NATURE

SATURDAY, SEPTEMBER 21, 1929.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3125, Vol. 124]

Colonial Development and the Scientific Worker.

ANYBODY who troubles to read the official reports of the debates which took place during the last session of Parliament would be struck by the continual references made to the importance of scientific research. The subjects upon which the debates centred, for example, industrial development in Great Britain, colonial development, and others which it is hoped will provide a solution to our unemployment problem, are not new. The principal protagonists in Parliament of scientific research have not changed, although their arguments have gained point and emphasis because scientific workers in recent years have proved themselves by the results they have obtained over a large field of endeavour. What is novel is the hold which science now has upon the imagination of a large number of rank and file members of both Houses of Parliament. Their critical interest in scientific research is one of the happiest auguries for the future.

When Mr. Thomas introduced the Colonial Development Bill, he occasioned some surprise by including in its clauses one providing for the encouragement of scientific research. It has been assumed for some time past that all schemes for the prosecution of scientific research in the colonial empire, other than those promoted by the colonies themselves, were covered by the activities of the Empire Marketing Board, which it will be remembered was set up in 1926 as a direct result of the recommendations of the Imperial Economic Committee. Some members feared that the introduction of this clause might lead to unnecessary overlapping between the Empire Marketing Board and the Committee which Mr. Thomas promised would be appointed to deal with the allocation of the funds provided by this new Bill. They expressed the fear also that since the expenditure under the new Bill was to be controlled by an annual vote of Parliament, and that any unexpended balances in one year could not be carried over to the next, that Mr. Thomas had been unduly influenced by those critics, including the Treasury, of the Empire Marketing Board who are still unconvinced of the desirability of providing funds for statutory bodies to enable them to consider long-range schemes in connexion with research and technical development. That their fears were justified was evident from Mr. Thomas' subsequent declaration that he proposed to bring the Empire Marketing Board funds under statutory control, a distinct reversal

of the method of administration of the funds at its disposal.

Lest the objections of Mr. Amery, Mr. Ormsby-Gore, Major Church, and others interested in the application of science to colonial development should be considered trivial by scientific workers unfamiliar with the machinery of State, it should be explained that a Parliamentary grant to a body for specified purposes differs greatly from a statutory grant. The former gives comparative freedom to those appointed to administer the grant to apply the funds at its disposal without constant reference to and sanction by the Treasury: a statutory grant involves Treasury control over every item of expenditure, and Treasury sanction of every scheme put forward by those theoretically charged with the administration of the funds annually voted by Parliament. Whatever may be the merits of this form of administration for most forms of State expenditure, it is not calculated to assist those responsible for the initiation of research and development schemes. Such schemes may involve financial commitments over a term of years, not infrequently they will not come to maturity for years, and the administering body must take these factors into account. It is obviously best able to do so if its unexpended balances at the end of a financial year can be carried over from one year to the next, instead of being returned to the Sinking Fund.

The fact that scientific workers as a whole registered no protest against what can only be considered as a retrograde act on the part of Mr. Thomas, is merely indicative of their apathetic lack of interest in the assembly which has so great an influence on their work. To this same cause can be attributed the absence of any scientific worker on the committee appointed by Mr. Thomas to administer the Colonial Development Fund, in spite of his declaration that this committee would be entrusted with the task of co-ordinating its own programme of research with that of the Empire Marketing Board. Were the debates in Parliament not fully reported, had scientific workers not been given so striking a lead by Mr. Amery in his speech on July 12 when he pleaded eloquently that the committee which Mr. Thomas proposed to appoint should not consist purely of eminent business men with a business chairman, their indifference to measures calculated to have a tremendous effect on the future of scientific research might be excused. Were the contributions already made by science to civilisation in general and colonial development in particular of small account, or were those scientific workers in the colonies adequately rewarded and given other forms of recognition commensurate with those of other professional workers, there might be some justification for their attitude of aloofness. But in present circumstances there is neither justification nor excuse for it. They may dislike and distrust politicians as a class, but they must realise that in our politicians is vested the power to vote the moneys necessary for all public services at home and in the colonial empire. Politicians reflect public opinion. They are most susceptible to the influence of the better-educated sections of the public, provided those sections are vocal.

In recent years successive Governments have appointed committees to deal with an extensive variety of subjects upon which scientific workers could speak with authority. There was a most important committee on industry and trade appointed in 1924 by Mr. Sidney Webb (now Lord Passfield). Its deliberations were spread over years. At various stages of its inquiries it consulted scientific experts. But no scientific worker was appointed to the committee, which means that no scientific worker was able to exercise any great influence on the committee's final recommendations. The same thing is true of the last Royal Commission on the Coal Industry. This Commission was assisted by scientific assessors, but science was not officially represented on the main body. Science, it might be assumed, might have had some real contribution to make to the recent deliberations of the Cotton Arbitration Committee. But its representatives, and there are many actively engaged in the industry, do not appear to have been consulted. Apart from Government committees there is another field which might reasonably be expected to engage the attention of scientific workers. For nearly two years past a committee has been sitting composed of representative employers, *e.g.* Lord Melchett, Lord Ashfield, Sir Robert Hadfield, and representatives of the Trade Unions. Had scientific workers as a body asked to be represented at this industrial conference, it seems reasonable to assume that they would have been welcomed. No such approach has been made.

It remains to be seen whether scientific workers will avail themselves of the opportunity to take a more active part in Imperial affairs which is afforded them by the recent formation of a Parliamentary Science Committee. This committee, which already numbers more than seventy members of the House of Commons, has been formed for the purpose of discussing the bearing of science on politics. Such matters as the wilful or unintentional omission of representatives of science from the Colonial Development Committee would come within its scope. Further, the Parliamentary Science Committee, being non-party, would probably be the best venue in which preliminary discussions could take place on the scope of scientific research as applied to the social as well as the economic development of our tropical Empire.

Epidemic Diseases.

(1) *Epidemiology Old and New.* By Sir William Hamer. (Anglo-French Library of Medical and Biological Science.) Pp. x + 180. (London: Kegan Paul and Co., Ltd., 1928.) 9*s.* net.

(2) *Common Colds: Causes and Preventive Measures.* By Leonard Hill and Mark Clement. Pp. viii + 126 + 6 plates. (London: William Heinemann (Medical Books), Ltd., 1929.) 7*s.* 6*d.* net.

(3) *Les ultravirus et les formes filtrantes des microbes: les maladies à ultravirus, leurs caractères cliniques, anatomopathologiques, épidémiologiques, l'immunité, techniques d'étude des ultravirus, les formes filtrantes des bactéries.* Par Dr. Paul Hauduroy. Pp. 392. (Paris: Masson et Cie, 1929.) 40 francs.

THE work of the nineteenth and of the present century has achieved much in the prevention of disease, but there are many maladies which still baffle public health endeavour. Of these, perhaps the most formidable are the great group of respiratory diseases, including influenza. Annually, few persons escape their attack, if merely in the form of the 'common cold', and the winter mortality figures for pneumonia impress the sad truth that this disease is not only "the friend of the aged", but also puts a premature end to the lives of the young. The three books before us are concerned with this subject in greater or lesser degree, and each of them attacks the problem at a different angle.

(1) Sir William Hamer's scholarly treatise, which embodies his teaching and medical philosophy, claims premier place; for Sir William is the protagonist of the new epidemiology, which in its essentials is the oldest epidemiology. Thomas Sydenham is its patron saint, and its motto is "that there is nothing new under the sun".

Sydenham's work on epidemics may be summed up as follows:—

(i) Certain fevers, he observed, had an epidemic character which bred true; they were of constant type year after year, or, as he puts it, "they were regular and uniform with the same phenomena and a general conformity of symptoms".

(ii) Variations occurred. The same disease, he believed, manifested itself with various dissimilar aspects as to origin, formation, decline, "like a monarch with a bodyguard of foreigners".

(iii) Both typical and atypical fevers prevailed at certain times, dependent, he considered, upon meteorological or atmospheric conditions or other external influences.

(iv) When several fevers infested the same period, one of them had an ascendancy over the others. When the paramount malady increased they declined; when it decreased they increased. The disease or symptoms which predominated determined the 'epidemic constitution' of that season, and thus there were different epidemic constitutions in different periods with a counterpart seasonal predisposition in the human constitution.

(v) Some epidemic constitutions were secular in length, long-period, and others were short and seasonal.

Sydenham's doctrine of epidemics, as has often been remarked, accords with the views of Hippocrates concerning the epidemics in the island of Thasos in the fifth century B.C. Sir William Hamer gives the doctrine the weight of his authority and the value of a modern interpretation. In the first chapter he describes the recent influenzas from 1915 to 1925 and maintains the thesis that cerebro-spinal fever, epidemic encephalitis, poliomyelitis, and the hosts of ills that have vexed mankind in recent years, are old foes with new faces, walking in the wake of influenza and part of an epidemic constitution. After discussing the contrasts and resemblances of London epidemics in the time of Sydenham and at the present day, and considering the history of epidemiology during the last hundred years, he elaborates his argument from a wealth of experience, and after pointing out that bacteriology has not been sufficiently careful in distinguishing causal from associated organisms, he leads the reader back in the concluding chapters to the starting-point, to Hippocrates and Sydenham. It would have been preferable for the findings of clinical medicine, pathology, and bacteriology to have received more weight in the discussion. It can scarcely be true that secondary organisms have so frequently led bacteriologists astray as the author would postulate.

Sir William Hamer's book is a fine exposition of certain epidemiological beliefs. While his interpretations of disease outbreaks may not receive unanimous acceptance, they must be weighed and considered by every serious student of epidemiology.

(2) The failure of the medical profession to cure a cold is a common grievance of the laity. Dr. Leonard Hill, with Mr. Mark Clement, has done his best to remove this reproach. The problem is dealt with exhaustively in the light of Dr. Hill's well-known physiological investigations. The authors conclude that "if cold weather gives rise to an epidemic of 'colds' the cause is not to be

sought in meteorological conditions, but rather in crowding in overheated and stuffy rooms, in ill-feeding and in 'coddling' ". The high incidence of illnesses spread by 'droplet' infection in crowded dormitories and the low incidence in open-air schools afford ample testimony to the value of the simple preventive measures detailed in this book.

(3) Common colds and influenza are believed by many authorities to be due to ultra-microscopic viruses. In the volume entitled "Les ultravirus et les formes filtrantes des microbes", Dr. Paul Hauduroy has assembled a collection of knowledge upon this subject which marks a new chapter in the record of bacteriology. Dr. Hauduroy is less critical than informative. The treatise is one which the investigator will consult to learn to what extent others have travelled on the road before him. At the same time, he will be chary of accepting all the accounts given as incontrovertible. Particularly is this true of the alleged ultra-microscopic forms of the tubercle bacillus, first announced by Fontés and afterwards supported by Calmette and others. British work, as yet unpublished, appears to be in conflict with these previous findings. It is interesting that Dr. Hauduroy believes that filter-candles in the investigation of these ultra-microscopic forms should be entirely replaced by collodion membranes, the latter giving more certain and accurate results.

The three works here reviewed are noteworthy contributions to the study of epidemic diseases.

A. S. M.

The Teaching of Science.

Science Teaching: What it Was, What it Is, What it might Be. By F. W. Westaway. Pp. xxii + 442. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1929.) 10*s.* 6*d.* net.

TEACHERS do not always regard a visit from H.M. Inspectors as an unmixed blessing, but were any justification of their existence necessary, it might be found in the appearance of such a book as Mr. Westaway's on "Science Teaching"; for here we have the essence of a wide and searching, but kindly, criticism presented to us in such a way that we realise our shortcomings without feeling aggrieved that they have been discovered. The final judgement is, however, by no means unfavourable; Mr. Westaway finds much to praise, even if he is not sparing of censure where he thinks it deserved. The book is consequently one that will be read with interest and profit by the beginner, but with a full appreciation of all its niceties only by the experienced teacher.

From a book of some 440 pages, whence the irrelevant has been ruthlessly excluded, it is not possible to select more than very few of the topics for detailed consideration in a short review. Like Mr. Bernard Shaw, however, Mr. Westaway puts the gist of the matter in the preface, though fortunately not at such inordinate length. It is, for example, in the preface that we find Mr. Westaway's view of the real claim of science to a place in the school curriculum, namely, its provision of new and increasing knowledge which every citizen ought to possess. Somewhat surprisingly, he refuses to admit that science can afford an insight into human motives, and denies that it provides for an analysis "of any sort of emotional experience". This is a statement that will not pass unchallenged, for in creative work science, art, and literature are closely allied, and many a man has had his sense of beauty awakened through his scientific training. Science is not necessarily unemotional, nor need art and literature be devoid of rigorous intellectual discipline.

At the same time, Mr. Westaway does well to insist that the science teacher's real battle is concerned at least as much with the dissemination of knowledge as with the training of the intellect. While it is true that the value of facts *qua* facts is comparatively small from an educational point of view, a brain well stocked with definite information is not to be despised; one remembers the "Yankee at the Court of King Arthur", who saved his life by a timely recollection of the date of the next solar eclipse. The modern world "is so full of a number of things" that a dull pupil, over whose head the tide of formal training passes undisturbed and undisturbing, may well find the greatest profit from his science teaching in the bare facts that he assimilates. The neglect to impart information is, as Mr. Westaway points out, the cardinal fault of the heuristic system, which renders progress excessively slow, even with exceptional teachers.

The judicial survey of various methods of teaching, and the suggestions for the content of the normal science course in schools, make very interesting reading. Mr. Westaway would make the periodic law the pole star of the chemistry course, and insists upon the necessity of building up chemical theory step by step, from plane to plane; only so can one avoid giving rise to such remarks as that made by a boy quoted in the book: "All the facts I have learnt in chemistry seem to be just a mixture, and not a compound." In physics, wave-motion

is assigned the most important position, ranking perhaps even before energy since it lies at the bottom of everything else—sound, heat, light, electricity, magnetism. Before any of these can be properly understood, a clear conception of wave-motion is essential. The transformations of energy should receive more attention than they get at present, and the whole of physics might be taught as just different aspects of energy.

On the question of biology in schools, Mr. Westaway offers no divided counsel. He says emphatically that it behoves all science teachers to help to educate public opinion as to the vital importance of a knowledge of biology; and he takes care to explain that by biology he does not mean "a perfunctory and amateurish study of an emasculated botany, a harmless hobby suitable for children and slow-witted girls", but a manly discipline on a level with chemistry and physics. Neglect of biology in the secondary schools accounts for the lamentable ignorance of biological principles—even of those most directly related to human welfare and right living—among the cultivated and educated classes of the country. Since the health and prosperity of the community depend very largely upon the systematic application of biological science, ignorance must quickly be replaced by knowledge if Great Britain is to retain her position in the van of civilisation.

Over the difficult problem of sixth form work, Mr. Westaway has no sympathy with the view that sixteen to eighteen years of age should be a breathing-space between the school certificate and the beginning of university work; he regards this period rather as a time when boys and girls should wrestle with serious intellectual exercises. Probably most science teachers will agree with him here, but many will nevertheless feel that the budding science specialist ought to have more time for 'leisurely thinking' and for the appreciation of poetry and art. The great danger of intensive specialisation in the last two years of school life is that the avenues to other interests may become permanently blocked; and this is, of course, true not merely of science but also of all subjects in which unfortunate higher certificate candidates are forced to specialise. A classical specialist is lucky if he gets a beggarly three periods a week at science, while his science fellow may be considered unusually well-informed if he knows more of the classics than may be gathered from "Ben Hur" at the cinema; and it would not be surprising to find that both exhibited an abysmal ignorance of art. They themselves are not to blame: they have never had the opportunity of learning. The Board of Education would do good service to future citizens if it reduced the time devoted to the study of 'special' subjects by post-school certificate boys and girls to, say, one-half of the whole; at present the fraction is nearer three-quarters, and sometimes larger still.

It is not only on such matters of grave moment that Mr. Westaway places his experience and wise counsel at our disposal. He is equally happy in suggesting improvements in detail, in directing our attention to unsuspected pitfalls, and in signalising what he has found to be good. His book will set many a young teacher on the right path, and will help many an older one to raise his performance to a much higher level of excellence; while the quiet humour and sympathetic understanding which permeate every chapter will go far to convince the harassed schoolmaster that there is, after all, something to be said for H.M. Inspectors.

E. J. HOLMYARD.

Minerals and Animal Nutrition.

Minerals in Pastures and their Relation to Animal Nutrition. By Dr. J. B. Orr, with the assistance of Helen Scherbatoff. (From the Reid Library, Rowett Research Institute, Aberdeen.) Pp. xv + 150. (London: H. K. Lewis and Co., Ltd., 1929.) 10*s.* 6*d.* net.

IN this volume Dr. J. B. Orr, Director of the Rowett Research Institute, Aberdeen, gives an extended, one might well say an exhaustive, review of the mineral content of pastures and its relation to the health and progress of animals grazing thereon. In addition, he describes the work which he has carried out on the subject in England, Scotland, Kenya Colony, and in other parts of the Empire. Dr. Orr sets out his conclusions as follows: Deficiencies of certain ash constituents are very widespread. Among the constituents most commonly deficient are calcium, phosphorus, potassium, sodium, chlorine, iron, and iodine.

The exclusive consumption of deficient herbage is often associated with decreased growth rate, malnutrition which may show itself in many forms, susceptibility to various diseases, development of pica or abnormal appetite which may cause animals to eat noxious materials, lowered fertility. There is some correlation between the degree of deficiency and the intensity of the symptoms produced, and between the type of deficiency and the kind of symptoms. Thus, for example, phosphorus deficiency is usually associated with pica of varying intensity according to the degree of deficiency.

There is also in general a correlation between mineral deficiencies in the herbage and the composition of the soil.

There are two methods of dealing with grass-land which produces deficient herbage. One is to manure the land with a fertiliser supplying the constituent which is deficient. The other is to give the grazing animals access to something which contains the deficient constituent. The latter method has been more widely employed because it is less expensive than to manure a whole district. In many cases it has been noticed that imported 'improved' animals are much more susceptible to deficiency symptoms than are native breeds of slower growth.

Dr. Orr's own work and all the literature on which his monograph is based support these conclusions. His book is full of valuable information and is written in a thoroughly convincing and stimulating style, which will arouse even more interest in the subject throughout the Empire than has already been created by his former reports and by his visits to several of the Dominions.

It is to be hoped that some among the many workers on pasture grass who owe their inspiration to Dr. Orr will direct their attention to an aspect of the subject as yet untouched, namely, the energy aspect. Kellner gives the starch equivalent of poor hay as 18·6 per cent, which corresponds to 200 net Calories per lb. The starch equivalent of the dry matter of young grass as determined by Dr. H. E. Woodman is in the region of 70 per cent, or 750 net Calories per lb. An average steer will not eat more than about 25 lb. dry matter per day. This amount would contain in the case of poor hay less than 5000 net Calories, and in the case of dried young grass, 18,700 net Calories. The daily maintenance requirement of an average steer is approximately 6000 net Calories. Such a steer eating his fill of poor grass or hay would therefore get barely enough net energy to maintain his live-weight, whilst from his fill of young grass he would get in addition to maintenance requirement something like 12,000 net Calories per day which he could convert into live-weight increase or any other form of production. May not this variation in the net energy value of grass be a possible explanation of some of the ills from which grazing animals suffer?

Dr. Orr quotes 270 calories per gram as the approximate caloric value of all the samples of dried grass he has examined, but from the method of calculation he has used this figure clearly represents gross calories, large and very variable proportions of which are not available in the animal's body for physiological purposes. There is a further question which I hope to investigate by the aid of samples of deficient hay kindly sent to me by Dr. Orr, namely, the method by which mineral deficiencies cause symptoms of malnutrition. Does deficiency of minerals limit appetite, or does it lower digestibility, or does it interfere with physiological utilisation?

T. B. WOOD.

The Low Veld.

The Low-Veld: its Wild Life and its People. By Lieut.-Col. J. Stevenson-Hamilton. Pp. x+288+16 plates. (London, Toronto, Melbourne and Sydney: Cassell and Co., Ltd., 1929.) 12*s.* 6*d.* net.

THE Transvaal Low Veld comprises that part of the province which lies below 2000 feet, forming a belt to its east, about 300 miles long and 70 miles broad. It has no gold, little commercial exploitation, and 8000 square miles had been established by statute as the Kruger National Park and has been left practically undisturbed for twenty-six years under the control of the author, who is almost its creator as well. It is tropical with wet and dry seasons that fluctuate greatly. Drought predominates, and in consequence fires are so common that any tree vegetation has to be drought- and fire-resistant, thus secondary and stunted, though some parts are open savannah, others dense thorn scrub, and yet others park-like with fine trees. The fires are not an unmixed disaster, for they destroy disease-carrying ticks and doubtless many other noxious pests, while they are followed by a richly nutritive vegetation. At the same time the loss of exposed soil in the heavy rains gradually adds to the desiccation.

Here, in the Park, wild Nature reigns, and probably the white rhinoceros is the only mammal out of 128 enumerated that has become extinct through the activities of white hunters. The tameness of antelopes, zebras, elephants, and many others, is strikingly depicted, and the book bristles with observations of value, such as the fact that lions in their cannibalism show a sexual consideration in that a male or female will not generally consume its species of the opposite sex. The gross increase of the larger antelopes is estimated at 30 per cent annually, net 15 per cent, and were lions not checked, 5 per cent. Deaths from old age occur after fifteen years, and other causes contributing to decrease are combats between males, calving, sickness, and snake-bite. In 1896 came the rinderpest, and the buffalo herds were reduced to about a

dozen individuals. Attention is directed to the fact that after its passing the tsetse fly, wherever rinderpest came, was found to have disappeared not only here but also all over Africa, an observation worthy of the close attention of every biologist.

Chapters on the vegetation, birds, reptiles, and fishes are equally illuminating, and the author, like all old inhabitants of native lands, loves to describe the medicinal and other uses of his fruits and trees. The crocodile is a real danger to drinking mammals, but it is kept in check by the egg-eating water monitor, which grows to 7 feet in length. The lizards, most pugnacious little warriors, would assuredly repay study, but the mambas, cobras, and puff adders sound unpleasant, especially the first, as it attacks whoever is in its route. The losses sustained by agriculture from insects are estimated " to exceed that from all other causes—drought, hail, disease, birds, and mammals—put together ". There are also hippo- and bot-flies and *Anopheles* to carry malaria, balanced by attractive stick and praying insects, and white ants, of which we cannot know too much. Locusts come occasionally, but it is questionable whether most insect migrations are correlated with winds. Lastly, there was the author's baboon, which specialised on scorpions, patiently turning over stones, then getting almost hysterical until her hand darted in, pulled off the terminal poison claw, and crammed the body into her mouth.

This most interesting book concludes with chapters on the recent history of the country and on its natives and their customs. J. S. G.

Our Bookshelf.

Cements, Limes and Plasters: their Materials, Manufacture, and Properties. By Edwin C. Eckel. Third edition; with Chapters on Alumina Cements and High-Strength Portlands. Pp. xxxiv + 699. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 35*s*. net.

THIS new edition of a standard American book contains an additional section of forty pages devoted to the alumina cements (*ciment fondu*) and the accelerated or high-early-strength Portland cements. Otherwise the book remains unaltered.

In the new section, the different processes of manufacturing the new high-speed cements are clearly and accurately described, and a good account is given of their remarkable physical and chemical properties. A useful list of references to the literature upon the subject is appended to each chapter. The superior resistance of *ciment fondu* to sea-water and to alkaline and sulphate-bearing waters is described, but nothing is said about its behaviour with other solutions. It is perhaps too early to give anything like a general account of the chemical behaviour of this material. The chemical engineer will be well advised to carry out exhaustive tests under plant conditions before using it for the construction of containers for his solutions. The author thinks that " the engineer will in the near future choose his cement from among three groups: (1) Alumina Cements, made in blast furnaces at or below the present Portland costs, and giving extreme high early strengths and high chemical resistance; (2) High-Strength Portlands, still made perhaps in the rotary kiln but with even higher lime and silica than now current; and (3) some type of Portland-Silica or Portland-puzzolan mixture, giving better chemical resistance than straight Portlands."

It is in every way an excellent book describing thoroughly and clearly, albeit from the American point of view, the manufacture of gypsum plasters, limes, magnesia and oxychloride cements, hydraulic limes, natural cements, Portland cement, puzzolan cements, alumina cements, and high-strength Portlands.

The author describes fully and clearly the design and arrangement of the different kinds of plant and discusses the power requirements, heat consumption, and operating costs of the various processes. In view of the rapid fluctuation in the price and manufacturing costs of cements since the War, the author wisely retains the pre-War costs data for purposes of accurate comparison. The book can be recommended to the chemical engineering student as a valuable text-book. It is a mine of reliable information to all who are interested in the particular manufactures with which it is concerned.

Photochemische Versuchstechnik. Von Prof. Dr. J. Plotnikow. Zweite, erweiterte, auf photomechanischem Wege hergestellte Auflage. Pp. xvi + 454 + 3 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) n.p.

THE first edition of Plotnikow's book was published in 1911, and the present edition, for the most part, is simply a reproduction made by photomechanical methods. Those who are acquainted with the first edition know that its main characteristics consist in the description of apparatus devised and of methods used by Plotnikow, comparatively little attention being paid to the work of other investigators. Much the same course is pursued in the following additions incorporated in the present volume. Pages 93-106 consist of descriptions of new 'light thermostats' and apparatus for exposure to light on a large scale devised by the author. Pages 202-226 describe methods for the measurement: (*a*) of the energy of radiation, (*b*) of absorption coefficients, (*c*) of light intensities by the tube photometer, (*d*) of the Schwarzschild constant. In connexion with the latter constant it is mainly Plotnikow's own methods to which reference is made, and no mention occurs of the accurate methods which have been used, for example, in very extended investigations in the Kodak laboratories. Pages 254-268 contain additions to the various lecture experiments described in the first

edition, and pages 416-438 contain new tables of the absorption coefficients of solutions of various substances. There are very few additions to the literature references given in the re-printed part of the book, and the references to the new parts are very far from complete. Apparently no corrections have been made in the older parts; for example, it is still stated that the action of light on silver chloride gives rise to sub-chloride.

In the preface the author states that complete revision of the subject matter is left to the next edition. It is to be regretted that such a revision was not carried out for the present volume. When such an edition is published, it is to be hoped that only the apparatus and methods of Plotnikow which have stood the test of experiment will be described, and that the work of other investigators will also be incorporated in its due proportion.

The Tropical Crops: a Popular Treatment of the Practice of Agriculture in Tropical Regions, with discussion of Cropping Systems and Methods of growing the leading Products. By Otis Warren Barrett. (The Rural Science Series.) Pp. xviii +445+24 plates. (New York: The Macmillan Co., 1928.) 17*s.* net.

THE author estimates that about one-half of the area of cultivable land in the world lies within the torrid zone. When one considers the wide range of rainfall, humidity, temperature, peoples and civilisations which exist in the tropics, one realises that the agriculture of this part of the world embraces a very much wider field than can possibly occur in the temperate zones, where the range of such conditions is much more limited.

As this book is based mainly on the personal observations of the author, it is evident that only those aspects of tropical agriculture with which he is familiar can be dealt with at all fully. The book is chiefly confined to the perennial crops of the tropics and to those grown in more humid climates. So far as these are concerned the book is of value, especially since the writer has had so long an experience of such crops and conditions.

More than a quarter of the book deals with tropical fruits, many of which are of purely local interest. Reference is made to many tropical plants which yield commercial products but are only remotely connected with agriculture. On the other hand, the arable crops of the tropics are very briefly dealt with, and this aspect of tropical agriculture is evidently outside the writer's experience. He makes the statement that "really proper tilth in tropical areas is rare". This entirely neglects the arable agriculture of the Old World tropical civilisations, such as is to be seen in India, China, and Egypt, where very high standards of arable farming exist. Crops such as tropical cereals, bast fibres, oil-seeds and pulses, all of which are vital to the needs of the dryer regions of the tropics, are dismissed in a few pages. Even rice, which the author refers to as the world's most important crop, is summarily dealt with in less than three pages.

H. C. S.

Automaton: or the Future of the Mechanical Man. By H. Stafford Hatfield. (To-day and To-morrow Series.) Pp. 100. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1928.) 2*s.* 6*d.* net.

THE idea of a 'mechanical man' has receded into the background since the advent of the mechanical age. When practically all our necessities are provided by automatic or semi-automatic machines, there is no necessity to construct things having the external appearance of men and doing our bidding. They would do it much more effectively if they were specially designed for the job. Yet it is interesting to follow the author's account of modern efforts towards complete automatism, from the sorting of letters to the self-steering aeroplane. He recognises that mechanisation has worked both ways, and that, while machines have been endowed with almost human faculties, man himself has become mechanised, inasmuch as civilisation and humanitarianism tend to "create communities of well-washed, well-fed, well-regulated, well-behaved, mildly cultured people as devoid of all individuality as machine-made automata". An eminently readable essay.

The Elasmobranch Fishes. By Prof. J. Frank Daniel. Pp. xi + 332 + 30 plates. (Berkeley, Cal.: University of California Press; London: Cambridge University Press, 1928.) 27*s.* 6*d.* net.

STUDENTS and teachers of zoology alike will welcome the second edition of Prof. Daniel's comprehensive treatise on the elasmobranch fishes. The same method of treatment as that adopted in the first edition has again been followed. In dealing with the various systems of organs, a detailed description of the condition found in the notidanid shark *Heptanchus maculatus* is given, followed in each chapter by a comparative account of the more specialised forms. In this way the reader is made familiar not only with the general structure of the group but also with the various modifications and specialisations exhibited by different members of it. A considerable amount of new subject matter, several additional illustrations, and a number of corrections of the original text serve greatly to enhance the value of this useful and attractively produced work.

Flora of the Presidency of Madras. By J. S. Gamble. (Published under the Authority of the Secretary of State for India in Council.) Part 8: *Ulmaceæ to Xyridaceæ.* By C. E. C. Fischer. Pp. ii + 1347-1532. (London: Adlard and Son, Ltd., 1928.) 10*s.* net.

SINCE, on the death of Mr. J. S. Gamble, the "Flora of the Madras Presidency" was left unfinished, the continuation has been undertaken (at the express wish of Mr. Gamble) by Mr. C. E. C. Fischer, late of the Indian Forest Service and now assistant for India at Kew. The present part comprises the concluding families of the Angiosperms (Ulmaceæ to Salicaceæ), Gymnosperms, and the Monocotyledons from Hydrocharitaceæ to Xyridaceæ.

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.*]

Glasses Transparent to Ultra-violet Radiation.

DURING the past few months an investigation has been carried out in this laboratory upon the transparency of various ultra-violet transmitting glasses under different conditions. In view of the conflicting statements that have been made concerning the behaviour of these glasses, the results are of considerable interest.

The apparatus used for determining the percentage transmission for radiation of different wave-lengths is set up as follows: A quartz mercury vapour lamp is the source of energy. Radiation from the lamp passes through either the piece of glass under test, or, alternatively, through an adjustable rotating sector. It then traverses two monochromators in series. These instruments select any particular wave-length which is required, and allow this radiation to fall upon a sodium photoelectric cell. The essential part of the determination consists in adjusting the rotating sector until an identical photoelectric current is obtained, when the glass is substituted for the sector, and vice versa. This apparatus is found to give accurate results. Transmission values are determined for several mercury lines, and curves drawn for each glass.

It is a well-known fact that glasses transmitting ultra-violet radiation undergo a change when exposed to such radiation, and become rather less transparent. The speed and magnitude of this change vary among different glasses, and even to a small degree among individual pieces of glass of the same general composition. The change is known as 'solarisation'. It is brought about very much more rapidly by exposure to a quartz mercury vapour lamp than to sunshine, the glass attaining a state, hitherto regarded as stable, after a period of a few hours instead of several days or weeks. These facts have led to the almost universal use of the mercury vapour lamp by investigators of these phenomena.

After solarising a number of specimens by means of the mercury vapour lamp, it was observed that they had taken on a brownish tint. These pieces of glass were placed upon a laboratory table under a window, at ordinary room temperature, and after some days it was noticed that the brownish tint was less pronounced. Upon re-examining these test pieces it was found that they had regained some of their lost transparency. Further investigations revealed the following facts:

(1) When kept in the dark, glasses solarised by the quartz mercury lamp do not regain any of their lost transparency.

(2) Glasses thus solarised, when exposed to sunlight, regain some of their lost transparency.

(3) Glasses thus solarised, when covered with ordinary window glass and exposed to sunlight, regain some of their lost transparency.

(4) Glasses thus solarised, when covered by a thick layer of ordinary window glass, and further exposed to the mercury vapour lamp, regain a similar amount of their transparency quite rapidly, the change being more rapid with a thick covering of ordinary glass than with a thin.

The following figures will show the extent of these changes for different types of glasses. The figures are percentage transmissions for radiation of wave-length 3000 A. for a thickness of glass of 2 mm. Transmissions for 3100 A., perhaps the most important physiologically, owing to its much greater intensity in solar radiation, are of course very considerably higher in each case.

All investigations have been carried out at ordinary room, or outside, temperatures, except in so far as the mercury lamp causes a slight warming of the specimens—an amount which we have found to be quite insufficient to have any effect upon transmission values.

Original Transmission (per cent).	After Complete Solarisation by Quartz Mercury Lamp (per cent).	After Subsequent Exposure of Solarised Glass to Sunlight (per cent).
59	35	47 (5 days' exposure)
59	32½	45 (5 ,,)
60	32½	45 (9 ,,)
59	31½	48 (9 ,,)
35½	25	31 (9 ,,)
35½	25	31½ (3 ,,)
		After Subsequent Exposure to Sunlight under Ordinary Window Glass.
57½	32½	44 (5 days' exposure)
		Further Exposed to Lamp shielded by Ordinary Window Glass.
75½	52½	58½ (8 hours' exposure)
66	35	46 ,,
66	38	47 ,,

Two pieces from the same sheet of ultra-violet glass were now taken. One of them was solarised completely by the quartz mercury lamp. Both were exposed during very fine weather to ordinary sunlight on the top of a building. The original untreated piece of glass, the transmission of which was 58½ per cent, was tested every day, and was found to have attained an almost steady state (46 per cent) in six days, of which two days had been dull, producing no change. After these six days the change in the glass was very slight indeed, the final transmission figure, after several weeks, being 45 per cent. The artificially solarised sample, the transmission of which was 33 per cent at the commencement of this experiment, was found to have improved in transmission during six days up to 43½ per cent. After 24 days the transmission was 45 per cent, and after 32 days it was still 45 per cent.

In view of these results we decided to send some specimens on a ship to Madeira and back. These specimens experienced very brilliant weather. Glasses of two different compositions were taken, and two specimens of each, one being new glass and the other glass completely solarised by the mercury lamp. Glasses widely different in transparency were chosen. The following are the figures for the transmission of these four specimens, before and after the voyage:

NEW GLASSES.			ARTIFICIALLY SOLARISED GLASSES.		
	Original (per cent).	At End of Voyage (per cent).		At Beginning of Voyage (per cent).	At End of Voyage (per cent).
A.	56	43	*A.*	29½	43
B.	34½	29½	*B.*	24	29½

It is significant that the two specimens of glass *A*, one untreated and the other artificially solarised, have

finished the voyage with identical transmissions, the falling off of one being of the same magnitude as the recovery of the other. The same is true of glass *B*, which is of very much lower transparency, and of entirely different composition.

We consider that these figures prove conclusively how completely misleading has been the use of the mercury vapour lamp by investigators to determine the loss in transparency of glasses when exposed to natural sunlight.

A. R. WOOD.
M. N. LEATHWOOD.

Research Laboratory,
Crown Glass Works,
St. Helens, Aug. 27.

Turbulence in the Sun's Atmosphere.

IT is well known that the density gradient in the solar chromosphere is vastly less than what it would be in ordinary gravitational equilibrium. This was a complete enigma until the advent of Milne's theory of selective radiation pressure in the case of ionised calcium. This theory has had many successes but does not seem to admit of generalisation to gases like hydrogen and helium which are present in abundance. It even seems that the radiation pressure is important for Ca^+ only if enough hydrogen is there initially to prevent excessive ionisation (McCrea, *Mon. Not. R.A.S.*, **89**, p. 843; 1929; NATURE, April 6, 1929, p. 527). We have still to explain the presence of these gases.

The failure to do so hitherto seems to illustrate a recent remark of Rosseland's that the use of more general hydromechanics is demanded in astrophysical applications (*Mon. Not. R.A.S.*, **89**, p. 49; 1928). In particular, he shows that if there is *any* relative motion of the gases in the sun, it must be *turbulent* motion. The reality of such turbulence is demonstrated by the 'granulations' of the solar surface and by the scattering of prominence material.

Unsöld has lately measured the contours of the chromospheric *H*, *K* lines of Ca^+ in emission and absorption and finds them determined by a Doppler effect (*Astrophys. Jour.*, **69**, p. 207; 1929). He, too, independently concludes that this is only to be accounted for by turbulence. He supposes the turbulent velocities (*U*, *V*, *W*, say) have a Maxwellian distribution and so derives scattering coefficients varying as $e^{-\left(\frac{\Delta\nu}{\Delta\nu_0}\right)^2}$, where $\Delta\nu$ is the distance from the line centre. He finds $\Delta\nu_0$ to correspond to 15 km./sec., which is large compared with the temperature motion. Neglecting the latter, the velocities in the line of sight must be distributed like $e^{-U^2/2\overline{U^2}}$, where $\overline{U^2}$ is the mean of U^2 and clearly $2\overline{U^2}$ corresponds to $\Delta\nu_0{}^2$. Hence the mean resultant velocity $C=\sqrt{\overline{U^2}+\overline{V^2}+\overline{W^2}}=\sqrt{3\overline{U^2}}$ is $15\sqrt{\frac{3}{2}}=18{\cdot}4$ km./sec. Supposing this to be true turbulence, it must be the same for all gases present.

For hydrogen at 5000°, the probable temperature *T* of the chromosphere, the mean resultant velocity *c* due to temperature alone is 11·1 km./sec. which is no longer small compared with *C*. The mean resultant square velocity C^* of the hydrogen atoms is found to be given by $C^{*2}=C^2+c^2$, so that $C^*=21{\cdot}5$ km./sec.

The question then arises as to the effect on the gas pressure. But the dynamical pressure in a gas is merely $p=\frac{2}{3}$ (mean kinetic energy) × (number of atoms per cm.^{3}) and, averaged over a sufficient area, is the same whether the kinetic energy is due to temperature or turbulence motion. Hence in calculating *p*, C^* and not *c* must be used. The result can be expressed simply by saying that *p* is given by an 'apparent temperature T' where $T=(C^*/c)^2T$. We find T = 18,800°. The density gradient must therefore also imitate that at temperature T, so that $\rho\propto\exp\left(-\frac{Hgy}{kT}\right)$ instead of $\exp\left(-\frac{Hgy}{kT}\right)$, where *H* is the atomic mass, *k* the gas constant, *g* gravity, and *y* height in the atmosphere. Hence $\rho\propto\exp\left(-1230\frac{y}{a}\right)$ and not $\exp\left(-4600\frac{y}{a}\right)$.

Now Pannekoek and Minnaert (*Verh. d. k. Akad. Amsterdam*, **13**, No. 5; 1928) have obtained from observation the empirical law for hydrogen $\rho\propto\exp\left(-1127\frac{y}{a}\right)$. The agreement of the new theoretical value is therefore very satisfactory. The fact that the *observed* value of the turbulence leads so immediately to this result seems scarcely to leave room for any other explanation.

We have neglected ionisation. In *Mon. Not. R.A.S.* (loc. cit.) I have estimated that hydrogen at the base of the chromosphere is only about 2 per cent ionised. This would be invalidated if the well-known anomalous behaviour of the ratio of excited to normal hydrogen atoms should affect the chromosphere. The extension of the above ideas to an ionised gas is not easy, because the electrons have already such a high velocity that turbulence scarcely increases it and so T for the electrons, T_e say, is still 5000°, while for the ions, T_i say, it is the 18,800° found before. It can be shown, however, that for a *highly* ionised gas the density gradient will be that for a neutral gas at temperature (T_i+T_e) instead of the usual result (Fowler, "Statistical Mechanics" (1929), p. 359) for such a gas, namely, 2*T*. The *neutral* atoms will in these cases have density gradients as at temperatures $\frac{1}{2}(T_i+T_e)$ and *T* respectively. We find, therefore, that the turbulence would mean a law $\exp\left(-1940\frac{y}{a}\right)$ instead of $\exp\left(-4600\frac{y}{a}\right)$ for these atoms. The agreement would not then be so good as before. But, since even in this most unfavourable case the turbulence, if real, must *necessarily* produce such a large part of the decrease in the density gradient, one can scarcely help concluding that in the actual case it must account for the whole of it. No other known agency gives anything but the law $\exp\left(-\frac{Hgy}{kT}\right)$ for the *neutral* atoms.

For all other elements, turbulence would give a density gradient only a little steeper than for hydrogen. So it would account for the presence of other gases in the chromosphere without appeal to atomic peculiarities, even lightness. Of course, ionisation may bring in minor complications; or, where selective radiation pressure is important, we may have still smaller gradients.

I have obtained a certain amount of success with a somewhat similar theory of the corona.

It would appear that the turbulence does not appreciably degenerate into heat in the chromosphere, but it must do so somewhere. Hence it must somewhere affect thermodynamic conditions. An attempt to picture the *modus operandi* of this degeneration seems to show that it will mean that at any instant a fraction of the atoms of the gas will have properties characteristic of a higher temperature than the gas as a whole. For one thing, the collisions between atoms belonging to portions of gas with different turbulent velocities would, in our case of hydrogen, be like those in a gas at real temperature T, although even if all the turbulence were transformed to heat it could not give a temperature so high as T because of the loss of kinetic energy transformed to internal energy (excita-

tion, etc.). The resulting deviation from thermodynamic equilibrium would be qualitatively of the kind observed in stellar atmospheres (Adams and Russell, *Astrophys. Jour.*, **68**, p. 9 ; 1928). It promises to be the true explanation, but first demands refinements of the theory of the turbulence.

A further account of this work is to appear in *Mon. Not. R.A.S.* Supp. Number 1929.

W. H. McCREA.

Göttingen, Aug. 23.

A Habit of the Common Periwinkle (*Littorina littorea* Linn.).

AN interesting habit of the common periwinkle, *Littorina littorea* Linnæus, which does not appear to have been recorded by previous writers, is worthy of some attention. On boulder-strewn shores, such as that at Penrhyn Bay, North Wales, where these observations were made, this species may occur in enormous numbers at and below the half-tide level in situations devoid of the larger Fucoid algæ. The boulders are covered with barnacles and afford no shelter from the sun except on the north side or in shady crevices. The periwinkles, nevertheless, cling

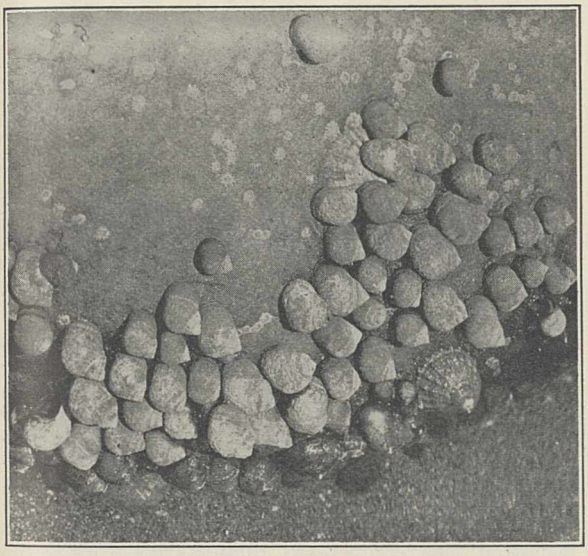

FIG. 1.—Photograph of *Littorina littorea* Linn. attached by dried mucus films to a boulder at low tide.

in closely packed rows to the sides of the boulders, especially near the base where it is damp, but also higher up, and they may become completely dried on a hot day.

Other writers have observed that these resting periwinkles are almost always orientated with the apex of the shell downwards, in which position the head and the lip of the shell are uppermost. But it does not seem to have been generally realised that if the day be dry the molluscs do not cling to the rock with the foot, but stick their shells to it and then completely retract the body, shutting themselves in with the operculum. In this condition they are in no danger of desiccation while awaiting the return of the tide.

The attachment is effected as follows. As the receding tide exposes the snails and they begin to dry in the sun, they secrete a little mucus in such a way that it forms a sticky film between the outer arc of the shell's lip and the rock surface. This film soon dries, becoming hard and brittle, but of sufficient strength to support the weight of the mollusc on a steeply sloping or even vertical surface. The animal then releases its foothold and completely retracts. The brittle film can support little more than the periwinkle's own weight, and that only in the position in which they are usually orientated, namely, with the lip uppermost. It sometimes happens that an individual orientates itself with the lip of the shell downwards, and then almost invariably the creature topples over as soon as it trusts to the film for support.

The accompanying photograph (Fig. 1) shows several rows of periwinkles stuck by their mucus films to the almost vertical side of a boulder. The close ranks of the molluscs are characteristic for the shore mentioned above. It will be noticed that all are orientated with the lip uppermost, with the exception of two individuals, one in the bottom left-hand corner and one near the right edge of the photograph. Apparently these had attempted to fasten themselves lip downwards but had toppled over on retraction. At the time, however, the mucus was probably still pliable, and they now rest with their lips still stuck to the rock but their weights partly supported by snails immediately below. Other specimens have occasionally been seen in similar positions. The dried and brittle mucus film is often so fragile that on a gusty day it is a common sight to see odd specimens blown off, and the sound of dropping periwinkles is heard at intervals.

Since these observations were made, it has been noticed that the periwinkles in the Plymouth Aquarium tanks frequently crawl up the glass or slate sides until they are well above the surface of the water, and if the air in the laboratory be at all dry they will stick themselves in position in the way they do on the shore and will pass several hours in a state of complete retraction.

D. P. WILSON.

Marine Biological Laboratory,
Plymouth, Aug. 8.

The Nitrogen Afterglow.

DURING the past year a further study has been made of the decay of the nitrogen afterglow and the phenomena connected with the production both of this luminosity and the accompanying chemical activity ; while the minutiæ of the quantitative parts of the investigation remain to be examined more closely than at present, certain very definite findings may briefly be given.

(1) The decay of the afterglow is without doubt only partly a homogeneous reaction in glass vessels which have been most scrupulously cleaned.

(2) The amount of divergence from the homogeneous reaction is determined, for any given vessel, by the purity of the nitrogen employed. In agreement with Bonhoeffer and Kaminsky, the writer finds that the influence of the traces of electronegative gas essential to the production of a glow is confined almost certainly to the surfaces and that the effective concentration of these 'photogens', as they may conveniently be termed, lies between definite limits which vary slightly from gas to gas ; within these limits the surface reaction is held down to a minimum and the gas phase decay is then of the second order with respect to the glow-producing system, and very probably of the third when the influence of the neutral nitrogen is allowed for.

(3) Unless the purity of the nitrogen is carefully controlled, the apparent 'order' of the decay can vary widely ; this is the most probable explanation of the discrepancy between the experiments of Kneser (*Ann. Physik*, **87**, 717 ; 1928) and earlier investigations (*J. Chem. Soc.*, 1620; 1928: 228; 1929) made by the writer.

(4) Under conditions where wall decay has been minimised and the gaseous process predominates, no appreciable change in the order of the reaction takes place with time and no apparent alteration occurs in the afterglow spectrum so far as λ4000 A.

(5) In glowless nitrogen the chemical activity is either absent or scarcely detectable; addition of photogenic gases causes, however, a development of chemical activity which generally increases less rapidly than the corresponding rise in luminosity. No simple relationship apparently exists between glow intensity and concentration of chemically active nitrogen, except possibly under certain conditions which are determined by the state of the walls; in this case there is direct proportionality.

(6) Addition of small amounts of oxygen or nitric oxide to a stream of glowing nitrogen causes a large development of radiations which lie in the blue and regions of shorter wave-lengths. (This has also been observed by Mr. G. C. Eltenton, using the writer's former apparatus at Cambridge.)

(7) The intensity of the green flame produced when 5 per cent or so of nitric oxide is fed into a stream of glowing nitrogen appears to follow the same intensity relations towards the concentration of chemically active nitrogen as does the luminosity of the nitrogen alone under the same conditions.

(8) The decay rate of a stream of luminous nitrogen can be varied by addition of photogens without affecting the amount of the chemically active species present. This suggests that two bodies of different types are concerned in the production of the glow, one being very susceptible to surface conditions and the other (which may be the chemically active form) much less so.

The existence of these strong wall effects would seem, assuming the analogy with active hydrogen to hold, to be very strong evidence in favour of the hypothesis that atoms are concerned in both the luminous and chemical phenomena associated with active nitrogen, and recent work by Compton and Boyce (*Phys. Rev.*, 1929) and Kaplan (*Phys. Rev.*, 1929) shows that two species of metastable atom (2·3 volts and 3·6 volts) and a metastable molecule (8·5 volts) are present.

Spectroscopic evidence is thus provided for a body of an energy content which agrees very closely with the energy of active nitrogen as found by Dr. E. K. Rideal and the writer, in agreement with Lord Rayleigh, the value of 2·0-2·2 volts (46,000-50,000 cal./gm. mol.) having been obtained from experiments upon the chemical reactions of this mysterious substance. But even if this does bring into harmony the physics and chemistry of active nitrogen, an explanation has still to be found as to why the other excited species present are apparently chemically inert and why also only about one-sixth of the total energy available is apparently effective.

If it could be proved that the chemical activity is due to these 2·3 volt metastable atoms and their precise nature established, it would clearly be of great value in leading towards an understanding of the nature of chemical reaction.

E. J. B. WILLEY.
University College, London,
July 24.

Natural Selection.

IN a communication in NATURE of Aug. 10, Prof. E. W. MacBride, while admitting the reality of natural selection, denies that it applies to random variation. He dismisses ill-adapted types found in Nature as "pathological", and states that selection favours "the most vigorous individuals". It is not clear to me that much is gained by substituting the words 'vigorous' and 'pathological' for Darwin's 'fit' and 'unfit'.

Little valuable result is likely to arise from a discussion of the subject which ignores the large amount of quantitative work that has been done in recent years on natural selection. Unfortunately, most of this work is published in Russian periodicals, which are not easily available in England. However, the readily available work of Sukatschew (*Zeit. Ind. Abst. u. Vererb.*, **47**, p. 54) illustrates the nature of the 'fitness' or 'vigour' which distinguishes varieties. Two races of dandelion, *B* and *C*, from the same lawn were grown at the same density in pure and mixed cultures. After two years, 49 per cent of *B* and 24 per cent of *C* survived in the pure cultures, 20 per cent of *B* and 58 per cent of *C* in the mixed cultures. The numbers of flowers per plant varied in the same direction. Clearly, vigour in this case is simply fitness in a given environment, and is mainly determined by physiological causes. No one could have predicted the above results from an examination of the morphology of the varieties.

Detlefsen and Roberts (*Genetics*, **3**, p. 573) in mice, and Pearl and his colleagues (*Am. Nat.*, **55-58**) in *Drosophila melanogaster*, have shown that Mendelian genes may determine differences in 'vigour', that is, in viability under the conditions of culture observed. Not all genes cause measurable differences. Thus only one out of the three tested in mice caused any appreciable difference in mortality during the first three weeks of life. The reason why black mice in captivity are about 2 per cent less viable than grey is not known, but has clearly nothing to do with protection from predatory enemies. Nevertheless, it is a fact, and one which should surely not be ignored in discussing why most wild mice are grey. When, in addition, it has been shown that local races of *Drosophila* and rodents, and also rodent species, differ by Mendelian colour genes, it is clear that such a discussion is relevant to the problem of evolution.

It seems likely that, as Prof. Watson suggests in his presidential address to Section D of the British Association (see "Adaptation", p. 231 in NATURE of Aug. 10), physiological differences between varieties, such as exist between *B* and *C* dandelions, or grey and black mice, may prove to be of greater selective value than the morphological differences which immediately strike the eye of the taxonomist or geneticist. But if the value to a species of such morphological differences has often been exaggerated, quantitative work shows clearly that natural selection is a reality, and that, among other things, it selects Mendelian genes, which are known to be distributed at random through wild populations, and to follow the laws of chance in their distribution to offspring. In other words, they are an agency producing variation of the kind which Darwin postulated as the raw material on which selection acts.

J. B. S. HALDANE.

Rate of Dissociation of Nitrogen Tetroxide.

THE speed at which the reaction $N_2O_4 \rightleftharpoons 2NO_2$ attains equilibrium has been a subject of investigation for the last half-century. Since ordinary methods are valueless, attempts have been made to determine this rate by using the velocity of sound in the dissociating gas.

Einstein (*Sitzungsber. d. Berl. Akad.*, 1920) has developed equations for the change of velocity of sound with frequency. At low frequencies the reaction is always in equilibrium as regards pressure changes due to the sound waves, while at high

frequencies the alternations of pressure are so rapid that the equilibrium cannot follow them. Therefore, in a gas such as nitrogen tetroxide, where increasing pressure promotes association, there will be a greater increase in density in the compressions and a greater decrease in the rarefactions at low frequencies than at high frequencies. Consequently there will be two values of the velocity of sound, the higher, u_∞, at high frequencies, corresponding to frozen equilibrium, and the lower, u_0, at low frequencies, corresponding to complete equilibrium. At some region of intermediate frequencies, the 'critical' region, where the time for the attainment of equilibrium and the time for one vibration are of the same order of magnitude, there will be a varying velocity of sound corresponding to partial equilibrium. For the critical region an approximation formula holds from which the velocity constant may be computed, and for the other two cases values of u_0 and u_∞ may be calculated corresponding to experimental temperatures and pressures.

Grüneisen and Goens (*Ann. Phys.*, **72**, 193; 1923), using a resonance method and audible sound up to 15,600 vibrations a second, found values of the velocity of sound always corresponding to u_0; for example, 187 m./sec. at 25° and 565 mm. (calculated value of u_0, 189 m./sec.).

In September 1927 we began a re-investigation of this problem, using ultrasonic vibrations produced by a quartz crystal as described by Pierce (*Proc. Am. Acad. Art. Sci.*, **60**, 271; 1925), Loomis and Hubbard (*J. Optical Soc. Amer.*, **17**, 295; 1928), and others. We found that contamination by air was a prolific source of error. For our purest sample (0·1 per cent air) we obtained a velocity of 192·6 m./sec. at 25° and 565 mm. pressure at a frequency of 51,570 vibrations a second, corresponding to a value of 5630 for the velocity constant. This result will be confirmed as soon as possible.

A. R. OLSON.
C. E. TEETER, JR.

Department of Chemistry,
University of California,
Berkeley, California,
Aug. 8.

A Function of the Adrenal Cortex.

SINCE the appearance of our communication in NATURE on a function of the adrenal cortex (Dec. 29, 1928, p. 998), a paper on the same subject has appeared in the *Journal of Physiology* (vol. 67, p. 343; 1929) by H. Florey, A. Szent-Györgyi, and M. E. Florey, in which they offer a 'criticism' of the statement that decerebrated adrenalectomised cats die in a short time from respiratory failure. These three investigators base their contradictions on two experiments, whereas our conclusions were drawn from more than one hundred experiments. The longer the interval that elapses after decerebration and before adrenalectomy the quicker the respiratory failure. But, in one of the experiments performed by these workers, adrenalectomy was performed *before* decerebration and therefore, so far as a repetition of our work is concerned, must be discounted altogether.

Naturally, there have been one or two exceptions in our own series due, probably, to accessory cortical bodies. The above-mentioned workers state that "post-mortem examination did not disclose any accessory adrenal bodies". We should like to know whether serial sections were cut of the whole reproductive organs. These bodies can rarely be found in the cat by ordinary methods of dissection. Again, they suggest that any other extracts increase respiration. This, of course, is possible, but they seem entirely to miss the main point that pneumin restores respiration after it has failed from adrenalectomy—an experiment they have not performed, since the condition did not occur in their one experiment.

Apart altogether from theoretical considerations, there can be no doubt that if a cat be decerebrated and then, after a lapse of one or two hours, the adrenal bodies be removed, symptoms of respiratory failure will not be long in appearing and the animal will be dead in an hour or so. A contradiction, based upon one experiment, of results obtained from a prolonged series of investigations, can scarcely be considered as obeying the elementary rules of scientific investigation.

SWALE VINCENT.
J. H. THOMPSON.

Dept. of Physiology,
Middlesex Hospital Medical School.

A Crystalline Tripeptid from Living Cells.

IT has recently proved possible to isolate from cell extracts, for example, from extracts of yeast and red blood corpuscles, a tripeptid containing glycine, glutamic acid, and cysteine, which readily crystallises. The separation is based upon the insolubility of the cuprous salt of the substance in normal sulphuric acid. This property of the salt makes cuprous copper an exceptionally selective precipitant.

The tripeptid is obtained in amounts which suggest that it is a cell constituent of importance. As a cysteine peptid the ease with which it crystallises is exceptional, and the unexpected instability which it displays in various circumstances makes it an interesting substance from the point of view of general protein chemistry.

The isolation of this pure substance has indicated that 'glutathione', as previously described by myself, is not an individualised substance. Preparations as described have contained a large proportion of the tripeptid. As a number of workers are employing such preparations in experimental work, it seems desirable that I should make the error known as soon as possible. A description of the tripeptia is in the press and will shortly appear in the *Journal of Biological Chemistry*.

F. GOWLAND HOPKINS.

Zoological Nomenclature.

IN accordance with the provisions of the International Rules of Zoological Nomenclature, the attention of the zoological profession is hereby invited to the fact that the secretary of the International Commission on Zoological Nomenclature is recommending to the Commission the nomenclatorial suppression of P. F. Gmelin's, 1758–1777, "Onomatologia Historia Naturalis Completa (Onomatologia Medica Completa)", volumes 1-7. This recommendation is based on the premise that the adoption of this nomenclator under the Rules will produce greater confusion than uniformity. Final vote in Commission will be taken about Sept. 1, 1930, and zoologists interested in this case are cordially invited to present to the Commission their views, *pro* or *con*, not later than that date.

C. W. STILES
(Secretary to Commission).

U.S. Public Health Service,
Washington, D.C.

The Enclosure of the Zuider Zee.

By Dr. BRYSSON CUNNINGHAM.

THE remarkable series of operations now in progress at the Zuider Zee scarcely seem to have received in England the attention which so extensive and fundamental an interference with the natural littoral and fluvial regimen of northern Holland might reasonably be expected to arouse. They are, indeed, of an epoch-making character, and the effect on the map will be striking and drastic. The coastal contour will be completely altered, entirely new drainage systems will come into existence, and vast areas of submerged land will be brought under cultivation. Although the works cannot be completed in their entirety for a number of years to come, some account of their inception and present position will be of interest. The moment, moreover, is appropriate, since the first section of submerged land, 50,000 acres in extent, scheduled to be reclaimed, has just been completely enclosed. The map reproduced as Fig. 1 shows the region of operations, with the reclamation areas indicated by broken lines.

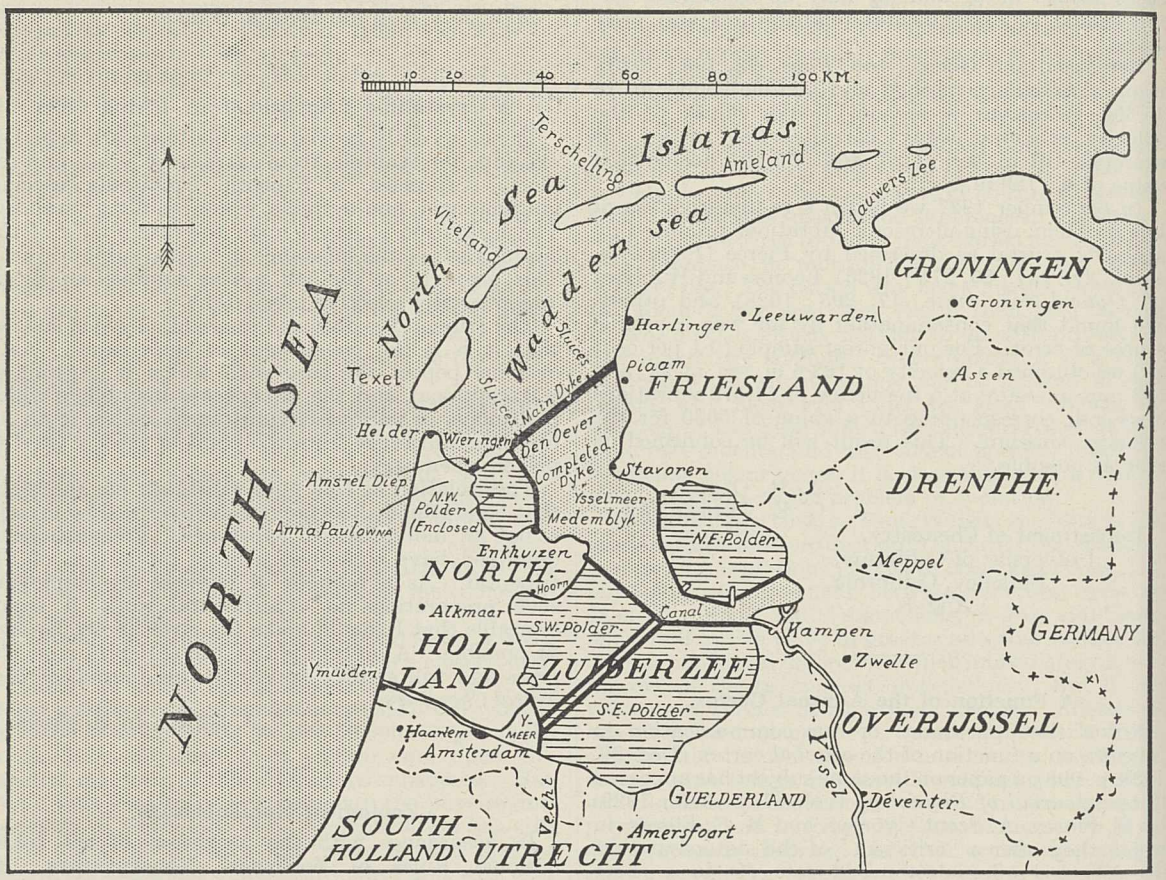

FIG. 1.

The coast of Holland is fringed by ridges of sand dunes which towards the north have been intersected by incursions of the sea, forming a series of islands between which and the mainland lies a kind of roadstead, or outer basin, called the Wadden Zee, and farther south, an extensive inland basin, the Zuider Zee, which probably acquired its present shape some time before the fourteenth century. There is a pronounced difference between the two basins. The floor of the Wadden Zee is full of irregularities. It consists largely of steeply rising sandbanks, many of which are exposed at low water, and are separated by more or less deep channels which become deeper as they approach the North Sea. The most important of these straits is that which finds an outlet between the island of Texel and the mainland, where it is from 100 ft. to 160 ft. in depth. Between the adjacent islands of Vlieland and Terschelling, a similar passage has depths varying between 60 ft. and 100 ft. The tidal range, though small compared with British standards, is appreciable, being as much as 5 ft. at Den Helder and 5½ ft. in the Vliestroom, and the currents are correspondingly swift.

The Zuider Zee, on the other hand, particularly that portion which lies south of a line drawn from Enkhuizen to Stavoren, has a remarkably even surface combined with relatively shallow depth. The depth varies from zero at the coastline to a maximum of about 16 feet below N.A.P. (Nieuw Amsterdamsch Peil, which is the average sea-level

datum for Holland) in the centre, and it is only to the west of the island of Urk that there is a slightly deeper channel of about 20 feet. The tidal range, moreover, is very moderate and does not amount to more than from 4 in. to 15 in.

Between the two basins lies an intermediate zone, the western section of which, called the Wieringen Lake, has a depth exceeding 14-15 ft. at low water, and probably represents a sheet of inland water which was in existence before the incursion of the sea.

The shallow depth and sheltered situation of the Zuider Zee have caused it to be the subject of speculative interest on the part of Dutch engineers for a long time past. Schemes of land reclamation, dear to the heart of the Hollander and indeed essential to the national development, have been propounded for several centuries. The earliest of which a plan is in existence dates from the seventeenth century. In the year 1667, Hendric Stevin published a treatise ("Wisconstich Filosophisch Bedryf") in which he proposed to link up the Frisian islands by means of dykes across the intervening channels. Nothing came of this proposal, the difficulties being too considerable. Various subsequent schemes were found either to be impracticable or were beyond the resources of the country at the time.

It is not until modern and comparatively recent times that we come to the definite promulgation of a feasible scheme which, after some vicissitudes of discussion and legislation, is now in process of being realised. In the early eighties of last century, Mr. Buma, a Frisian member of the Chamber of Deputies, was instrumental in establishing a Zuider Zee Association having for its object the institution of a technical and financial investigation into schemes for the enclosure of the Zuider, Wadden, and Lauwers Zees and their partial reclamation. Dr. C. Lely was appointed civil engineer in charge, and between 1887 and 1891 he published a series of eight reports, in which all the details of a properly conceived plan were thought out and determined. It was demonstrated that the best solution of the problem would be to construct, first of all, an enclosing dyke or embankment from the province of North Holland, by way of the island of Wieringen, to the Frisian coast near Piaam, and then to proceed with the reclamation of four *polders* or marshlands so defined as to leave a sufficient area of water to form an estuary for the effective discharge of the River Yssel. The length of the enclosing dyke was to be 18½ miles and the enclosed area would amount to 360,000 hectares (889,560 acres), of which 232,000 hectares (573,272 acres) would be reclaimable. The total cost was estimated at 190 million guilders, say £16,000,000.

A State Commission was appointed in 1892 to examine the scheme, and in 1894 a favourable report was presented subject to some slight modification of the plan in detail. Here for a time the matter rested. On two occasions, in 1901 and 1907, bills were introduced into Parliament for the purpose of giving effect to the Commission's recommendations, in whole or in part, but without avail. Finally, in 1918, an Act was passed authorising the enclosure and partial reclamation of the Zuider Zee. By a Royal decree of July 16 of that year, the Zuider Zee Council referred to in the Act was instituted to render advice and assistance to the Government in the further preparation and execution of the work and a technical service was at once created.

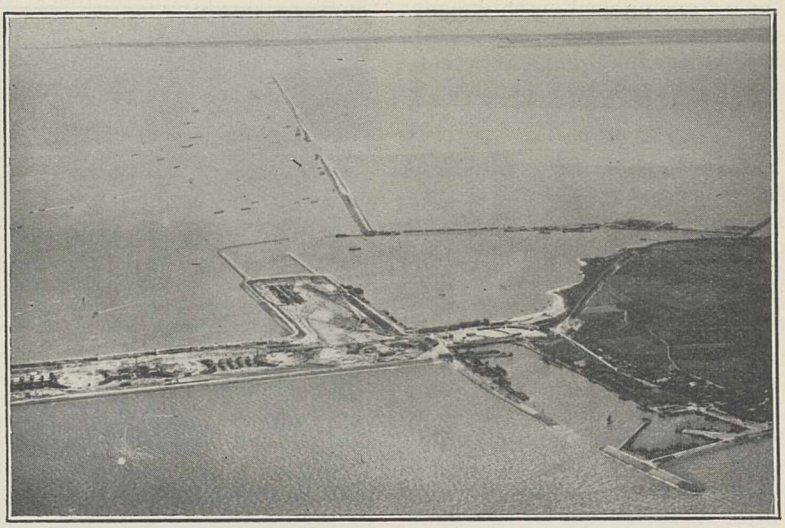

Photo.] [*Royal Dutch Air Co.*

FIG. 2.—Aerial view at Den Oever showing main dyke extending to left, and in centre, dyke, enclosing North-West Polder, stretching towards Medemblyk on horizon. In the foreground, foundations for sluices and lock, with working depot and harbour.

The Act, which is based on the plans approved by the 1892 Commission, prescribes the construction of an enclosing dyke and decrees that the work shall be carried out at the expense of the State. It does not specify the number and extent of the polders to be reclaimed, leaving these to be determined by later investigation.

Constructive work was actually begun in 1920 after some preliminary operations in the preceding year. The Amstel Diep lying between the island of Wieringen and the mainland was partially filled and the general level of the bed of the channel raised to a height of 15 feet below N.A.P. so as to provide a foundation on which the enclosing dyke could be constructed. In the following year, 1921, a works harbour with storage depot was constructed at the easternmost point of the island of Wieringen close to the little village of Den Oever. During the next four years, 1922–1925, the work proceeded but slowly, the Government feeling that the condition of the national exchequer would not permit of the expenditure of large sums of money. In 1925, however, restrictions were removed. Two Acts were passed to accelerate the progress of the work, and it was decided to proceed forthwith with

the construction of the great enclosing dyke from Weiringen to the Frisian coast and with the reclamation of the first polder, known as the North-western or Lake Wieringen Polder.

Since then progress has been steady and continuous. I visited the works in the early part of July and found that great strides had been made. By the courtesy of Heer J. A. Ringers, the managing director of the contracting company for the works, I had an opportunity of traversing the whole extent of operations along the western side of the Zuider Zee. The island of Wieringen is now integrally connected with the mainland, and where formerly was the Amstel Diep I motored over a properly made and substantial roadway protected on the seaward side by a stone pitched embankment. Southward from Den Oever towards the town of Medemblyk, the enclosing dyke (a view of which is given in Fig. 2) was well advanced and at the point of completion. Within a few weeks of my visit it presents an unbroken front and an area of 50,000 acres (the North-West Polder—see Fig. 1) has now been enclosed for reclamation—a process which will, of course, require some little time to effect, as the water has to be pumped out and the land prepared for cultivation. The seasoning and purification of the soil must necessarily be a slow process after its saturation for so long a period with salt water. An agricultural commission has estimated that a period of six or seven years must elapse before the polders can reach their full cultivable value. It is expected, however, from results obtained on a small experimental polder with the use of rape seed, that productivity will begin with the lapse of a couple of years.

The main dyke (the eastern extremity of which is to be seen in Fig. 3) connecting the island of Wieringen with the Frisian coast is proceeding apace and may be expected to be completed about the year 1934. It is being formed of earthwork (clay hearting and sand backing) and is being given a base width of about 120 metres (say 400 feet) and a height at the crest of 7·25 metres (24 feet) above N.A.P. As in the case of the dam across Amstel Diep, it will be provided with a roadway for vehicular traffic and space also for rail locomotion, as may be required. Locks are to be installed to permit the passage of shipping to and from the Yssel Lake (as the enclosed water area will be called), the level of which will be maintained at about 16 inches below N.A.P. The surplus water of the lake is to be discharged at low tide through sluices in the dyke. Sluice gates are being constructed at two points, at Kornwerderzand, an artificial location, about $2\frac{1}{2}$ miles from the Frisian coast and also just to the east of the island of Wieringen. Each sluice gate will have a width of 40 feet, and the total breadth of sluice opening will be 1000 feet.

Reclamation work is comprised under the following four sections, one section lying to the east and the remainder to the west of the Yssel Lake:

N.W. Polder	20,000	hectares or	50,000	acres
S.W.	,, 56,000	,,	140,000	,,
S.E.	,, 95,000	,,	235,000	,,
N.E.	,, 53,000	,,	130,000	,,
	224,000		555,000	

As the total area of the Netherlands is about 3,262,000 hectares or 8,060,000 acres, it will be seen that as a result of the reclamation work in the Zuider Zee the area of the country will be increased by about 7 per cent. As a matter of fact, the arable land will receive an increment of 10 per cent, a very substantial addition to its productive capacity. The cost of the enclosure works is estimated approximately at £7,500,000, and of the reclamations, including the drainage of the polders and their upkeep until full productivity is attained, at something more than £30,000,000. It is a great financial enterprise for a small country like Holland, and one cannot but be impressed by the courage of its promoters, as well as by the careful and systematic arrangements which have been made to carry it through to a successful conclusion.

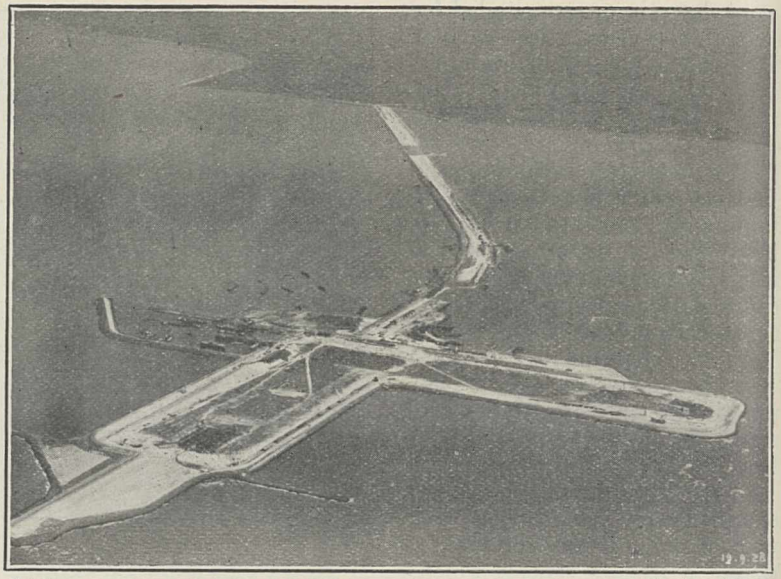

Photo. [*Royal Dutch Air Co.*

FIG. 3.—Aerial view of main dyke, with foundations for sluices and lock at Kornwerderzand. Frisian coast in background.

Apart from personal observation and conversation and correspondence with Heer Ringers, to whom I tender my acknowledgments and thanks, I have derived much information on the subject, on which, of course, a great deal more could be written, from publications of the State Department of the Waterstaat. The photographs have been courteously furnished by Heer Ringers.

Botanical Records of the Rocks: with Special Reference to the Early *Glossopteris* Flora.[1]

By Prof. A. C. SEWARD, F.R.S.

EARLIER CHAPTERS OF THE HISTORY OF THE PLANT WORLD.

IT may be helpful as a preliminary to my treatment of certain aspects of plant-life in former ages to glance at a table of contents of the geological history of the world. The crystalline rocks classed by geologists as Archæan represent inconceivably ancient land surfaces on which were accumulated vast piles of detrital material furnished by agents of erosion, and from time to time products of volcanic activity. Plants may have lived on the Archæan, or pre-Cambrian, continents; they probably did, but as yet we have no certain knowledge of them.

Passing higher in the geological series to the marine sediments and associated lavas and volcanic ash included in the Cambrian, Ordovician, and Silurian systems, we find clear evidence of the existence of lime-secreting Algæ, the precursors of some of the modern reef-forming seaweeds, and, in Silurian strata, a few traces of plants which probably lived on dry land. It is true to say that as yet we know practically nothing of the terrestrial vegetation of the world before the beginning of the Devonian period.

Attention has been directed by many writers to the recently acquired knowledge of the floras that have left well-preserved samples in rocks of the Devonian period: we speak of Devonian plants as the oldest known relics of terrestrial vegetation; but we cannot believe that in them we have the first of a succession of colonists which spread over the face of the earth. Whether they are regarded as the modified descendants of more ancient types, which evolved in the sea and afterwards accommodated themselves to existence above the tides; or whether we prefer to think of Devonian plants as descendants of Silurian or still older progenitors, the fact remains that their ancestry is shrouded in mystery. Stress has been laid on certain morphological features presented by members of the older Devonian floras; on the other hand, we must remember that the best-known of these extinct plants lived in swamps and under conditions that were favourable to their preservation as fossils. We know only in part.

A few plants have been recorded from Devonian rocks in South Africa, but the records so far obtained from beds below the Karroo system are very disappointing. Further research may yield valuable results.

Leaving the Devonian period we pass to the Carboniferous and Permian periods, and here there is much to discuss which has a special application to South Africa. At many localities abundant *disjuncta membra* of plants have been found in sediments deposited in shallow water near the coastlines, and in volcanic ash flung from craters over forest-clad regions beyond the reach of the sea. This Lower Carboniferous vegetation, though more varied than that of the latter part of the Devonian period, was its direct derivative. Identical genera and identical, or at least very closely allied, species have been found in north-eastern Greenland, in Spitsbergen, in Europe and North America, in South America and Australia.

Many instances of the wide geographical range of early Carboniferous plants might be given: it is evident that during the first half of the period the vegetation of the world, so far as we can tell, was less diversified than it is at the present day. Genera such as *Lepidodendron* and allied forms, *Asterocalamites*, the earliest, well-defined example of an Equisetalean type, *Rhacopteris* and *Clepsydropsis* among the ferns, *Cardiopteris*, which may be a pteridosperm, were common to both hemispheres. Here again we lack data from South Africa.

During the latter part of the Carboniferous period and the first half of the Permian period the vegetation of North America and Europe was also more uniform in composition than the floras of the old and new world to-day. Far-travelled members of this northern vegetation were discovered a short time ago in Sumatra and the Malay Peninsula: their geological age is either uppermost Carboniferous or Lower Permian. The coal seams of China, though probably rather younger in age than the richest seams of Europe and America, consist of the altered debris of forests which had spread across the world.

Before leaving the northern hemisphere attention must be directed to the records of a late Palæozoic flora scattered over a broad region stretching from northern Russia to the Pacific coast: its most striking peculiarity is the presence of *Gangamopteris* and some other types characteristic of the *Glossopteris* flora, which presumably, as immigrants from the southern continent, had found a passage across the Tethys Sea.

THE *GLOSSOPTERIS* FLORA AND THE LATE PALÆOZOIC ICE AGE.

At the stage of geological history we are considering, a broad expanse of water—the Tethys Sea—formed a west and east boundary between the northern continent and Gondwanaland. Let us now pass across the Tethys and take note of the conditions farther south. In that part of Gondwanaland that is now South Africa, as elsewhere in the southern hemisphere, there is proof of a long-continued reign of ice-sheets and glaciers. The occurrence of well-preserved impressions of plants at the base of the old boulder beds at Vereeniging shows that some members of the *Glossopteris* flora coexisted with the ice. The problem which I now propose to discuss is this: At what period did the Ice Age begin, and what is the geological age of the first phase of the *Glossopteris* flora?

The most important of recent contributions to the

[1] From the presidential address to Section K (Botany) of the British Association, delivered at Johannesburg on Aug. 1.

vexed question of the date of the Gondwanaland Ice Age and of the initial stages of the *Glossopteris* flora is from Prof. Schuchert, of Yale University (*Bull. Geol. Soc. America*, vol. 39, pp. 769-886; 1929). Though this is scarcely a suitable occasion for a full discussion of a controversial subject, it is not inappropriate to consider a few of the arguments advanced by the distinguished American geologist.

Prof. Schuchert concludes the summary of his views with these words: "It is therefore certain that the widely spread tillites (that is, the old boulder clays) are of Permian time and in all probability of late Middle Permian age. In any event, not even those of Australia can be of Upper Carboniferous time." He bases this very definite pronouncement mainly on the fossil animals obtained from marine strata associated with the Palæozoic boulder beds. After referring to views expressed by the late Dr. Arber and by myself that "the lowest beds containing remains of the *Glossopteris* flora are, in all probability, homotaxial with the Upper Carboniferous rocks of the northern hemisphere", he adds: "They believe that while the cosmopolitan Upper Carboniferous Flora was living in the northern hemisphere, the *Glossopteris* one was in existence south of the equator".

My view is that no Upper Carboniferous flora was in the strict sense cosmopolitan. Prof. Schuchert continues: 'This contemporaneity of the very different northern and southern floras . . . can not be maintained when the floras are checked into the stratigraphical and marine records. We will repeat", he adds, "that even though there are in none of the continents of the southern hemisphere, other than the west coast of South America, any known plant-bearing rocks of Upper Carboniferous age, yet in this single occurrence there is at hand a small plant assemblage of the cosmopolitan Upper Carboniferous Flora". These South American plants were assigned by Mr. Berry to an Upper Carboniferous horizon, but both Dr. Gothan and myself believe them to indicate a Lower Carboniferous age.

The glacial deposits are stated by Prof. Schuchert to be one of the finest means of making definite time correlations from continent to continent, but in another place he admits that the scattered tillites of Gondwanaland, though regarded as the products of one glacial age, are not all exactly of the same age. It may well be, he adds, "that the basal moraines in south-eastern Australia are somewhat older than those of other continents, as maintained by David and Süssmilch; but by no possible chance can the Australian tillites be stretched into the Upper Carboniferous, nor does it seem possible to place them even below the Middle Permian". Here we have an assertion which challenges criticism.

I am indebted to my friend Sir Edgeworth David for information on the succession of boulder beds and fossil-bearing strata displayed in a section in the Hunter River district of New South Wales: this section gives the sequence of events antecedent to and during the existence of the *Glossopteris* flora. In brief, the evidence furnished by the Australian sections indicates the existence of a flora, which in the northern hemisphere is accepted as Lower Carboniferous, at a stage followed by strata which have furnished the oldest members of the *Glossopteris* flora. The break in succession at this level, between the Kuttung and Lower Marine series, is regarded by Schuchert not merely as evidence of shifting of the scenes inaugurating a new type of vegetation—the *Glossopteris* flora—but also as representing a long interval of time during which rocks of Upper Carboniferous age were being deposited in the northern hemisphere. It is difficult to believe that events which occurred during the latter half of the Carboniferous period are entirely lacking in the geological records not only of Australia, but also of India and South Africa. The more probable view, in my opinion, is that the Lower Marine Series and the corresponding strata in Western Australia containing *Paralegoceras* are homotaxial with the Upper Carboniferous system in Europe and North America.

There has been much discussion on evidence, relevant to the age of the Glacial period and the *Glossopteris* flora, derived from the Indian Peninsula and from regions farther north. Prof. Schuchert, after mentioning the discovery of *Gangamopteris* and *Glossopteris* "in marine strata beneath fossils of the Productus limestone", goes on to say that this discovery proves that the *Gangamopteris* flora is of Upper Permian time.

The age of the Productus Limestone is a determining factor in Prof. Schuchert's contention, and as the evidence is outside my own province, I consulted Dr. Dighton Thomas, of the British Museum, who has made a special study of the palæozoological data bearing on the correlation and age of the Carboniferous and Permian rocks with particular reference to the problems under dispute. Dr. Thomas points out that "the question of the lower limit in age of the Productus Limestone series, and of the beds below them as far as the boulder bed, hinges on the means of determining the age of the Amb to Virgal series [of the Salt Range]". In his letter of April 19, from which he kindly allows me to quote, he goes on to say that the best means of settling the age of the Salt Range beds is furnished by the Brachiopods, a group which Prof. Schuchert "practically ignores". The evidence of the Brachiopods "would point to the Amb series (that is, essentially the lower Productus Limestone) being of Lower Permian age at the latest, and I cannot agree with Schuchert's reference of these beds to the Upper Permian". It follows that the underlying Speckled Sandstone, classed by Schuchert as Middle Permian, is "of high Carboniferous age".

In the same letter Dr. Thomas quotes the following statement by Prof. Schuchert: "The interregional correlations are made, however, not so much from the evolution of the Brachiopods as from that of the Ammonites", and, Dr. Thomas adds—"But there are no Ammonites in the succession under dispute in New South Wales, nor are there any in the whole Salt Range Series between the boulder bed and the base of the *Xenaspis carbonarius* zone; nor in South Africa, nor in South America". I have quoted only in part from Dr. Dighton Thomas's letter in the hope that he will

publish in full his criticism of Prof. Schuchert's views.

We now pass to South Africa : as already stated, at Vereeniging impressions of *Gangamopteris* were found between the base of the Dwyka boulder bed and the underlying pre-Devonian platform. The Dwyka shales above the tillite have yielded *Eurydesma* and a crustacean, *Pygocephalus* : the latter is believed by Mr. Woods of Cambridge to indicate an Upper Carboniferous horizon. Prof. Schuchert attaches no importance to the crustacean. At a higher level is the so-called White Band, which, as Mr. Du Toit points out, affords a valuable connecting link between the South American and South African succession of strata.

An important consideration raised by the South African beds is the occurrence at Vereeniging of *Glossopteris* and *Gangamopteris* with *Lepidodendra*, *Sigillaria*, and *Psygmophyllum*, which furnish a strong argument in favour of an Upper Carboniferous or at latest a Lower Permian age. An assemblage of plants such as that discovered by Mr. Leslie at Vereeniging has never been found in Middle Permian beds : but Prof. Schuchert definitely states that the tillites which occur below the Vereeniging plant beds are not older than Middle Permian. A collection of plants recently submitted by Dr. Maufe to Mr. John Walton includes species of *Glossopteris* in company with several forms of *Sphenophyllum*, *Pecopteris arborescens* and other plants : comparison with northern floras indicates an age which is at the latest Lower Permian and not improbably near the top of the Upper Carboniferous. The evidence furnished by these and other South African plant-beds is directly opposed to Prof. Schuchert's view.

The summary, though necessarily very incomplete, may enable us to reconstruct in broad outline the closing scenes in the Palæozoic era on the continent of Gondwanaland. In the course of this phase, ice-sheets and glaciers spread from the remote south beyond the equator : lands that are now tropical were then ice-bound. The world was divided into at least two sharply contrasted regions, a northern region where rank vegetation covered thousands of square miles of swamp and low hills, and a vast southern continent where another and less luxuriant vegetation flourished in proximity to retreating glaciers.

An argument stressed by Prof. Schuchert in the presentation of his case for the Middle Permian age of the *Glossopteris* flora and the boulder deposit is based on the marine fossils. The only piece of evidence furnished by marine fossils available in the Indian Peninsula is unfavourable to his view. Moreover, the *Paralegoceras* of Western Australia and the South African crustacean *Pygocephalus*, support the opinion that the *Glossopteris* flora was evolved before the close of the Carboniferous period. If the *Glossopteris* flora is not older than Middle Permian, we are left in complete ignorance of the state of the plant world in Gondwanaland during the long interval between Lower Carboniferous and Middle Permian time.

I have dwelt longer than I intended on certain questions connected with the *Glossopteris* flora, but the publication of Prof. Schuchert's stimulating, and I would add, provocative article, is my excuse. He has stated his case clearly though not convincingly and has collected a mass of material for which many of us are grateful. We are not yet in a position to make positive statements on the age of the *Glossopteris* flora or on the precise correlation of the late Palæozoic plant beds of Gondwanaland and those north of the Tethys Sea. More evidence is needed. Meanwhile, I am not shaken in my opinion that if we could transport ourselves back through the ages into a forest of the northern hemisphere in the latter part of the Upper Carboniferous period, and thence travel by aeroplane to the land that is now South Africa, we should find retreating glaciers and a vegetation in which *Glossopteris* and *Gangamopteris* were prominent plants.

A Critical Stage in the History of the Plant World.

There is another exceptionally interesting problem worthy of South African investigators. It is this : the closing stages of the Palæozoic era in the northern hemisphere were marked by widespread crustal displacements. Crustal movements are a determining factor in the evolution of the plant kingdom : in other words, geological revolutions afford an impressive example of the co-ordination of the inorganic and organic worlds, a theme which has been elaborated by General Smuts in his fascinating book " Holism and Evolution ".

The vegetation of the early part of the Permian period, though generally similar to that of the latest stage of the Carboniferous period, was relatively much poorer in genera and species. There were connecting links between the Palæozoic and the early Mesozoic floras, but in the main the two floras differed widely from one another. The more orderly succession of plant-bearing strata in most parts of the southern hemisphere justifies the hope that an intensive and comparative study of the transitional stage between the earliest and the latest phase of the *Glossopteris* flora will furnish valuable data. In this field of work Mr. Du Toit has shown the way : may his example be followed.

Fossil Plants as Tests of Climate.

I now propose to intercalate a few words on another question of general interest. Fossil plants of many different ages frequently occur in unexpected and, from some points of view, very inconvenient places where they raise problems which have so far baffled the ingenuity of students. The best examples are from Arctic regions, and there is also the rich Jurassic flora described some years ago by Prof. Halle from the edge of the Antarctic region. In brief, there are numerous examples of fossil floras from the Arctic or Antarctic which are composed of genera and of plant forms regarded as characteristic of temperate or sub-tropical habitats at the present day. If we plot on a map of the Arctic regions the distribution of ancient floras, it becomes clear that no shifting of the earth's axis,

even if this favourite device were admissible, would give a satisfactory explanation of the contrast between the past and the present.

Discarding as inadequate, and as a method wholly displeasing to astronomers, an attempt to create geographical environment consistent with palæobotanical facts by altering the position of the north pole, we turn to the alternative of rearranging, within the Arctic circle, the distribution of land and sea and the consequential shifting of cold and warm oceanic streams. Dr. C. E. P. Brooks suggests a possible rearrangement of land and water which, he believes, would go some way towards the provision of climatic conditions such as the fossil plants of the Tertiary period appear to demand; but it would seem from a more recent contribution by Dr. G. C. Simpson that we cannot hope to obtain all we need, or nearly all we need, by any method of redistribution of land and sea on the assumption of a fixed pole, and without recourse to Wegener's hypothesis of drifting land areas.

We are left with two other alternatives: the adoption of Wegener's views or some modification of them; or the possibility that plants are less trustworthy as indices of climates than has generally been supposed. It may be that a combination of these two methods of attack is the clue to our problem. Let us take the second first: assuming that the ferns to which reference has been made flourished on the parallels of latitude where their remains have been found, and assuming such amelioration of the present Arctic conditions by a rearrangement of land and water as meteorologists permit, there must have been in the past, as there is to-day, a long and relatively dark period of sleep, and a summer no longer than the growing season now available for the almost miraculous development of Arctic plants. Can we imagine, to take one instance, the Cretaceous flora of Greenland enduring a sunless Arctic night more than six months in duration?

There is another, and to my mind an important and neglected consideration; we are too prone to speak of such a genus as *Gleichenia* as tropical because it happens to be one of the commoner ferns in tropical countries; but like many other genera characteristic of the warmer parts of the world, it includes species which grow vigorously at an altitude of 10,000 ft.-12,000 ft. where the climate is by no means tropical. Is it not legitimate to suggest that a plant that is now confined to the tropics may at a much earlier stage of its career have been able to live under other conditions? Is it unscientific to express the opinion that we may think of plants not only as organisms which have changed in form and structure in the course of thousands or millions of years, but also as organisms which have changed in their susceptibility to external factors?

I suggest that there is a tendency to rate too highly the value of extinct plants as guides to climatic conditions, and I would emphasise the desirability of obtaining more definite information than is at present available on the effect of continuous light and continuous darkness, under suitable temperatures, on plants which do not at present occur in Arctic habitats. Even if the foregoing suggestions have any merit, and if we have underestimated the capacity of plants to survive Arctic seasons, there is still a serious obstacle to surmount before it is possible to imagine, let us say, the Rhætic vegetation of Scoresby Sound and that of southern Sweden flourishing in regions separated from one another by at least ten degrees of latitude.

Wegener speaks of the upper portion of the earth's crust as travelling in an easterly and westerly direction; he also assumes a slight movement of the poles. If it is permissible to postulate a drifting of fractured slabs of the crust in a north and south direction, we can then think of the disunited pieces, now occupying positions more or less remote from one another, as the severed portions of a formerly compact region. To take a concrete example: the Rhætic plant beds of eastern Greenland, now remote from those of Sweden, may formerly have been portions of one mass well to the south of the Arctic circle. This may be merely a figment of the imagination; but such evidence of correspondence, both in the succession and nature of the stratified rocks and in the fossil contents, as Mr. Du Toit has obtained from a comparative study of the rocks of South America and South Africa, or as Mr. Harris is finding in his comparison of the Greenland and Swedish Rhætic strata, is arresting enough to make us pause before abandoning the principle of continental drift.

Palæobotany as a Key to the Present Distribution of Plants.

If time allowed it would be tempting to deal with still another aspect of palæobotany; the importance of a critical study of the floras which immediately preceded the Pleistocene Ice Age. Progress made in recent years in the improvement of methods of deciphering the relics of plants of other days increases the confidence with which it is possible to recommend, as a promising field of work, the investigation of Tertiary floras. The Tertiary floras were more uniform than the floras of to-day. We cannot understand the present distribution of human races if we confine attention to the present, nor can we appreciate the significance of the geographical distribution of floras and their composition unless we consult the herbaria of the rocks.

Low Frequency Sound Waves and the Upper Atmosphere.

By E. H. Gowan.

THE transmission of low frequency sound waves, such as those from explosions, to very great distances has been an accepted fact for some time, but for careful investigations it was inevitable that mechanical instruments should eventually replace the ear in receiving the waves. These instruments have the advantage of being more certain, more accurate, and of producing a permanent record. Some types show the form of the wave, and all are more sensitive to the longer wavelengths which may be completely missed by the ear, even though they are not quite outside the

audible limit. Those beyond this limit are actually the more useful because they tend to be less strongly absorbed in their passage through the air.

One of the most important instruments used is the hot wire microphone. A suitable closed box has in one wall a small orifice in which is placed a fine wire coil, heated by an electric current. This filament forms one arm of a sensitive resistance bridge, of which disturbances of balance can be shown by a short period recording galvanometer. The passage of a wave causes a draught to flow in and out of the orifice, cools the wire, thus changing its resistance and destroying the balance of the bridge. A moving film shows the deflection of the galvanometer beside time marks which are recorded automatically at suitable intervals.

Another recording instrument is the undograph, which has received wide use and commendation in Germany. A steel fibre is fastened to a thin mica sheet along an axis of symmetry, and is arranged to act as a taut suspension. The sheet swings freely, one half, with as little clearance as possible, in an opening through the wall of a large air-tight box; the other half swings in a small chamber, providing some damping, but is protected from the incoming wave. The motion is shown by a beam of light reflected from a mirror on the mica, and the optical, mechanical, and photographic arrangements for recording this, along with the necessary time marks, are all contained inside the box. The natural period of the system is of the order of a second, and the records obtained from waves just below the audible limit are very good, and easily distinguishable from accidental and wind disturbances because they are approximately sinusoidal.

A comparison of the two instruments shows that there is not much to choose between them in the matter of maximum sensitivity, though the undograph is less disturbed by wind and other accidental causes, and can perhaps be used in an adjustment nearer its maximum. The microphone gives a non-symmetrical record and does not show up the form of the wave. On account of greater complication it is only with difficulty made portable, but the undograph is very conveniently self-contained. The fact that the undograph is much the cheaper instrument is perhaps after all the greatest point in its favour.

A large body of observations has resulted from great activity in Germany,[1] culminating in a systematic series of experiments under the Notgemeinschaft der Deutschen Wissenschaft. Early results indicated a marked seasonal effect, the minimum distance at which sound was heard in the outer zone being 110 km. in winter and 190 km. in summer. Corresponding distances for maximum intensity were 125 km. and 230 km. The later results followed a searching investigation of the effect on the consistency of the observations of kind and amount of explosive, its position with respect to the ground, the nature of the soil, and methods of detonation. The velocity for the inner zone is normal for the temperature of the air at the ground, 330-340 m./sec., but the apparent velocity for the outer zone is lower than this, 280-300 m./sec. The conclusion is that the sound has travelled a much longer path through the upper atmosphere. In different directions from the source of the wave the time of travel to the same distance in the outer zone varies by so much as 35 sec. This is attributed to upper air winds. It can be shown that the apparent surface velocity of the returned ray, measured by means of two instruments grouped a few hundred metres apart, on a line containing the source, is equal to the velocity at the highest point of the trajectory. As one also knows, from the interval between reception at the two instruments, the angle at which the ray comes down, an estimate of the height is possible. The average results of several methods of analysis show that at about 40 km. the velocity must be in the neighbourhood of 340 m./sec.

Several theories have been put forward to account for the existence of one or more zones of abnormal audibility. The effect was at first ascribed to strong winds in the stratosphere, but so soon as it was established that waves were received in all directions, this idea was abandoned as untenable. It was next suggested that the increase in velocity was due to a settling out of the heavier gases and the relative predominance of hydrogen and helium at the heights where bending takes place. From other considerations, however, it seems unlikely that there is much change in composition below 80-100 km. Even if 25 per cent of the lighter gases were possible at 50 km., the time of travel is not sufficient for the wave to reach the necessary height, and also the diminution of intensity would be too great in passing through regions of such low pressures.

The ordinary formula for the velocity of sound in a gas is valid only if the amplitude of the wave is small in comparison with the total pressure. If this is not so the values are much greater, and in the immediate vicinity of explosions, velocities so great as 900 m./sec. have been observed. It has been claimed that the velocity increase in the upper regions is due to such a breakdown of the ordinary formula, but it is perhaps doubtful that the total pressure falls off more rapidly with height than the amplitude falls off with distance from the source, when the smallness of the average angle is considered. Though this last explanation may perhaps claim a share of the responsibility, and cannot be peremptorily dismissed, another has been more widely accepted as being primarily responsible. The supposition that above 30 km. the temperature of the atmosphere increases again with height until it reaches, or even surpasses, ground temperature, is sufficient in itself to account for the abnormal zone of audibility. The above-mentioned velocity of 340 m./sec. at 40 km. indicates a temperature of about 15° C. there. Such

[1] British observers have in the past few years been working with the hot wire microphone, registering the waves from experimental gunfire at Shoeburyness. It is not my intention, however, to treat these results in any detail here. On p. 114 of the second report of the Committee on Solar and Terrestrial Relationships, International Research Council, will be found an admirable summary by Dr. F. J. W. Whipple.

high temperatures in the upper atmosphere were first indicated by a study of meteors, and it has recently been shown that the absorption of solar energy in the ozone layer (centre of gravity about 45-50 km.) is responsible for their maintenance. This explanation, supported as it is by evidence from two independent sources, seems likely to remain as the most important in the field.

The experimental investigation of conditions in the upper air is full of difficulty, and one of the most fruitful and powerful methods seems to be by the use of these low frequency sound waves. The institution of consistent and systematic explosions to be observed by registering instruments in groups of two as above, spaced, say, 10 km. apart so as to cover the whole abnormal zone on a suitably chosen diameter (with the addition, if feasible, of a radius at right angles), could give much information about the seasonal and possible diurnal variation of the radius of the inner edge. Perhaps a simpler method of getting information about the upper winds would be the grouping of three instruments in a triangle, a few hundred metres apart, enabling both the vertical and horizontal angles to be measured. A most important step is to have work of this sort undertaken at representative and suitable parts of the world. Increases in our knowledge of the physics of the upper air are almost certain to result from the co-operation of workers in various countries, once the highly important problem of defraying the cost is solved.

Obituary.

Dr. W. G. Duffield.

IT is but a few weeks ago that we were giving a welcome to the first publication (*Memoirs*, vol. i. No. 1), issued from the Solar Observatory of the Australian Commonwealth, at Canberra; and now to our deep regret comes the news of the death, on Aug. 1 after a brief illness, of Dr. Walter Geoffrey Duffield, the Director of the Observatory.

Dr. Duffield was the son of the late Mr. W. Duffield of Adelaide, and a grandson of Senator Walter Duffield, one of the first members of the South Australian Parliament. He graduated first at the University of Adelaide in 1900, and then at Cambridge, where he passed out in the Mechanical Sciences Tripos in 1903. He married Miss Doris Boult, of Adelaide. Later, at the University of Manchester, from which he received the degree of D.Sc. in 1908, he became an honorary research fellow, and worked at the subject of the effect of pressure upon arc spectra. He held a Mackinnon Studentship awarded by the Royal Society in the years 1906 and 1907, and under the stimulating influence of Sir Arthur Schuster he communicated four memoirs on the subject named above to the *Transactions* of the Royal Society in the years 1907–15, extending thereby the work of Humphreys and Mohler, especially in relation to the metals iron, copper, silver, gold, and nickel, and studying the arc spectra of those metals at pressures ranging from 1 atmosphere to 101 atmospheres.

In 1911, Duffield was appointed to the professorship of physics at University College, Reading, a post which he held until 1923. Though the claims on his time and energies were considerable, both as professor and as dean of the Faculty of Science, he found time for research work and for encouraging such work amongst his post-graduate students. Among other subjects he studied the electric carbon arc from the point of view of the consumption of carbon under varied conditions of current strength and length of arc, and their influence on the luminosity of the arc. Papers on the subject were published in the *Proceedings* of the Royal Society, vol. 92.

In 1912, Duffield had discovered the existence of minute repulsion between the poles of an electric carbon arc. Seven years later he carried out, with the assistance of two of his post-graduate students, a beautiful set of experiments designed to eliminate all extraneous disturbing forces. He succeeded in measuring the outstanding force of repulsion though it was only of the order of a dyne, and showed that it was due to the recoil consequent upon the projection of electrons from the poles (*Trans. Roy. Soc.*, A, vol. 220). A year later he had extended the observations to the case of metal arcs.

During the War Duffield served, despite ill health, as captain in the Royal Air Force.

Another piece of Duffield's research work may be mentioned here, namely, his attempt to determine the value of gravity over the ocean, on a voyage to Australia and back, in 1914. His results were published in the *Proceedings* of the Royal Society, vol. 92. A vivid account of the preparations for the work and the difficulties experienced was given in the report of three pages in the British Association Report for 1915, p. 48. The main object of the research was to obtain results bearing on the theory of isostasy. Duffield showed undaunted perseverance in discovering and remedying leaks in the four barometers which were involved in his operations in the refrigerators of the s.s. *Ascanius*. The whole-hearted assistance which he evoked from all those with whom he came in contact in his enthusiastic efforts was a splendid testimonial to the fervour of his devotion.

When the British Association in 1908 appointed a committee with Sir David Gill as chairman to aid the work of establishing a solar observatory in Australia, Dr. Duffield was chosen as secretary. The matter was one requiring considerable tact and perseverance in addition to a knowledge of local politics and local conditions. The first report of the committee was published in the British Association Report for 1909, and contains a statement of the history of the movement. It sets forth the grounds on which the committee urged the participation of Australia in the international co-operation in solar research then in full activity. Dr. Duffield made three voyages to Australia with such good results that in 1914, when the Associa-

tion met in Australia, the committee, reinforced by new members, was received by the Prime Minister and was assured of favourable consideration, so far as was possible at the outbreak of the War.

It was not until 1923 that the decision to found an observatory at Canberra was ultimately reached, and a not unnatural sequel to the multifarious activities of Dr. Duffield was that he was elected to be the first Director, but it is within the knowledge of the present writer that it needed considerable persuasion to induce him to accept the post, so convinced was he that his own tastes and studies could not be regarded as any qualification for the post of astrophysicist. It was a difficult task that he undertook, and we are scarcely in a position yet to estimate the degree of success that he had in carrying out his aims for the equipment and initiation of the work at the observatory on Mount Stromlo. He has many friends who will deeply deplore his premature death, and will think with warm sympathy of his wife and children. H. F. N.

WE regret to announce the following deaths:

Mr. Arthur Berry, O.B.E., vice-provost of King's College, Cambridge, author of a "Short History of Astronomy" and of many mathematical papers, on Aug. 15, aged sixty-six years.

Mr. Anthony Collett, author of "The Heart of a Bird" and other natural history books, and a member of the staff of the *Times*, on Aug. 22, aged fifty-two years.

Mr. Walter Heape, F.R.S., a distinguished worker on embryology and on the comparative physiology of the generative system, on Sept. 10, aged seventy-four years.

Mr. Montague Hill, C.I.E., formerly chief conservator of forests in the Central Provinces, India, on Aug. 12.

M. Auguste Lebeuf, director of the Observatory of Besançon, known for his work on chronometry and celestial mechanics, aged seventy years.

Sir Seymour Sharkey, consulting physician to St. Thomas's Hospital and president in 1904 of the Neurological Society, on Sept. 6, aged eighty-two years.

Sir Edward Maunde Thompson, G.C.B., director and principal librarian of the British Museum from 1888 until 1909 and author of "Introduction to Greek and Latin Palæography," on Sept. 14, aged eighty-nine years.

Dr. Naomasa Yamasaki, professor of geography in the Imperial University of Tokyo, member of the Imperial Academy, chairman of the National Committee on Oceanography of the Pacific, and chairman of the Division of Geology and Geography of the National Research Council of Japan, on July 26, aged fifty-nine years.

News and Views.

DR. BONHOEFFER'S discovery that it is possible to separate out two distinct kinds of molecules from ordinary hydrogen, to which reference was made in NATURE of April 20 (p. 621), would appear, from Press reports of the Minneapolis meeting of the American Chemical Society on Sept. 10. to have formed the subject of a further communication there by Dr. Bonhoeffer himself. Dr. Bonhoeffer has not attempted to split up the proton, the nucleus of the hydrogen atom (H), but has simply subjected hydrogen gas (H_2), as usually prepared, to treatment similar to that employed in many other physico-chemical processes. It appears that he has not only shown that it consists of two molecular species—each, however, with the same formula, H_2—but has also been able to prepare at least one form in a practically pure state, and to find a number of its physical constants, which are not the same as those of the mixture which is ordinary hydrogen.

THESE experiments with hydrogen have been inspired by the new mechanics, by means of which it was predicted that two protons and two electrons could link together to form a normal hydrogen molecule in two quite different ways. Other evidence for this admittedly revolutionary idea comes from the analysis of the multilinear secondary—band—spectrum of hydrogen, in which two types of terms have been found, analogous to two types found in the corresponding line spectrum of helium, which may be looked upon in one sense as a hydrogen molecule with the two nuclei coincident: the names 'parahydrogen' and 'orthohydrogen' have been coined by reason of this analogy with 'parhelium' and 'orthohelium'. Whether or not it will prove possible to analyse other diatomic—or more complicated—gases in the same way can scarcely be stated at this stage. Dr. Bonhoeffer's work, apart from its intrinsic value, is of considerable importance in that it is likely to attract more general attention to the many contributions to chemical theory which have already been made by the new mechanics.

AN association such as the British Broadcasting Corporation, which has a vast audience almost at its mercy, obviously stands in a very critical position. It speaks well for the judgment and sanity with which its affairs are managed that notwithstanding the frequent comment, not always favourable, which appears in the Press, the total volume of criticism is relatively small when the range of the Corporation's activities is taken into account. It must have occurred to many when listening-in first became almost universal a few years ago that the real danger lay, not in the possibilities that the programmes arranged for the public might be too frivolous in character, but rather that they might be too academic. An educational instrument of such unbounded possibilities was scarcely likely to escape the attention of the over eager enthusiast. This danger has been successfully avoided. The educational section of the Corporation, which is assisted by a subsidy from the Trustees of the Carnegie Foundation, has proceeded with admirable caution. Having due consideration for the weaker brethren, it has on the whole avoided at any rate the appearance of the academic and the abstruse by exercising a judicious selection in its choice of lecturers and in censoring their titles.

IT also stands to the credit of the educational section of the B.B.C. that it appreciates the fact that its work to be effective cannot stop at merely the provision of lectures. The formation of circles for discussion among listeners—a feature which every effort is being made to extend—and the provision of pamphlets dealing with the subject of each lecture, well illustrated and provided with select bibliographies and sets of questions on each lecture, ensure that the listener has at any rate an admirable apparatus for extending and deepening his knowledge of the subject. We welcome the opportunity of directing attention to the British Broadcasting Corporation's educational work which is afforded by the issue of the series of pamphlets covering the broadcast talks to schools for the coming autumn term. The programme of this series of talks is controlled by a Central Council for School Broadcasting which works through a sub-committee for each subject.

THE number of sub-committees dealing with school broadcasting has recently been enlarged, and in several subjects lectures are now to be given for the first time; such, for example, is the geography course planned by Prof. H. J. Fleure on "Peoples of the World and their Homes", in which a number of travellers will speak of people with whom they are intimately acquainted. Among the lecturers are the Right Hon. W. Ormsby-Gore, Capt. Hilton Simpson, Mrs. Rishbeth (Kathleen Haddon), and Mr. E. B. Haddon, to name a few only. A history course will be given by Miss Rhoda Power, the first series of whose "Days of Old" will cover the Middle Ages. The pamphlet accompanying this course is in itself most illuminating, especially as regards its illustrations. Nature study also is new, the lecturer being Miss Clotilde von Wyss. This course aims especially at developing individual practical work. Sir Walford Davies initiates a course on music in his entirely original and entertaining manner. Finally, among the new courses is one on French designed specially for central schools by M. E. M. Stéphan, of University College, London. Special attention should be given to a course on "Rural Survey" and "Farming" by Miss Charlotte Simpson and Dr. B. A. Keen of Rothamsted, which aims at arousing interest in the problems of the countryside not only among children of rural schools but also among their elders. A series of "Readings and Talks for Secondary Schools" by various lecturers covers a wide field, ranging from the classics to current events and the principles of air navigation.

ON Sept. 11 the British Broadcasting Corporation and the Baird Television Development Company issued a statement about television broadcasting. The experimental broadcasting of Baird television outside programme hours will begin on Sept. 30. These transmissions will normally take place through London (2LO) from 11 A.M. to 11.30 A.M. daily, except on Saturday and Sunday. The object of the demonstrations is to give the Baird Company a wider opportunity than it has hitherto possessed for developing the possibilities of the Baird system of television. It will also enable the Company to extend its scope and improve the quality of the reproduction. In granting these experimental facilities, in which some of the public will doubtless desire to assist, neither the Postmaster-General nor the B.B.C. accepts any responsibility for the quality of the transmission or for the results obtained. We hope that these experiments will be successful and that television will soon take a permanent place in our everyday life. In particular, we shall be interested to know the breadth of the band of frequencies required in the ether; the trend of invention seems to be in the direction of narrowing this band very appreciably.

SIR PHILIP DAWSON points out in the *Times* of Sept. 10 that the grouping of the railways some years ago had the effect of stopping several schemes for the electrification of railways in Great Britain which had been accepted by the companies. He mentions that so far back as 1922 the chairman of the Brighton Company stated that his experts and officers unanimously agreed that electrification was necessary if the traffic was to be held. He also added that if they were independent he would do it at once. Sir Philip hopes that when the Weir Committee reports, main line electrification will be begun at once. Main line electrification will not only help many of the railways but it will also materially reduce the cost of electricity to all the consumers supplied by the Central Electricity Board. There is no difficulty in obtaining evidence in support of main line electrification both from America and Europe. In the same issue of the *Times* an ingenious argument is used against electrification. It is pointed out that with electric traction 30 to 50 tons of coal will be used in place of every 100 used with steam traction. The railways use more than thirteen million tons of coal annually. Hence any decrease in this consumption would affect materially an industry on the prosperity of which the railway companies so largely depend. The validity of this argument in favour of extravagance seems to us very doubtful.

AN Optical Congress, organised by the editor of the *Optician* to commemorate the three-hundredth anniversary of the granting of a Royal Charter to the Worshipful Company of Spectacle Makers, was held at the Northampton Polytechnic Institute, London, E.C.1, on Sept. 10–12. The Congress reflected all phases of activity in the sphere of ophthalmic optics and directed attention to undoubted progress during the last decade in the technique of eye examination and the production of spectacle lenses and frames and ophthalmic testing instruments. Papers on subjects dealing with the theory and practice of ocular examination were read, and the discussions showed a growing interest on the part of opticians in the scientific aspects of their work. Great interest was shown in a particularly fine display of historical literature and ophthalmic instruments arranged by the Applied Optics Department of the Northampton Polytechnic Institute, the original charter and by-laws of the Spectacle Makers' Company having been loaned for this exhibit. The technique of such instruments as the corneal microscope, stereoscopic fixation device, muscle-testing appliances, recent ophthalmoscopes,

etc., were demonstrated on living subjects by the inventors or originators of the methods. The appliances on view on the stands of the well-arranged trade exhibition illustrated the efforts that manufacturers are making to support the recent developments in sight-testing methods. There is a tendency, if anything, however, to employ old methods of treatment in new guise and to be somewhat precipitate in establishing them in practice. It would be an advantage if they were now subjected to close theoretical and experimental investigation. Nevertheless, the Congress afforded abundant evidence of definite progress in all branches of the optician's work.

FOLLOWING up the successful defence of the Schneider trophy, the same British seaplane (Supermarine Rolls-Royce), piloted by Squadron-Leader Orlebar, has established a new world's record over a straight 3 km. course of 575 km./hr., or 360 miles an hour, an increase of about 65 km./hr. over the previous Italian record. This is about half the speed of sound. We may agree with M. Blériot in his praise of aeroplane and engine, for indeed the smooth running of the latter and the steady, perfectly controlled flight of the former show that they are not mere freaks, but examples of sound engineering design and construction, which promise even better things in the future. But his suggestion that the speed of sound will be exceeded is not to be taken seriously at present. Apart from the difficulties imposed by a landing speed of about one-third of the flying speed, it appears from our limited knowledge that the drag of an aircraft increases enormously near the speed of sound, while the aerodynamical circulation round wings and air screw blades, and with them the lift and traction, fall off completely at the same time; so that flight as we understand it at present is deprived of its physical basis. Even before the limit is approached, we must expect something like the law of diminishing returns to apply, rendering each successive advance more and more costly in proportion to its magnitude.

THE severe earthquake in New Zealand on June 17 is being investigated very thoroughly by several government departments, and a provisional report has been issued by the Acting-Director of the New Zealand Geological Survey. Seismographs have been erected at Murchison and Westport in the hope of determining the epicentres and the depth of the foci of the after-shocks. Two geologists have already spent some time in the central district and further investigations will be made during next summer. Observations have been repeated from one of the Wellington City triangulation stations, and these will probably be made periodically. In addition to the renewal of the levelling from Glenhope down the Buller Gorge, bench marks have been placed on each side of the active White Creek fault, which appears to have allowed movements of earth-blocks to take place since the earthquake. Soundings have also been made off the west coast by the Marine Department. The principal results so far obtained are as follows. The centres of the main earthquake of June 17 and of the severe after-shock of June 23 seem to have been on the White Creek fault-plane that crosses the Buller River seven miles west of Murchison. Possibly a second centre was on the Kongahu fault-plane off the north-west coast of the South Island. Differential displacement of the order of 14 feet has taken place at the White Creek fault, though it is not yet known whether it took place suddenly or gradually, nor is it yet certain that the movement has ceased. On the west coast, at Whitecliffs, a strip of sea-bottom has been uplifted and now forms a ridge about a quarter of a mile long and 60 yards wide. It appears to be the western side of a small fault-block that is tilted eastward away from the Kongahu fault.

IN a speech in July last to the Sheep Breeders' Association of Australia, the Prime Minister of the Commonwealth emphasised the need for scientific investigations into problems facing Australian pastoralists to-day and handicapping them in both wool and meat production in competition against other countries. He stated that the Government is prepared to go a long way, through the Council for Scientific and Industrial Research, to meet the cost of the needed research work, but in its present serious financial difficulties it could not do everything. He invited the pastoralists to provide the main immediate need, which is a central building to house the Council's veterinary workers. Within a few weeks, Mr. F. D. McMaster, a leading stock-owner of New South Wales, offered to place £20,000 at the disposal of the Council for the erection of an Animal Health Laboratory. This generous offer was immediately accepted, and its acceptance carries with it an obligation on the part of the Council for Scientific and Industrial Research to equip, staff, and conduct the laboratory. In all probability the Council will seek the co-operation of the University of Sydney in establishing a Division of Animal Health, and the new laboratory will, in that case, be erected in the University grounds.

AT the sixth Pan-American Conference held at Havana in February last, it was resolved to establish an Inter-American Institute of Geographical Science. Mexico City was chosen as its permanent seat. A recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., announces that in furtherance of this scheme the Mexican Government is calling all American States to a geographical congress to be held in Mexico City on Sept. 18. The aim of the new organisation, which will eventually be housed in the suburb of Tacubaya, on a hill overlooking the city, is the co-ordination and distribution of geographical knowledge of the Americas. It will initiate and facilitate research and issue a series of publications. A library and map collection relating to American countries will be formed. The purpose of the present meeting is to complete the organisation of the Institute, to select its committee of control, and to fix the quotas that each State is to pay. Señor P. C. Sanchez will preside.

MORE than once reference has been made in these columns to the attractive way in which American scientific institutions display their wares to the public, partly for the sake of popular education, partly for the reflex interest which flows from an educated

public towards the institution and its works. Field exploration is an indispensable tool in the hands of the scientific worker, and the great part which it plays in the discovery of new knowledge may be guessed from the summaries of the year's expeditions in the "Explorations and Field Work of the Smithsonian Institution in 1928". This summary of 198 pages deals in a simple way (the scientific results will appear later in technical journals) with 29 expeditions, sent to the ends of the earth for a multitude of scientific purposes, from studying the heavens to studying the prehistoric Eskimo in Alaska, the Indian in Canada and the United States, shells in Cuba, grasses in Newfoundland and Labrador, and so on. It is a useful and, perhaps more to the point, an interesting summary, made vivid by a lavish use of reproductions of photographs.

THE August issue of the *Journal of the Franklin Institute* contains a 70-page report of the work done at the Bartol Research Foundation during the session 1928–29 under the direction of Dr. W. F. G. Swann. Four of the investigations mentioned relate to the detection and properties of radiations of cosmic origin, and three to the effects of the bombardment of atoms by electrons or by other atoms. Two deal with the behaviour of thin films towards incident light or electrons, and others with the nature of the processes associated with the emission of light from the electric arc, the reflection of atoms from crystals, and the relations between physics and vital processes. Progress in each of these investigations has been made, and the Foundation is thoroughly justifying its existence.

DURING the forthcoming winter Mr. H. V. Garner, the guide demonstrator of the Rothamsted Experimental Station, and other members of the staff will be available for giving lectures to chambers of agriculture and horticulture, farmers' clubs, agricultural societies, etc., on the Rothamsted experiments. Communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

A GENERAL discussion, arranged by the Faraday Society, on "Molecular Spectra and Molecular Structure", will be held in the Department of Physics of the University of Bristol on Sept. 24 and 25, under the chairmanship of Prof. T. M. Lowry. The proceedings will be in three parts, dealing respectively with band spectra in the visible and ultra-violet, the Raman effect and infra-red spectra, and papers have been promised by many distinguished scientific workers. Among the well-known foreign workers taking part are Dr. H. A. Deslandres, Profs. R. T. Birge, R. S. Mulliken, F. Hund, V. Henri, E. Hulthén, Sir C. V. Raman, R. W. Wood, J. C. McLennan, and J. Cabannes. This discussion promises to rank high among the symposia arranged by the Faraday Society.

THE Carnegie Institution of Washington celebrated the twenty-fifth anniversary of the inauguration of research activities on board the ship *Carnegie* at San Francisco on Aug. 27 and 28. The commemoration referred generally to all the research work of the Institution, but more specifically to the investigations in terrestrial magnetism, atmospheric electricity, and oceanography. An exhibit of instruments was arranged on the *Carnegie*, which is in course of completing her seventh long cruise through the oceans of the world. The present cruise began in 1928 and is to end in 1931.

THE following appointments have recently been made by the Secretary of State for the Colonies, in the Colonial agricultural services: Dr. J. D. Tothill, superintendent of agriculture, Fiji, to be director of agriculture, Uganda; Mr. A. C. Barnes, assistant director of agriculture, Zanzibar, to be superintendent of agriculture, Fiji; Mr. H. Macluskie, to be agricultural superintendent, British Guiana; Mr. F. C. Cooke, to be assistant chemist for copra investigations, Federated Malay States; Mr. R. G. H. Wilshaw, to be assistant agricultural chemist, Federated Malay States; Mr. A. G. Turner, to be citrus specialist, Palestine; Mr. W. B. Hutchinson and Mr. R. D. Linton, to be district agricultural officers, Tanganyika Territory; and Mr. C. H. Clifford, to be a produce inspector, Nigeria.

THE retirement of Prof. F. W. Oliver from the Quain chair of botany at University College, London, was made the occasion of an appeal for funds to commemorate the sixty-nine years' association of Prof. Oliver and of his father, Prof. Daniel Oliver, with the chair of botany at University College. The appeal resulted in the collection of a sufficient sum of money to enable the committee to found an Oliver Commemoration Bursary of the annual value of about £20 for the purpose of assisting graduate students of University College to prosecute research in botany. At a dinner given to Prof. Oliver at University College on July 3 last, under the chairmanship of Prof. F. O. Bower, the Committee's decision with regard to the disposal of the funds was announced and a cheque for his personal use, together with an album of the autograph signatures of the contributors to the Fund, were presented to Prof. Oliver.

APPLICATIONS are invited by the Director of Agriculture, Punjab, for the Maynard Ganga Ram Prize, the value of which is 3000 rupees, for a new practical method tending to increase agricultural production in the Punjab on a paying basis. The prize is open to all. Applications must reach the Director of Agriculture, Punjab, Lahore, on or before Dec. 31 next.

THE *Natural History Magazine* for July contains a short, illustrated account of some aspects of the work of the Great Barrier Reef Expedition of 1928–29, by Geoffrey Tandy, of the British Museum (Natural History), who worked for some time as botanist to the Expedition.

THE nineteenth meeting of the Australasian Association for the Advancement of Science was held at Hobart in January 1928, and the Report has recently been published by the Association (5 Elizabeth Street, Sydney, N.S.W.). The volume contains the usual information relating to officers and statutes of the Association, the presidential address delivered by the

late Mr. R. H. Cambage (referred to in NATURE of Feb. 11, 1928, p. 225, and April 7, 1928, p. 554), the reports of research committees, addresses delivered by presidents of sections, and abstracts of papers read. There is a subject and author index.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A resident tutor and lecturer in geography at St. John's College, York—The Principal, St. John's College, York (Sept. 24). Two mechanical engineers, technical assistants, at the Royal Arsenal, Woolwich—The Chief Superintendent of Ordnance Factories, Royal Arsenal, Woolwich, S.E.18 (Sept. 28). An engineering inspector under the Minister of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (Sept. 28). A curator-secretary for the Victoria Memorial Hall, Calcutta—Sir Evan Cotton, 14 Craven Hill Gardens, W.2 (Sept. 30). An instructor in commercial fruit growing under the Kent Education Committee—The Agricultural Organiser, Springfield, Maidstone (Sept. 30). A full-time lecturer in pure and applied chemistry at the Leicester College of Technology—The Registrar, College of Technology, Leicester (Sept. 30). The William Julius Mickle Fellowship of the University of London—The Academic Registrar, University of London, South Kensington, S.W.7 (Sept. 30). An assistant pathologist and research fellow in the Pathological Department of the Hospital for Sick Children, Great Ormond Street—The Secretary, Hospital for Sick Children, Great Ormond Street, W.C.1 (Sept. 30). A demonstrator in electrical engineering in the City and Guilds (Engineering) College—The Secretary to the Delegacy, City and Guilds (Engineering) College, Exhibition Road, South Kensington, S.W.7 (Oct. 1). An assistant for mathematics and physics at the Coventry Municipal Technical College—The Director of Education, Council House, Coventry (Oct. 1). An assistant examiner in the Standards Department of the Board of Trade—The Principal Establishment Officer, Board of Trade, Great George Street, Westminster, S.W.1 (Oct. 2). A technical officer at the Royal Aircraft Establishment for writing technical descriptive matter and instructional handbooks on aircraft, aero-engines, and accessories—A. 371, The Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants (Oct. 2). An agricultural and horticultural organiser under the Bedfordshire County Council—The Clerk of the County Council, Shire Hall, Bedford (Oct. 5). An instructor in smithing and sheetmetal work at the Government Technical School, Makerere, Uganda—C.A. (T.), The Secretary, Board of Education, Whitehall, S.W.1. Scottish candidates should apply to (T), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Oct. 7). A principal of the L.C.C. Paddington Technical Institute —The Education Officer (TIA), County Hall, Westminster Bridge, S.E.1 (Oct. 7). An assistant anatomist in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Oct. 8). A Mary Louisa Prentice Montgomery lecturer in ophthalmology of the School of Physic, Trinity College, Dublin—The Registrar, School of Physic, Trinity College, Dublin (Nov. 1). A physiological botanist at a Sugar Research Station in Mauritius—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (Dec. 15). A full-time lecturer in physics at the Sunderland Technical College—The Chief Education Officer, Education Offices, 15 John Street, Sunderland. Two assistants in the Motor Car Engineering Laboratory of the Polytechnic School of Engineering—The Director of Education, The Polytechnic, Regent Street, W.1.

Our Astronomical Column.

Attempts to photograph the Corona without an Eclipse.—A. Hnatek contributes a note to *Astr. Nach.*, 5652, in which he refers to the attempts of Herr Blunck to photograph the corona in full sunlight by the use of plates sensitised for infra-red light, and special light-filters. Herren Kienle and Siedentopf afterwards gave reasons to doubt whether the images obtained by Herr Blunck were really coronal: A. Hnatek agrees with Kienle and Siedentopf in considering the images spurious. He describes some experiments of his own which gave markings resembling the corona round the sun, but their coronal nature was afterwards disproved. He thinks that coronal photography in daylight would be feasible only on the supposition that the coronal light was relatively much stronger in the infra-red than ordinary sunlight; he gives reasons for thinking that such is not the case. It would seem to be a safe precaution that those claiming to have taken such photographs should take photographs at times when the moon is just outside the sun's disc. Failure to show the moon's outline at such times would definitely disprove the coronal origin of any markings visible on the plates.

Bergedorf Observatory.—The annual report of this Observatory for 1928 contains a record of much useful work. In connexion with the photographic reobservation of the stars in the zones of the Astronomische Gesellschaft catalogue, the Observatory has undertaken the meridian observation of the 13760 reference stars, and the photography of the zones between 20° and 70° North Declination. The publications of the Observatory contain discussions on the theory of instruments, the Cepheid variables, the Schwassmann-Wachmann Nova of 1927, etc.; a catalogue of 4983 stars observed on the meridian between 1913 and 1926; the useful reference volumes containing indices of meridian observations of stars.

Dr. Baade exposed 241 plates in the reflecting telescope, on comets, minor planets, variable stars, clusters, and nebulæ. Prof. Schwassmann and Dr. Wachmann used the Lippert astrograph for photography of the Kapteyn selected areas, including spectrum plates: the spectra of meteors were photographed and discussed.

The report contains reproductions of photographs of the full moon and Jupiter; the latter bring out the great contrast in albedo between a bright zone south of the equator and a dark one to the north.

The report also gives summaries of meteorological observations during 1928: the months March and September gave an unusual number of clear nights. The Observatory is open to visitors twice a week in the summer: some two thousand people availed themselves of this permission last year.

Research Items.

English Gypsy Taboos.—In the *Journal of the Gypsy Lore Society*, sec. 3, vol. 8, pt. 1, Mr. T. W. Thompson has some notes of gypsy uncleanness taboos additional to those published by him in 1922, which were observed by the Midland Boswells. The Locks of Bala were found to be almost as particular as the Boswells. Food and food vessels over which a woman stepped were destroyed, men's and women's clothes were not washed together, or packed together for travelling. The handling of red meat was forbidden to women at all times. Menses might not be mentioned, even to a husband. At childbirth a woman had a separate tent and separate crockery. The latter was afterwards destroyed but the tent blanket was not. A period of a week's seclusion preceded the birth, and the mother did not live with the family for a month after the event. After this period she might cook for the family once more. Among gypsies of Lee extraction, any food in which a hair was found was regarded as unfit to eat and was thrown away, while some gypsies would not eat from a plate that had touched the trodden ground of a camping-place or the floor of a tent or living waggon. Among Boswell women it was a belief that if they let down their hair it would facilitate delivery at childbirth. Hence a rule that a woman must not let down her hair where men were, or indeed anywhere but in her own hut unless she were sure that only women were about. All babies under a year old were regarded as unclean, and some gypsies would not sit down at a meal with or accept food from a couple who had very young children, while some men would not kiss or even touch their own babies. Boswells would not eat the flesh of any unweaned animal. Also, like German gypsies, they regarded a knife which had been used for slaying a horse as unclean.

The Navajo.—In a monograph recently published by Columbia University (*Contributions to Anthropology*, vol. 7) on the social life of the Navajo—a subject which appears hitherto to have escaped investigation on scientific lines—the author, Miss Gladys A. Reichard, has some amusing observations to make upon the difficulties which stand in the way when the United States authorities have endeavoured to make a census of the population. One of the difficulties is the frequent change both of residence and of name. Hence one individual with his family may be noted; a week later he may be living fifty miles away under a different name, and again be noted by a recording officer. In her own work, Miss Reichard used the genealogical method, and it was often only after elaborate study that she was able to identify two or more names as referring to the one individual. Owing to the difficulties of the Navajo country (New Mexico and Arizona), some regions have not yet been penetrated by whites, and it is said that there are Indians living around Black Mountain who have never seen a white. The genealogical method employed by Miss Reichard in her field work may throw a valuable light on their history, but until the uncharted fields mentioned by her have been visited, the question of the extinction of certain clans of which she has found a record cannot be settled, as localisation seems to have taken place. The Navajos are perhaps best known for the skill of the men as silversmiths, and of the women as weavers of blankets. Their artistic sense, however, finds highest expression in the making of sand or dry paintings—a man's art. Unfortunately, if æsthetically the most pleasing, it is also the most evanescent.

Trawling in the Moray Firth.—A detailed report of the Committee appointed by the International Council for the Exploration of the Sea to consider this vexing question has recently appeared (*Rapports et Procès-Verbaux des Réunions*, vol. 52). The terms of reference to this Committee were arranged as follows: "To inquire as to the effects of trawling in the Moray Firth in the light of the scientific investigations already carried out or of any further investigations which the Committee may deem necessary, or of any other relevant considerations, and to consider particularly whether it is desirable to continue the existing prohibition of trawling there, and whether the prohibition in its present or any modified form should be applied to any other method of fishing and to fishing vessels of all nationalities in the whole or any part of the extra-territorial waters of the Firth". In its report the Committee makes a definite suggestion for the experimental closure of some part of the Moray Firth, with the view of protecting spawning plaice. The proposal entails the exclusion of trawlers and seiners from that part during a period of each year. Twelve papers dealing with the various aspects of the general question are appended.

Halosphæra in the North Sea.—C. H. Ostenfeld brings together notes by himself and other workers on the pelagic alga *Halosphæra* in *Dansk. Bot. Arkiv.*, Bd. 5, No. 8, 1928. His observations were made in the North Sea and certain parts of the North Atlantic. In the spring the species found was *H. viridis*, but in the autumn a much smaller form, *H. minor*, occurred. He considers that *Halosphæra* belongs to the large group of warm-temperate and subtropical plankton organisms which are driven far north and eastwards by the North Atlantic Drift. It has exceptional powers of floating and its cell wall, which in *H. viridis* contains silica, enables it to resist changes in external conditions. The author believes that most of the individuals die in the winter, that in the spring the remaining examples produce the maximum and end by forming zoospores, but the latter do not succeed in producing a new generation in the North Sea. In this he differs from Gran, who stated that *H. viridis* goes through its whole life-cycle in the Norwegian sea in the course of a year. Ostenfeld places the genus in the Heterokontæ—not in the Chlorophyceæ—and Pascher agreed with this view.

Growth of a Pond Snail.—E. D. Crabb, having developed a method of rearing pond snails in the laboratory for experimental purposes, using *Limnæa stagnalis appressa* for the purpose (*Biol. Bull.*, vol. 56), proceeded to make experiments by varying the conditions of food and media from the optimum with the view of testing the results obtained by previous workers, including Semper. His principal conclusions are as follows: Food insufficiency and foul media are the most common growth-inhibiting factors; extreme crowding retards growth, but individuals, if not too old, rapidly reach the norm on being isolated; the volume of medium has little effect if foulness be avoided; there is no evidence that dwarfing produced by unfavourable culture conditions is transmitted.

Aspergillosis.—Investigators interested in aspergillosis should consult the memoir (1928) on *Aspergillus fumigatus* by Dr. Vittorio Pettinari which has been awarded the Cagnola Prize by the Reale Istituto Lombardo di Scienze e Lettere. This species of *Aspergillus* is highly pathogenic to the guinea-pig, rabbit, dog, cat, rat, pigeon, and fowl when introduced intravenously, intraperitoneally, or into the trachea, but cold-blooded animals—frog and fishes—are refractory. The fluid from cultures has a strong hæmolytic action

in vitro and the hæmolytic substance is thermostable and cannot be extracted with ether, but it does not exercise a demonstrable toxic action when introduced into the common mammals. In acute infections there is rapid emaciation, paresis, and death in a few days. The introduction of a suspension of spores intravenously may cause mycotic nodules in nearly all the organs and tissues, or a localised infection for the most part in the kidneys. The localisation depends not only on the mode of introduction but also on individual conditions. In the normal animal infected with *Aspergillus*, the latter exercises a strong hæmolytic action. An account is given of the immunisation of dogs; the immunity lasts at least a year.

Genetical Studies at Cold Spring Harbor.—Year Book No. 27 of the Carnegie Institution of Washington contains a condensed account of the genetical investigations which are being carried on in connexion with that Institution at Cold Spring Harbor. Among the subjects in which further developments are reported may be mentioned Belling's studies of chromomeres by a new method. He found the number of chromomeres in the pachynema thread of *Aloe purpurascens* to be 1240 and he believes they correspond with the genes. In *Datura*, Blakeslee has found several new Mendelian characters and has obtained further evidence that in certain races with linked chromosomes there has been an interchange of segments between non-homologous chromosomes, resulting usually in the formation of a ring or chain of four chromosomes. Experiments of Demerec in producing mutations in *Drosophila* by X-ray treatment, and of similar treatment of pollen and pollen tubes by Buchholz, are also reported. Miss Satin finds that in the bread moulds the female or plus mycelium has a higher sugar content than the male. In ringdoves, Riddle finds that females have 5-10 per cent longer intestines and larger pituitaries than males; also that there is a seasonal increase in the size of liver and spleen in both sexes during spring and summer. In the biological section, Castle reports on a continuation of his investigations of size-inheritance in rabbits, and Harris on fecundity in fowls and various other biometric problems. Sumner has made an intensive study of the differentiation of certain native varieties of *Peromyscus* in Alabama, and Morgan and his colleagues report on their continuation of the *Drosophila* work. In a strain with frequent non-disjunction of the *X*-chromosome, it is found that this rate is modifiable by agencies in other chromosomes. There is a relation between non-disjunction and suppressors of crossing-over, and it is suggested that translocation of a portion of a chromosome has taken place, so that homologous parts are no longer opposite each other.

Competent or Incompetent Folding?—Despite H. G. Busk's recent exposition of the anticline and syncline in all their aspects, and notwithstanding the claim that geometrical conics may make to their interpretation, there still remain many cases in which the inexactitude of geology is glaringly apparent, when surface evidence conflicts with subsurface conditions to the extent of making one an unreliable guide to the other. The Rock Creek oilfield, Wyoming, described by Messrs. C. E. Dobbin, H. W. Hoots, C. H. Dane, and E. T. Hancock (*Bulletin* 806-D, 1929, United States Geological Survey), provides an excellent example of this in the Medicine Bow Anticline, one of the dominant structures mapped. The sequence involved is Cretaceous, of which the top of the Cloverly formation, Wall Creek Sandstone and Mesaverde formation, are the chief members (with intervening shales), the latter being the youngest. Two interpretations of the structure are possible in view of the data collected. The Cloverly and Wall Creek beds are either folded parallel with the Mesaverde (competent), in which case the anticlinal axis shifts considerably in position with depth (that is, westward); or they are 'similarly' folded with the Mesaverde (incompetent), in which case the productive beds are attenuated on the steeper limb of the fold (eastward) and the trace of the axial plane remains vertical. In view of the types of rock involved, it is probable that the second suggestion is the correct one. The example shows (*a*) how difficult it is in many cases to anticipate, let alone follow, the trend of a fold in depth, and (*b*) what a difference an erroneous interpretation, based on what ought to, rather than what does happen, can make to the economic exploitation of an oil-pool.

New Eocene Crab from Florida.—Miss Mary J. Rathbun has described a new crab from the Eocene Series of Florida (*Proc. U. S. Nat. Mus.*, vol. 75, art. 15). *Ocalina*, as the new genus is called, is nearest to the recent genus *Carpilius* Leach, of which one species is not uncommon in the West Indies and the Bahamas; the specific name *floridana* has been given to the new form, which is illustrated on three plates.

New Zealand Tertiary Mollusca.—Dr. J. Marwick has published a description of the molluscan fauna of Chatton, near Gore, Southland, New Zealand (*Trans. New Zealand Inst.*, vol. 59). Accurate correlation of the Chatton Sands with other fossiliferous deposits of New Zealand is difficult; the assemblage of genera, however, agrees much more closely with that of the Middle Tertiary faunas (Ototaran to Awamoan) than with early Tertiary ones, and probably belongs to the Ototaran. Altogether 77 species are described, including 44 claimed as new, whilst two new genera are established. Illustrations by very clear line drawings of the new species occupy the last eight pages of the paper.

Physical Constants.—The first number of the *Physical Review Supplement*, the new quarterly publication of the American Physical Society, contains a valuable critical summary of the probable values of the general physical constants, by Prof. R. T. Birge. These have been recalculated, wherever it seemed necessary, by analytical methods, usually by the method of least squares, and the probable errors have also been computed wherever possible. The results have been grouped under three heads, principal constants and ratios, additional quantities closely connected with these, and miscellaneous derived constants, and the tables have also been published separately in the form of handy reference cards. It is impossible to refer here to the many interesting points that are raised by Prof. Birge's article, which really summarises a great part of experimental physics, but there are two discrepancies which are of special importance. The first is in the values for the specific charge of the electron (e/m). This can be determined by deflection experiments and spectroscopically, and there is a difference between the numbers found in these two ways which is four times the probable error of the former, and apparently real. The deflection value is the larger, or, in other words, e/m appears to be less for an electron when it is *inside* an atom than when it is *outside*. The other discrepancy is that existing between the theoretical and experimental values for Eddington's constant, and Prof. Birge is unable to trace definitely the origin of this; the present impasse is, as he points out, a most unsatisfactory way to leave the situation in the case of the most important constants known to science.

New Ester Synthesis.—The important position which acetoacetic and malonic esters occupy in synthetic organic chemistry make a new synthesis of these compounds worthy of note. Such a synthesis is described in the July number of the *Berichte* (vol. 62, p. 1824) by Hermann Lux, of Karlsruhe, who uses as reagent the ester of the simplest organic dibasic acid, namely, ethyl carbonate. This compound is treated in ether with finely divided metallic sodium, and acetone is slowly dropped into the liquid, which is kept vigorously boiling. Acidification of the cooled product, followed by fractionation, gives a 40 per cent yield of acetoacetic ester. Malonic ester is prepared in a similar way, replacing acetone in the reaction mixture by ethyl acetate; an 18 per cent yield is obtained. It is proposed to extend the new synthesis to higher esters; if it is successful with these, it should be a valuable new method in chemical synthesis.

Synthesis of Hæmin.—Hæmoglobin, the red colouring matter of blood corpuscles, consists of about 4 per cent of a pigment, hæmatin, supposed to be the same in all corpuscles, with 96 per cent of a protein, which is different in different animals. The empirical formula of hæmatin is $C_{34}H_{33}N_4FeO_5$, and it is the carrier of oxygen in respiratory exchange. By the action of glacial acetic acid on hæmoglobin, the coloured hæmatin is formed, whilst if sodium chloride is present a hydroxyl group of hæmatin is replaced by chlorine, and hæmin, $C_{34}H_{32}N_4O_4FeCl$, is produced. Hæmin forms characteristic microscopic reddish-brown crystals, and its production is used in the identification of blood. In the issue of *Die Naturwissenschaften* for Aug. 2, H. Fischer, of the Technical High School, Munich, describes the synthesis of hæmin. This closes a series of researches on the synthesis of pyrrol derivatives: the synthesis begins with 4, 5 dimethylpyrrol, which by a series of reactions was converted into deuteroporphyrin. A further series of reactions led to hæmatoporphyrin, a product free from iron which is obtained by the action of hydrobromic acid on hæmin. On heating, this loses two molecules of water, giving protoporphyrin, into which iron and chlorine were introduced, giving hæmin. The constitutional formula of this substance was thus established. Roughly speaking, it consists of a rosette of four substituted pyrrol rings linked together by CH groups, and of the four nitrogen atoms in the centre, two are directly linked to FeCl, the other two being linked by subsidiary valencies to this group. It contains two COOH groups and two vinyl groups.

Nitrogen Distribution of Gelatin.—Within the past few years, several publications have appeared from the Biochemical Department of the Imperial College of Science, London, on the effect of certain preliminary treatments of the protein on the nitrogen distribution of gelatin. For example, it has been stated that if gelatin is allowed to stand at laboratory temperature with 20 per cent hydrochloric acid, before hydrolysis proper, a marked increase in the percentage of basic nitrogen (that present in compounds precipitated, under defined conditions, by phosphotungstic acid) occurs. Some of the results from the same laboratory are inconsistent, and in view of the importance of the data the experiments have been repeated and extended by F. S. Daft in Prof. Sörensen's laboratory at Carlsberg. The results obtained fail to substantiate the principal contention of the Imperial College workers, since they show no change in nitrogen distribution due to preliminary treatment of gelatin with acid or alkali. They appear in No. 12 of vol. 17 of the *Comptes-rendus des travaux du Laboratoire Carlsberg*, 1929. No. 14 of the same volume contains a long and important paper by Prof. Sörensen and I. Sladek on the solubility of casein in sodium hydroxide. As in the case of globulin (investigated by Hardy and Mellanby), increasing quantities of casein, with constant sodium chloride concentration and constant amount of sodium hydroxide, result in the solution of greater quantities of casein. No. 9, by Linderström-Lang, is a long memoir on the fractionation of casein, in which it is shown that this protein is complex.

Persian Alchemy.—In a recent number of the *Memoirs of the Asiatic Society of Bengal* (vol. 8, No. 7, pp. 419-460; 1929), Mr. Maqbul Ahmad describes a Persian translation of the eleventh century Arabic alchemical treatise "Essence of the Art and Aid to the Workers" (*'Ain aṣ-Ṣan'ah wa 'Aun aṣ-Ṣana'ah*), a work which is attributed to Muhammad al-Kathi and is supposed to have been written at Baghdad in 426 A.H. (A.D. 1034). The Arabic version was described by Stapleton and Azo in 1905, from an incomplete manuscript in the library of the Nawwab of Rampur. The Persian translation was discovered by Stapleton in 1925 in the library of the Nizam of Hyderabad, and has now been studied by Mr. Ahmad, while Prof. B. B. Datta contributes a useful note on the chemistry of the processes given in the treatise. The importance of the Persian version lies in its rendering of the seventh chapter, which is almost completely missing from the Arabic original. The first part of this chapter describes four major operations by which copper was supposed to be changed into silver, but was actually converted into (*a*) an alloy of silver and copper, (*b*) a white fusible sulpho-arsenide of copper, (*c*) a white arsenide of copper, and (*d*) an amalgam. Among the substances employed, it has been possible to identify solutions of sodium polysulphide, sulphuretted hydrogen, and basic arsenosulphide of lead and calcium, as well as the following solids: mercuric chloride, ferric acetate and impure mercuric oxide, realgar, cuprous oxide and ferric oxide. The sixth chapter, which also is not found in the Arabic, deals with the substitution of one instrument or substance for others where circumstances necessitated such a course; it is interesting as an indication of the difficulty frequently experienced by the alchemists in obtaining suitable apparatus. Among the authorities mentioned in the treatise are Andriyya the Sage, Moses, Khalid ibn Yazid, and Sa'd ad-din; nothing is known of the last, while Khalid is described wrongly as one of the Barmecides.

Mercury Arc Rectifiers.—Instead of using rotating machinery to convert alternating into direct current for use on railways and tramways, it is now becoming customary abroad to use mercury arc rectifiers. They have the advantage of being static and require very little floor space. We learn from the June number of the *Oerlikon Bulletin* that the Oerlikon Company has now evolved rectifier types and carried out tests in its workshops for equipments with capacities up to 2500 kilowatts which operate at 1500 volts. The Company is constructing for the Bernese Oberland Railway rectifiers which will work at 1550 volts. These rectifiers are put into operation by a simple switch. A pilot lamp is provided which shows whether the ignition device is working properly. The direct reading vacuum meter is based on the principle that in a vacuum tube the cathode drop depends on the degree of the vacuum. The pressure variations are read on a static voltmeter connected to the terminals of the tube. The readings give the pressure directly in millimetres of mercury. The cooling of the rectifier is generally done by means of water which circulates in a closed circuit. All the transformers are built so as to withstand short circuits.

The Treatment of Slash in Chir Pine Forests in the North-west Himalaya.

THAT fire is more dangerous to the well-being of coniferous than broad-leaved forests, and more especially in the young crops, is beyond dispute. Climatic factors and topographical features may, however, add very considerably to the danger. Hot, dry periods of the year, steep declivities, and the species of conifer comprising the crop, have all an important bearing on the question. To take a European example, the maritime pine forests of the Landes in France are exceedingly inflammable during the hot summer months, and their protection from fire entails considerable work and a heavy responsibility on the forest staff. The tree is tapped for resin, a factor adding greatly to the inflammable character of the forest, as is the case in the resin-tapped forests in America. In the Landes, however, the terrain is mostly approximately flat.

Perhaps one of the most inflammable types of forest in India is the Chir pine (*Pinus longifolia*) forests on the lower slopes of the north-western Himalaya. This long-leaved pine, as its name implies, has long needles, which often collect in thick, undecomposed deposits on the soil. The forest not uncommonly occupies undulating hilly ground with steep slopes and declivities, and is exposed every year for two or three months to a hot sun accompanied by hot winds. As in the case of the Landes and American forests, this pine is also tapped for resin. Serious fires have from time to time devastated the areas covered by the *chir* pine in Kumaon in the United Provinces, fires which may be said to have culminated with the insensate incendiarism of 1921, during which large areas of established young growth, established by the arduous work of the forest staff, were swept away. Such calamities necessitate a heavy expenditure, since the areas so affected, in the absence of all seed trees, can only be reclothed by artificial means, as the result of much careful work.

Mr. J. E. C. Turner, a Deputy Conservator of Forests, has had great experience of this type of forest in Kumaon and of the excessive harm resulting from fire. As a result of his study of the question he has drawn up a monograph entitled "Slash in Chir Pine Forests", which is published as Part VII. of Vol. 13 of the *Indian Forest Records* (Silviculture Series, 1928). To this monograph the Commissioner of Kumaon, Mr. N. C. Stiffe, has contributed a foreword, thereby emphasising the importance of the matter in this type of forest and his recognition of the difficulties experienced by the forest staff in protecting it from the acts of a population by no means enamoured of forest protection—for of true forest conservation they know little or nothing. "The subject", writes the Commissioner, "is really too technical for the amateur, but its importance cannot be missed by any one who has traversed any considerable area of the Kumaon forests."

It will be remembered that a notice was given in NATURE of April 14, 1928, under the title "Injury by Fire and Bark-beetle Attack", to two small monographs published in the United States dealing with the relation of fire injury to insect attacks in coniferous forests (Western yellow pine), and such attacks in connexion with the slash left over after exploitation has been carried out. Although Mr. Turner is not primarily concerned with insects, the investigation work treated of in the American monographs merits consideration, when read in conjunction with the paper now under notice.

The author comprehensively defines slash as including all debris resulting from operations involving the felling and utilisation of *chir* trees, and also from the destruction of this species by such agencies as wind, snow, fire, lightning, floods, landslips, insects, and fungi. In addition to the above, he says, there will be present in *chir* forests, especially in the higher parts of the *chir* zone, slash resulting from broad-leaved species such as *Quercus incana*, *Rhododendron arboreum*, *Pieris ovalifolia*, and other associates of less importance. He rightly insists—a point not usually given sufficient attention—that the treatment of slash is an integral part of the practice of sylviculture, and more especially is this the case in forests susceptible to severe damage by fire.

"There is abundant evidence to show that the subject of slash disposal has not received sufficient attention in the past, and that its sylvicultural importance has not been adequately appreciated. . . . It is necessary to realise that the prompt treatment of slash is a preparatory and essential measure towards the successful and rapid natural regeneration of areas allotted to the first periodic block; and that it clearly behoves us in future to consider slash disposal in a systematic and generous manner, so that the operation shall automatically and quickly follow exploitation."

Briefly, the author's aim is to lay down definite and constructive suggestions in order to attain so far as possible the complete natural regeneration of given areas in a given time; and to indicate how the fire danger in the intermediate and last periodic blocks can be reduced to a minimum, and thereafter maintained in that condition.

The main factors governing the quality and size of slash on an area depend upon the extent of utilisation of the material (that is, the trees) and on local conditions. Mr. Turner treats of the former in great detail; the second, the local conditions, is complicated in Kumaon by the necessity of making provision for right-holders amongst the villagers. When the village population is dense, and the right-holders' demand for firewood consequently large, slash is removed in a relatively short time. If, however, a locality is sparsely populated, the slash, unless removed by departmental action, will lie on the forest floor for a considerable period, which may extend to five years or more. The precise influence of local conditions on slash removal demands a close study on the part of the local forest officers. A knowledge of such conditions will dictate the extent to which departmental action is necessary, and will suggest the least amount of expenditure with which the work can be efficiently accomplished.

These remarks apply to artificially formed slash, the debris from felled trees. Natural causes such as wind, snow, avalanches, etc., may be responsible for heavy amounts of slash, which may include numbers of whole trees. When slash cannot be sold or absorbed by right-holders, for whom provision must be made in the Almora region, within a reasonable time, various methods of burning are resorted to, a difficult business requiring the greatest care. Limitations of space make it impossible to follow Mr. Turner in his discussion on the technique of burning and other points dealt with. The monograph, which is excellently illustrated, merits a close study by the forest officer, and it may be recommended, amongst others, to those responsible for the protection and management of the large areas of coniferous and other inflammable types of forest in Canada, the United States, and Australia, in all of which countries fire damage is so terribly prevalent.

Prehistoric Society of East Anglia.

RESEARCHES in East Anglia of considerable general importance were described at the summer meeting of the Prehistoric Society of East Anglia, held at the Royal Anthropological Institute in June last. The president, Mr. J. E. Sainty, of Norwich, gave an account of investigations undertaken by aid of the Sladen trust into the contents of the Stone bed beneath the Norwich Crag, the equivalent of the basement bed of the Red Crag in Suffolk. The conclusions were wholly in favour of the human origin of the flaking upon the flints, which, from the bold character of the work upon a hand-axe from Whitlingham, was considered to date from the Early Chellean period. It appears probable that there is little difference in geological age between the Norwich Crags and the deposits of the Cromer Forest bed.

Mr. J. Reid Moir showed black unrolled hand-axes of Combe Capelle, Early Mousterian type, which with numerous flakes and remains of mammoth and reindeer, and also fine Early Solutrean flint blades, were recovered from below thick deposits of gravel forming the flood plain of the River Gipping, near Ipswich. The Solutrean implements come from a clay at the base of the gravel which is here ten to eighteen feet thick, and the Early Mousterian hand-axes from a peaty loam beneath. In the Orwell estuary, the tidal part of the same valley, below Ipswich, peat occurs at a depth of thirty feet below high-water mark, and numerous teeth of the mammoth have been dredged from it. This peat is covered by gravel and grey alluvial mud, and may possibly be the equivalent of the peaty loam of the Early Mousterian horizon farther up the valley. It is seen, therefore, that a date much older than that usually assumed must be assigned to the greater part of the deposits filling the deep channels beneath the river valleys of the east of England, as the Neolithic layer appears to be only about four feet from the surface in the Orwell alluvium.

In the discussion, in which Messrs. R. A. Smith, H. Dewey, and Henry Bury took part, it was recalled that black unrolled hand-axes have been dredged up at Erith, which may indicate a horizon in the bed of the Thames equivalent to that in the buried channel of the Gipping. Another significant fact was that on the south coast the 'Coombe Rock' deposit is known to pass below sea-level. The new evidence was unexpected, and as it points to an order of events different from that assumed for the formation of the deposits of the lower Thames valley, it is important that investigations in that area should be commenced.

In reply, Mr. Moir stated that the trend of the evidence suggested to him that the buried channels beneath the river valleys of the east of England were excavated so early as the second interglacial period.

The discovery of thin ovate palæoliths in a clay deposit at Denham, Bucks, at 214 feet, O.D., and covered by gravel, hitherto classed and mapped as glacial, was reported by Mr. J. G. Marsden, and Mr. E. J. Guerrard Piffard exhibited microliths from the Horsham district showing a considerable amount of wear.

Scientific Utilisation of Coal.

THREE Cantor Lectures on the "Treatment of Coal" were delivered last winter before the Royal Society of Arts by Dr. C. H. Lander, Director of Fuel Research; these have been printed in the Society's *Journal* of Aug. 9, 16, and 23. The first lecture details steps taken in Great Britain to standardise methods of sampling and analysis—a task long overdue and of great importance to those engaged in buying and selling fuel and also in the testing of fuel-using appliances.

Recent work on the constitution of coal is surveyed and the problem of burning coal in large and small particles is subjected to a critical analysis. The combustion of gaseous fuel is so rapid that it is merely a question of bringing air and gas into intimate mixture. With solids, even the smallest solid particles in practice are gross compared with simple gaseous molecules, and the rate of supplying oxygen to the surface of the fuel becomes the dominating factor. A rapid velocity of air-flow relative to the coal is essential to facilitate the supply of oxygen and removal of products from the surface of the fuel. In modern practice this is attempted by the use of 'turbulent' burners.

Successful as this has been, Dr. Lander believes that it will be preferable to obtain a stable and streamline motion of air and induce the particles of fuel to move from one stream-line to another in controlled manner. By facilitating the supply of air to the coal dust, it has become possible to reduce the 'combustion volume' considerably until the properties of the refractories have become a limiting factor. It has also become possible to burn pulverised coal in the Scotch marine boiler, and Dr. Lander considers that eventually this will be done in the locomotive boiler.

The importance of these developments to the British coal industry is obvious. Encouraging results have been obtained with ships adapted to use pulverised fuel, and recently a new vessel, the *Berwindlea*, specially constructed for this purpose, made its first voyage, apparently with complete success.

In the second lecture, Dr. Lander traversed briefly the methods and results of chemical investigations of the structure and composition of coal, of which a great volume has been made in recent years. The replacement of cruder methods of fuel use by more refined treatment necessitates an investigation of these fundamentals.

So far as standard practice of carbonisation at high temperature is concerned, there is no prospect of any revolutionary improvements in efficiency, although advances in technique in recent years have been made which, reckoned on such large industries, amount in the aggregate to very considerable financial savings. The recent technical history of the gas and coke industries is traversed in an informative manner, and some indication is made of problems under investigation and of topical interest.

The third lecture deals with the attainments and prospects of processes of low temperature carbonisation. Much money has been squandered on this subject owing to the earlier methods of 'research by catastrophe'. More recently the extensive investigations of many serious workers have placed the subject on a more certain basis, and one can justifiably say that there are processes which are technically satisfactory. It is emphasised that the ultimate test, namely, whether the processes can produce dividends on invested capital, is not yet answered with certainty. In order to secure answers to these questions the Government has made technical trials of processes, cost free, and reports of these have been from time to time referred to in the columns of NATURE. In

addition, it has entered into an arrangement with the Gas Light and Coke Company, whereby the latter operates the Fuel Research Board process under commercial conditions at its Richmond works. The results are to be published, and should give a good idea of the commercial status of such processes.

Other processes which have reached a working scale in Great Britain were discussed by Dr. Lander. Experience with the process of coal hydrogenation was discussed, but the results do not suggest any immediate possibility of competing with mineral oil at present prices. A most interesting discovery is the possibility of converting a non-coking coal into a strongly coking product by the addition of less than 1 per cent of hydrogen.

Processes for the synthesis of fuels from water-gas do not seem to have any immediate commercial possibilities, although high-priced products such as methyl alcohol are already being made by such methods.

The three lectures give a concise amount of the scientific and technical work on the treatment of coal and the nature of the problems under investigation and awaiting solution in Great Britain.

H. J. H.

Ventilation.

IN a recent lecture before the London and South-Eastern Counties Section of the Institute of Chemistry, R. C. Frederick discussed some of the problems involved in securing adequate ventilation under various conditions. He also reviewed some of the work (to which he has himself contributed) which has already been carried out towards their elucidation.

Air is vitiated by abstraction of oxygen and by the addition of carbon dioxide, aqueous vapour, heat and bacteria, when human beings are congregated in an environment with poor ventilation. The most useful index of inadequate ventilation is the percentage of carbon dioxide present; but the discomfort experienced is not due to accumulation of this gas or to decrease in the oxygen since the greatest changes found are entirely without physiological influence. A poison in expired air has never been demonstrated; so that it is to the physical conditions of the atmosphere that one must turn for an explanation of the stuffiness of a confined environment.

Temperature, especially that registered by the wet bulb, humidity and air movement are the important factors. In estimating the degree of comfort to be expected, the cooling power of the atmosphere is of great importance: for its estimation Hill's kata-thermometer may be used. In America, Yaglou and his co-workers have developed the idea of 'effective temperature': with varying combinations of temperature, humidity, and velocity of air movement there is the same effect on the rate of heat loss from the body, and therefore the same sensation of comfort, or the reverse, and the same physiological response. The 'comfort' zone extends between 63 and 71 effective temperature. The results are not strictly applicable to conditions in Britain, since we are accustomed to somewhat lower temperatures.

Finally, there is the psychological or personal factor to be considered: if an occupant of a space believes the ventilation to be unsatisfactory he will suffer discomfort. Again, fresh air appears to exert a tonic effect as compared with washed and filtered air, and also to lower the incidence of minor respiratory disease. The reason for this effect is at present unknown and should form the subject of future research.

Calendar of Patent Records.

September 22, 1856.—The invention for which a patent was granted to Robert F. Mushet on Sept. 22, 1856, was very largely responsible for the immediate success of the Bessemer steel process. By the addition of from one to five per cent of molten spiegeleisen to the iron treated by the Bessemer process, Mushet regulated the supply of carbon and restored the small amount necessary for the production of steel. Mushet received little recognition at the time, and his patent did not run its full course. He was awarded the Bessemer gold medal of the Iron and Steel Institute in 1875.

September 24, 1921.—An important patent for the indiarubber industry was that granted to Paul Schidrowitz on Sept. 24, 1921, for the direct vulcanisation of rubber latex without coagulation, which enabled a vulcanised rubber in liquid form to be obtained without the necessity of a costly series of operations and expensive solvents.

September 25, 1791.—Cheap soda, for which many industries were waiting, was first produced under the process invented by Nicholas Leblanc and patented by him in France on Sept. 25, 1791. The manufacture did not become established in Great Britain until the repeal of the Salt Tax in 1823 reduced the price of salt (cf. Calendar of Patent Records, July 31).

September 26, 1836.—One of the inventors who contributed to the success of the Birmingham papier-mâché industry introduced by Henry Clay in the second half of the eighteenth century was William Brindley, paper maker. His invention for making papier-mâché articles in dies, of which the patent specification was enrolled on Sept. 26, 1836, received an award at the Great Exhibition of 1851.

September 26, 1867.—The first publication of the modern dry 'contact' process of filtering and deodorising mineral oils in which finely divided fuller's earth is mixed with the oil and the mixture subjected to constant agitation and heat, appears in the provisional specification of John Fordred, a London chemist, filed with his application for a patent for bleaching and purifying paraffin, dated Sept. 26, 1867. The patent was not sealed, but Fordred obtained later grants in which the process was applied not only to paraffin, but also to hydrocarbon oils and animal and vegetable oils and fats.

September 27, 1822.—One of the earliest improvements on the stop-watch—the construction of which in those days necessitated the stopping and restarting of the whole mechanism—was that patented by Frederick Louis Fatton, of London, a pupil of Breguet, on Sept. 27, 1822. Fatton's watch had a centre seconds hand working on a dial at the back of the case and having mounted on it apparatus capable of making a distinct mark, in ink or pencil, on the dial at any required moment, a button on the case serving to operate the mechanism without interfering with the going of the watch.

September 28, 1836.—One of the first-fruits of the introduction of the hot-blast for iron smelting was the solution of the problem of the use on a commercial scale of anthracite in the blast-furnace. The first successful production of pig-iron with anthracite was made at Yniscedwin, in South Wales, by George Crane in 1837, and the process was rapidly adopted both in Great Britain and in America. Crane's English patent for the use of anthracite with the hot-blast is dated Sept. 28, 1836. A United States patent for the same process had been granted to Dr. Geissenhainer in 1833, but no large-scale production there was made until Crane bought the patent rights and improved the process.

Societies and Academies.

LONDON.

Institute of Metals (Annual Autumn Meeting at Düsseldorf), Sept. 11.—W. J. P. Rohn: The reduction of shrinkage cavities and vacuum melting. Shrinkage cavities may be diminished if care is taken that the solidification of an ingot starts from its bottom end and advances gradually to the top end. This control can be approximated with water-cooled copper moulds. Shrinkage cavities may be totally avoided if melting and freezing are performed in an electrically heated melting furnace in a crucible of the shape of a finished ingot, and, after melting and refining is completed, the current is cut off gradually from the bottom with a well-controlled speed.—M. Tama: Progress in electric furnaces for non-ferrous metals. New induction furnaces of large capacity are described. They have been developed for high melting-point alloys such as nickel-brass and phosphor-bronze. Thirty-four electric annealing furnaces of the resistor type are in successful operation in one large metallurgical plant.—N. F. Budgen: Pinholes in cast aluminium alloys. Gas evolution at solidification is the causation factor of greatest importance, and the means whereby gases may be absorbed by aluminium alloys are discussed. Shrinkage during solidification plays some part in producing pinholes.—O. F. Hudson, T. M. Herbert, F. E. Ball, and E. H. Bucknall: Properties of locomotive firebox stays and plates. Of the two main sections of the paper the first is devoted to a consideration of the conditions existing in a locomotive firebox. The other main section of the paper gives the results of an investigation of the oxidation of arsenical copper in firebox atmospheres. The rate of oxidation of arsenical copper in various atmospheres has been determined within the range of 260°-600° C. Small proportions of chlorine as hydrochloric acid gas and also of sulphur dioxide cause marked increase in the amount of oxidation. There was no evidence that the presence of arsenic in the copper had any influence on the rate of oxidation. The softening and elastic properties of cold-worked copper containing small percentages of other elements has also been investigated, the object being to obtain, by alloying and suitable mechanical and thermal treatment, copper, otherwise suitable for firebox purposes, which will have and retain at service temperature a reasonably high elastic limit, say, of the order of 5 tons/in.^{2} One of the most promising alloy additions is silver, of which so small a quantity as 0·05 per cent appears to be sufficient.—A. v. Zeerleder and P. Bourgeois: Effect of temperatures attained in overhead electric transmission cables. Cables made, respectively, of copper, pure aluminium, steel-aluminium, and Aldrey were submitted to temperatures lower than the usual annealing temperatures for periods ranging from several months up to one year, and the effect on the mechanical properties was examined. Aldrey is not affected by temperatures which will seriously diminish the tensile strength of copper. Cables consisting of aluminium alloys having undergone previously an appropriate heat-treatment—such as Aldrey—are thus able, in spite of their lower electrical conductivity, to be loaded with higher current densities than copper cables, without danger of slow annealing.—J. Newton Friend: The relative corrodibilities of ferrous and non-ferrous metals and alloys. (2) The results of seven years' exposure to air at Birmingham. The metals examined included tin, lead, nickel, zinc, aluminium, and various coppers and brasses. All resisted corrosion much more efficiently than the wrought iron and carbon steels. Nickel proved less resistant than copper. Aluminium ranked with lead, tin, and stainless steel in offering a very high resistance to corrosion.—C. Blazey: Idiomorphic crystals of cuprous oxide in copper. A description is given of idiomorphic crystals of cuprous oxide in copper, containing 0·43 per cent oxygen, which had been heated for a long time at a temperature above 800° C. The grain size of the copper was large and the cuprous oxide crystals were arranged in groups with uniform orientation, but in any one grain of copper the orientation of the groups varied. Long heating at a high temperature is necessary with, possibly, a favourable relationship to the crystallographic planes of the copper matrix.

PARIS.

Academy of Sciences, Aug. 12.—N. Lusin: Implicit functions.—A. Lokchine: The stability of a plate fixed between two concentric circles.—L. Escande and Teissie-Solier: The chronophotographic determination of the potential of velocities in plane flow by application of Stokes's theorem and the similitude of barrage weirs.—Mlle. Nelicia Mayer: The potential of solutions of glucides. An extension of the results obtained by Wurmser and Geloso with glucose and fructose to other glucides.—N. P. Péntcheff: The quantitative determination of neon in natural gases. The method is based on the determination of the density of the helium-neon mixture isolated from the rare gases by means of coconut charcoal cooled with liquid air. The accuracy of the method has been verified by analyses of synthetic mixtures.—A. Villachon and G. Chaudron: The amounts of hydrogen and carbon monoxide contained in some metals fused in a vacuum.—Mlle. M. Pernot: The system mercuric iodide, potassium iodide, and acetone.

Aug. 21.—Eduardo Mª Galvez: The characteristic constants of electrical generators.—Mlle. Y. Garreau and N. Marinesco: The dielectric polarisation of solutions of egg-albumen. The experimental results are shown on a diagram giving the dielectric constant as a function of the *p*H of the solution.—Mme. N. Demassieux: The action of alkaline carbonates on lead chloride. The equilibria have been studied by the method of electrical conductivity: phosgenite $(PbCl)_2CO_3$ is the first product, and further additions of sodium carbonate transform this into lead carbonate.—G. Favrel: The formation of mixed azo bodies corresponding to the alkylacetylacetones.—Joseph Robin: The formation of rubrene starting from non-chlorinated derivatives. Esters of the type

$$(C_6H_5)_2 . C(O . CO . R) . C{:}C . C_6H_5$$

heated under certain conditions give rubrene. The reaction is violent with the acetate, more moderate with the propionate, butyrate, and benzoate. The yield of rubrene is a maximum with the acetate.—J. Régnier: The action of alkaloids of the cocaine type on the nerve trunks. Comparison of their activity on the sensitive fibres with their activity on the motive fibres. Similar experiments to those already described with cocaine have been carried out with the hydrochlorides of pseudococaine, novocaine, racemic stovaine, dextrorotatory stovaine, lævorotatory cocaine, butelline, and tutocaine.—P. Grassé and Mlle. O. Tuzet: The tegosomes in the spermatogenesis of the prosobranch molluscs and their relations with the nucleus.

SYDNEY.

Linnean Society of New South Wales, July 31.—J. R. Malloch: Notes on Australian Diptera (20). Contains notes on Calyptrate Diptera and is a final contribution on the genus *Rutilia*. Eight genera and twenty-four species from Australia and one genus

from New Zealand are described as new. Keys are given to the genera of Australian Tachinidæ.—**G. E. Nicholls**: Some new species of *Stenetrium* from Western Australia. Description of one species from Dongarra, obtained from seaweeds on the piles of a disused pier some six feet or more below the surface of the water, and three species from Bathurst Pt., Rottnest Island.—**H. G. Raggatt**: Note on the structural and tectonic geology of the Hunter Valley between Greta and Muswellbrook, with special reference to the age of the diastrophism. An orogenic movement took place in Tertiary time which was, to a considerable extent, responsible for the formation of the meridionally arranged structures such as the Lochinvar dome and the Muswellbrook structure. The problem remains of determining the relative importance of the movements in the late Palæozoic and Tertiary eras.—**G. H. Hardy**: Fourth contribution towards a new classification of the Australian Asilidæ. The characters to be used include those of certain thoracic sclerites, part of which have not hitherto been discussed. Species under tribe Laphriini are reviewed, only one generic conception being regarded as valid. Three more tribes are considered necessary for including certain genera of the Dasypogoninæ.

Royal Society of New South Wales, Aug. 7.—**A. R. Callaghan**: The development of the inflorescence of *Avena sativa* L. Relative morphological features of the oat inflorescence are discussed, and a scheme of panicle branching, as propounded by Fernekess, is figured and explained. Only one primary branch arises from each node in the rachis; subsequent branching is of a secondary nature. Various expressions of false nodes in unilateral panicles are described and figured. The development of the inflorescence is correlated with vegetative developmental phases. Relationship of inflorescence development to the physiological conditions of 'oat blast' and 'bolting', to frit fly (*Oscinella frit*) attack, and to the grazing problem is discussed.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 6, June 15).—**H. C. Ramsperger, M. E. Nordberg, and R. C. Tolman**: The rate of decomposition of nitrogen pentoxide at moderately low pressures. The reaction was observed in a 45-litre flask to minimise the effect of adsorption on the walls, and initial pressures varied from 6 mm. to 1 mm. of mercury. In these conditions nitrogen pentoxide shows no change in its specific first-order rate of decomposition.—**Oscar Knefler Rice**: Types of unimolecular reactions. A discussion of predissociation, unimolecular and also photochemical decompositions of complex organic compounds in the gaseous state.—**Ralph E. Winger and Don M. Yost**: The valence of sulphur in dithionates. Measurements of the position of the *K*-absorption edge of potassium dithionate indicate that the two sulphur atoms are equivalent.—**Wanda K. Farr**: Studies on the growth of root hairs in solutions: the *p*H molar-rate relation for *Brassica oleracea* in calcium sulphate. Three-dimensional graphs were prepared showing amount of growth at varying concentration and *p*H values.—**Harold D. Babcock**: Some new features of the atmospheric oxygen bands, and the relative abundance of the isotopes O^{16}, O^{18}. Intensity measurements indicated the ratio 1 : 1250 for the isotope O^{18} to O^{16} in agreement with Aston's mass-spectrograph results.—**Edward W. Berry**: Fossil plants and mountain uplift in the Pacific States. The fossil plants of the Spokane area are mesophytic in type and Upper Miocene in age. Moisture-carrying winds making such vegetation possible have been cut off by the elevation of the Cascade Range, which is thus considered to have happened in not earlier than very late Miocene time.—**Francis B. Sumner**: The analysis of a concrete case of intergradation between two subspecies. (2) Additional data and interpretations. Reconsideration of earlier data leads to the view that the colour changes of the two races of *Peromyscus* studied afford an example of protective coloration achieved through differential survival of paler variants. The cause of the abrupt transition between the ranges of the two races remains obscure.—**Oscar Zariski**: On the linear connexion index of the algebraic surfaces $z^n = f(x, y)$.—**Thomas Harper Goodspeed and Priscilla Avery**: The occurrence of a *Nicotiana glutinosa* haplont.—**Edwin H. Hall**: Further remarks concerning thermionic '*A*' and '*b*', a revision and an extension.—**F. Rasetti**: On the Raman effect in diatomic gases (2). Amplification and correction of the communication in NATURE, May 18, p. 757.—**Allan C. G. Mitchell**: On the theory of electron scattering in gases. The Born collision theory is used in connexion with the Fermi statistical potential for atomic fields.—**Louis A. Turner**: Molecular binding and low ^5S terms of N^+ and C.—**J. A. Bearden**: Wave-length of the *K*-lines of copper using ruled gratings. A glass grating of 600 lines per mm. and a glass and a speculum grating each with 50 lines per mm. were used, and exposures varied from twenty-four hours to seventy-two hours. The wave-lengths obtained were always greater than those obtained from crystal diffraction data (see also NATURE, Aug. 24, p. 319).—**E. O. Salant**: Effect of volume changes on the infra-red vibrations of simple crystals. A theoretical discussion indicates that the effects should be measurable.

Official Publications Received.

BRITISH.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1929. Vol. 41, August. Pp. 455-551. (London.)

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1929-30. Pp. 325. (Manchester.)

Uganda Protectorate. Annual Report of the Geological Survey Department for the Year ended 31st December 1928. Pp. 43+1 plate. (Entebbe.) 3*s*.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1229 (Ae. 384): Loads on the Main Planes and Tail of an Aeroplane when recovering from a Dive. By H. Bolas and G. A. Allward, of Messrs. George Parnall and Co. (T. 2673.) Pp. 24. 1*s*. net. No. 1235 (Ae. 390): On the Stability of Controlled Motion. By W. L. Cowley. (T. 2695.) Pp. 9+3 plates. 9*d*. net. No. 1183 (M. 57): The Behaviour of a Single Crystal of Zinc subjected to Alternating Torsional Stresses. By Dr. H. J. Gough and H. L. Cox. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 212.) Pp. 32+9 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Society for Psychical Research. Part 112, Vol. 39, August. Pp. 192. (London: Francis Edwards, Ltd.) 8*s*.

The Journal of the Institute of Metals. Vol. 41. Edited by G. Shaw Scott. Pp. xii+825+42 plates. (London.) 31*s*. 6*d*. net.

Australasian Association for the Advancement of Science, Hobart Session, 1928. General Observations on the Australian Flora. By J. W. Audas. Read before the Australasian Association for the Advancement of Science, Tuesday, 17th January 1928. Pp. 23. (Sydney, N.S.W.)

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1928. By Dr. H. A. Tempany. Pp. 17. (Kuala Lumpur.)

Journal of the Chemical Society: containing Papers communicated to the Society. August. Pp. iv+1623-1849+xii. (London.)

Queensland. Department of Agriculture and Stock: Division of Entomology and Plant Pathology. Pests and Diseases of Queensland Fruits and Vegetables. By Robert Veitch and J. H. Simmonds. Pp. 198+64 plates. (Brisbane: A. J. Cumming.)

Proceedings of the Society for Psychical Research. Appendix to Part 3, Vol. 38. Pp. 518-560. (London: Francis Edwards, Ltd.) 2*s*. 6*d*.

Union of South Africa: Department of Agriculture. Science Bulletin No. 79: Official Soil Map of the Union of South Africa, with Explanation compiled in the Office of the Soil Survey. (Division of Chemistry Series, No. 94.) Pp. 12+1 plate. (Pretoria: Government Printer.)

East London College (University of London). Calendar, Session 1929-1930. Pp. 194. (London.)

The Botanical Society and Exchange Club of the British Isles. Vol. 8, Part 5: Report for 1928 (with Balance-Sheet for 1927), by the Secretary, Dr. G. C. Druce. Pp. 595-800+xxxviii+112+37 plates. (Arbroath: Printed by T. Buncle and Co.) 10*s*.

FOREIGN.

Bernice P. Bishop Museum. Bulletin 58: Growth of Hawaiian Corals. By Charles Howard Edmondson. Pp. 38+5 plates. Bulletin 59: Ferns of Fiji. By Edwin Bingham Copeland. Pp. 105+5 plates. Bulletin 60: Archaeology of Tonga. By W. C. McKern. (Bayard Dominick Expedition, Publication No. 15.) Pp. 123+6 plates. Bulletin 61: Tongan Society. By Edward Winslow Gifford. (Bayard Dominick Expedition, Publication No. 16.) Pp. iv+366+1 plate. Bulletin 62: Lau Islands, Fiji. By A. M. Hocart. Pp. iv+241+4 plates. Bulletin 63: Measurements and Landmarks in Physical Anthropology. By Frederic Wood Jones. Pp. 67. Bulletin 64: Food Values of Bread-Fruit, Taro Leaves, Coconut and Sugar Cane. By Carey D. Miller. Pp. 23. (Honolulu.)

Publications of the Allegheny Observatory of the University of Pittsburgh. Vol. 6, No. 11: Wave Lengths and Atomic Levels in the Spectrum of the Vacuum Iron Arc. By Keivin Burns and Francis M. Walters, Jr. Pp. iii+159-211+7 plates. (Pittsburgh, Pa.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. First Series (Mathematics, Physics, Chemistry), Vol. 18, No. 2. Pp. 155-302+2 plates. (Tokyo and Sendai: Maruzen Co., Ltd).

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 123: Farm Milk Houses. By F. E. Fogle and P. S. Lucas. Pp. 7. Circular Bulletin No. 124: The Young Vineyard. By N. L. Partridge. Pp. 16. Circular Bulletin No. 126: Essentials of a Mulch Paper Laying Machine. By H. H. Musselman. Pp. 7. Special Bulletin No. 183: Common Pests of Field and Garden Crops. By R. H. Pettit. Pp. 77. Special Bulletin 190: Oak Forests of Northern Michigan. By Joseph Kittredge and A. K. Chittenden. Pp. 47. Technical Bulletin No. 99: Defective Graft Unions in the Apple and Pear. By F. C. Bradford and B. G. Sitton. Pp. 106. (East Lansing, Mich.)

Department of the Interior: U.S. Geological Survey. Bulletin 797-B: The Skwentna Region, Alaska. By Stephen R. Capps. Pp. ii+67-98+1 plate. 15 cents. Bulletin 797-E: Aerial Photographic Surveys in Southeastern Alaska. By R. H. Sargent and Fred H. Moffit. Pp. ii+143-160+plates 4-5. 15 cents. Bulletin 797-F: Geology and Mineral Resources of the Aniakchak. By Russell S. Knappen. Pp. ii+161-227+plate 6. 20 cents. Bulletin 805-B: Deposits of Vermiculite and other Minerals in the Rainy Creek District, near Libby, Montana. By J. T. Pardee and E. S. Larsen. Pp. ii+17-29+1 plate. Bulletin 806-B: The Northward Extension of the Sheridan Coal Field, Big Horn and Rosebud Counties, Montana. By A. A. Baker. Pp. iv+15-67+plates 6-29. 45 cents. Bulletin 806-C: Geology and Oil and Gas Prospects of part of the San Rafael Swell, Utah. By James Gilluly. Pp. iv+69-130+plates 30-35. 25 cents. Bulletin 806-D: Geology of the Rock Creek Oil Field and adjacent Areas, Carbon and Albany Counties, Wyoming. By C. E. Dobbin, H. W. Hoots, C. H. Dane and E. T. Hancock. Pp. iv+131-153+plates 36-43. 20 cents. Bulletin 806-E: Thrust Faulting and Oil Possibilities in the Planes adjacent to the Highwood Mountains, Montana. By Frank Reeves. Pp. iv+155-195+plate 44. 10 cents. (Washington, D.C.: Government Printing Office.)

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 593: Surface Water Supply of the United States, 1924. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+264. 30 cents. Water-Supply Paper 594: Surface Water Supply of the United States, 1924. Part 13: North Pacific Slope Drainage Basins. C: Lower Columbia River Basin and Pacific Slope Drainage Basins in Oregon. Pp. vi+215. 30 cents. Water-Supply Paper 595: Surface Water Supply of Hawaii, July 1, 1923 to June 30, 1924. Pp. iv + 157. 20 cents. (Washington, D.C.: Government Printing Office.)

Diary of Societies.

FRIDAY, SEPTEMBER 20.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Western District) (at Hulme Hall, Port Sunlight), at 11 A.M.—P. Parr: Development and Works in the Bebington and Bromborough District.

MONDAY, SEPTEMBER 23.

NORTH STAFFORDSHIRE INSTITUTE OF MINING ENGINEERS (at Technical College, Stoke-on-Trent), at 5.—J. A. Bloor: Notes and Suggestions on the Underground Transport of Workmen.

THURSDAY, SEPTEMBER 26.

IRON AND STEEL INSTITUTE (at Chamber of Commerce, 95 New Street, Birmingham), at 7.30.—Discussion on following papers:—Constitutional Diagrams for Cast Irons and Quenched Steels, A. L. Norbury; Iron-Silicon-Carbon Alloys: Constitutional Diagrams and Magnetic Properties, T. D. Yensen.

FRIDAY, SEPTEMBER 27.

INSTITUTE OF MARINE ENGINEERS (at Olympia), at 6.30.—H. Barringer: Modern Tanker Practice (Lecture).

INSTITUTION OF MUNICIPAL AND COUNTY ENGINTERS (in Isle of Ely).

SATURDAY, SEPTEMBER 28.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (in Isle of Ely).

CONFERENCES.

SEPTEMBER 20–23.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trinity College, Cambridge).

Friday, September 20, at 6.45.—Reception of Delegates by the Council of the Association.

At 7.15.—Dinner. Address by Sir J. J. Thomson, the President-elect.

At 8.30.—Brig.-Gen. M. Mowat: The Year's Work of the Association.—Laurie Magnus: The Approach of the Producer to the Consumer of Information.

Saturday, September 21, at 10 A.M.—S. H. Hamer: The Preservation of Places of Natural Beauty and Historic Interest.—A. Parker: Duplicating Machinery: A Survey of Modern Methods.—E. J. MacGillivray: Duplication, and Infringement of Copyright.—Dr. W. Bonser: The Ideal Form of a Journal from the Librarian's Point of View.

At 5.30.—Annual General Meeting.

At 8.30.—G. T. Hankin: Books versus Text-books, the Problem of the Schools.—R. A. Austen-Leigh: Organised Information in the Printing Trade.—E. W. Ashcroft: Technical English.—E. Green: The Information Service of a Public Library.—P. A. Green: The Information Service of a Bank.

Sunday, September 22, at 10 A.M.—A. F. Ridley: The Training of Special Librarians.—H. Rottenburg: Indexing and Classifying of Individual Collections of Data.—A. P. L. Gordon: Sources and Application of Business Data.—E. T. Elbourne and H. G. T. Cannons: An Indexing System for Published Business Information.

At 8.30.—P. Otlet: International Organisation of Information Services.

SEPTEMBER 24 AND 25.

FARADAY SOCIETY (General Discussion on Molecular Spectra and Molecular Structure) (in Physics Department, University, Bristol).

Tuesday, September 24, from 2.30 to 4.30 and 5 to 7 P.M.—General Introduction by Prof. W. E. Garner and Prof. J. E. Lennard-Jones.

Part I. Band Spectra in Visible and Ultra-Violet.

Introductory Paper.

Band Spectra in Visible and Ultra-Violet.—Prof. O. W. Richardson.

Special Papers.

(*Personal Researches.*)—Prof. H. A. Deslandres.

The Band Spectrum of Helium.—Prof. W. E. Curtis.

The Detailed Electronic Structure of Molecules.—R. C. Johnson.

Band Spectra and Atomic Nuclei.—Prof. R. S. Mulliken.

Recent Work on Isotopes in Band Spectra.—Prof. R. T. Birge.

The Isotope Effect in the Absorption Spectrum of ICl.—Prof. J. Patowski and Prof. W. E. Curtis.

Chemical Binding.—Prof. F. Hund.

The Determination of Heats of Dissociation by Means of Band Spectra.—Prof. R. T. Birge.

The Recombination Spectra of Halogens and the Probability of the Molecule Building from the Atoms.—Prof. V. Kondratjew and A. Leipunsky.

Adsorption Spectra of Simple and Complex Molecules in Ultra-Violet. Predissociation and Dissociation of these Molecules.—Prof. V. Henri.

New Investigations on the Band Spectra of Metal Hydrides.—Prof. E. Hulthen.

Metallic Band Spectra.—S. Barratt.

Visible Band Spectra in Some Crystalline Salts of the Rare Earths.—F. I. G. Rawlins.

Wednesday, September 25, from 10.30 A.M. to 12.30 P.M., and 2.30 to 4.30 P.M.

Part II. Raman Effect.

Introductory Paper.

The Raman Effect.—Sir C. V. Raman.

Special Papers.

(*Raman Effect.*)—Prof. R. W. Wood.

(*Raman Effect.*)—Prof. J. C. McLennan.

The Degradation of Luminous Frequencies—Molecular Diffusion.—Prof. J. Cabannes.

Polarisation of Raman Radiations in Liquids and Crystals.—Prof. J. Cabannes.

A Study of the 'Raman Effect' in Some Liquefied Gases.—Prof. P. Daure.

Raman Lines in the Spectrum of the Electric Discharge.—Prof. H. S. Allen.

The Raman Effect of AX_4 Ions in Solution.—Prof. A. M. Taylor.

A Note on the Plane Polarisation of the Raman Spectra.—A. C. Menzies.

Part III. Infra-Red Spectra.

(a) *Solids.*

Introductory Paper.

Infra-Red Spectra in Solid Media.—Prof. C. Schaefer.

Special Papers.

The Infra-Red Spectra of Chemical Radicles.—Prof. A. M. Taylor.

The Band Spectrum of $KMnO_4$ in the Crystalline State and in Solution.—Prof. A. M. Taylor.

(b) *Liquids.*

Introductory Paper.

The Study of Infra-Red Spectra in Liquid Media.—Prof. J. Lecomte.

Special Papers.

On the Ultra-Red Lines of Hydrogen Combined with Carbon in the Molecule of Organic Compounds.—Prof. G. B. Bonino.

Molecular Absorption Spectra of Liquids below 3μ.—Prof. J. W. Ellis.

(c) *Gases.*

Introductory Paper.

Infra-Red Spectra of Gases.—Sir R. Robertson.

Special Papers.

On the Infra-Red Spectra of Gases under High Dispersion.—Prof. E. F. Barker and Prof. C. F. Meyer.

Chemical Structure and Infra-Red Analysis.—Dr. E. K. Rideal.

The Form of the Molecule of Carbon Dioxide—Evidence from the Infra-Red.—F. I. G. Rawlins.

The Infra-Red Spectra of Sulphur Vapour.—Prof. A. M. Taylor.

Vibration-rotation Spectra of Diatomic Molecules.—C. P. Snow.