is satisfactory to find that the utilisation of coal and the products derived from it are on the increase, and that serious attention is being given to the question of the use of compressed gas for motors. The statement, though now old, that during November 1933 the Secretary for Mines opened the first public filling station for vehicles using compressed gas, is repeated in the report, and it is decidedly interesting to have it thus authoritatively stated. It is obvious from the report that the mining of iron improved during 1933, the increase in the output being more marked in the second half of the year than in the first, as in the case of coal. The remainder of the report of the Secretary for Mines is not of great scientific importance, although his summary of the results obtained in the various testing stations is of a certain amount of public interest. The report of the Chief Inspector of Mines is, as usual, mainly of importance for the numerous tables which it presents.

Weekly Weather Reports

THE *Weekly Weather Report* of the Meteorological Office, Air Ministry, for the period February 28,

1932–February 25, 1933, in the British Isles, is the fifth of a new series that began with vol. 45, published in 1929; the introduction to that volume explained the changes introduced in the new series. The week is commonly regarded as the unit of time best suited to the needs of agricultural meteorology, and this report is designed in other respects with the same needs in mind—for example, 'accumulated temperature', which is calculated with 42° F. as base, above which many forms of plant begin to grow, and statistics of ground frosts, that is, frosts registered by a thermometer set on the grass and freely exposed to the sky as are the upper surfaces of the leaves of the topmost sprays of plants, are among the items included. The tables are set out in such a way that the whole year's succession of weekly data for a single station occupy one page. There are 57 stations, well distributed throughout the British Isles; these are also grouped into twelve so-called 'districts', and the deviations of the various meteorological elements, temperature, rainfall and sunshine, from normal values of these elements for a long period (generally 1881–1915) are averaged so as to give 'district values'. The district values are set out for individual weeks, and these are grouped into the four seasons, for each of which there is an appropriate seasonal mean deviation from normal. The season under review was one of generally deficient sunshine with more than the usual rainfall. The data for the Midlands and for the eastern districts of England and Scotland would be suitable in a study of the agricultural results of a wet spring, as that season was notably wet in those districts.

Investigation of the West Kennet Avenue, Avebury

Mr. Alexander Keiller has reported briefly in *Antiquity* of September on the results of an examination of the West Kennet Avenue, which leads from the Great Circle of Avebury to the Stone Circles on Overton Hill, undertaken recently with the view of determining its exact line. The Avenue has never been excavated scientifically; and in the spring of the present year operations were begun in a field about five hundred yards long near the middle of the course. Eight stones were still visible there, as well as one stone, which had never fallen, and one which had been re-erected by Mrs. Cunnington in 1912. The work began in April, and was planned to occupy three seasons. Fallen stones, or stones discovered beneath the surface, are being re-erected in the original holes as the work proceeds. Up to the time of writing, one buried stone, of which the previous existence had been unsuspected, and one fallen stone had been re-erected. In all, eight stone-holes have been discovered on the eastern side of the Avenue and eleven on the western side. One stone hole, despite careful searching, remains undiscovered. It is thought that the stone for which it is sought may not have penetrated the sub-soil, as the soil at the point where this stone most probably stood is unusually deep. Four other buried stones have been found and on three of these are markings which may be inscribed ornament. Post holes for timber uprights of which traces remain may, it is thought, represent a habitation site. The associated pottery is of the type known as Neolithic *B*, that is, Peterborough, which in this region belongs to the secondary occupation of the neighbouring Windmill Hill. Two finds of foreign stone, broken polished axes, are of augite-granophyre from Graig Llwyd. This occurs only at Penmaenmawr, North Wales, and previously only three specimens had been recorded outside Wales, one being from Windmill Hill, and equating with Neolithic *B* pottery.

Experimental Soil Science

The experimental study of the soil is so essential a branch of courses in agriculture, horticulture, botany and biology, that it seems a pity it is rather neglected, especially in the last two subjects, from elementary school courses up to courses in the universities. Most textbooks of botany, for example, devote little space to soil science in spite of the fact that the soil is the sole environment responsible for the physiological, biological and edaphic factors affecting one of the most important organs of the normal plant, namely, the root. We would therefore direct the attention especially of teachers of elementary biology and botany to an article on the experimental study of the soil by Dr. B. A. Keen, assistant director of Rothamsted Experimental Station, in *School Nature Study*, vol. 29, No. 117, October 1934. The author describes 18 experiments with a running commentary divided into four sections: what is meant by soil; organic matter; mineral matter; and separation of soil constituents. The paper is also published separately as Leaflet 22, copies of which can be obtained at 2½*d*. each, or 2*s*. a dozen, from Mr. E. G. Clarke, 7 Stanley Avenue, Wembley, Middlesex.

Gulls Destroy Grasshoppers

It is surprisingly seldom that one comes across telling examples of the activity of birds as destroyers of harmful insects. F. Bradshaw records an interesting experience in Canada, on the west side of Last Mountain Lake, east of Liberty, Saskatchewan (*Canadian Naturalist*, **48**, 68, April 1934). On June 18, 1933, he observed there what in the distance appeared to be a cloud of smoke, but on nearer approach turned out to be enormous flocks of the black-headed Franklin's gull. They alighted in column formation and gorged upon an army of grasshoppers. The number of birds present could not be estimated closely, but the column of close-set birds was a mile in extent and sixty birds in width, and two miles to the south-west an even larger cloud of gulls was seen. Estimates suggest that a Franklin's gull might devour 500 grasshoppers daily; the protective value of a flock, which at a very conservative estimate numbered more than a million, is, therefore, of considerable moment.

Giuseppe Peano

Among the eighteen papers in the *Rendiconti del Seminario Mathematico e Fisico di Milano* (**7**, 1933), the longest, and, to the general reader, most interesting, is an account of the scientific work of G. Peano of Turin (1858–1932). His publications, numbering

more than two hundred, ranged over pure and applied mathematics, logic, philosophy, grammar, comparative philology, international languages, and even politics. Some early papers dealt with the algebra of invariants. He then turned to calculus and differential equations. His 'space-filling curve' has been described as one of the most remarkable results in the theory of aggregates. The investigations of the foundations of geometry and arithmetic are of great importance, but his crowning achievement is his system of mathematical logic, with its elaborate symbolism (the 'Peanese' ridiculed by Poincaré), which has been used in England by Russell and Whitehead. Peano applied his logical methods to grammar, and this led to other linguistic studies, including the invention of the international language Interlingua. As a contrast to his abstract work may be mentioned his methods for the approximate solution of problems in practical mathematics. He stands out in the history of science as one of the few modern thinkers who have combined profound originality with a wide range of activities.

The Indian Mathematical Society

THE jubilee commemoration volume of the *Journal* of this Society contains, in addition to the usual research papers, an account of the history of the Society. It began in a very modest way in 1907, when Mr. V. Ramaswamy Aiyyar, then deputy collector at Gooty, formed the "Analytical Club", the object of which was to subscribe for mathematical periodicals and circulate them among the members. In 1909 appeared the first number of the *Journal*. By the end of 1910, the name of the Society had changed twice, first to the "Indian Analytical Club" and then to the "Indian Mathematical Society". The number of members, originally about twenty, is now nearly three hundred. A central library is maintained at Poona, and conferences are held biennially in different parts of India. The Society is conducting an inquiry into the present conditions of mathematical teaching and examinations in schools and colleges, with the view of introducing certain reforms, and is also trying to set up prizes for research. It is considering the advisability of dividing its *Journal* into two parts, an advanced part for the publication of research papers, as at present, and a new elementary part, similar to the *Mathematical Gazette* or the *American Mathematical Monthly*. The achievement of which the Society is most proud is the discovery of the great Indian mathematician Ramanujan, whose contributions began to appear in the *Journal* in 1911. In the present volume, the place of honour is given to two papers developing Ramanujan's results.

The Automatic Telephone

WE think that an elementary knowledge of automatic telephony is almost a necessity to every well-educated young man. We therefore welcome the brief description in pamphlet form of the processes involved in making a call on the automatic systems of the British Post Office. It forms an excellent supplement to the demonstrations given daily on the automatic telephone equipment installed at the Science Museum by the Post Office. The various ways in which a call can be made are described and illustrated by four simple diagrams. It is possible with the aid of the pamphlet to understand the main features of automatic telephony without going too deeply into technicalities and manufacturing expedients. The pamphlet (price 6*d*.) is published by H.M. Stationery Office, and is useful for reference.

Regulations for the Electrical Equipment of Buildings

THE Institution of Electrical Engineers has just published the tenth edition of its regulations for the wiring of buildings. The ninth and preceding editions were entitled the "I.E.E. Wiring Rules". This publication is very opportune, for the wide use of luminous discharge tubes and 'all electric' receiving sets has introduced several new problems as to the necessary requirements and precautions required for ensuring satisfactory results and providing immunity from fire and shock. The regulations do not take the place of a detailed specification but are supplementary to it. We think that any wiring system which complies with the instructions laid down in this little book (price 1*s*.) will be found satisfactory. The Wiring Regulations Committee has obviously taken great pains in its preparation. The definitions of the technical terms used are clear and the instructions for testing the completed installation are very good.

Congress of Anthropological and Ethnological Sciences

THE September issue of *Man* is devoted to the first session of the International Congress of Anthropological and Ethnological Sciences which was held in London on July 30–August 4. A group photograph in three sections of the members of the Congress forms the frontispiece of the issue, and a general survey by Prof. J. L. Myres, one of the general secretaries, opens the report. Full summaries are given of Lord Onslow's presidential address on "Anthropology in Administration" and of the Huxley Memorial Lecture by Sir Aurel Stein, as well as of the evening discourses delivered by Prof. T. C. Hodson on the census of India, by Dr. R. R. Marett on the tendency of anthropological studies and by Prof. J. B. S. Haldane on "Anthropology and Human Biology". The proceedings in each of the eleven sections among which the work of the Congress was distributed are briefly reported either by the sectional president or the secretary. As some delay is inevitable before the volume containing the full account of the proceedings with abstracts, etc., is available, this very full report is not only welcome, but also will be extremely useful for purposes of reference until a more authoritative source is available.

Boots Pure Drug Company's Medical Products

MESSRS. BOOTS Pure Drug Co., Ltd., Nottingham, have issued a small booklet about the therapeutic uses of medicinal glucose or anhydrous dextrose. Glucose is usually given by mouth but may be administered by rectum or intravenously. Its great advantage over other forms of carbohydrate in the

diet is that it is absorbed without change and so provides an easily assimilable foodstuff. The list of indications for glucose therapy is lengthy, including acute infections, conditions of malnutrition and more specifically hepatic toxæmias and insulin hypoglycæmia. The gonococcus vaccines issued by Messrs. Boots Pure Drug Co., Ltd., are prepared in the Department for Venereal Diseases at St. Thomas's Hospital, London. Three types of vaccine are available—a simple emulsion of gonococci, a detoxicated vaccine, making it possible to inject with safety a considerably larger dose, and also a mixed vaccine of gonococci with streptococci, staphylococci, diphtheroids and coliform bacilli, organisms commonly found in gonorrhœa complicated by secondary infection. The organisms in all vaccines are killed by the addition of 0·5 per cent phenol. The vaccines appear to be of distinct value in the treatment of all gonococcal infections, although it may be advisable to defer their use until the acute symptoms of urethritis have subsided. The number of organisms in the vaccines ranges from 200 to 10,000 million per c.c.

Announcements

THE Council of the Institution of Civil Engineers has made the following awards: Baker Gold Medal to Ralph Freeman (London). For papers read and discussed at ordinary meetings: Telford Gold Medals to Dr. J. J. C. Bradfield (Sydney, Australia) and to Ralph Freeman (London); Webb Prize and Telford Premium to W. E. Gelson (Delhi); Indian Premium to J. D. Watson (Lahore); Telford Premium jointly to Ralph Freeman (London) and Lawrence Ennis (London); Telford Premium jointly to E. F. Law (London) and Vernon Harbord (London); Manby Premium jointly to J. F. Pain (Winchester) and Gilbert Roberts (Margate); Trevithick Premium jointly to R. W. Foxlee (London) and E. H. Greet (Iver, Bucks.). For papers published without discussion as "Selected Engineering Papers": Telford Premiums to E. F. Reid (London); jointly to F. W. H. Stileman (Weybridge, Surrey) and J. S. Young (Perth, Australia); to E. H. Bateman (Birmingham); to A. C. Gardner (Glasgow); to W. G. Morrison (London); to B. C. Hammond (Worcester); Crampton Prize to G. M. T. Rees (Gerrards Cross, Bucks.). The Charles Hawksley Prize has been awarded to H. G. Cousins (London) and the Coopers Hill War Memorial Prize to F. V. Appleby (Brighton).

THE Carnegie Institution of Washington, Washington, D.C., has issued its annual catalogue of publications (pp. xlv+131). A few copies of each publication are reserved for sale at prices below printing cost, and price lists or classified lists may be obtained upon request.

THE National Council of Social Service would be very grateful for gifts of second-hand microscopes and telescopes. There are four training centres at which selected unemployed men are instructed in subjects which can be carried on in the Clubs to which they belong. There is a strong desire for instruction in scientific subjects and there are no funds wherewith to buy the instruments. Gifts should be sent to the Secretary, National Council of Social Service, 26 Bedford Square, W.C.1.

A SERIES of 'class' catalogues of the books in the Library, including the Departmental Libraries, of the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, is in course of preparation, the first of which has just been issued. This contains the books in Class B (Natural Science). University theses are included, but not periodical publications and pamphlets. The works are classified under subject headings which in many cases are duplicated, and are arranged chronologically by date of publication. The entries are abbreviated to the barest essentials, and an alphabetical index to the subjects represented in Class B is appended. The work will be sent gratis upon request to the Librarian.

MESSRS. HUTCHINSON'S Technical and Scientific Book Co. are publishing a new "Technical and Scientific Encyclopædia" under the editorship of Messrs. C. F. Tweney and I. P. Shirshov. It is being issued in about forty weekly parts (1*s.* 6*d.* a part); and Part 1, which has just appeared, contains 48 double-column pages. The type is small but clear, the headings stand out plainly, and many of the short descriptive articles are accompanied by useful diagrams. It is proposed to cover the whole field of science as it is applied in industry. The editors have secured the services of a very competent panel of contributors, each of whom deals with his own particular subject. A list of standard books and papers on each subject is promised in the concluding parts.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An instructor in the Department of Mechanical Engineering, Leeds College of Technology—The Director of Education, Education Offices, Leeds (Oct. 15). An executive engineer in the United Provinces Service of Engineers (Irrigation (Hydroelectric) Branch)—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Oct. 20). A lecturer in veterinary hygiene at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the Council, County Hall, Chelmsford (Oct. 24). A principal and head master of the Gravesend Technical Institute and Junior Technical School—Mr. W. A. Clench, Bank Chambers, Windmill Street, Gravesend (Oct. 27). A lecturer in biology at the Warrington Training College, Wavertree, Liverpool, 16—The Principal. An assistant conservator of the museum of the Royal College of Surgeons of England, Lincoln's Inn Fields, W.C.2—The Secretary (Nov. 8). Research workers to take charge of nutritional research under the Indian Research Fund Association at Coonoor—The High Commissioner for India, India House, Aldwych, London, W.C.2 (Nov. 30). A water and drainage engineer for the Simla Municipality—The Secretary, Municipality, Simla, India (Dec. 10). An assistant for work in connexion with research in aeronautic instruments in the Directorate of Scientific Research, Air Ministry—The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants.

Letters to the Editor

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Thermal Decomposition of Acetaldehyde

IN the note which I contributed on behalf of the workers in my laboratory to the discussion at the meeting of the Royal Society on May 10, it was stated that our results showed that the rate of thermal decomposition of acetaldehyde was influenced by the state of the surface of the silica, which was contrary to the conclusion arrived at by Hinshelwood and Hutchins[1], who had stated that the process was "practically entirely homogeneous". When I had read my note, Mr. Hinshelwood commented on my statement, and according to the report of the meeting which has just been published said,—"In our experiments the decomposition of acetaldehyde is an absolutely homogeneous reaction unaffected by the character of the vessel." A reply demanded reference to the actual facts recorded by Hinshelwood and Hutchins, and I proposed to look up the paper and submit one in writing, but I was not permitted to do so. As Mr. Hinshelwood built up his hypothesis on the results of these and similar experiments, it is worth while considering how far his deductions are legitimate, and I take this opportunity of making a few observations regarding them.

In the paper to which I have referred, it is stated that in two experiments carried out at 518°, in which two different silica bulbs were used, values of the velocity constant were obtained, (I) 0·333 0·352, (II) 0·350 0·349, showing a maximum difference of only 3 per cent. When one of these tubes was packed with silica chips, the values of the constant obtained were 0·461 0·477, the maximum increase being 43 per cent. In experiments at 464° the value for the constant with the empty bulb was 0·049 and for the packed bulb 0·066, the increase being 35 per cent. The authors argue that because the surface of the silica chips represented an area of some twenty times that of the empty bulb, the increase in the velocity constant is negligible. They assume that the effect of unit area of the broken silica and of the fire-polished surface of the tube are identical, which is not in accordance with experience. These experiments merely show that with different tubes treated in a similar manner one may obtain almost identical results, but that the effect of surface is not negligible. With this we are in perfect accord. Certainly the data do not justify the statement that the thermal decomposition of acetaldehyde is "absolutely homogeneous".

Mr. Hinshelwood's suggestion that the effect of surface would only be observed at low temperatures is negatived by subsequent experiments in my laboratory. His second suggestion that our experiments were affected by the condensation of oxygen on the walls of the reaction tubes is not supported by the facts. It is our invariable practice to fill a reaction tube with hydrogen, and to heat it overnight to about 600°. It is then exhausted while hot, cooled, and the measured quantity of acetaldehyde vapour is condensed in it, after which it is sealed. There is no chance of oxygen coming into contact with the surface. The removal of oxygen from liquid acetaldehyde, in which the gas is very soluble, is a very difficult matter. It was effected by distilling the liquid *in vacuo* at low temperature through a series of vessels sealed together, and finally condensing it in the filling apparatus without contact with air.

The pre-treatment of the tubes with hydrogen for some hours enables one to obtain concordant results in the case of most reactions when using the same tube, but only in the case of very few reactions with all the tubes used. Indeed, out of a large number of reactions which we have studied, only in the case of the pyrolysis of ethane-ethylene-hydrogen equilibrium mixtures does the effect of surface appear to be practically negligible. Even in this case I should not care to use the word "absolutely", even in the broadest and most popular sense. The criteria of surface action are very obscure, and two or three experiments with similar tubes, treated in an identical manner, are insufficient to determine whether the influence of surface is material or not. The experiment described by Dr. A. Farkas at the recent meeting of the British Association, in which D_2 was replaced by H_2 by heating it in a silica tube which was supposed to be completely degassed by the usual high temperature and high vacuum treatment, suggests caution in dealing with the results of gas reactions carried out in silica apparatus.

Actually the main difference between our experimental results and those which I have discussed lies in the fact that, in one case the reaction rates are measured by observing the rate of formation of methane, which requires detailed analysis, and in the other they are deduced from the total rise of pressure, from which it is not possible to eliminate the effect of side reactions.

M. W. TRAVERS.

University of Bristol.
Sept. 16.

[1] *Proc. Roy. Soc.*, A, **111**, 384.

Human Daily Requirements of Dietary Ascorbic Acid

EARLIER investigations[1] on insane, but physically healthy, experimental subjects, who have been forcibly tube-fed owing to their refusal to take nourishment, have established certain relations between the protective dose of an antiscorbutic required by man and the protective dose of the same antiscorbutic required by a guinea pig, on the view that the degree of susceptibility to microscopic scorbutic alterations in the teeth in guinea pigs and the pre-scorbutic reduction in the strength of the cutaneous capillaries in man are approximately the same. On the basis of this result, further experiment showed that, in order barely to protect himself against the earliest onset of a shortage of vitamin C, an adult weighing 60 kgm. requires a daily dose of an antiscorbutic (fresh orange juice) fourteen to twenty times as large as a guinea pig weighing one third of a kilogram requires barely to protect itself against scorbutic alterations in the teeth which can be determined microscopically. In a further investigation, these facts have been utilised to establish indirectly man's daily requirements of ascorbic acid by means of experiments on guinea pigs.

Of thirty guinea pigs with initial weights between

260 gm. and 336 gm., three were put on each of ten different doses of ascorbic acid, increasing regularly by 35 per cent, of the following amounts : 0·4, 0·54, 0·73, 1·0, 1·33, 1·80, 2·42, 3·27, 4·4, 6·0 mgm. The ascorbic acid was a crystallised preparation from the Chinoin factory in Ujpest.

The basal diet in the guinea pig experiments was of the following composition :

48	parts	of crushed oats.
24	,,	,, wheat bran.
15	,,	,, dried skim-milk powder autoclaved for 2 hours at 110° C.
10	,,	,, melted and strained butter-fat.
2	,,	,, raw egg yolk.
1	,,	,, sodium chloride.
0·1	,,	,, Osborne's nutrient salt.

The diet was given for 50 days. A fresh solution of ascorbic acid was prepared every day and given to the animals by means of a pipette graduated in 0·01 c.c.

At the end of the experimental period, the microscopical investigation of the molar teeth[2] showed that microscopic prescorbutic alterations were found up to 1·0 mgm. dose, but that they were absent with the 1·33 mgm. dose and with the larger doses, while protection against *macroscopical* scorbutic alterations had been reached with 0·5 mgm. 1·33 mgm. is thus the smallest dose of ascorbic acid which insures protection to the guinea pig against microscopical prescorbutic alterations in the molar teeth.

If, on the basis of this result, a calculation is made using the relation previously ascertained between the ascorbic acid requirements of man and the guinea pigs, it is found that the smallest daily dose of ascorbic acid which, given *per os*, protects a person weighing 60 kgm. against the slightest objectively ascertainable prescorbutic alterations—those in the capillaries—is 19–27 mgm.

GUSTAF GÖTHLIN.

Laboratory of Physiology,
University, Uppsala.
Sept. 4.

[1] G. F. Göthlin, *Skand. Arch. Physiol.*, **61**, 252–259 ; 1931.
[2] G. F. Göthlin, *Acta Medica Scandinavica*, Supp. 53, 22–26; 1933.

Action of Oestrin on the Coagulating Glands and on certain Vestigial Structures in the Mouse (*Mus musculus*)

THE appearance of a squamous keratinising epithelium in the coagulating gland of the mouse following the prolonged administration of oestrin has been recorded by Lacassagne, de Jongh, and Burrows and Kennaway. In these earlier observations, the effects observed were regarded as occurring in the prostate. More recent work by the author has shown that the organ characteristically affected in this way is the coagulating gland, the separate nature and function of which were first discovered by Walker in 1910.

Under the prolonged influence of oestrin this structure becomes converted into a sac lined by stratified, keratinising epithelium. The wall of such a sac resembles microscopically that of the vagina and is capable of undergoing alterations which recall those of the oestrous cycle as occurring in the latter organ. If the administration of oestrin be stopped, the stratified, keratinising epithelium disappears from the coagulating gland and is replaced by a single layer of cuboidal cells which resume their normal function ; that is to say, they secrete a fluid which coagulates the contents of the seminal vesicles immediately after ejaculation. Coincidentally with these restorative changes the gland ceases to retain the obvious form of a sac, its walls again becoming much plicated as in the normal state.

A metaplasia similar to that mentioned above has also been observed in two other situations in male mice which have undergone prolonged treatment with oestrin.

(*a*) In some mice—though not in all—which have had long-continued treatment with oestrin a sac has been found on the dorsal aspect of the prostatic urethra between the distal ends of the vasa deferentia and projecting towards the peritoneal cavity immediately behind the urinary bladder. Such sacs, the largest hitherto observed measuring 13 mm. × 13 mm. × 10 mm., are lined by a stratified, keratinising epithelium, and, like the uterus in the female after similar treatment with oestrin, are distended by clear fluid. The lower ends of the vasa deferentia are displaced by these sacs and the coagulating glands are closely associated with their lateral walls. It seems probable that these sac-like structures should be regarded as representing the utriculus masculinus, persistent in some individuals only and rendered manifest through the action of oestrin. Rauther states that, in the new-born mouse, between the distal ends of the vas deferens there is a small slit-like vesicle ending in two short tips. This he regards as a utriculus masculinus. He affirms, however, that no remnants of Müller's ducts are to be found in the adult mouse. Regarding this statement, which is contradictory to Leuckart's observations, it may be remembered that vestigial structures show some inconstancy in their persistence and post-natal development, and any generalisation as to this persistence in the adult of a particular species can be made only after the examination of a large number of individuals.

(*b*) Recently, in a mouse which had undergone treatment with oestrin for a period of 62 days, a structure, consisting of a number of tubules lined with squamous epithelium and filled with keratinised material, has been found in connexion with the epididymis—where vestiges of the cranial end of Müller's duct might be expected. The plane dimensions of this structure in a microscopic section are 2 mm. × 3 mm.

The foregoing observations suggest, subject to further inquiry, that oestrin may perhaps have a specific action on structures derived from the Müllerian apparatus, and may be of value in the study of certain embryological problems. In connexion with such a hypothesis is the possibility, which awaits proof, that the coagulating glands are in fact derivatives of the Müllerian ducts. These glands open into the dorsal wall of the prostatic urethra close to the orifices of the ejaculatory ducts on their cranial side—a position which seems compatible with such an origin.

HAROLD BURROWS.

Research Institute,
Cancer Hospital (Free), London.

REFERENCES

Burrows, H., and Kennaway, N. M., *Amer. J. Cancer*, **20**, 48 ; 1934.
Jongh, S. E. de, *Acta Brevia Neerl.*, **3**, 112 ; 1933.
Lacassagne, A., *C. R. Soc. Biol.*, **113**, 590 ; 1933.
Leuckart, R., *Göttinger Studien*, 259 ; 1847.
Rauther, M., *Jenaische Z. Naturwiss.*, 377 ; 1904.
Walker, G., *Johns Hopkins Hosp. Bull.*, **21**, 182 ; 1910.

Science at the Universities

MR. TIZARD'S address[1] to Section L (Educational Science) of the British Association calls for certain comments. In view of the existing unemployment among scientifically trained men and women, he calls for a reduction in the number trained in future, and suggests that it is a good policy deliberately to keep the supply somewhat short of the demand, at least in the case of biologists. This may be economically sound from the point of view of persons already trained in biology, who would thus acquire a scarcity value, like those pigs which have survived the recent massacre of their species in the United States.

But is it a sound policy from the point of view of the community, and should a biologist regard himself as a mere commodity? Whatever may be the case with engineering, I submit that training in pure science has value of another kind. A century ago the founders of this College wrote[2]: "It is rather for another class of sciences, the knowledge of which is not profitable to the possessor from the pecuniary point of view, but which exert a great influence on the well-being of society, that such an Institution was required." I find little trace of this idea in Mr. Tizard's address. Yet I believe that it is still true, and that a training in biology is of value not merely for success in science, but also for success in citizenship.

Whether or not this is true, many students, who are interested in science for its own sake, believe that they are regarded as mere commodities. This belief is one cause of the spread among them of revolutionary views, in which I fear Mr. Tizard's address, if it is taken as expressing the general views of university authorities, will go far to confirm them.

J. B. S. HALDANE.

University College,
London, W.C.1.
Oct. 2.

[1] NATURE, **134**, 405, Sept. 15, 1934.
[2] Report of Council, 1833.

The Philosophy of Sir James Jeans

DR. JEFFREYS and I do not always agree; but I want to support him against H. D., who misses the point[1]. If in the days of the 'old' physics, there was in existence a 'philosophy' applicable to the 'new', that is evidence that there is not nearly as much difference between the old and the new as Jeans, Eddington and their followers pretend. That is what Dr. Jeffreys and I maintain; the argument is unaffected by the number of people who held the 'philosophy'.

I want to support him too concerning the neglect of inference. Indeed, I would go further than he. The only way to discover what science means is to study how its conclusions are reached. Interpretations of science that are not based on a theory of inference are worthless. Unfortunately, Dr. Jeffreys and I differ concerning inference; and so, at the risk of self-advertisement, I want to point out that his argument, restated above, supports my view.

My doctrine of inference, expounded in my "Physics", depends on an essential distinction between laws and theories, which everyone else ignores, and leads to a particular view of the logical structure of theories. The doctrine was based on a study of the 'old' physics; but Dirac's great book (which is the Bible of the 'new') might have been written (of course it was not actually written) to illustrate the doctrine. Dirac starts, as I said he should, in defining his 'hypothetical ideas' and stating his 'hypothesis'; he then formulates his 'dictionary' in a separate section. The only difference between a typical 'old' theory (such as the kinetic theory of gases) and a typical 'new' theory is that the 'analogy' is mechanical in the former, mathematical in the latter. But, as I pointed out, there were mathematical theories even in the old days.

NORMAN R. CAMPBELL.

155 Hagden Lane,
Watford, Herts.
Sept. 28.

[1] NATURE, **134**, 499, Sept. 29, 1934.

Cosmic Rays and the Earth's Potential

IN a recent communication[1] I have outlined a theory of the origin of cosmic rays in which the earth is regarded as a magnetised sphere carrying an electric charge, and the cosmic rays as charged particles which are drawn to it by electrostatic attraction. I find, employing the dynamics of relativity, and assuming that the particles possess small energies at great distances from the earth, that the theory leads to the following conclusions: if the earth, regarded as an isolated sphere, has a potential of 3×10^{10} volts, particles bearing a single atomic charge can reach it only at magnetic latitudes greater than 60°, while if its potential exceeds $1{\cdot}5 \times 10^{11}$ volts, the earth's magnetic field does not greatly influence the geographical distribution of the intensity of the radiation. Consequently, the particles should arrive at the earth's surface each with an energy the value of which expressed in electron volts lies between these limits. A potential of 6×10^{10} volts is just sufficient to bring the particles to the magnetic equator.

Calculations by Lemaître and Vallarta[2], who suppose the earth to be magnetised but uncharged, and the particles to be projected towards it from all directions, afford the values 10^9 and 5×10^{10} electron volts for the corresponding limits of the energies.

It is significant that Kolhörster[3] has detected cosmic rays in a salt mine and concludes that the minimum energy of the primary cosmic rays must exceed 10^{11} electron volts, while Compton[4] states, "Regarding the more penetrating component, we must conclude that if they are electrified particles, they must have an energy of 3×10^{10} electron volts or more".

In addition to affording satisfactory numerical agreement with these observations, the theory of a charged earth gives a simple explanation of the fact that cosmic rays arrive with equal intensities from all regions of the heavens, so that it is unnecessary to adopt the somewhat unsatisfactory hypothesis that space is filled with particles moving with vast energies in all directions.

With the earth at a potential of 7×10^{10} volts, the particles would arrive at the equator at an angle of 60° with the vertical from a westerly direction if positively charged, but from the east if they carry negative charges, so that there exists a possibility

of testing the theory by experiment and also of determining the sign of the earth's charge, should the theory prove correct.

Details of the calculations and other aspects of the theory are given in a paper which will appear elsewhere.

I have found since writing my first communication[1] that the hypothesis of a radial cosmic electric field, with the earth near its centre, had previously been suggested by T. H. Johnson[5] in an attempt to account for his observation that the primary corpuscular radiation is exclusively positive.

L. G. H. HUXLEY.

University College,
Leicester.
Sept. 15.

[1] NATURE, **134**, 418, Sept. 15, 1934.
[2] *Phys. Rev.*, **43**, 87; 1933.
[3] NATURE, **132**, 407, Sept. 9, 1933.
[4] NATURE, **131**, 713, May 20, 1933.
[5] *Phys. Rev.*, **45**, 569; May, 1934.

Distortion of the Crystal Lattice of α-Brass

WHEN a metal is cold-worked, its X-ray spectrum is modified. In most cases, this modification includes a diffusion of the diffraction lines. If the diffused lines are photographed in an X-ray camera giving high dispersion, and analysed with the aid of a microphotometer, it is found that, in general, the broadening does not take place symmetrically about the normal position of the line.

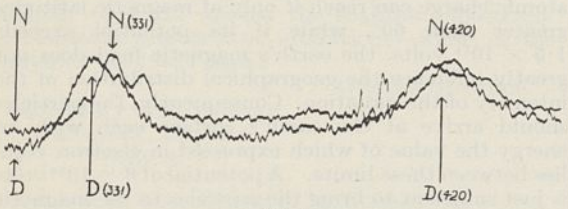

FIG. 1.

This observation is illustrated by the accompanying microphotometer record (Fig. 1). It is selected from results obtained on specimens of α-brass which have been cold-rolled to different degrees. The curve marked *N* shows the trace of the (331) and (420) lines of the spectrum; these are given by a normal annealed specimen. That marked *D* is the corresponding trace, taken on the same record, from the same specimen but after deformation has occurred. For convenience of illustration, the photographic negatives were placed in the microphotometer carrier in such a way that the (420) line of the normal specimen was made to fall directly above that of the cold-worked specimen. It is seen that the (331) line of the latter is then definitely displaced relatively to the normal (331) line; it differs in position and in intensity distribution.

This means that the deformation of the metal is accompanied by a change in the average size and shape of the unit cell, and by a change in the latent energy of the crystal lattice.

W. A. WOOD.

National Physical Laboratory,
Teddington,
Middlesex.
Sept. 14.

Raman Spectrum of Nitrosylsulphuric Acid

THE structure of nitrosylsulphuric acid is being investigated by Raman spectra. The acid was prepared by bubbling sulphur dioxide into specially purified nitric acid to which a small amount of glacial acetic acid had been added. A solution of nitrosylsulphuric acid in commercial 100 per cent pure sulphuric acid was examined using a Hilger Raman spectrograph and Ilford New Double X-Press plates. The spectrum obtained after $6\frac{3}{4}$ hours exposure was rich in Raman lines. Raman displacements of 424, 549, 730, 915, 1043, 1181 and 1378 cm.$^{-1}$ were obtained. These clearly arise from the sulphuric acid and are in good agreement with previously recorded values. In addition, a number of other lines due to the nitrosylsulphuric acid were present; most of these were faint, but one corresponding with a displacement of 2340 cm.$^{-1}$ had an intensity comparable with the intensities of the sulphuric acid lines.

Further work is in progress, and a full discussion of the results will be published elsewhere.

W. ROGIE ANGUS.
A. H. LECKIE.

Sir William Ramsay Laboratories of
Inorganic and Physical Chemistry,
University College,
London, W.C.1.
Sept. 20.

Denitrification in Sunlight

THE ordinary denitrification taking place in the absence of oxygen and in presence of an easily oxidisable organic substance and a nitrate effected by many micro-organisms, is well known. There is another variety of nitrogen loss, which takes place in presence of oxygen, but has not yet been satisfactorily explained. It will be evident that this loss of nitrogen from the soil, which may amount to double the quantity of nitrogen taken up by plants, is due to an oxidation process followed by a photochemical and catalytic decomposition.

J. G. Lipman and A. W. Blair[1] have shown that nitrogen in the gaseous state is lost from soils when the conditions are favourable for oxidation. The loss amounted to 100 lb. per acre per year in the first nine inches of the soil, both in New Jersey and California. In these experiments, the conditions existing in the soil in the past were disturbed by making the soil suitable for more oxidation. Similar nitrogen losses have been observed at Rothamsted, Minnesota, Kansas, Indian Head (Saskatchewan), Nagpur (India) and other places. Nearly 70 per cent of the added nitrogen is said to have been lost when wheat plots in Rothamsted have received 14 tons of farmyard manure containing 200 lb. nitrogen. These losses are more pronounced in soils which have been highly aerated.

That the oxidation of ammonium salts is an important factor in this type of denitrification is also evident from the following observations. Niklewski[2] reported that when the manure was free from nitrifying bacteria, only 3 per cent nitrogen was lost as ammonia but when supplied with nitrifying bacteria, the manure lost more than 20 per cent of its nitrogen. Moreover, Russell and Richards[3] have observed a greater loss of nitrogen when a manure was composted under aerobic than anaerobic condition. Vishwa Nath[4] has obtained greater nitrogen loss and velocity of oxidation in the nitrification of

ammonium salts than with farmyard or green manure. Moreover, the total amount of nitrate present in soils with crop is less than that in neighbouring fallow soils, even when correction is applied for the amount of nitrate taken up by the crop. Neller[5] has concluded that much more rapid oxidation takes place in the soil with growing plants than in the uncropped soils under identical conditions.

These observations on nitrogen loss can be explained from the following considerations: The soil invariably contains some ammonium salts. By the process of nitrification, which is an oxidation reaction, the ammonium salts are first oxidised to nitrite. In other words, ammonium nitrite may be produced in the soil when a supply of air is available. Dhar[6] has observed that solutions of ammonium nitrite decompose into nitrogen and water when exposed to sunlight, and this photochemical decomposition is facilitated by acids and different solid surfaces. Recently we have carried on several experiments by exposing solutions of ammonium salts alone and mixtures of ammonium salts and sodium nitrite mixed with sterilised or unsterilised soil or surfaces like TiO_2, ZnO, Fe_2O_3, etc., to sunlight, and we have observed marked decomposition of the ammonium nitrite in light. The loss of nitrogen in the dark is always much less than in light. Similar decomposition of ammonium nitrite formed temporarily in the soil from the processes of ammonification and nitrification is likely to take place in Nature. This decomposition of ammonium nitrite in the soil will be more evident when virgin or prairie soils are ploughed for cultivation. The organic nitrogenous compounds present in the soil have a chance to be oxidised first to ammonia and then to nitrite and finally to nitrate by the increase of aeration effected by ploughing.

It seems that in the soil, normally the processes of ammonification and nitrification can go on simultaneously, and thus at a certain stage in the processes of oxidation, ammonium nitrite may be generated, and this being an unstable substance specially in presence of light and the soil surface acting as a catalyst, will decompose with the liberation of gaseous nitrogen. Moreover, when the nitrogenous manure is in large amount and there is sufficient aeration, the possibility of the formation of the easily decomposable ammonium nitrite is increased. For the production of ammonium nitrite in the soil, aeration is necessary and that is why Russell and Richards observed more marked loss of nitrogen in aerobic than anaerobic conditions as already reported. In tropical countries, the formation and decomposition of ammonium nitrite formed in the soil are marked because of the high temperature and strong sunlight; like sunlight, high temperature also facilitates the oxidation of nitrogenous compounds and the decomposition of ammonium nitrite. The greater loss of nitrogen in cropped soils than in uncropped ones is evident from the fact that there is more oxidation taking place in soils with growing crops than in fallow lands.

This process of denitrification can be minimised by the addition of carbonaceous substances, which retard the oxidation of nitrogenous compounds.

N. R. DHAR.

Chemical Laboratories,
Allahabad University,
Allahabad, India.

[1] *Soil Sci.*, **12**, 1; 1921.
[2] *Roczników Nauk Rolniczych*, **9**, 1; 1923.
[3] *J. Agric. Sci.*, **10**, 22; 1920.
[4] *Sci. Reports, Dept. Agric. Madras*, 1930–31.
[5] *Soil Sci.*, **10**, 29; 1920.
[6] *Proc. K. Akad. Wetensch. Amsterdam*, **23**, 308; 1920.

The Fungus on *Zostera marina*

THE fungus *Ophiobolus halimus*, which has recently been described as parasitic on *Zostera marina* L., has this summer been discovered on this plant in the British Isles. It has been found in several localities in Devon (Plymouth, Cawsand, River Yealm, Salcombe), the north coast of Guernsey and Lough Ine, Ireland. Dr. E. J. Butler has compared the British material with authentic specimens of *O. halimus*, Diehl et Mounce, recently described on *Z. marina* on the Atlantic coast of North America[1], and finds it to be identical with the Canadian material.

It was at first thought that this fungus might be *O. maritimus*, Sacc. (*Rhaphidophora maritima*, Sacc.), which is stated by Saccardo to grow on *Zostera*, but inquiries instituted by Mr. A. D. Cotton led Prof. E. Ulbrich, of Berlin, to re-examine the type specimen collected by Magnus, when it was found that the fungus occurred on a leaf of a grass, probably *Elymus*, but certainly not *Zostera*. This identification was afterwards confirmed at the Kew herbarium, where the type specimen was sent on loan. The incorrect statement that *O. maritimus* occurred on *Zostera* was due to an error by Saccardo, for Magnus expressly states on his label that the habitat was "unter *Zostera*", not "auf *Zostera*". Taking into account the morphological differences in the description, there can be, therefore, no question of the fungus which is at present so abundant on *Zostera marina* being *O. maritimus*, Sacc.

Assuming that Dr. H. E. Petersen's recent note[2] refers to *O. halimus*, the known distribution of this newly described fungus is as follows: parts of the Atlantic coast of North America (not in the Woods Hole district[3]), Ireland, south-west England, Channel Islands and Denmark.

The widespread occurrence of the fungus on *Z. marina*, and its absence on *Z. nana*, Roth (at least in the Plymouth neighbourhood), suggests that *O. halimus* may perhaps be partly responsible for the disappearance of *Z. marina*, but it is impossible to make any definite statement at present as to this. Experiments on its pathogenicity are in progress at the Marine Biological Association's laboratory at Plymouth.

T. G. TUTIN.

The Laboratory,
Citadel Hill,
Plymouth.
Sept. 13.

[1] Mounce, Irene, and Diehl, W. W., "A New *Ophiobolus* on Eelgrass", *Canadian J. Res.*, **11**, 2, 242–246; 1934.
[2] Petersen, H. E., "Wasting Disease of Eelgrass", NATURE, **134**, 143; 1934.
[3] Renn, C. E., "Wasting Disease of *Zostera* in American Waters", NATURE, **134**, 416; 1934.

Alleged Stimulation of Moulds by Paraffin in Heavy Water

IN a letter to NATURE of July 21, Dr. R. Klar suggests that the increased growth of moulds in 0·5 per cent heavy water observed by Meyer[1] and by Larson[2] was produced by an unsuspected paraffin impurity. A brief consideration of the facts, however, will show that such an explanation is untenable. Organic matter of paraffin nature influences the growth of certain moulds and bacteria (*Penicillium*, *Actinomyces*, tuberculosis bacteria) solely by serving as a source of carbon (Rahn[3], Büttner[4], Haag[5], Tausson[6], Hopkins and Chibnall[7]) and consequently

a trace of paraffin would be without effect in the experiments of Meyer and Larson in which an abundance of more suitable carbon sources is present. Haag[5] writes: ". . . Bacterien wachsen auf den Paraffinstückchen nicht, wenn andere Kohlenstoffquellen (Glyzerin, Zucker) vorhanden sind". In Meyer's tests sucrose was added as a carbon source and in Larson's experiments the moulds were growing in the tissue of the flatworms. It is inconceivable that a trace of paraffin could account for the sixteenfold increase in dry weight of *Aspergillus* reported by Meyer.

Dr. Klar states, "it is clear that the water used . . . was twice-distilled", but it is not clear to us how he is in a position to describe our technique, which was not mentioned in the communication. As a matter of fact, the 0·5 per cent heavy water is stated by the manufacturer to contain 0·01 per cent alkali and a trace of organic matter. We therefore distilled five times, including twice from concentrated permanganate, and we fail to see how any significant impurity could survive this treatment and exert an effect under conditions in which salts and organic nutrients are added to both the heavy water and controls. Moreover, we found that 0·06 per cent heavy water was without a noticeable effect on moulds even after being in contact with rubber stoppers coated in paraffin.

The results with moulds are supported by the greater length of life of *Spirogyra* and Planaria and the slight slowing down of zymin and pancreatin to which results the paraffin explanation could not be applied. Also, Richards[8] has found an increase in dry weight of yeast in our dilute heavy water.

I do not doubt Dr. Klar's experiments showing that paraffin in the absence of other material may support the growth of certain moulds—indeed, this has been known for more than a quarter of a century.

T. CUNLIFFE BARNES.

Osborn Zoological Laboratory,
Yale University.
Sept. 7.

[1] *Science*, **79**, 210; 1934.
[2] NATURE, **133**, 873, June 9, 1934.
[3] *Centralb. Bacteriol.*, Pt. 2, **16**, 382; 1906.
[4] *Archiv. Hygiene*, **97**, 12; 1926.
[5] *ibid.*, **97**, 28; 1926.
[6] *Biochem. Z.*, **193**, 85; 1928.
[7] *Biochem. J.*, **26**, 133; 1932.
[8] *Amer. J. Bot.*, **20**, 679; 1933.

Mitogenetic Radiation of the Urea-Urease System

ALL fermentative processes hitherto investigated have been found to be accompanied by mitogenetic radiation; but owing to the complexity of the substrata and the mechanism of splitting, it is not always possible to attribute radiation to a certain phase of fermentative splitting. Therefore it is of interest to study radiation in rather a simple system. We have chosen the system of urea-urease.

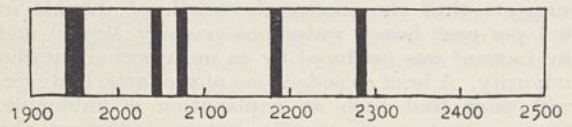

FIG. 1.

The ferment has been obtained from an extract of soy bean flour deprived of fat and urea, used in 5 per cent solution. The methods of investigation and in particular those of spectral analysis have been the usual ones employed in our laboratory and recently described in Prof. Gurwitsch's recent monograph[1].

The spectrum of radiation (Fig. 1) has been established on the basis of about three hundred experiments. The whole mitogenetic region has been broken up into strips of 10 A. width.

In a number of other experiments in our laboratory, it has been ascertained that all substrata subject to fermentative disintegration are also capable of emitting secondary radiation when irradiated by mitogenetic rays. Urea is no exception, and by radiating it we have succeeded in obtaining the secondary radiation of approximately the same intensity as in the case of the fermentative process.

The full details of our results will be communicated elsewhere.

E. G. PROKOFIEWA.

Institute for Experimental Medicine,
Leningrad.
Aug. 20.

[1] "L'Analyse mitogénétique spectrale". Paris: Hermann et Cie., 1934.

Bird Migration and the Red Sea

THAT change of temperature has little to do with bird migration is well illustrated by the fact that flocks, apparently of ducks, are seen as early as the middle of August, moving south past the Biological Station of the University of Egypt at Ghardaqa just south of the entrance to the Gulf of Suez. Not only are they beginning their migration when it is warmest in the north, but also, a few days after passing here, they enter the hot part of the Red Sea, where, in August, conditions are truly dreadful from the human point of view.

I write in order to point out the excellent position of this Station for observation on this fascinating subject. The Red Sea is evidently a main route, and appearances suggest that at this point two lines cross, a north to south-west line via Sinai and the Nile, and the main line north-west to south-east along the Red Sea coast. I have neither the leisure nor qualifications for making adequate notes, but no one can see this wonderful sight without wishing that regular and detailed observations should be made.

C. CROSSLAND.

Marine Biological Station,
Ghardaqa.
Aug. 27.

Ionic Product of Heavy Water

A PRELIMINARY determination of the dissociation of heavy water, by measurement of the electromotive force of cells containing pure deuterium electrodes in solutions of KOD and DCl in heavy water containing 95·5 per cent D_2O, has given the result that K_W for D_2O is of the order of one third the ionic product for ordinary water, at the same total ionic strength (0·1 and 0·05). It is proposed now to use the same method for an accurate determination.

B. TOPLEY.
W. F. K. WYNNE-JONES.

Frick Chemical Laboratory,
Princeton.
Aug. 18.

Research Items

Metal Images from Southern India. Mr. T. B. Nayar has recently published (*J. Annamalai Univ.*, 3, No. 1) an account with illustrations of three metal images from a Śaivite shrine, called Pāśupetēśwarar Kovil, at Tiruvēṭkaḷam, South Arcot, Madras. The images are said to have been excavated from a mound a few yards southward of the present shrine within the memory of the great-grandmother of the present hereditary priest. Local tradition credits the place with Arjuna's penance, and an annual festival is celebrated here for two days in the month of May–June. The chief interest of the festival is a fight between men dressed as hunters and men dressed as Arjuna. The festival, however, is of recent growth and not more than twenty-seven years old. The first of the three metal images is that of Kirātārjuna-mūrti, that is, Siva as he appeared to Arjuna in the story of Arjuna's penance. Representations of the penance are rare in art and few images of Siva in this manifestation, either in stone or metal, are in existence. The image here described is 23·2 in. high and is made of copper, cast solid by the cire perdue process. The figure wears the sacred thread and a loin-cloth tightly wrapped and kept in position by a decorated belt or girdle. Its arrangement is unique in South Indian metal figures. The figure stands with the weight on the left leg, the right arm raised at right angles, holding the arrow, the left arm being raised vertically from the plane of the shoulder as if holding the top of a bow. An oval ring fringed with tongues of flame surrounds the image. When excavated, this figure had the figure of Arjuna on its left and a broken image of Indra on its right, both engaged in sockets. If this statement be correct, the image of Indra is difficult to explain. Verification is not possible, as the figure was destroyed for its metal. The arrangement is not known in any other South Indian examples. The figure of Arjuna wears no thread, and the loin-cloth is kept in position by three bands, below which is an arrangement of two sashes, characteristic in certain sculptures.

Shamanism in North America. In a study of shamanism in North American society by Mr. Leonard L. Leh (*Univ. Colorado Studies*, 21, No. 1), the position and functions of the shaman are surveyed in each of the regional areas of Amerindian culture in turn. The shaman in some form existed throughout North American society, notwithstanding the great variety of cultures. It was not, however, everywhere the same thing. The background is the supernatural world which the Indians believed to control their destinies. In some tribes, the guardian spirit concept was sufficient to explain all the powers of the shaman, as, for example, among the Eskimo, the Algonkin and the Plains Indians. Among the Eskimo, Tlingit and others the shaman might have a number of such guardian spirits. In part of the Californian area, however, this idea was poorly developed, or absent. In addition, the shaman might have to be trained by other shamans, or undergo a period of preparation as an additional qualification to the vision in which the spirit appeared to him. He might become a shaman by initiation—a method developed to a high degree among the Central Algonkin. In general, both men and women might become shamans, though in the south-west it was not often that a woman took on the full burden of shamanistic powers. There was throughout a marked tendency for shamanism to run in families : but over a large part of the continent there was no restriction to prevent anyone becoming a shaman. The function of the shaman was to compel the supernatural powers to serve human needs, healing the sick being the most common. The shamans were also capable of causing sickness. Not all the various functions of a shaman were performed by all the shamans in a tribe. There were specialists—prophets, seers, rain-makers and so forth. Originally the shaman does not appear to have been a public functionary, but the tendency was for the shaman to become socialised, with a quasi-public position, and later for them to form an organisation.

Madras Fisheries. The administrative report for the year 1932–33 by the director, Dr. B. Sundara Raj, describes the activities of the Department, which include research in marine fisheries, minor marine and estuarine fisheries of prawns and edible oysters, inland fisheries, fish breeding, pearl and chank fisheries, with inspections, besides a large amount of miscellaneous work. There are three biological research stations, at West Hill, Krusadai and Ennur. Great possibilities for pond- and well-culture in rural areas are shown but there is a need for more research with regard to the fish for them. It is hoped that a fresh-water biological station and central fish farm for research will soon materialise. There is also a scheme for the establishment of a technical laboratory for research in fish manures, fish oil and fish meal. A specially important part of the report deals with the chank fishery. Little is known of the biology of the chank, *Turbinella pyrum*. Extensive marking experiments have been made which, it is hoped, will throw much light on the rate of growth, mortality and migrations ; also researches on its breeding habits. Large egg capsules, measuring 7–10 in. and containing 30–33 chambers, are laid with one end fixed in the ground, where about the first nine chambers are empty ; in the others, young chanks were found, two to each chamber. The veliger stage is passed within the chamber, the embryonic shell having a conical transparent shell of four to six whorls and the velum having four lobes. When ready to hatch, the shell has quite a different form, is 9–10 mm. long and has lost the velum.

Ciliates from Bermuda Sea Urchins. Miriam S. Lucas has recorded (*J. Roy. Micro. Soc.*, 54, 1934) observations on ciliates of the genus *Metopus* which occur in the intestinal cæca of sea urchins from Bermuda. Practically all the sea urchins (*Diadema setosum*) contained *Metopus circumlabens*, and a second and new species occurs sparingly in some of the urchins. The ciliates are commensals, feeding on diatoms, fragments of algæ and cellular debris in the host's intestine. Particular attention was devoted to the neuromotor system, which consists of the peristomal membranelles of the lower lip, the motorium, the ventral and dorsal adoral fibres, the pharyngeal strand and the peripheral cilia. The motorium is a centre whence various peristomal fibres arise and lies deeply imbedded in the cytoplasm posterior to the cytostome. It is highly chromophilic, staining deeply with fuchsin in Mallory's triple stain. The pharyngeal strand appears to be very striking in this ciliate, arising from the

motorium and passing posteriorly to the right of the cytopharynx into the hinder part of the animal where it forms a large spiral coil. This strand is fibrillar and the author is disposed to regard the neuromotor system as bearing "a specialised relationship to the ingestatory cilia and to the cytoplasmic mass of the cell including the digestive, absorptive and excretory organelles". Observation of fission stages indicates that the neuromotor fibres arise as outgrowths from a clump of specialised posterior basal granules of the membranelle zone (the future motorium ?).

Anthozoa of the North Sea and Baltic. Included in Part 26 of "Die Tierwelt der Nord- und Ostsee" (Leipzig : Akademische Verlagsgesellschaft m.b.H., 1934. 17.60 gold marks) is the systematic account by Ferdinand Pax of the Anthozoa, namely, the Ceriantharia, Antipatharia, Zoantharia and Madreporaria. The last group is represented in these northern seas by five genera, three of which are solitary corals—*Flabellum*, *Caryophyllia* and *Paracyathus*, and two, *Lophohelia* and *Amphihelia*, are colonial. All are represented by single species except *Paracyathus*, of which three species occur in the area. The anatomy and biology are concisely described and notes are added on the habitat and geographical distribution of the species. In a postscript, we are informed that the names *Lophohelia* and *Amphihelia* (both due to Milne Edwards and Haime, 1857) should be replaced by *Lophelia* and *Amphelia* respectively as these have priority, having been used by Milne Edwards and Haime in 1849.

Fireblight of Pears and other Plants. Dr. K. M. Curtis, chief of the Mycology Department of the Cawthron Institute, has prepared a useful synopsis of present-day knowledge of the destructive disease known as fireblight (Mycology Pub., No. 10, Cawthron Institute, Nelson, New Zealand. Reprinted from *Orchardist of New Zealand*, June 1, 1934). Fireblight attacks apple, pear, hawthorn, quince, medlar, loquat and *Pyracantha angustifolia*. It is caused by *Bacillus amylovorus*. Symptoms of the malady are a brown discoloration of the affected parts, wilting and discoloration of the blossoms and leaves, and a slowly advancing canker of the main branches and trunk. The bacillus travels along the soft tissues of the plant, but overwinters in the cankered branches and larger twigs. Insects and birds transmit the organism from tree to tree, whilst pruning or grafting and even showers of rain can disseminate the disease. The bacillus gains entrance to the plant through wounds or through the stomata. Control measures are the removal of infected parts six inches below the lowest canker, and the treatment of the cut surface with acid mercuric chloride solution. A slight amount of control was obtained by spraying the open blossoms with weak Bordeaux fungicide.

Treatment of Lawns. The North of Scotland College of Agriculture has recently published a booklet entitled "Experiments on Lawns" by Mr. W. M. Findlay (reprinted from the *Scottish Journal of Agriculture*, **17**, No. 2, April 1934). The suitability of various mixtures of lawn grasses is discussed, and a seeding of $\frac{1}{3}$–$\frac{1}{2}$ oz. per square yard of New Zealand bent grass, or a mixture of $\frac{3}{4}$ oz. of New Zealand bent and $\frac{1}{4}$ oz. Chewing's fescue per square yard is recommended. Manurial trials have also been carried out, and sulphate of ammonia has been found to be the best form of nitrogen. It stimulates the turf, and kills most weeds. Superphosphate and sulphate of iron have also a beneficial effect in eradicating weeds. It is suggested that two dressings of sulphate of ammonia be given in spring, and two in autumn, both at the rate of 1 oz. per square yard. Half an ounce of sulphate of iron may be applied in spring, and 1 oz. superphosphate per square yard in the autumn. There is general agreement of these results with others on the manuring of lawns, notably with those obtained by the Golf Green Research Station, Bingley, Yorks.

Dhubri Earthquake of July 3, 1930. A valuable report on this earthquake has been written by Mr. E. R. Gee (*Mem. India Geol. Surv.*, **65**, pt. 1, 1–106, 1934). The earthquake is interesting from its possible connexion with the great Assam earthquake of June 12, 1897. From observations in the field, it appears that the earthquake originated in the strata that underlie the alluvium of the Brahmaputra River, a few miles to the south of Dhubri, in lat. 25° 57′ N., long. 90° 0′ E. This point, the position of which agrees closely with that indicated by the seismographic records, lies close to the north-west boundary of the epicentral area of the Assam earthquake, as laid down by Mr. Oldham. The intensity of the shock was far less than that of the Assam earthquake, for in no place did it exceed degree 9 of the Rossi-Forel scale. At Dhubri, however, a single determination of the maximum horizontal acceleration showed that it was not less than 2,200 mm. per sec., or about the same as that at Messina in 1908 and San Franciso in 1906. The area disturbed was probably about 322,000 sq. miles, or about the same as that of the Mino-Owari earthquake of 1891, and about double that of the Kwanto earthquake of 1923. The number of after-shocks, though large, was by no means unusual, and they declined in frequency very rapidly, the numbers felt in July, August and September 1930 being 223, 35 and 17, and, in the three years succeeding the earthquake, 294, 35 and 68, or altogether 397.

Cold-Working of Copper. A recent paper by W. A. Wood, of the National Physical Laboratory, deals with the lattice distortion due to cold-working of copper (*Phil. Mag.*, Sept.). Copper strip was annealed and then rolled, specimens being examined at various stages in a specially constructed X-ray diffraction camera. The negatives were measured on a microphotometer. The lines due to reflection by the (420) lattice phases of the crystal were broadened and also displaced in a way corresponding to an increase in the average spacing of the planes. This increase in the lattice spacing corresponds to an increase in latent energy, which may be estimated by comparing it with the energy absorbed by the lattice in thermal expansion. The maximum distortion observed corresponds to an increase in energy of the order 1·7 cal. per gm. This magnitude is comparable to that obtained by direct measurement in the case of copper under torsion.

Quantitative Study of Pleochroic Haloes. G. H. Henderson, with S. Bateson and L. G. Turnbull, has recently described quantitative measurements of the blackening in pleochroic haloes in mica (*Proc. Roy. Soc.*, A, July). The haloes were examined directly in a specially constructed recording photoelectric photometer, and a number of curves are given showing the darkening at each point of the halo. These curves

show humps corresponding very clearly to the dark rings in the haloes. A specimen of the mica was artificially blackened by exposure to radium emanation and a 'characteristic curve', including the phenomenon of reversal, was obtained. It is then shown that the darkening in the haloes may be calculated on the assumption that the 'effective exposure' produced along an α-particle track is proportional to the ionisation produced along the corresponding part of a track in air, the blackening produced being calculated from the 'exposure' by use of the characteristic curve. The method has been applied to several biotites. In some biotites, rings due to actinium products are found, and it is shown that the relative intensity of these rings and the uranium series rings gives values for the ages of the minerals which are in tolerable agreement with other estimates.

A New Multiple-Electrode Thermionic Valve. The now common supersonic heterodyne type of wireless receiver involves the use of a frequency changing stage, which, until comparatively recently, included two valves. One valve operated as an oscillator, and its output was applied with the incoming signal to the second valve, which functioned as a detector producing oscillations of an intermediate frequency for subsequent amplification. Progress in the technique of valve design and construction led to the combination of these two valves in one envelope; first, as a pentode frequency changer, and later, when additional electrodes were required for volume control purposes, the heptode and octode were developed. Such valves have previously operated with all the electrodes lying in a single electron stream, and this gives rise to interaction between the signal-frequency and oscillator circuits, which is very undesirable, particularly in short-wave reception. In the *Wireless World* of October 5, an article by E. E. Shelton describes a new valve, which is claimed to be free from faults of this type. This new frequency changer consists of two separate valves constructed in a single envelope. These two valves, one a triode and the other a hexode, operate with separate electron streams although the emission for these is obtained from a common cathode. The triode is employed as the oscillation generator, and its grid is directly connected to the appropriate grid of the hexode, which receives the incoming signal at controllable intensity and rectifies the combination of the two sets of oscillations. Owing to the fact that two screen grids of the hexode are connected together internally, the valve is provided with the conventional seven-pin base, with an additional electrode at the top for the control grid, which is connected to the signal circuit. The advantages claimed for this new valve over other frequency changers are that, while it is non-radiating and can be employed with an automatic volume-control system, it gives complete freedom from interaction between the signal and oscillator frequency circuits, and also a lower level of background hiss. These points are important in normal broadcast reception, but they are doubly so on short wave-lengths.

***d*-Sorbitol.** The rare sugar alcohol *d*-sorbitol has been found by H. H. Strain (*J. Amer. Chem. Soc.*, **56**, 1756; 1934) to occur in large quantities in the so-called Toyon berries, the fruits of *Photinia arbutifolia*, Lindl., from which it may be isolated by extracting with hot water, filtering through charcoal and siliceous earth, fermenting with yeast, evaporation under reduced pressure and extraction with alcohol. Another process depending on crystallisation from pyridine was also used. The properties of the purified *d*-sorbitol (m.p. 89°–93°; specific rotations) and some derivatives (triacetone-sorbitol, triformal-sorbitol, benzal-sorbitol and sorbitol hexa-acetate) are described. Sorbitol forms crystals containing one molecule of pyridine; this compound and triacetone-sorbitol are easily converted into triformal-sorbitol, and this reaction provides a ready means for the identification of *d*-sorbitol and many of its derivatives.

Molecular Weights of Red Blood Proteins. The red blood protein, to which the old name erythrocruorin has been applied by Svedberg, exists in several different modifications characterised by different molecular weights as determined by the ultra-centrifuge method (cf. Svedberg and Hedenius, NATURE, **131**, 325; 1933). T. Svedberg and I. B. Eriksson-Quensel (*J. Amer. Chem. Soc.*, **56**, 1700; 1934) now report investigations on the erythrocruorins from *Planorbis corneus*, *Daphnia pulex*, *Petromyzon fluviatilis*, *Arca pexata*, *Notomastus latericius*, *Chironomus plumosus*, *Thyone briareus* and *Myxine glutinosa*. These red respiratory proteins form, together with hæmoglobin (which is strictly limited to the five higher classes of the vertebrates), a system of molecules built up of units of weight 34,500 and half this value in simple multiple proportions. In some cases, mixtures of molecules are present. The observed molecular weights range as high as above three million, corresponding with 192 hæmin groups, and the multiples of the unit ($\frac{1}{2} \times 34{,}500$) found by the sedimentation method are 1, 2, 4, 24, 96 and 192; the multiples 8, 16 and 48, not determined for red pigments, are known from measurements on other proteins.

Dimensions of the Galactic System. The apparent disparity between our galaxy and the Andromeda nebula (which is the largest known external galaxy) has long been a problem requiring explanation. The theory of galactic rotation gives an independent method of computing the size of our galaxy, and Drs. J. S. Plaskett and J. A Pearce, using this method, have now given evidence that the disparity is not real (*Mon. Not. Roy. Astro. Soc.*, **94**, 680; 1934). They have used the radial velocities and proper motions of *O*5 to *B*7 stars alone, in order to obtain homogeneous material from stars at distances as great as possible. They find the centre of the galaxy to be 10,000 parsecs from the sun, and its diameter 30,000 parsecs, values agreeing with Shapley's, if the latter are corrected for the absorption of light in space. The diameter is thus only 2·5 times that assumed for the Andromeda nebula, while independent investigations by Hubble and by Stebbins have shown that this assumed value is probably too small, and should be about 30,000 parsecs—thus completely removing the above-mentioned difficulty. Incidentally, the problem of the well-known '*K* term' in the radial velocities is also solved in the course of the above investigation. Where corrected for galactic rotation and (in the southern hemisphere) for stream motion of the *B*-type stars, this *K* term is reduced to 1·1 km./sec., a quantity which can then be explained by the Einstein gravitational displacement of spectral lines towards the red without assuming unduly large masses or densities.

Colloidal Electrolytes

THE general discussion on colloidal electrolytes, organised by the Colloid Committee of the Faraday Society, took place at University College, London, on September 27–29. The meeting was well attended and a number of eminent foreign chemists were present as guests. This was the first general discussion organised by the Society that has ever been held at a London college. University College may for two special reasons be regarded as a happy choice of meeting place since in the first place Prof. F. G. Donnan (in the absence of the president of the Society) was chairman, and in the second place Thomas Graham carried out much of his pioneer work there. A more mundane reason for congratulating the Society on its arrangements was the success which attended them. The close proximity of lecture room, rest room and an excellent refectory reduced physical fatigue to a minimum and allowed the protagonists to expend all their energy in coping with intellectual problems.

The programme of the discussions was divided into Part I, General, (*a*) Theory, (*b*) Methods and Experimental Technique, and Part II, Special and Technical, (*a*) Soaps and other Long-Chain Colloidal Electrolytes, (*b*) Dyestuffs, (*c*) Silicates and Silicic Acid, (*d*) Proteins, (*e*) Other Substances. Prof. H. Freundlich (London) opened the meeting with a general introduction on the nature of colloidal electrolytes and their importance for colloid science. He pointed out that colloidal electrolytes can to-day be prepared in many cases as pure substances. As a class they are characterised by the fact that they form ions of colloidal size spontaneously. They can be classified into three types, those with ionic micelles sensible to dilution forming small dialysable ions; those with ionic micelles sensible to dilution but forming non-dialysable ions; and those not influenced by dilution. In the case of the proteins, their amphoteric nature gives them certain special properties.

The discussion on general theory, which followed, illustrated once again how mankind can be divided into two classes—those who think in terms of three dimensions and those who think in terms of mathematical abstractions. The former, among whom Prof. H. R. Kruyt (Utrecht) and Prof. A. J. Rabinovich (Moscow) may be mentioned, warned the meeting against being over-impulsive in extending to systems containing large ions of colloidal dimensions general equations such as those of the Debye-Hückel theory, which had been worked out for systems containing only the small ions of the ordinary dialysable electrolyte. Nothing daunted, however, Prof. Donnan (London), with the support of Dr. G. S. Hartley (London), Dr. C. Robinson (London) and others, by adding new factors to their equations and extending in this way their range of operations, organised a charge of mathematicians on to the field and engaged in what looked like a winning battle. Extrapolation from molecular dimensions to colloidal dimensions is, after all, no more dangerous than extrapolation from extended surfaces to colloidal dimensions.

An excursion from the main battle turned up in a lively discussion as to whether a charged colloidal particle were more profitably regarded as a large colloidal ion surrounded by small *gegenions* or as a large colloidal particle surrounded by an electrical double layer. Prof. E. K. Rideal (Cambridge) dealt with the problem in the detached manner of a judge, but unlike most judges produced experimental evidence in support of his opinions. Prof. Kruyt (Utrecht) pointed out with considerable effect that paraffin and water make an electrical double layer without the intervention of any ions, and suggested that the influence of oriented dipoles should be considered. This was immediately responded to by Dr. N. K. Adam (London), who stated that the ε-potential could be built up by dipoles but the ζ-potential could not. It is interesting to note that, on a later occasion, Mrs. Laing-McBain described the ζ-potential as "rather mythical"—to the consternation of some but the comfort of others.

The meeting was brought back to earth or, in other words, to the realm of experimental science, by the papers of Prof. A. Frumkin and Dr. Proskurnin (Moscow), Mr. G. S. Adair and Mrs. Adair (Cambridge) and Dr. H. B. Oakley (London) on new developments in experimental methods.

In the special sections, the discussion on the soaps turned rather round the criticism made by Mrs. Laing-McBain that the electro-kinetic theory of soap solutions had unfortunately grown up apart from the electrolytic theory of ions; the two theories, however, could be brought together. The properties of soap curds and solid soaps and the mechanism of the sudden change which a critical temperature provokes in a soap solution received attention. While some speakers attributed this to a change in the properties of the solution, others favoured a change in the properties of the solid soap. Dr. Adam (London) showed that ionic effects and an influence on the cohesion of the long hydrocarbon chains are both involved.

The discussion on dyestuffs was the most animated of the whole meeting, and the interest betrayed is a measure of the great progress which has been made in recent years in the colloidal chemistry of these substances. Prof. E. Elöd (Karlsrühe) started the ball rolling by a paper discussing the reaction between protein fibres and substantive dyestuffs and Messrs. Valkó (Ludwigshafen), Robinson (London), Moreton (Braintree) and Hartley (London) ranged the discussion round the problem of the size and state of aggregation of the dye particle, the influence of dissolved salts on this and on the factor introduced by the size of pore in the material being penetrated by the dye. In the complete absence of salts, dyeing does not occur, and this was generally attributed to the aggregated state of the dye particles preventing diffusion, though an alternative suggestion that the salt influences the properties of the ultrafilter was also put forward.

A short discussion on silica was launched by Prof. Rabinovich (Moscow) and Prof. W. D. Treadwell (Zurich). The latter described the complicated changes occurring in silica gels on standing due to the polymerisation of the silica molecules.

The discussion on the proteins was opened by Dr. D. Jordan Lloyd (London) who indicated that the properties of this class of colloidal electrolytes are influenced by three special features, the static nature of the ionic equilibrium where *zwitterions* are concerned, the special capacity of the hydrogen ion to influence this equilibrium on account of its power of forming co-ordinated links with both acid and basic

groups, and the power of large multivalent *gegenions* to form compounds of greater stability with proteins than small mono- or di-valent *gegenions*. To these Prof. Rideal (Cambridge) added a fourth in the power of proteins to form co-ordination complexes with dipole molecules of the type of thiourea. The discussion centred largely on titration curves, and Dr. R. K. Schofield (Harpenden) brought forward a valuable new technique based on the use of metaphosphoric acid. Prof. E. J. Bigwood (Brussels) dealt with diffusion in gelatin gels and came in for some friendly criticism at the hands of Mr. E. Hatschek (London). Dr. E. B. R. Prideaux (Nottingham) dealt with diffusion potentials of protein ions and Prof. T. Weigert (Leipzig) with colloidal electrolytes in photographic emulsions. Prof. E. Hammarsten (Stockholm) and his colleagues pursued the chemistry of the proteins into the chromosomes—to the satisfaction of Dr. Dorothy Wrinch (Oxford), who has worked out the electric behaviour of these bodies. Two papers by Prof. K. Linderstrøm-Lang (Copenhagen), in the absence of the author, were taken as read and the same fate unfortunately fell to the contributions on colloidal carbohydrates from Profs. A. Lottermoser (Dresden) and M. Sameč (Ljubljana). The meeting was brought to an end by a paper on tungsten sols contributed by Dr. F. Eirich (Vienna).

A brief notice cannot do justice to the thirty-seven official papers given at the meeting or to the ensuing discussions, but the full printed report will be issued by the Faraday Society on January 1, 1935.

D. J. L.

Economic Problems of Technological Progress

IN a contribution to the discussion on "The Need for a Technique of Economic Change" arranged by the Department of Industrial Co-operation of Section F (Economic Science and Statistics) at the Aberdeen meeting of the British Association, Mr. N. F. Hall examined the more specifically economic problems which arise as a consequence of technological improvements. Economics, like other sciences, he pointed out, has in the past made progress by adopting the well-tried method of limiting the number of variables in any problem under review. The necessity for the limitation of variables has resulted in the development of the idea of the 'Stationary State', which has been the most fruitful abstraction for purposes of economic analysis. As soon, however, as one or more of our hypothetical constants becomes a variable, the stimulus of a change in population or increasing technological knowledge alters our simple stationary State into a dynamic system.

The technique of economic change is therefore the accurate interpretation of changes in relative prices under dynamic conditions. Among such changes are those associated with developments in scientific knowledge, which make possible new methods of production and lead either to the output of entirely new goods or to the better fabrication of old ones, or to both things concurrently. This sort of technological change gives rise to numerous economic disturbances, such as the problem of obsolescence or the territorial re-grouping of industries. Limiting the subject, however, for the present purpose to the economic difficulties which arise in securing the orderly development of the new processes rather than in the decent burial of the old, we are confronted with a special case of the general problem of 'uncertainty'. The economist has learned in the last decade to distinguish between those incidents in economic life which are called risks and those which he now defines as 'uncertainties'. A risk such as that of shipwreck or fire is a recurrent circumstance and consequently capable of quantitative measurement and actuarial treatment. Uncertainties, however, are unpredictable and incapable of quantitative measurement; they arise out of the freedom of the mind and the continual possibility of change in human tastes and human knowledge. They reflect in brief the difference between the hypothetical stationary State of simpler economic theory and the real world.

The necessity for specialisation introduces the element of 'true' uncertainty and a specialised economy can only be, in a very limited sense, a competitive one. The greater the degree of specialisation, the larger will be the zone of uncertainty, as the obstacles in the way of adjustment and re-adjustment will increase as specialisation continues. Here then is the economic problem which is created by every forward step in scientific and in technological knowledge. The utilisation of advancing knowledge in the service of society demands an ever-increasing specialisation both of the men and of the capital goods with which they co-operate. The more both plant and labour are specialised, the greater the difficulties of bringing about further changes, particularly when these changes are on so large a scale that they require a more extensive re-distribution of both men and plant than can be secured by a wise direction of new entrants into industry or by far-seeing investment of new savings. The need for a technique of economic change arises because the benefit of further developments in scientific knowledge would be lost unless in the economic sphere the rigidity which specialisation necessarily brings with it can be overcome.

In the past, neglect of the price problems set up by uncertainty in connexion with the task of introducing new plant and new processes has been a cause of many difficulties. The inherent tendency in free as in 'planned' economic systems to over-develop the new thing seems in large part to arise from a misunderstanding of the way in which these zones of uncertainty, arising out of technological change, influence the price system, so that the economic danger signals given by price changes are either disregarded or entirely ignored. Confusion arises because changes in the prices of, and the economic return upon, new fixed plant—which are the result of changes in the element of uncertainty—are mistakenly considered to represent a permanent shift in the nature of the demand for the particular plant and its products.

Nearly all proposals for monetary manipulation seem to be open to the fatal objection that they are built upon the assumption that there is little or no change in technological processes and that uncertainty is absent. The result is that they cannot be made to apply to 'real' conditions. Proposals for arbitrary alterations in the supply of legal tender money will also fail to achieve the objectives of stabilising the price level or of providing a quantity

of purchasing power "sufficient to carry off the whole potential product of modern industrial plant", because this stream of purchasing power—however it might be injected into the system—has an influence upon the general price level and upon the volume of economic activities, which varies with the degree of uncertainty present. It is necessary rather to look to improvements in the methods employed in financing new processes as the first practical step in the development of a technique of economic change.

Changes in uncertainty lead to extensive variations in capital values and in the prices of capital goods. The objective must be to isolate the economic effects of these price shifts to prevent them causing either over-investment in new processes or general Stock Exchange disturbances. Existing financial institutions in their own interest might agree that they would not themselves finance directly the development of any new process but would pool a limited quantity of their resources to form a special holding company, which would itself finance the necessary number of unit companies to try out a new process or processes. The knowledge that such a pool existed should deter the private investor from walking into a field which is already undergoing professional development, and the Stock Exchange might be prevailed upon not to give facilities to competing new issues. Financial interests would lose some of their spectacular profits, but their business would become more stabilised and less subject to violent fluctuation than in the past. Once the method had been fairly tried and tested, there would soon be felt a need for closer co-operation between financial interests and technological research, as well as for a centralisation of part of the economic intelligence services of finance.

Scottish Fisheries in 1933*

ACCORDING to the annual report of the Fishery Board for Scotland, both the white-fish and herring fishing branches of the Scottish fishing industry gave cause for anxiety during 1933, and, while the prospects of the former afterwards improved, those of the latter steadily deteriorated. The fishing industry as a whole continued to suffer from the effects of the world-wide economic depression, and the herring industry has proved specially vulnerable, owing to the preponderating degree to which it is dependent on overseas markets.

The white-fish fisheries yielded actually a catch lighter by some 4 per cent than in 1932, and the lowest aggregate value for any post-War year; but the decline in the average price per cwt. which had been in progress for a number of years was arrested, the average for 1933 being 17*s*. 9*d*. as against 17*s*. 4*d*. in 1932. In very many cases, operations were being conducted on an unremunerative basis, and new construction, even to replace vessels lost, had therefore been suspended. This was believed to be largely due—apart from the effects of the general depression—to unregulated competition, partly owing to the large foreign landings and imports, and partly to failure to maintain a proper standard of quality and size in much of the fish marketed; and a comprehensive policy to deal with the situation was embodied in the Sea-Fishing Industry Act, 1933.

It was hoped that the imposition of minimum sizes for fresh fish exposed for sale, with its corollary of minimum mesh, would not only ensure better prices, but tend also to conserve stocks, and lead ultimately to a marked improvement in both the quality and value of landings; that the closing of the distant northern grounds for the four warmest months of the year would prevent excessive supplies of fish which, under present conditions, are necessarily of inferior quality when landed and tend seriously to depress the market; and that the regulation of imports would check competition that seemed to threaten the existence of the British industry.

Owing to the variety of factors operative, including the 10 per cent import duty imposed in 1932, and the adverse exchange as affecting German fishermen in particular, as well as normal fluctuations in the fisheries and changing economic conditions, it did not prove possible up to the end of the year to appraise with certainty the effects of this new legislation. It seemed clear, however, that it would be of benefit to fishermen and vessel owners, and this general impression has been confirmed by later experience. The new legislation is approved by the trawling section of the industry, but some dissatisfaction has been expressed by fish merchants and export curers at the curtailment of supplies necessarily involved, and also by some inshore fishermen.

No further large fishing units have yet been constructed for use in Scotland as a result of the improvement in returns; but steady progress is being made in the construction of medium-sized motor-boats for white-fish fishing, especially seining in the Moray Firth area, which is doubtless encouraged by the assurance of better markets.

Herring fishing was conducted under conditions which almost precluded any possibility of general success. The development of the summer fishing was delayed until beyond the middle of June by a dispute regarding the discount allowed by fish salesmen on curers' purchases of herrings; and when a settlement was reached, catches during what is normally the main part of the season were so light that, although prices rose to an uneconomic level for curers, fishermen failed to earn sufficient to cover working expenses. A heavier fishing unexpectedly experienced in August retrieved to some extent the position of fishermen, but a break in the Continental prices for cured herrings consequent on the increase in supplies adversely affected curers and other firms engaged in the distribution of cured herrings.

The principal markets for cured herrings, in order of importance, were Germany, Poland (with Danzig), Latvia and the United States. Several attempts were made during the year to dispose in the home markets of pickled herrings put up in small containers, and herrings prepared in various new ways usually involving smoking, but in no case so far with any outstanding success.

The encroachment of trawlers on Scottish inshore waters, particularly on the west coast, caused much concern during the year, and the Board found it necessary to submit proposals for the strengthening of its patrol fleet, and at the same time a Government Bill, since passed, was introduced increasing the penalties for illegal fishing.

* Fishery Board for Scotland, Fifty-second Report, for the year 1933. (Edinburgh and London: H.M. Stationery Office, 1934.) 1*s*. 6*d*. net.

University and Educational Intelligence

AT the beginning of November, Loughborough College will inaugurate a series of intensive management courses under the direction of Mr. E. T. Elbourne. Each of the eleven courses will last ten days. Lectures will follow in the main the sectional syllabuses of the Institute of Industrial Administration's diploma, and subscribers to any course may, on completion, sit for the Institute's examination accordingly. The tuition fee for any ten-day course is five guineas, including the loan of books and demonstration materials. Further information can be obtained from the Registrar, Loughborough College, Loughborough, Leics.

A NEW high-voltage laboratory at East London College enables that institution to offer greatly improved facilities for study and research in a branch of electrical engineering, the practical importance of which at the present time is obvious. Towards the cost of its erection and equipment the Court of the University made a grant of £12,000 and the Drapers' Company gave £5,000 and lent another £5,000 to enable the College to proceed at once with this and other enterprises. The calendar for the present session announces that the equipment will include a 500,000-volt testing transformer, a surge generator with a maximum capacity of a million volts, a direct-current generator of 200,000 volts capacity, a cathode ray oscillograph recording surge voltages up to a million volts, Schering bridge for measurement of dielectric losses, and transformers of 30,000–250,000 volts capacity for experiments. A course in high-voltage technology for degree students is being introduced under the direction of Prof. J. T. MacGregor-Morris.

A REVIEW of the school year 1933–34 in the United States is published in the June issue of *School Life*. Dr. G. F. Zook, who assumed the office of Commissioner in June 1933, has now relinquished it to become director of the American Council on Education and has been succeeded by Mr. J. W. Studebaker, who for the past twenty years has been superintendent of public schools in Des Moines, Iowa. The year is characterised in an editorial as one of sensational progress in the following respects: the Federal Government did more for schools than in any year since 1787; State support for public education came into being in many States; adult education classes attracted more than a million students; nursery schools increased from 300 to 2,500; practical camp schools were set up for 300,000 boys in "civilian conservation camps"; and industrial child labour was ruled out. As regards the last point, the retiring Commissioner points out that the prohibition (by two thirds of the codes) of the employment of 'under-sixteens' means that millions of young people have little or no opportunity of regular employment. Either the industries must co-operate, he says, in setting up extensive apprenticeship programmes including part-time instruction, or the Government will have to adapt the civilian conservation camps to enable them to reach a larger proportion of the adolescent population, or the school system must provide types of training that will appeal to all who do not go on to a university. It may be noted that, on June 27, President Roosevelt made the Secretary of Labour an educational dictator for industry.

Science News a Century Ago

Faraday's Experiments on Self-Induction

In 1834, a young man, Mr. William Jenkin, brought to Faraday's notice a new effect of electro-magnetic induction. The shock obtained on breaking contact with a voltaic battery was greatly enhanced if a coil instead of a straight wire was used as the conducting circuit. On October 15, 1834, Faraday began experiments on this action of the 'extra current', as he called it, and traced it to induction between the neighbouring turns of the coil at the moment of disjunction. "These effects," he wrote in his Diary a month later, "show that every part of an electric current is acting by induction on the neighbouring parts of the same current, even in the *same wire* and the *same part* of the wire."

The Ninth Series of the Experimental Researches in Electricity contains a description of these experiments on self-induction. The action had interesting consequences, as for example, if a wire was doubled and formed into a coil, the induction in one half neutralised that in the other, and a non-inductive coil resulted.

It is of this occasion that Faraday said, years afterwards: "The number of suggestions, hints for discovery, and propositions of various kind offered to me very freely, and with perfect goodwill and simplicity on the part of the proposers for my exclusive investigation and final honour, is remarkably great, and it is no less remarkable that but for one exception—that of Mr. Jenkin—they have all been worthless".

Sturgeon's Electro-Magnetical Experiments

On October 15, 1834, William Sturgeon sent to the editors of the *Philosophical Magazine*, then conducted by Sir David Brewster, Richard Taylor and Richard Phillips, an "Account of some Electro-magnetical Experiments made with the Large Magnet at the Exhibition Room, Adelaide Street". The experiments, he said, were made by the permission of the proprietors of the Exhibition Room, and he acknowledged the obligations he was under to Mr. Payne, who procured the use of the magnet, and to Mr. Maugham, the chemical lecturer, for his assistance. Among the results of his experiments, Sturgeon mentioned the decomposition of "hydriodate of potassa" in solution and the decomposition of sulphate of copper and of water. "The experiments were made by changing the connexions and reversing the current, and the results were exhibited with as much promptitude as they would have been by the employment of a voltaic battery. . . . I have also made a great variety of electro-magnetic rotations, and some other rather novel motions, with electric currents by magnetic excitation, which I intend to publish as soon as opportunity offers."

The Gresham Chair of Physic

The death of Dr. Christopher Stanger in September 1834 had left vacant the professorship of physic in Gresham College. In connexion with this, the *Times* on October 18, 1834, said: "We understand that the place of Lecturer in Physic in the Gresham Institution is now vacant and that it is shortly to be filled up. Contrary to the intentions of the enlightened founder, the lectureships in this institution have been for a lengthened period mere sinecures. We hope, however,

that advantage will be taken of the present opportunity to pave the way for a better system, by the appointment of at least one competent and efficient teacher. All favouritism ought in a case of this sort to be, as we have no doubt it will be, entirely laid aside, and the situation should be given to the candidate who produces the least unequivocal proofs of industry learning and talent".

Iron Shipbuilding

Among the pioneers of iron shipbuilding was Sir William Fairbairn (1789–1874) who, in 1835, opened a shipbuilding yard at Millwall on the Thames. Prior to this, however, he constructed several iron vessels at Manchester. These were built in sections, taken to pieces and reconstructed at the ports. On October 18, 1834, the *Mechanics' Magazine* said that an iron steamer of 96 tons of Fairbairn's was launched at Selby. As she was for Swiss owners, the vessel was to be navigated up the Rhine as far as possible, taken to pieces again, carried overland a distance of forty miles and ultimately launched at Zurich, "and after all this will be considerably cheaper and better than if built on the continent".

Societies and Academies

PARIS

Academy of Sciences, August 27 (*C.R.*, **199**, 501–544). LOUIS BLARINGHEM: The temperature of flowers. From the results of about 3,000 observations, the author concludes that most plants, at certain stages of growth and especially in the course of the development of the flowers, show a regular excess of temperature of the internal tissues and of the floral organs over the temperature of the surrounding air. This excess is usually 1°–6° but in one case amounted to 9°. EMILE MATHIAS: Blue globular lightning. HANS SCHWERDTFEGER: The characteristic roots of the matrices of linear forms. Y. WHY FSCHEN: Remark concerning the solution of the mixed problem relating to the equation $\Delta u - 1/\omega^2 u_{tt} = 0$ for $\omega \to \infty$. ROLF NEVANLINNA: The harmonic measurement of ensembles of points. EDGAR ODELL LOVETT: Bertrand's problem for certain curves which generalise conics. CHARLES PLATRIER: The most general infinitely small isothermal transformation of the homogeneous material medium. MIROSLAV NÉNADOVITCH: Contribution to the theory of supporting wings. PIERRE LEJAY: Gravity anomalies in the south of Indo-China. A map is given showing the anomalies. ALBERT PÉRARD and MIROSLAV ROMANOWSKI: New comparisons of national standards of electrical resistance. Comparison of the standard ohms of Germany, United States, France, Great Britain, Japan and Russia, showing secular changes between December 1932 and November 1933. PAUL JANET: Remarks on the preceding note. It is pointed out that this is the first work done by the Bureau international des Poids et Mesures in the field of electrical units. ARCADIUS PIEKARA: The magnetic anisotropy of the fatty acids. PIERRE BRICOUT and ROBERT SALOMON: The use of the cathode ray oscillograph for the study of the magnetisation of ferromagnetic substances. The apparatus described showed differences between specimens of identical composition when the annealing temperatures differed by only 10° C. It has proved capable of showing when the time of annealing has been sufficient to bring about the steady magnetic state. CHARLES COURTOT and ABBAS MOTAMEDI: Introduction to the study of the chemistry of diphenylene selenide. PAUL SELTZER: The vertical distribution of temperature in a forest. JACQUES EMILE ABELOUS and RENÉ ARGAUD: The formation of adrenaline in the suprarenal capsule. The rôle of lipids and lipoids in adrenalogenesis. MARC ANDRÉ: An American crayfish multiplying near Paris. MAURICE DOLADILHE: Researches on the complementary power of blood sera. MLLE. MATHILDE ZIRNHELT: A new culture medium specially favourable to the development and maintenance of the virulence of *B. typhi murium*. Sterilised rye, impregnated with ordinary peptone broth, forms an excellent medium for the culture of this organism. The virulence is increased and the rye can be directly used for the destruction of rats.

CAPE TOWN

Royal Society of South Africa, May 16. J. L. B. SMITH: The South African species of the triglid genera: *Lepidotrigla* and *Peristedion*. The paper revises the South African species of *Lepidotrigla*. *L. Faurei* and *L. Natalensis* are maintained as distinct species, and one new species is described. A new species of *Peristedion* is also described.

GENEVA

Society of Physics and Natural History, June 7. LÉON W. COLLET and ED. PAREJAS: The presence of the Upper Cretaceous in an alpine nappe of Elba. The authors describe grey limestones occurring at the Colle Reciso containing *Coccolithus pelagicus* and *C. leptoporus* with several species of *Actiniscus Ehrenberger*. It is the first time that Upper Cretaceous has been discovered above Biancone in Elba. LÉON W. COLLET: On a nummulitic breccia, with Wildflysch facies, from Elba. The elements of the breccia are made up of ophites. The cement is calcareous and contains *Nummulites lucasanus* of the Lower Lutetian. The formation of these breccias shows that movements occurred in the Lower Lutetian, in one of the alpine nappes of the island. LÉON W. COLLET and J. BUFFLE: The transportation of alluvial matter in suspension in the waters of the River Arve at Geneva, in 1933. The run off of the River Arve in 1933 was low. The total amount of alluvial matter transported in suspension in its waters was 1,506,000 tons. During 1915 the run off of the river was much larger and the alluvial matter transported amounted to 3,644,000 tons. ED. PAREJAS: Some species of *Actiniscus* of the Upper Cretaceous of Brasses (Préalps médianes) and of the island of Elba. The author describes a fauna of *Actiniscus* observed in the red layers (Upper Cretaceous) of Brasses (Haute Savoie) and in a limestone of the Colle Reciso (Elba). The species *Actiniscus quinarius* and *A. Stella* have been found. The following species and varieties are new: *A. cruciatus*, *quinarius* var., *Stella Ehrenb.* var., *Colleti* var., *Chaixi*, *ilvensis*, *decapetalus* and *Verandi*. G. TIERCY: (1) The function introduced in the calculation of the distribution of the temperatures in the interior of a star. The numerical variation of this function has been given in a preceding note; it is now given as an algebraical function of the radius. An empirical solution, numerically satisfactory, has been found. (2) Remarks on a particular model of the

temperature distribution in a star. The author discusses a consequence which can be drawn from a formula given by J. H. Jeans for expressing the radiative viscosity of stellar matter. G. TIERCY and A. GROSREY: The width of the spectrograms of *F*5 and *G*0 stars. A discussion, as for other types previously studied, of the variation of the width of a spectrum as a function of the magnitude of the star and the time of exposure.

LENINGRAD

Academy of Sciences (*C.R.*, n.s., 2, No. 6). I. M. VINOGRADOV: A new solution of Waring's problem. N. KOSHLIAKOV: Some identities in the analytical theory of numbers. L. LEIBENSON: Theory of the movement of petroleum in the stratum. V. T. MITKEVITCH: Some fundamental statements relating to the domain of physics. A. KRASIN: Influence of illumination on dielectric losses in rock salt irradiated with X-rays. The illumination increases the angle of losses by more than 12 per cent. N. DANKOV and A. KOTCHETKOV: On limiting dimensions for particles of catalysts. The maximum catalytic activity occurs with particles of 40 and 50 A., and absence of catalytic effect is to be expected close to 20 A. F. FEDOROV, I. MOTCHAN, S. ROGINSKIJ and A. SCHECHTER: Synthesis of ammonia by collision between positive ions. The action of positive ions consists in producing a new active form of nitrogen, not yet studied in detail. N. PETINOV: Grain quality control of irrigated wheats of the Transvolga areas. The quality of grain of irrigated wheats is not inferior to that of non-irrigated wheats. An increase in the protein content of the grain with a simultaneous increase in the yield can be obtained by regulating the watering. I. E. FIMOV: The distribution of organic remains in the roofing of coal measures of the Donetz basin. The following five successive facies are established by studying the fauna and flora of the respective strata; the continental or coal facies; the facies overlying the coal (with vegetable remains); the facies of anthracosids; the marine argillaceous facies; and the facies impregnated with hydrogen sulphide. L. LUNGERSHAUSEN: Stratigraphy of the "Balta" stratum. B. ZENKOVITCH: Some data on whales of the Far East. The food of the Californian grey whale (*Rhachianectes glaucus*, Cope) consists of the sea-bottom crustaceans living in the shallow parts of the continental shelf, mainly *Amphipoda*. There were no females amongst 57 sperm whales (*Physeter macrocephalus*, L.) caught in the Russian Far Eastern waters in 1933. Weights of *Balaenoptera physalus* and *Megaptera nodosa* are given.

MELBOURNE

Royal Society of Victoria, June 14. A. B. EDWARDS: Tertiary dykes and volcanic necks of South Gippsland, Victoria. A suite of dykes with a prevalent north-westerly strike, was intruded into the Jurassic sediments of South Gippsland in Lower Oligocene time. The suite comprises trachyandesites, analcite-olivine-dolerites, olivine-analcite-basalts, monchiquite-basalts, monchiquites, and possibly olivine-nephelinites. When arranged in this order of increasing basicity they exhibit chemical and petrological gradation into the adjacent types, and are considered to have been derived from a common magma, of a composition about that of the olivine-analcite-basalt.

ROME

Royal National Academy of the Lincei, May 6. P. ALOISI: Questions of Tuscan, especially Elban, geology (2). MARIA CIBRARIO: Certain theorems of the existence and unicity for the equation $xu_{xx} + u_{yy} + 2u_x = 0$. B. FINZI: Integration of the indefinite equations of the mechanics of continuous systems (2). G. PERETTI: Groups of electromagnetic waves in anisotropic media. According to the most general hypothesis of a medium which is magnetically isotropic and electrically anisotropic (for example, a crystalline medium), there exist, besides groups of electromagnetic waves of the first order, also groups of the second and third orders. J. J. PLACINTEANU: The wave equation of a body of variable mass. Application to radioactivity. G. L. ANDRISSI: Determination of latitude in prime vertical. A. CAVINATO: The use of the prism for the determination of the principal refractive indexes of crystals (1). Various methods, and the calculation of the errors involved, are discussed. V. CARMINATI: Cariometric determinations on the liver of rats inoculated with the nucleoproteins of calf thymus (2). Parenteral administration of the nucleoproteins of calf thymus produces a distinct increase in the nuclear dimensions of rat liver. C. GUARESCHI: First experimental results on the centrifugation of the chrysalis of *Lina populi* and of *Pieris brassicae*. GIUSEPPINA DRAGONE TESTI: Germination of embryos of grain outside the seeds. A. DE-AGAZIO: Action of histamine, ephetonine, caffeine and camphor on the isolated heart of *Bufo vulgaris* (3).

SYDNEY

Royal Society of New South Wales, August 1. G. J. BURROWS and R. H. PARKER: Some tetra-covalent platinum compounds derived from tertiary arsines. The authors describe the preparation of compounds of platinous chloride and platinous bromide with phenyl dimethyl arsine and with diphenyl methyl arsine. The derivatives are stable, crystalline, non-polar compounds with definite melting points of the type R_2PtCl_2, where R represents a molecule of the arsine. It was not found possible to separate any of the compounds into isomeric forms by means of solvents. Evidence of *cis-trans* isomerism was afforded by the behaviour on heating to the melting point. As a result of this treatment, the compounds appeared to change into forms having the same composition but solubilities different from those of the original compounds. F. P. DWYER and D. P. MELLOR: An X-ray study of opals. Powder photographs of opals which have been formed under different geological conditions fall into either one of the two classes: (*a*) those showing a well-defined diffraction pattern characteristic of β-cristobalite, (*b*) those showing a broad band in the position of the most intense line of either α- or β-cristobalite. Opals of the former class have been associated with lava flows at some time during their geological history, while those of the latter class have been associated with ground water only. It is considered that silica gel possesses a pseudo-crystalline structure—most probably α-cristobalite—and that under the influence of hot magmatic waters, inversion to β-cristobalite, followed by crystal growth, has occurred. The remarkable persistence of the β-form of cristobalite seems to be dependent on its low temperature of formation.

Forthcoming Events

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

Monday, Oct. 15

UNIVERSITY OF LEEDS, at 5.15.—Prof. C. Burt: "The Backward Child."*

Tuesday, Oct. 16

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. L. J. Henderson: "Physiological Equilibrium" (succeeding lectures on October 17 and 18).*

EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, London, W.1).—Prof. F. C. S. Schiller: "Ant-Men or Super-Men."*

KING'S COLLEGE, LONDON, at 5.30.—H. R. Lupton: "Pumping Machinery as Developed to meet Modern Conditions" (succeeding lectures on October 23 and 30).*

INSTITUTION OF ELECTRICAL ENGINEERS, at 5.30.—Dr. W. Estorff: "Extra High Tension Engineering Practice (200 KV and upwards) with Special Reference to Power Transmission and Control" (succeeding lectures on October 17, 19, 22, 24 and 26).*

Thursday, Oct. 18

CHEMICAL SOCIETY, at 8—(at the Royal Institution, London, W.1).—Prof. P. M. S. Blackett: "Induced Radioactivity."

Friday, October 19

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 6—(in the lecture theatre, Literary and Philosophical Society, Newcastle-upon-Tyne).—Annual General Meeting. John T. Batey: Presidential Address.

SCOTTISH NATIONAL CONFERENCE ON THE PLACE OF BIOLOGY IN EDUCATION, Oct. 19.—Organised by the British Social Hygiene Council. To be held at City Chambers, Edinburgh.

Official Publications Received

GREAT BRITAIN AND IRELAND

Technical Publications of the International Tin Research and Development Council. Series A, No. 1: The Electrodeposition of Tin from Sodium Stannate Solutions with the Use of Insoluble Anodes. By A. W. Hothersall, S. G. Clarke and D. J. Macnaughtan. Pp. ii+101–124. Series A, No. 3: A Microscopic Examination of Iron-Tin Reaction Products. By Dr. W. D. Jones and W. E. Hoare. Pp. 4+2 plates. Series A, No. 4: The Corrosion of Tin and its Alloys. Part 1: The Tin-Rich, Tin-Antimony-Copper Alloys. By Dr. T. P. Hoar. Pp. 201–214+2 plates. Series A, No. 5: The Electro-Chemical Behaviour of the Tin-Iron Couple in Dilute Acid Media. By Dr. T. P. Hoar. Pp. 472–482. Series A, No. 8: The Improvement of White Bearing Metals for Severe Service; Some General Considerations. By D. J. Macnaughtan. Pp. 285–299+1 plate. Series A, No. 9: The Behaviour of White Bearing Metals when subjected to various Deformation Tests. Part 1: Indentation Tests, by A. S. Kenneford and Dr. Hugh O'Neill; Part 2: Tensile Tests, by R. Arrowsmith; Part 3: Pounding Tests, by H. Greenwood. Pp. 301–339+6 plates. Series A, No. 10: Some Properties of Tin containing small amounts of Silver, Iron, Nickel or Copper. By Prof. D. Hanson, E. J. Sandford and H. Stevens. Pp. 341–357. Series C, No. 1: The Féry-Carbone Dry Tin Accumulator. By Prof. C. J. V. Féry. Pp. 5. (London: International Tin Research and Development Council.)

Sir John Cass Technical Institute. Syllabus of Classes, Session 1934–35. Pp. 116. (London.)

Experimental Researches and Reports published by the Department of Glass Technology, The University, Sheffield. Vol. 16, 1933. Pp. iii+180+3 plates. (Sheffield.) 7*s.* 6*d.*

Board of Education: Science Museum. Technical Pamphlet No. 2: The Automatic Telephone; a Brief Description of the Processes involved in making a Call on the Automatic Systems of the British Post Office. By W. T. O'Dea. Pp. 13+5 plates. (London: H.M. Stationery Office.) 6*d.*

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1934–1935. Pp. 93. (Edinburgh.)

Proceedings of the Royal Society of Edinburgh. Vol. 54, Part 2, No. 15: The Structure and Relationships of Lamellibranchs possessing a Cruciform Muscle. By Alastair Graham. Pp. 158–187. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s.* 6*d.*

OTHER COUNTRIES

Agricultural Experiment Station of the Rhode Island State College. Bulletin 244: A Hemophilic Bacillus as the Cause of an Infectious Rhinitis. By J. P. Delaplane, L. E. Erwin and H. O. Stuart. Pp. 12. (Kingston, R.I.)

Exhibition of First Editions of Epochal Achievements in the History of Science (on Display at the University Library). Pp. 48. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 30 cents; 1*s.* 6*d.*

The Journal of the Indian Mathematical Society. Vol. 20: Silver Jubilee Commemoration Volume. Pp. x+248+2 plates. (Trichinopoly: Indian Mathematical Society.)

Punjab Irrigation Research Institute. Research Publication, Vol. 6, No. 1: A Gravitational Survey of the Sub-Alluvium of the Jhelum-Chenab-Ravi Doabs, and its Application to Problems of Water-logging. By B. H. Wilsdon and Dr. N. K. Bose. Pp. 44+17 plates. (Calcutta: Punjab Irrigation Research Institute.) 5 rupees; 7*s.* 6*d.*

Summary Proceedings of the Twenty-eighth Meeting of the Indian Central Cotton Committee, Bombay, held on the 29th and 30th January 1934. Pp. 84. (Bombay.)

The Indian Forest Records. Vol. 20, Part 8: Immature Stages of Indian Coleoptera, 15 (Scolytidae). By J. C. M. Gardner. Pp. 17+2 plates. (Delhi: Manager of Publications.) 8 annas; 10*d.*

Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 17: Fodders and Feeding Stuffs in Malaya. By C. D. V. Georgi. Pp. iii+35. (Kuala Lumpur.) 50 cents.

Forest Bulletin No. 84: The Identification of the Commercial Timbers of the Punjab. By K. Ahmad Chowdhury. Pp. vii+70+28 plates. (Delhi: Manager of Publications.) 3 rupees; 5*s.* 3*d.*

Publications of the South African Institute for Medical Research. Vol. 6, No. 33: Entomological Studies; Studies on Insects of Medical Importance in South Africa. By Dr. Botha De Meillon. Pp. 249–308. (Johannesburg.)

Union of South Africa: Department of Mines: Geological Survey. The Geology of the Country between Springs and Bethal; an Explanation of Sheet No. 51 (Bethal). By F. A. Ventner, with a Chapter on Underground Water Supplies, by H. F. Frommurze. Pp. 87. (Pretoria: Government Printer.) 5*s.* (including Map).

Hamburger Sternwarte in Bergedorf. Zweites Bergedorf Sternverzeichnis 1930.0. Nachtrag enthaltend die mittleren Örter von 671 Sternen (Eros-Anhaltsternen 1. Ordnung für die Opposition 1930–31) nach photographischen Aufnahmen mit dem AG-Astrographen in den Jahren 1930 und 1931. Herausgegeben von Dr. Richard Schorr. Pp. ii+81–92. (Bergedorf.)

The Indian Forest Records. Vol. 20, Part 7: Methods of Testing the Susceptibility of Timbers to Termite Attack. By Cedric Dover and R. N. Mathur. Pp. iii+20. 5 annas; 6*d.* Vol. 20, Part 9: Entomological Investigations on the Spike Disease of Sandal, (24) Pentatomidae (Hemipt.). By N. C. Chatterjee. Pp. ii+31. 10 annas; 1*s.* 6*d.* (Delhi: Manager of Publications.)

Records of the Survey of India. Vol. 25: Surveys in Swat, Chitral and Gilgit and neighbouring Territories carried out by 'A' Survey Company from 1925 to 1931. By Lieut.-Col. C. G. Lewis. Pp. vi+47. (Dehra Dun: Survey of India.) 1.8 rupees; 2*s.* 6*d.*

Gold Coast Colony. Report on the Gold Coast Survey for the Year April 1933 to March 1934. Pp. ii+16+2 plates. (Accra: Government Printing Office; London: Crown Agents for the Colonies.) 2*s.*

Commonwealth of Australia: Bureau of Meteorology, Melbourne. Bulletin No. 18: Foreshadowing Monsoonal Rains in Northern Australia. By H. M. Treloar. Pp. 29. (Melbourne: Government Printer.)

A Further Account of the Anti-Tsetse Campaign in Tanganyika Territory by Officers of the Tsetse Research Department. Pp. 32. (Shinyanga: Department of Tsetse Research.)

Tanganyika Territory: Department of Agriculture. Annual Report, 1933. Pp. ii+118. (Dar es Salaam: Government Printer.) 2*s.* 6*d.*

Uganda Protectorate. Annual Report and Bulletin of the Geological Survey Department for the Year ended 31st December 1933. Pp. 93. (Entebbe: Geological Survey.) 4*s.*

Fiskeridirektoratets Skrifter, Serie Havundersøkelser (Report on Norwegian Fishery and Marine Investigations). Vol. 4, No. 9: Animal Plankton of the Norwegian Coast Waters and the Open Sea. 1: Production of *Calanus finmarchicus* (Gunner) and *Calanus hyperboreus* (Krøyer) in the Lofoten Area. By Jacob D. Sømme. Pp. 163. (Bergen: A.-S. John Griegs Boktrykkeri.)

Geophysikalisches Institut der Universität, Leipzig. Über Niederschlagsperioden in den gemässigten Zonen der Erde: eine Bestätigung der Ergebnisse Defants in der Abhandlung: Die Veränderungen in der allgemeinen Zirkulation der Atmosphäre in den gemässigten Breiten der Erde (Wiener Sitzungsberichte 121, I, 1912). Von Dr. Walter Preusche. Pp. iv+72. Ein Beitrag zur 16 jahrigen Klimaschwankung. Von Gerhard Seidel. Pp. iii+58. Veröffentlichungen des Geophysikalischen Instituts der Universität Leipzig. Serie 2: Spezialarbeiten aus dem Geophysikalischen Institut. Band 6, Heft 2: Einfluss der Grossstadttrübung auf Sicht und Sonnenstrahlung. Von Fritz-Holm Bielich. Pp. 69–119. (Leipzig.)

CATALOGUES

Astronomical and Optical Instruments. (Publication No. 9.) Pp. 68. (Newcastle-on-Tyne: Sir Howard Grubb, Parsons and Co., Ltd.)

Recent Developments in the Electrodeposition of Nickel. By A. W. Hothersall. (Nickel, L5). Pp. 12. (London: The Mond Nickel Co., Ltd.)

Books for Everybody at Reduced Prices. (Catalogue 437.) Pp. 48. (Cambridge: W. Heffer and Sons, Ltd.)

pH Acidity and Alkalinity. (Folder No. 42.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 1, No. 2, September. Pp. 15–27+v. (London: Wild-Barfield Electric Furnaces, Ltd.)