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Geological Survey of India.

THE Geological Survey of India has won a well-deserved reputation as one of the leading surveys of its kind in the world. An unusually high proportion of its officers, past and present, have attained international fame as geologists, and in keeping with this fact its publications rank amongst the most important of those which make genuine contributions to the advance of geological knowledge. It is therefore both surprising and alarming to find, in connexion with the financial retrenchment imposed upon the Government of India by the necessity of balancing its budget, that serious proposals have been put forward to reduce the staff and salary scales of the Survey to an extent that would be nothing short of disastrous.

In our issue of Nov. 14 we commented on the retrenchment proposals which affect the Zoological Survey of India, relative to which Sir C. V. Raman has issued a timely Memorandum. In a similar Memorandum on the Geological Survey of India, Sir C. V. Raman discloses the fact that it has even been urged that the Survey could be permanently or temporarily closed down. Another proposal would reduce the personnel to a nucleus of eight members. The Retrenchment Advisory Committee, however, has finally recommended the retention of the director, three superintendents, and ten assistants; three superintendents and twelve assistants being dispensed with.

All of these disturbing proposals seem to be based on the extraordinary assumption that as the Survey has already been in existence for eighty years it has begun to outlive its usefulness. Nothing could be further from the truth. Sir C. V. Raman clearly shows in his Memorandum that the need for intensive geological investigation is steadily increasing and that the present activities of the Survey are actually insufficient to meet the demands of a territory so vast as that of the Indian Empire. He claims with justice that many of the mineral and associated manufacturing industries of India owe their present status to the discoveries of the Survey, and he points out that the royalties and income-tax derived from these sources can legitimately be claimed as a direct financial return for the money spent on its maintenance. It is also shown that the advisory work of the Survey results in the saving of large sums every year and in the prevention of waste and the avoidance of disaster to life and property that would otherwise be, for the most part, inevitable.

An alternative scheme of reorganisation suggested

by Sir C. V. Raman involves considerable reductions in salaries on an increased staff of one director, forty geologists (superintendents being regarded as unnecessary), one chemist, one artist, and six museum assistants. It must not be overlooked, however, that the traditionally high standard of the Survey is in no small measure attributable to the attractive conditions offered by the service. Hitherto the Survey has recruited its officers from the most promising of our post-graduate geologists. At present a geologist enters at Rs. 400 and rises in sixteen years to Rs. 1200, with a reasonable chance of promotion to the grade of superintendent at Rs. 1500 to Rs. 2000. On the proposed scale a geologist would enter at Rs. 300 and, after passing an efficiency bar at Rs. 750, rise to Rs. 1000 in eighteen years. It cannot be anticipated that a scale so drastically reduced will continue to maintain the Survey at its wonted level of achievement.

Sir C. V. Raman makes a very good point in directing attention to the cost of other leading geological surveys. The United States and Canada, countries comparable with India in the nature and magnitude of the problems requiring attention, expended respectively in 1929–30, 4,212,294 dollars and 705,325 dollars. We may add that the U.S.S.R. in 1928–29 devoted £1,359,000 to the activities of the Russian Geological Committee. That the results have justified this unprecedented expenditure and that geology is appreciated at its true worth in that much criticised land would appear to be shown by the official announcement that in 1932–33 more than three thousand field workers will take part in some eighteen hundred expeditions at a budgeted cost of £5,918,000.

Can it be seriously pretended that India can afford to dispense with an efficient geological service? Sir Albert Kitson stated the case unanswerably in his presidential address in 1929 to Section C (Geology) of the British Association on "The Utility of Geological Surveys to Colonies and Protectorates of the British Empire". Unfortunately, recent events have driven home the bitter truth of his comment that such surveys have benefited the British Dominions "immeasurably more than is yet realised by them".

We have discussed the position as regards the Zoological and Geological Surveys of India. Drastic proposals have also been made by the Retrenchment Advisory Committee for reducing the expenditure of other scientific departments. Accepting the fact that the Government of India, like most other governments, is faced with a grave financial crisis, we may take exception to the steps which have been adopted to secure recommendations for economies. When a business firm is faced with such a situation, the usual procedure is to call a conference of departmental heads and ask them to prepare a scheme to enable the firm to carry on over the crisis with the least possible damage to the efficiency of the organisation. The Government of India has sought advice from an able body of men who, however, know little or nothing of the highly specialised activities of the scientific departments of the Indian Empire. This raises again the problem to which we have repeatedly referred in these columns, namely, the alleged incompetence of scientific workers in administration. It is safe to say that, had anyone familiar with the methods and achievements of science been included in the personnel of the General Purposes Sub-Committee of the Retrenchment Advisory Committee, its present report would never have been published unchallenged.

The Internal Combustion Engine.

(1) *Power and the Internal Combustion Engine.* By Prof. W. E. Dalby. Pp. viii + 280. (London: Edward Arnold and Co., 1931.) 18*s.* net.

(2) *The High-Speed Internal-Combustion Engine.* By Harry R. Ricardo. New edition. Pp. vi + 435. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1931.) 30*s.* net.

WITH two newly issued volumes on the internal combustion engine lying on the table, one by Prof. Dalby and the other by Mr. Ricardo, the reviewer expected new light on a subject at once important, interesting, and strangely elusive. The new light is rather disappointing. Where one hoped to find a general illumination on an ordered scene, one finds in the former book much attention given to the author's special interests, and in the latter just as good a presentation of modern knowledge as a very busy investigator, with a somewhat less easy command of English than the best, can give time to produce. Perhaps it would be fair to add that a few years ago books of this kind would have been read with minds less critical than those of to-day, and that if one man more than another is responsible for this, the 'blame' may be put on Sir James Jeans, who, whether in the simple "Stars in their Courses" or the comprehensive "Astronomy and Cosmogony", has shown us how lucidly and forcefully information on natural phenomena of great complexity may be presented.

(1) In Prof. Dalby's book, with the broad title of "Power and the Internal Combustion Engine",

one expects to find a unitary conception of the engine and its path of development to date. This, however, is scarcely attained. The general scheme adopted is to proceed from the ' working agent ' to mixtures and fuels, thence to the engine itself and the ' Dalby diagram ', followed by the suction gas plant, the petrol engine in detail, and finally heat flow in its effect on design. The author has a curious way of giving authority for his statements and figures : thus, in his first chapter the number of molecules in the cubic centimetre is given on the unexpected authority of the " Encyclopædia Britannica " —scarcely an original source ; and a few pages later he includes, without a smile, under the heading of " some gases whose molecular weights are given " elsewhere, " the Liverpool Gas Company ". The author endeavours to state all measurements in engineers' units even when dealing with the work of chemists and physicists. This makes the reading somewhat heavy, and it does not help the student when he has to refer to books on chemistry and physics.

As an occasion for desultory—but pleasant—wandering there is much to be said in the book's favour, and in fairness to the author it should be mentioned that the preface contains the warning that " to read Chapter i. involves knowledge of Chapter iii.", though somewhat unexpectedly it explains also that " to read Chapter iii. involves some knowledge of Chapter i." Such a book is scarcely for the training of students. What would a student make, for example, of the information that " the weight of vapour or gas which will enter a given volume at a given temperature is the same whether the space be a vacuum or contains other gases " ? Is he to measure the temperature of a vacuum, and if so, how ? In another place the author seeks to explain the simple ratio " 1/4 per cent by volume " by the elucidation that it is " less than half a fluid ounce per gallon ".

The author sums up towards the end of the book that " probably no invention in the history of man has at one and the same time so much increased his comfort and so much increased his anxieties, as this small, light and efficient prime mover—the petrol engine ". It is evident that these anxieties are shared by the engineer, for the last sentence in the book gives warning of the danger of " cracked liners, cracked pistons and cracked cylinder heads ".

The book contains, or gives references to, much of the best work which has been done on this subject in the last twenty years, and one cannot but be grateful to any author who helps, as Prof. Dalby does, to make such work more readily accessible to the investigator.

(2) Mr. Ricardo's book is in very interesting contrast to Prof. Dalby's. It is written by a man with a synthetic brain, and if he were not so occupied with his important research work he could probably write the best book on this subject that has ever been written. The present volume is, however, a reissue, after eight years, of an earlier book now partly out of date. In the first edition there were errors common to most first editions, and it was to be expected that the issue of a new edition would have afforded an opportunity to correct them, but this expectation is not entirely fulfilled ; nor has the chance been taken to correct certain statements and definitions which contain so much scientific error, as presented, as make it impossible to pass them by. Examples are seen in the author's strange use of ' internal energy ' and his loose way of speaking of heat energy in fuels. Certainly the definition of ' total internal energy '—on p. 21—is wrong and should be deleted. In the same chapter the reader is told that the heat value of a volatile fluid has no relation to the power output—again quite untrue and the blue pencil needed. The reader may know what the author means, but that is no excuse for the use of incorrect language ; and those who do understand the meaning will scarcely be those who need to read the book. Nor is it wise to mix both Centigrade and Fahrenheit scales of temperature. Indeed, in a book not intended for popular consumption there can be little excuse for using the latter at all.

The author's remark on p. 40 that the reaction velocity is trebled by a three per cent rise in temperature for all hydrocarbon fuels, probably refers to the work of Tizard and Pye. If it does, is the figure ' three ' correct, and was it shown by them to apply to all hydrocarbon fuels ?

As regards the new sections on detonation, it is fair to state that a general result which has emerged in recent years is that detonation is mainly a chemical problem which cannot well be explained by treating the explosive mixture in bulk ; there is no mention, however, in Ricardo's treatment of detonation of Callendar's and Egerton's theories and the idea of chain reactions. Mention of these is, it is true, made later when the author deals with the action of metallic dopes, but this rather suggests that these theories do not apply to the initiation of detonation in general but are only of interest in connexion with ' dopes '.

Nevertheless, the reviewer considers the book the best there is in the English language on the present position of research work on the internal combustion engine. At the moment this research work is

proceeding on healthy lines. It is chiefly guided in Great Britain by the Engine Sub-Committee of the Aeronautical Research Committee, the Air Ministry providing most of the funds for such researches, whether undertaken at the aero engine builders' works, at the Government research establishments, or in the research laboratory of Mr. Ricardo himself. All this research work is published, when it has reached a suitable stage, in the Reports and Memoranda Series of the Aeronautical Research Committee. So much work is now in hand in Great Britain alone on compression ignition types, two-stroke cycles, sleeve-valve operation, fuel injection, supercharging, and 'boosting', that any summary of it all issued to-day must speedily become out of date. It is too much to expect, therefore, that Mr. Ricardo's volume can give an entirely synchronous account of the present position, but it certainly comes much nearer to doing so than does the writing of any single author in Great Britain or elsewhere.

Studies in Immunity.

Medical Research Council. A System of Bacteriology in relation to Medicine. Vol. 6. By J. A. Arkwright, S. P. Bedson, C. H. Browning, H. R. Dean, A. T. Glenny, P. Hartley, J. C. G. Ledingham, H. B. Maitland, R. Muir, H. L. Schütze, W. M. Scott, D. B. Steabben, J. W. Trevan. Pp. 538. (London: H.M. Stationery Office, 1931.) 21*s.* net.

THE literature on immunity has almost got beyond the limit of the capacity of any one worker, and this volume on the "System of Bacteriology" will be welcomed not only by laboratory workers, but also by all interested in this difficult but fascinating subject. The volume stands out as one of the best in the "System", and each chapter is written by a worker who has an intimate experimental knowledge of his subject. There is an adequate summary of most of the important papers which have been published, and the writers have given their own views, based largely on their own experimental work, but have, at the same time, dealt very fairly with the writings of other experimenters in the same field.

Chap. i., on "Bacteria in Relation to Disease", is a necessary introduction, and is concise, well written, and accurate. A subject such as immunity, which is still based to a considerable extent on theory, has had associated with it various terms which were useful but the meanings of which were not at all definite. We are glad to see in this chapter a suggestion that some of these, such as endotoxin, leucocidin, aggressin, have served their purpose, but have lost their usefulness and should be avoided. This will be a difficult task to accomplish, and it is significant that the succeeding writers have not followed, even one step, in this suggested path. A brief account is given of the very important and difficult subject of the virulence and antigenic complexity of bacteria in its bearing on the genesis and extinction of epidemics.

Chap. ii., on "Natural Immunity", by Prof. Ledingham, is very detailed, but so well written that the detail does not in any way detract from its interest. There are many points of great importance not merely mentioned but discussed. In the first place, he deals with the normal defence mechanisms, such as bactericidal and hæmolytic action, opsonins, leukins, etc. He emphasises the fundamental importance of phagocytosis, and then he discusses the modifications which may be induced on these normal and 'non-specific' substances found in the body by the parenteral injections of proteins, etc., and by various physical and chemical agents, such as ultra-violet light, fatigue, and certain reflexes, such as sound. The bearing of nutritional factors is discussed, especially in relation to the antibody-forming mechanism and the resistance to spontaneous and induced infection. The natural resistance to various infections, the problem of local immunity, and much of the recent work on the reticulo-endothelial system are dealt with very thoroughly. The whole chapter bristles with interesting facts.

Chap. iii., on the "Production of Active Immunity to Bacterial and Virus Infections", is by Ledingham and Schütze. They deal with the work of Jenner, the early work of Pasteur, and the modification of their methods, and follow this up with the whole subject of bacterial vaccines, dealing with the work on typhoid, cholera, plague, etc., and the virus diseases, such as rabies, foot-and-mouth disease, distemper. A very interesting discussion is given on immunity as influenced by recent knowledge of bacterial antigens, and it is shown how our views have been modified by the investigations on the subject of the flagellar and somatic antigens.

Chaps. iv. and v. deal with toxins, and relate largely to chemical and physical problems. They are written by experts on the subject, and will prove of great value to laboratory workers, but their interest will be mainly for such.

In Chap. vi., by Prof. Browning, the antigens and antibodies are discussed. Among the many interesting points there are some which are perhaps not sufficiently recognised by vaccine therapists.

We are told that, as a rule, antigens introduced into the stomach are either destroyed by the digestive ferments or fail to be absorbed. Thus, the oral administration, though not rejected altogether, is regarded as generally useless. The transference of antibodies from mother to fœtus occurs, apparently, only in some species of animals and not in others. The whole chapter will repay careful reading, and may be regarded as a standard work on the subjects.

Chap. vii., by Dr. Hartley, gives a very full account of the effect of physical and chemical agents on the properties of antigens and antibodies. This study of the chemistry of bacterial cells and bacterial products is still very imperfect, though the work of Hartley himself and those whose investigations are recorded in this chapter have done something to clear up doubts and difficulties.

Chaps. viii., ix., and xi., on "Anti-bacterial Sera, Hæmolytic Action, and Opsonic Action", are by Prof. Muir, with certain minor sections by other authors. These chapters, with Chap. x., by Browning, and xii., by Arkwright, are, we think, the most important and valuable in the volume. They cover the whole ground with great success. They are well written, and are clearly the work of men who not only have an intimate working knowledge of the subjects with which they deal, but also have the faculty of conveying their knowledge to others. There are many points to which one would like to refer, but space will not permit.

In Chap. xiii., Dean deals with the precipitin reaction in considerable detail; discusses the source of the precipitate, its specificity and practical application, and its relation to other serum reactions. This chapter will, we hope, have the effect of clarifying the somewhat hazy views which are held by many people on precipitins. It is a chapter of very great value.

Chap. xiv. is a brief critical survey of antiferments and defensive ferments, by Prof. Browning, in which he emphasises the fact that many of the observations on these subjects have not led very far in the investigation of disease.

Chap. xv. is an excellent and fairly exhaustive review of the work on anaphylaxis and serum sickness and allergy. There are many practical points concerning the therapeutic uses of serum, and Dr. Scott emphasises the dangers and uncertainties, especially of desensitisation. This is an extremely useful contribution both to the laboratory worker and the clinician.

Miss Steabben in Chap. xvi. gives a short survey of immunological problems in their relation to colloid chemistry, and in Chap. xvii. Prof. Browning has given a very clear summary of the value of chemo-therapy particularly in protozoal infections, though he also deals with antiseptics in a limited field in bacterial infections.

We heartily welcome this volume as a really valuable and up-to-date contribution. It should find a place in every bacteriological laboratory and in the library of every medical practitioner.

J. M. BEATTIE.

Ore-Minerals and the Microscope.

Lehrbuch der Erzmikroskopie. Von Prof. Dr. Hans Schneiderhöhn und Prof. Dr. Paul Ramdohr. Band 2. Pp. xii + 714. (Berlin: Gebrüder Borntraeger, 1931.) 72 gold marks.

Erzmikroskopische Bestimmungstafeln: Anhang zum Lehrbuch der Erzmikroskopie. Von Prof. Dr. H. Schneiderhöhn und Prof. Dr. P. Ramdohr. Pp. 47. (Berlin: Gebrüder Borntraeger, 1931.) 3·80 gold marks.

IT would be difficult to over-estimate the value of the contributions to our knowledge of rocks and rock-forming minerals that have resulted from the adaptation of the microscope to petrographical research. The technique of rock examination with the polarising microscope, evolved since the pioneer work of H. C. Sorby, has long been so effective as to make the instrument indispensable to the petrographer.

Naturally, this technique has been focused in the main upon the examination of the transparent minerals—principally silicates—that are the chief constituents of ordinary rocks. Of late years, however, with a growth in the study of mining geology, and especially in view of the remarkable results that have been obtained in the investigation of polished surfaces of metals with the metallographic microscope, increased attention has been paid to the opaque minerals which, while frequently occurring as minor components of common rocks, enter so largely into the constitution of those highly specialised rocks, the metalliferous ores.

As a result a new mineralogical technique, involving the systematised use of reflected instead of transmitted light, is being rapidly developed, and promises eventually to be as serviceable in the study of ores as the old has been in that of rocks. This technique, similar to that of metallography, is variously known as mineralography, mineragraphy, chalcography, and ore-microscopy, but still awaits an appropriate designation.

The application of metallographic methods to the study of opaque minerals began in America soon after the opening of this century, the names of

Campbell, Murdoch, Davy, and Farnham being especially associated with early publications. Good progress was made by these workers both in the methods of preparing polished surfaces of the complex mineral aggregates so often presented by ore-specimens, and in the optical identification of a wide range of opaque minerals difficult to distinguish from one another microscopically. In the course of time the possibilities of work along these lines were realised by mineralogists of other nationalities, and during the last decade contributions of great value have been made by Schneiderhöhn, van der Veen, Orcel, and others in Europe. There have also been numerous recruits in the United States and Canada, and in most laboratories in which ore research is undertaken, investigation by this method is becoming standard practice.

At first the microscope employed differed in no essential from that of the metallographer. Ordinary, that is, unpolarised, light was used, the determination of mineral species being based upon such simple criteria as colour, hardness, cleavage, and so on; and upon micro-chemical reactions obtained with a selected series of etch-reagents. While the data so obtained were in many cases satisfactory, they often proved insufficient for unequivocal identifications, and the need was felt for additional means of diagnosis. The principal innovations of recent years have been designed to provide such extra data, and have consisted of ingenious modifications in the ore-microscope to permit of the accurate measurement of the reflecting power of the various opaque minerals, and of the examination of polished surfaces in polarised as well as in ordinary light.

These refinements have added greatly to the effectiveness of ore-microscopy and to the amount of information it is able to supply. The reflecting power, observed either visually or by means of a photoelectric cell, promises to provide a quantitative factor of great discriminative value. The examination in polarised light, besides giving characteristic reflection-pleochroism in many cases, yields interference effects—reminiscent of the polarisation colours and extinctions shown between crossed nicols by transparent minerals—from which important diagnostic data as to crystallisation, twinning, and so forth may be deduced. As adapted for these additional observations, the ore-microscope is rapidly acquiring distinctive peculiarities, and there can be little doubt that further modifications, making for still greater effectiveness, will be introduced in the near future.

Pre-eminent among those who have helped in the building up of this new branch of mineralogical research is Dr. Hans Schneiderhöhn, formerly of Giessen, now of Freiburg i. Br., who first became interested in it while engaged on the ore-fields of south-west Africa. After returning to Germany, Schneiderhöhn published, in 1922, his "Anleitung zur mikroskopischen Bestimmung und Untersuchung von Erzen und Aufbereitungsprodukten"—an admirable treatise which has since been a standard work of reference. The rapid developments of the last decade, however, have made a fuller and up-to-date presentation of the subject desirable, and this, under the simplified title, "Lehrbuch der Erzmikroskopie", he is now producing in collaboration with Dr. Paul Ramdohr of Aachen. This much-enlarged work is to consist of two volumes and a supplement. The second volume and its supplement have already appeared and are now under review, while the first volume of the complete work, the authors hope, will be available shortly.

The first volume will deal with general principles, apparatus, and technical procedure. The second is descriptive of the minerals met with in ores, no fewer than two hundred species being considered in detail. These are classified on a chemical basis, and include besides the ore-minerals, whether opaque or not, most of the common gangue-minerals also. A uniform system of description is adopted covering composition, physical characters, polishing properties, colour, reflecting power, polarisation effects, etch-reactions, occurrence and genesis, etc. There are nearly 250 admirable reproductions of photomicrographs, and an indication of colour effects observable with or without polarised light is given in a number of beautifully reproduced colour-prints. The supplement—"Erzmikroskopiche Bestimmungstafeln"—consists of an ingenious set of tables for the practical identification of the minerals described by a comparatively simple system of physical, optical, and chemical tests applicable under the microscope. It is put up in the form of a booklet convenient for use in the laboratory.

The preparation of this ambitious publication has obviously entailed much time and labour. The authors state that they have been engaged upon it for eight years, and that in the course of their work they have made and investigated some six thousand polished surfaces of ores from all parts of the world. The volumes when finished will constitute the most complete treatment of the subject ever attempted, and will be invaluable to all who have to investigate ores with the microscope. C. G. C.

Short Reviews.

A Hand-Book to the Flora of Ceylon: containing Descriptions of all the Species of Flowering Plants indigenous to the Island, and Notes on their History, Distribution, and Uses. By Henry Trimen. Published under the Authority of the Government of Ceylon. Part 6: *Supplement.* By A. H. G. Alston. Pp. vi+350. (London: Dulau and Co., Ltd., 1931.) 30*s.* net.

PENDING a complete revision of the flora of Ceylon, Mr. Alston, lately systematic botanist in the Agricultural Department in that island, has done valuable service in publishing the volume under review. His aim has been twofold: first, to bring in additional matter with regard to a few new species and a number of known species which had been omitted, for one reason or another, from Trimen's "Hand-Book to the Flora of Ceylon", with the appropriate additions to the keys to the families and genera; secondly, to bring to notice nomenclatural changes due to research and to altering concepts of generic and specific limitations.

In connexion with the latter aspect, it is not obvious why the author has rejected certain views of other botanists; for example, the substitution of *Nervilia* for *Pogonia* and *Platanthera* for a section of *Habenaria*, both of which have been accepted by Schlechter, among other authors. Further, it is not permissible, as apparently Mr. Alston thought at the time (the introduction is dated March 20, 1928), to substitute *zeylanicus* where an author has used the form *ceylanicus*; the original spelling must be respected. Nor can these two orthographic variants be valid in the same genus, as the reference to them seems to indicate. A number of typographical errors have escaped detection.

Tamil names taken from the "Flora of the Presidency of Madras" have been incorporated. It is not stated whether these names have been tested in Ceylon. Vernacular names are often very local and Tamil names are apt to vary from district to district in the Tamil country; thus, so widespread and well-known a tree as *Dalbergia latifolia* Roxb. is known as *Iti* in Coimbatore and is called *Eravadi* in Madura and Tinnevelly.

The work will be of great assistance in the revision of the flora of Ceylon which, we believe, is contemplated in the near future.

We Indians: the Passing of a Great Race. Being the Recollections of the last of the Great Indian Chiefs, Big Chief White Horse Eagle, as told to Edgar von Schmidt-Pauli. Translated by Christopher Turner. Pp. 256. (London: Thornton Butterworth, Ltd., 1931.) 10*s.* 6*d.* net.

THIS interesting document is transcribed from the narrative of a great chief of the Osage tribe of Colorado, who it is claimed, not without some sort of corroboration, had attained the age of one hundred and seven years at the time of his narrative. It sketches the life of the Indian of the south-western United States in the earlier half of the nineteenth century, before the buffalo had disappeared and white settlement had restricted the Indian hunting grounds. It also outlines the events which later led up to the defeat of Custer in 1876 and the great peace treaty which, in the view of the narrator, was the death-blow to the Indian.

The Big Chief's claim to the memory of posterity will rest almost equally on the facts that he, as representative of the Indians, buried the hatchet under the steps of the White House at Washington, and as a young man rescued from a massacred emigrant train and brought up with his own children an infant who afterwards became 'Colonel' William Cody, better known as 'Buffalo Bill'. The narrative, which is not without naïveté, has a certain importance as giving the Indian point of view on a number of historical events, though, not unnaturally perhaps, little stress is laid on Indian aggression. The Bureau of Indian Affairs is criticised in strong terms and not without cause.

A History of Surnames of the British Isles: a Concise Account of their Origin, Evolution, Etymology, and Legal Status. By C. L'Estrange Ewen. Pp. xx+508. (London: Kegan Paul and Co., Ltd., 1931.) 25*s.* net.

THERE is perhaps room for a new history of British surnames since Bardsley and Harrison published their works on the subject. Mr. Ewen has given his history a wider scope than Bardsley and has brought into use much new material. Obviously the "History" has been a labour of love, and there is an inclination to overload it with matter, industriously collected, which has not much direct bearing on the subject in hand and is not always culled from the best authorities. Apart from this criticism, however, Mr. Ewen has given us a work which will be of considerable value to the genealogist and to a lesser extent to the anthropologist. Although the history of personal names has not the scientific value of its sister study of place names, yet much can be learnt by a cautious use of it to show the migrations of races and the settlements of groups of immigrants from other lands, the prevalence of industries in particular districts and the distribution of dialect. But the mobility of the human race and the change of surnames necessitate the greatest care in its use for these purposes. Mr. Ewen has recognised this difficulty and so has wisely emphasised the genealogical value of his study. Of not the least importance is the bibliography given at the end of the volume, which appears to be most comprehensive.

The Spore Ornamentation of the Russulas. By Richard Crawshay. Pp. 185+48 plates. (London: Baillière, Tindall and Cox, 1930.) 12*s.* 6*d.* net.

Russula is one of the more easy genera of Hymenomycetes to recognise, but one of the more difficult to classify into species. The spores of *Russula* are ornamented with minute tubercles or warts, sometimes joined together by lines, and the disposition of this ornamentation is used by Mr. Crawshay as an accessory character in the specific classification of the genus. The spores themselves, however, are only a few micromillimetres in length, and

the differences in the surface markings are so slight that it would, in many cases, need an experience as intensive as that of the author himself to distinguish them.

The book seems to be directed to the serious amateur possessing a compound microscope, and the first four chapters contain somewhat elementary accounts of microscopic optics, photomicrography, and micrometry. The main portion of the book consists of a useful dichotomous key to the genus, notes on certain species, and forty-six plates of spore drawings, as well as colour charts for spore-deposits and gills. There is an introduction by Bataille.

Apart from its value as a guide to the genus *Russula*, the work is important as marking a step in the endeavours of systematic mycologists to base the specific classification of Hymenomycetes upon something more objective than colour, feel, taste, and smell. W. B. B.

Edward Carpenter: in Appreciation. Edited by Gilbert Beith. Pp. 246+2 plates. (London: George Allen and Unwin, Ltd., 1931.) 7*s.* 6*d.* net.

A Heathen's Thoughts on Christianity. By E. Upasaka. Pp. 92. (London: The Pioneer Press, 1930.) 1*s.*

A BRIEF notice may cover various books either by reason of their sympathy or their mutual antagonism. So, in the present instance, in the late Edward Carpenter was encountered a man of strong individuality who grew into a life of practical socialism, surrendering for its attainment a curacy and holy orders, but by no means surrendering the essentials of a religious life. He was, peculiarly, one with many friends and no enemies, though not everyone could approve his views. This "Appreciation" contributed by a few friends bears eloquent testimony to his sterling qualities; his own farewell (written some years prior to his death, to be read from the graveside) is a fitting conclusion. His views upon "A Heathen's Thoughts" would have been welcome as an antidote against its virus. The author has obviously a right to his opinions, nor can he properly be charged with blasphemy where he has no religious belief. But it is a grievous error wilfully to shock the religious beliefs of others, and this book is one which, whilst it can do no good, may conceivably do harm. The 'higher critics' may note that biblical history is worthily championed to-day by those who support their arguments on logical foundations. P. L. M.

Die Nordsudetische Dyas: eine stratigraphisch-paläogeographische Untersuchung. Von Prof. Dr. Hans Scupin. (*Fortschritte der Geologie und Paläontologie*, Band 9, Heft 27.) Pp. viii + 246+4 Tafeln. (Berlin: Gebrüder Borntraeger, 1931.) 30 gold marks.

THIS memoir contains the results of a detailed stratigraphical and palæogeographical investigation of the Permian of the region to the north of the Riesengebirge in Silesia. The succession, reaching from the Middle Rothliegendes to the Upper Zechstein, is subdivided on palæoclimatic evidence. The history of the struggle between deepening and filling-up at the margins of the sinking Variscan land provides an interesting study in palæogeography. The memoir closes with an account of the Zechstein copper ore of the district, which is shown to be stratigraphically and mineralogically distinct from the famous Mansfeld Kupferschiefer. It is considered to have been formed by the action of copper sulphate solutions, derived from the weathering of basic igneous rocks, on the calcium carbonate of the Zechstein sea—a conclusion showing the importance of palæogeography in the elucidation of syngenetic ore-deposits.

Mental Nursing (Simplified). By O. P. Napier Pearn. Pp. viii + 304. (London: Baillière, Tindall and Cox, 1931.) 5*s.* net.

DURING the last decade great progress has been made in the nursing of the mentally afflicted. This most difficult branch of nursing in many ways requires more attention and training than its sister branches, due to the fact that the mental side is the more important and is a really difficult subject to understand. Dr. Pearn in his "Mental Nursing (Simplified)" has in many ways made the path of the mental nurse easy. He gives many interesting little artifices for remembering difficult things, and the nurse who knows this book well before he or she begins the familiar "Red Book" of the Royal Medico-Psychological Association will find the latter book a much easier proposition than is usually the case. The subject matter throughout is extraordinarily well set out, following the general plan of the "Red Book". Dr. Pearn has earned the gratitude of that large body of excellent men and women who, although at times subject to criticism, spend their time in a very arduous but nevertheless fascinating vocation.

A Bibliography of Sex Rites and Customs: an Annotated Record of Books, Articles and Illustrations in all Languages. By Roger Goodland. Pp. v+752. (London: George Routledge and Sons, Ltd., 1931.) 63*s.* net.

MR. GOODLAND'S bibliography of sex rites and customs is a monumental work of 9000 entries, which have taken, we gather, between fifteen and twenty years to compile. The entries are arranged alphabetically under authors' names. The place of a subject-catalogue, which is essential in a work of this kind if it is to be of any practical use, is taken by a copious subject-index. In view of the present cost of printing, this is perhaps the best solution of a difficulty which confronts every bibliographer. Mr. Goodland, however, has added greatly to the value of his work by the inclusion under each entry of a brief indication of the precise subject or subjects with which the book or paper deals, giving the page reference for each topic. A high standard of accuracy is maintained, and a careful scrutiny of the entries has not revealed any serious omission or error. Such omissions as have been noted would seem to be due to Mr. Goodland's interpretation of what is to be regarded as ritual.

Oxygen and Everest.

By RAYMOND GREENE.

THE recent success of the British Himalayan Expedition in climbing, without the use of oxygen, ten of the greater Himalayan peaks, including Kamet (25,447 feet), the highest summit yet attained, has brought once more into prominence the question of the use of oxygen on Everest. It is a question on which both climbers and physiologists are divided. It is possible that an attempt to sum up the present position may be of use in future discussion.

The problem to be solved is whether or not oxygen can be regarded as a helpful factor in high climbing. One school of thought claims that, in the face of theoretical considerations and practical experience, it is impossible to deny its usefulness. The special difficulties of Everest are due chiefly not to terrain or climate but to want of oxygen. To supply this want can scarcely fail to reduce the difficulties of the ascent. Moreover, Prof. J. Barcroft has shown by direct experiment that, under laboratory conditions, it is possible to do by means of oxygen what is certainly impossible without it—to climb at a rate of a thousand feet an hour, without previous acclimatisation, at a barometric pressure equal to that of the summit of Everest. Much practical experience points in the same direction. Of the ascent of the Rapiu La (21,000 feet), Prof. G. I. Finch wrote: "Colonel Strutt and Doctor Wakefield, unoxygenated, accompanied us on this little expedition, and oxygen at once proved its value, so easily did Bruce and I outpace them". Later, writing of May 22, 1922, he recorded that "There had been a considerable amount of step-cutting, but even so, oxygen had made a brief alpine ascent of what is otherwise a strenuous day's work". Of May 24 he wrote: "No longer did the porters regard oxygen as a foolish man's whim. One and all appreciated the advantages of what they naïvely chose to call 'English air'." As to its use in emergency, I will again quote Finch. He and Geoffrey Bruce had spent a miserable night at a height of 25,500 feet, about the height of Kamet. The weather was cold and windy but they decided to spend a second night at this camp. He wrote: "a dead, numbing cold was creeping up my limbs, a thing I had only once before felt. . . . Something had to be done. Like an inspiration came the thought of trying the effect of oxygen. . . . A few minutes later, after the first deep breath, I felt the tingling sensation of returning life and warmth to my limbs. We connected up the apparatus in such a way that we could breathe a small quantity of oxygen throughout the night. The result was marvellous. We slept well and warmly. Whenever the tube delivering the gas fell out of Bruce's mouth as he slept, I could see him stir uneasily in the uric, greenish light of the moon as it filtered through the canvas. Then, half unconsciously replacing the tube, he would fall once more into a peaceful slumber. There is little doubt that it was the use of oxygen which saved our lives during this second night in our high camp." On the next day, the two climbers climbed a further 1800 feet at an average speed of nine hundred feet an hour. An earlier party, using no oxygen, a stronger party from a mountaineering point of view, in better weather and after only one night in the high camp, covered roughly the same zone of altitude at a speed of only 330 feet an hour. It is on such data, derived from theoretical considerations, laboratory experiment, and practical experience, that the oxygen school bases its conclusions.

The no-oxygen school claims, on the other hand, that the conclusions are unsound because, both in the Barcroft steel chamber experiment and on Everest, the 'subjects' were either unacclimatised or only partially acclimatised. Acclimatisation appears to occur in three different ways. In the well-trained person, oxygen secretion by the lung epithelium increases the oxygen supply to the blood at a very early stage of an ascent. The existence of oxygen secretion is denied by some physiologists. In this battle of the giants I do not propose to take a part. It does not affect our main issue, because it does not occur to a sufficient extent to affect the question of whether or not oxygen should be carried on Everest. A great increase in the hæmoglobin percentage of the blood undoubtedly occurs, but this increase will not make possible the continuance of life at very great altitudes, unless supported by an actual increase in the pressure of oxygen in the lung alveoli. This increase is attained by deep breathing.

The first deep breathing of the ascending climber is caused by the effect of oxygen want, which increases the susceptibility of the respiratory centre to an increase in the carbon dioxide of the blood. The 'subject' responds to oxygen want by breathing more deeply. In so doing he washes carbon dioxide out of his blood and so lowers the acidity of the latter, and the tendency towards deep breathing. He may even show the periodic type of breathing known as 'Cheyne-Stokes breathing'. The most important element of acclimatisation is the overcoming of this 'alkalosis', and the breaking of the vicious circle. This compensation is brought about by an increased excretion of alkali by the kidneys. Thus a compensation towards acidosis is produced and permanent deep breathing with increased oxygen tension follows. Now the exponents of oxygen point out that although it is obvious that the supply of oxygen to an unacclimatised person would increase his working capacity, the acclimatised person would be unaffected. His deep breathing keeps his oxygen tension as high as he wants it.

The no-oxygen school can also quote from practical experience, for the evidence of the 1924 Everest Expedition was less favourable than that of the 1922 Expedition. There is, it is true, a record of

a quick oxygen-assisted climb between Camps III. and IV. by Mallory and Irvine, and there is a note by Mallory, written from Camp VI., telling Noel to be on the look-out with his cinema at 8 A.M., when he expected to be at the foot of the final pyramid. This suggests that Mallory expected to make, with oxygen, very rapid progress. On the other hand, Geoffrey Bruce and Odell both reported that they obtained little or no benefit from its use. The first such occasion was up to 23,000 feet, where its use could scarcely be expected to produce dramatic results in acclimatised climbers. The second occasion was at 27,000 feet, when Odell discarded oxygen and felt better without it. With the deference due from one who was not actually present, I suggest that the fault may have rested with the apparatus, and that the improvement in Odell's condition may have been due to the discarding of useless weight and partly possibly to the euphoria usually associated with anoxæmia. We know that the apparatus was cumbersome, inefficient, and leaky. We do not know to what extent Irvine's improvements and corrections, carried out without proper equipment and under the most difficult of conditions, may have broken down in use. The appearance of Mallory and Irvine, still below the final pyramid at 12.50, four and a half hours late, may have been due to a breakdown of the apparatus.

If, then, the oxygen school believes in the usefulness of oxygen for high climbers, whether acclimatised or not, and the no-oxygen school believes in its usefulness for the unacclimatised, a method of attack in conformity with both points of view appears at first sight to be obvious. It should be possible to eliminate the necessity for acclimatisation by using oxygen from a low level on the mountain and climbing it at alpine speed. But here two great problems present themselves. It is very difficult to construct an apparatus which will without waste deliver the required quantity of oxygen while the climber is eating and sleeping; and it is impossible at the moment to find an apparatus which can be trusted never to go wrong. The failure of his oxygen apparatus near the top of Everest would mean death to the unacclimatised mountaineer.

The other extreme view has also been presented, but never by anyone with experience of Himalayan climbing—the view that Everest should be attacked by a party prepared, if necessary, to spend a year upon the mountain. To rush a mountain is folly, unsound in theory and disastrous in practice. Siege tactics have been proved sound. But there must be moderation even in slowness. The weather of the great peaks allows only a limited time in which to make the ascent, and many months upon a mountain undermine the health of the climbing party. It is possible that before sufficient acclimatisation for an oxygenless assault on the summit of Everest has been attained, altitude deterioration may have set in. If by relying on oxygen for the last few thousand feet of Everest it is possible to reduce the time on the mountain and thus the danger of deterioration, the chances of a successful attempt will be increased. Whether this can be done will be determined by direct experiment in a steel decompression chamber.

The practical difficulties of oxygen are serious. The apparatus in use in 1924 was so heavy that, in the opinion of some, its weight outbalanced its advantages. Valves tend to freeze or leak, and complicated taps are difficult to work under trying conditions. Many improvements have been made in the last five years, but there is room for more. There should be produced a light, simple, and efficient apparatus, thoroughly tested in refrigerators and mid-tunnels and on the mountains of Europe. This task has been undertaken by a committee of the British Association. If such an apparatus can be designed it should, as soon as permission can be obtained, be placed in the hands of a young, well-drilled, and well-organised party. Such a party will, in my opinion, climb Everest. It will at any rate show us whether or not oxygen can be of service to the unacclimatised man.

The Principles of Evolution Revealed by Palæontology.*

By Prof. HENRY FAIRFIELD OSBORN, For.Mem.R.S.

IN honour of Darwin our first thought is that natural selection is the sole survivor of the age-long theories and hypotheses clustering about evolution. Selection alone has stood the test of survival of the fittest, yet we must severely limit the powers of selection as Darwin imagined them in his earlier and more sanguine frame of mind, and glean the elements of truth pervading all the other hypotheses and theories. It is a striking fact that the zoologists, experimentalists, and geneticists who, a quarter century ago, were stoutly combating Wallace, Weismann, and other super selectionists, have, one after another, returned to the Darwinian fold and are now almost unanimously teaching their students, as if it were a demonstrated fact, that evolution progresses by the survival of fortuitously adaptive mutations.

To the mind of the palæontologist these teachings are pure Darwinism camouflaged in new language. Bateson, founder of the genetic school, was the only one to confess frankly his utter failure to explain the origin of species; few have displayed similar courage.

When we consider the youthful zoology and the infantile palæontology of Darwin's time (1809–82), our admiration for his genius and marvellous powers of generalisation constantly increases. What would his generalisations have risen to with our present knowledge? He foresaw the promised land of palæontology, but did not live to enter it. The ratio of the 8767 vertebrate species known in

* Paper read before Section D (Zoology) of the British Association, following Prof. E. B. Poulton's presidential address, entitled "A Century of Evolution", on Sept. 24. This is the sixth of a series of papers by the author on the origin of species.

his time to the 65,939 species known in 1925, nearly 8 to 1, is about the measure of the biological progress of the first century of evolution. The 'biochemical' adaptations underlying coloration, as well as the 'biophysical' adaptations controlling many of the animal instincts, are beyond the ken of the palæontologist who is bounded by his biomechanical fossils.

Far from marking any real progress toward the eternal question of the origin of co-ordinated mechanical adaptations, the experimental zoologist and geneticist are making little progress along the biochemical line. In order to ascertain the state of current observation and opinion on the mutational origin of species, sub-species, or adaptive mutations, as well as on the experimental results of biochemical, biophysical, and endocrine action, the following questionnaire (slightly modified) was sent out on July 17, 1931, to forty-one leading zoologists :

1. Do you know of a single concrete case of the origin of a species, of a sub-species, of an adaptive mutation of De Vries, or of a single adaptive character, arising suddenly by mutation or saltation either under natural or experimental conditions ?

2. Granted that permanent hereditary sports, mutations, and modifications of existing characters are being produced by biochemical and biophysical means, has a single adaptive character been produced by such means by experiment in your laboratories ?

3. Granted that profound changes in colouring, in form, in somatic proportion, in the developmental acceleration or retardation of characters, may be produced by glandular action, is there sufficient evidence that Nature has ever proceeded in this way except in producing immunity and non-immunity ?

Up to the present time (Aug. 13) seventeen replies have been received. To Questions 1 and 2 the prevailing answers are negative as indicated by the reply "No". More or less positive or affirmative replies were also received to Question 1, but analysis of most of these replies indicates that the crucial element in Question 1 is evaded, namely, *the origin of adaptive characters*. No doubt certain mutations do survive ; many of them are recorded in the answers to the questionnaire ; Crampton has discovered mutations in his monographic researches on the mollusc *Partula* ; Chapman in the avian genus *Buarremon* ; the short-legged Ancon sheep is a classic ; certain biomechanical mutations in the pelagic Ciliata, such as the spiral shelf of *Xystonella scandens* observed by Kofoid, may be of sudden or mutational origin although this is not proved. The answers of seventeen zoologists to Question 2, namely, to adaptive biochemical origins by experiment, are uniformly negative ; new and hereditarily permanent mutations may be aroused by more or less violent chemical or physical means, but not a single one is known to be adaptive. The answers to Question 3 are five negative and five affirmative ; the negative squarely meeting the question, the positive reaffirming the granted postulate that endocrine secretions profoundly modify all existing characters and processes of development, but not a single case can be cited wherein a new biomechanical character has arisen through endocrine action.

In this struggle for existence of bygone theories and of new hypotheses, it seems that palæontology, with its world of new and wholly undreamt of evidence as to the *origin of adaptive biomechanical characters*, serves as the two-edged sword of biology ; it cuts hypotheses unfit to survive ; it strengthens hypotheses fit to survive. It calls for conceptions of a new and synthetic physico-chemical order to supplant outworn hypotheses dating back to Empedocles (600 B.C.). Palæontology disestablishes the entelechy hypothesis of Aristotle (300 B.C.) and of all his 'vitalistic' followers like Driesch and Bergson. It substitutes for Aristotle's 'internal perfecting tendency' the idea of adaptive reaction and interaction of internal with external energies which has been formulated (Osborn, 1912–1929) into a new *tetraplastic* principle of the 'four inseparable energetic factors of evolution', namely : (1) physical environment, (2) ontogeny including habit, (3) living environment, the biota, (4) the germ plasm. The above energetic complex is subject to the non-energetic selection—survival of the fittest.

This tetraplastic principle which seeks to combine the elements of truth in preceding hypotheses and theories has, thus far, won no acceptance.

In causation of the origin of species and sub-species, palæontology unites with modern field zoology in firmly establishing the direct action of environment (Buffon, 1755–Wagner, 1870) on the germ plasm as a causative factor. It disestablishes the habit-inheritance law of Erasmus Darwin and of Lamarck (1790–1809) ; through auto-adaptation it establishes habit as a *guiding* principle in evolution, but not in the Lamarckian sense. Palæontology eliminates selection from the energetic complex ; it establishes the non-energetic selection as a universal and outstanding guide and principle of progress from the beginning of time ; it disestablishes the third and fourth principles of Charles Darwin (1859), namely, of the origin of adaptations through the survival of the fortuitously adaptive. It firmly establishes the inconspicuous adaptive origins of new characters first observed by Waagen (1869), which may be distinguished as *W.* mutations when compared with the fortuitous *D.* mutations of De Vries (1911). At least from biomechanical evolution it excludes entirely the fortuitous *D.* mutations of De Vries. It helps to disestablish the 'pangenesis' of Darwin and all similar theories of the somatic origin of adaptive characters ; it accordingly disestablishes the 'inheritance of acquired characters' and establishes the complementary principle of the 'continuity of germ plasm' of Weismann (1880). It disestablishes the super-selection theories of Weismann and other neo-Darwinians. In its earliest (1806), as well as its latest phases (1931), palæontology undermines the primitive idea of 'created evolution' ; of recent years it tends to establish the wholly different idea of 'creative evolution', which may be provisionally termed *aristogenesis*. Finally, palæontology unites with systematic and experimental

zoology in compelling us to concentrate research on the origin and co-ordination of bio-characters, in the lower animals and in man, as the outstanding problem of the second century of evolution.

Although primarily an original observer rather than a collator of other people's ideas, Darwin was more or less familiar with ten of the principles of 'biomechanical' adaptation which had been observed in the hard parts of animals from the time of the earliest Greek anatomists and philosophers. Throughout his frequent discussions of the biomechanical evolution of animals, are included the bony and muscular adaptations brought about through processes of (1) degeneration, (2) development, (3) compensation, (4) economy, (5) change of proportion, (6) co-adaptation, (7 and 8) acceleration or retardation, (9) self-adaptation, and (10) sports and discontinuities. One great principle remained to be established after his time, namely, (11) continuity of the germ plasm, in antithesis to all pangenetic hypotheses of the origin of hereditary characters. Note that all these ten pre-Darwin principles of adaptation relate not to the *origins of organs*, but to the *modification of existing organs*, as of the wings of the duck, the neck of the giraffe, the speed of the wolf. Darwin realised that the weak point in his theory was in the matter of origins; he could, and did, largely explain the survival value of organs once established, but was hard put to place a survival value on fortuitous variations.

Palæontology (1869–1931) has changed all this through a succession of discoveries revealing nine principles of *adaptive biomechanical origin in the germ plasm*. Thus, up to the present time, we have established through zoology and palæontology no less than twenty more or less distinct but invariably co-operative principles of bio-mechanical adaptation, as follows:

of Waagen (1869), in which is involved (13) the 'trend' or 'mutations richtung' of Neumayr (1875); (14-15) the 'acceleration and retardation' of Hyatt (1880), principles which Darwin could not clearly comprehend. In the year 1889, Osborn, at the time a convinced neo-Lamarckian, began his extremely intensive observations upon the origin and development of single adaptive characters, aided by unprecedented fossil material first in the primates and then in five independent divisions of the ungulates, wherein were revealed five previously undiscovered principles of biomechanical adaptation, namely: (16) germinal continuity versus discontinuity, and *W.* mutations ascending and descending; (17) germinal potentiality, as a basis of Lankester's principle of *homogeny*; (18) germinal predetermination, as distinguished from indeterminate origins; (19) germinal rectigradations, as distinguished from fortuitous or chance origins. Finally, in the synthesis of the orthogenetic origin of new adaptive characters in all the mammals, including man, there was reached (20) the principle now provisionally termed *aristogenesis* for the want of a more appropriate word to express continuously creative adaptation.

A very important distinction is observed between *rectigradations* which are predetermined, and changes in proportion, as in the elongation of the neck of the giraffe, technically known as *allometrons*, which are not predetermined. Rectigradations are relatively rare, while allometrons, or changes of proportion in the teeth, skull, and limbs, are constantly in progress and make up a larger part of the definition of species. Similar rectigradations arise through community of descent. Similar allometrons are constantly arising in animals of dissimilar ascent.

Whereas the zoologist, comparative anatomist, and geneticist by the very nature of the evidence at their command, find difficulty in distinguishing

MODIFICATION OF EXISTING ORGANS, ONTOGENY.

Discovered in Anatomy and Embryology. Known to Darwin.

1.	Biomechanical *onto-retrogression* (Aristotle), degeneration, atrophy of organs.
2.	,, ,, *-progression* (Aristotle), development, hypertrophy of organs.
3.	,, ,, *-compensation* (Aristotle), metatrophy and eutrophy of organs.
4.	,, ,, *-economy* (Aristotle), metatrophy and eutrophy of organs.
5.	,, ,, *-allometry* (Lamarck-Darwin), allometrons, changes of proportion in organs.
6.	,, *co-adaptation* (St. Hilaire), co-ordination, correlation of organs.
7.	,, *onto-acceleration* (v. Baer) into earlier growth stages of organs.
8.	,, ,, *-retardation* (v. Baer) into later growth stages of organs.
9.	,, *auto-adaptation* (Goethe) through principles 1-8.
10.	,, *onto-saltation* (St. Hilaire), sports, discontinuities.
11.	,, ,, *-continuity of germ plasm in the perpetuation of organs* (Weismann).

ORIGIN OF NEW CHARACTERS, PHYLOGENY.

Discovered in Palæontology. Not known to Darwin.

12.	Biomechanical *phylo-mutation* (Waagen, 1869), orthogenesis in new characters.
13.	,, *-trend* 'mutations-richtung' (Neumayr) in new characters.
14.	,, *-acceleration* (Hyatt, 1880) in the evolution of characters.
15.	,, *-retardation* (Hyatt, 1880) in the evolution of characters.
16.	,, *-continuity* (Osborn, 1889–1931) vs. discontinuity in characters.
17.	,, *-potentiality* (Osborn, 1889–1931) in the origin of new characters.
18.	,, *-predetermination* (Osborn, 1889–1931) in the origin of new characters.
19.	,, *-rectigradation* (Osborn, 1889–1931) in the origin of single characters.
20.	,, *-aristogenesis* (Osborn, 1889–1931) in the rise of characters.

Of the nine principles of biomechanical origin discovered in phylogeny since Darwin's "Origin of Species" (1859), the first three were observed in fossil invertebrates, namely: (12) the *D.* mutations between the accidental, fortuitous, and temporary variations, fluctuations, and *D.* mutations, the palæontologist is absolutely sure of his footing as soon as he is enabled to observe the ascending

geological mutations of animal mechanisms, whether invertebrate or vertebrate. He advances solely by inductive means, after the manner of Darwin. If he is not sure of the adaptive trend of a certain rectigradation in its feeble, incipient stage, he may observe it a hundred thousand or a million years later as the dominant and commanding character of the entire organism. As Weismann spoke of the immortality of the germ plasm, the palæontologist may speak of the secular immortality of thousands of characters which he is enabled to observe through the whole cycle from potentiality and predetermination in the germ plasm until, after æons of use and service, they may subside again into the mysterious germinal substance—mysterious because utterly inexplicable. The biomechanism of the titanothere and of the elephant is due to a complex of energetic factors which is entirely beyond our present comprehension.

The palæontologist concludes that the origin of species, so far as species are defined by various stages of biomechanical adaptation, has long ceased to be a problem; the manner by which sub-species, species, genera, families, and orders arise through divergence, acceleration, retardation, and rectigradation is also perfectly clear.

Selection acts incessantly, but it originates nothing, and it does not control either the origin of characters or their rate of evolution after they arise.

We can affirm that it is the essential living principle of biomechanical reaction which calls forth the adaptive biomechanical response, whether in ontogeny or in phylogeny.

While we know infinitely more about the principles of evolution than did Charles Darwin, and while we can demonstrate beyond refutation the prevailing twenty principles of biomechanical adaptation discovered in ontogeny and phylogeny, *we are more at a loss than ever before to understand the causes of evolution.* One after another the Buffonian, Lamarckian, Darwinian, Weismannian, and De Vriesian theories of causation have collapsed; each, however, contains elements of truth. All that we can say at present is that Nature does not waste time or effort with chance or fortuity or experiment, but that she proceeds directly and creatively to her marvellous adaptive ends of biomechanism.

Biology and Civilisation.

IN his Norman Lockyer lecture, delivered to the British Science Guild on Nov. 24, Dr. H. H. Dale dealt with the part which biology and biologists should play in modern civilisation. It is a commonplace that physical science and mechanical inventions have probably made greater changes in the conditions under which human beings live in the past hundred and fifty years than in the preceding twenty centuries. But this progress has led to many thinking of it in quantitative rather than qualitative terms, and forgetting that machinery was made for man and not man for machinery. It is possible that the imposing achievements of physical science have already, in the thoughts and interests of men at large, in our educational and public policy, as well as in technical and industrial development, overshadowed those of biology to an extent which threatens a one-sided development of science itself, and of the civilisation which we hope to see based on science.

Dr. Dale illustrated his argument by a reference to the physiological problems involved in flying. At the beginning of the War, physiologists were consulted on the subject of the difficulty of breathing at high altitudes. They sought permission to take small quantities of blood for investigation, and were asked by the authorities, what had blood to do with breathing? The question was not easy to answer with polite brevity, since British physiologists had, for several hundred years, been attempting to describe what blood has to do with breathing, and how it does it. To-day physiology has a proper place in the research organisation of the Royal Air Force; and with the development of machines capable of flying at several hundred miles an hour, has come the realisation that the reactions of the human organism to the stresses occasioned by these great speeds will play an important part in any further advances and may well prove to be the limiting factor.

Although biology and physical science have supplemented each other in our modern civilisation in such directions as the provision of pure water supplies and the disposal of sewage, in other directions there has been a lamentable divergence. The pollution of the atmosphere by smoke involves not only a direct waste of fuel and destruction of other materials, but also a very definite increase in ill-health from the absence of direct sunshine, which may be indicated indirectly by the stifled and stunted plant life in our northern cities and directly by the presence of rickets—the 'English disease' of German medical writings—among the growing children.

Dr. Dale described in some detail how our present knowledge of the etiology of this disease has come about. It is now certain that it is due to the absence from the body of a compound which is known as vitamin D, which can be supplied either in the food or by exposure of the surface of the body to the sun's rays, or to some artificial source of light. The vitamin is formed from a compound known as ergosterol, under the action of the rays in the shorter wave-length region of the solar spectrum, either in the skin or in any food material containing its precursor. In practice, for its manufacture, an artificial source of light is used, which emits more of the shorter wave-lengths than reach the earth's surface from the sun. Recent work by Bourdillon and his colleagues in Great Britain, and by Windaus in Germany, has led to the preparation of a pure crystalline compound, of very great activity, which is probably the vitamin itself. In spite of our knowledge of the necessity of supplying

vitamins to growing children, margarine still too frequently replaces butter in their diet. Surely a community which respects human life should insist on the production of margarines biologically equivalent to, as well as physically like, butter.

Looking further afield and considering the problem of the qualitative and quantitative dietary needs of men of different races of civilisation, in all varieties of climate, it appears that only the fringe of this great problem of human nutrition has begun to be touched by science. It is very probable that a large proportion of the human race is living at a nutritional level which prevents them from achieving more than a small part of the physical and mental efficiency of which they are racially capable.

Even the bodily well-being of man demands more than food. We have not properly begun to use the available resources of physical science to provide for other factors of a healthy environment, nor have we properly applied the botanical and zoological knowledge which bears on the problems of disease, or made the fullest efforts to extend it. In cold or temperate climates, the white races can only exist in winter with the aid of artificial heat; in the tropics no attempt has so far been made to supply artificially cooled houses. Again, we are only beginning to realise the dimensions of such problems as those presented by the tsetse flies, by the plagues of locusts, and by the hosts of external and internal parasites which prey upon the higher animals and plants.

Dr. Dale referred to the recent work on virus diseases, pointing out that it is probable that biological research has here reached a point at which progress is delayed, because it is trying to advance beyond the range of the methods which physical science has yet made available. There are other points at which functional biology finds itself halting for want of physical methods of the required delicacy and precision. The work requires a partnership between biology and physics, of which there is little sign at present. The lack of it is connected with the tendency, referred to above, to a one-sided development of civilisation.

The causes of this are complex. They are partly due to the increasing specialisation which accompanies increased knowledge, partly to the fact that biology, in its observational and systematic stage, was considered to demand a smaller intellectual effort than the sciences of chemistry and physics. To-day, biology calls to its aid the resources provided by the latter sciences, as seen, for example, in the work carried out on the processes accompanying a simple muscular contraction. It is making a bold approach to the task of analysing vital processes into sequences of associated chemical reactions. The problems differ from those with which the ordinary chemist deals only in their complexity and difficulty. The reactions proceed with extraordinary rapidity, and the substances concerned are very unstable and are present in only minute amounts. Organic chemistry, which started as the chemistry of living organisms, has been prone to forsake its original objective for the fascinating pursuit of making unnatural substances by artificial synthesis, for practical use in industry or medicine, or for their theoretical interest. Similar complexities face the physicist who may interest himself in biological problems; in fact, although the cleavage between the physical and chemical sciences and biology may have been inevitable when the problems of biology seemed too superficial and too easy, it is of the utmost importance to the future that this cleavage should not persist unnaturally, because the problems of biology are now becoming too complex and too difficult.

The widespread desire to know something of the achievements of science is concerned almost solely with those of physical or chemical science, and the unequal concentration of this interest, reflected in our educational and administrative systems, may become a real danger to our civilisation. An intelligent appreciation of the fundamental facts of biology is not regarded as a necessary part of the equipment of an educated man. Even an eminent physicist may preserve his aloofness from biological knowledge to a degree quite impossible to the normally educated biologist in relation to physics and chemistry. This anomaly in our education is part of a vicious circle: it arises in response to a one-sided demand of our civilisation, which, in turn, it tends to confirm in its asymmetry.

The problem of the improvement of the human race is ultimately biological and demands a biological outlook for its investigation. Thus it involves the application of genetics to the production without conflict with the existing social order of desirable human types. The problem is difficult, but this does not justify us in ignoring it; on the contrary, it makes more urgent the need for the most complete scientific knowledge that can be obtained. Such biological knowledge may make the human race capable of a civilisation beyond any that we can imagine at the present day.

Obituary.

Dr. John Sampson.

BY the death on Nov. 8 of John Sampson, D.Litt., for many years librarian of the University of Liverpool, England loses its most eminent Gypsy scholar. He became interested in Gypsies, more particularly on the linguistic side, as a young man; and after exhausting the possibilities of English Romani, which indeed is a poor, broken-down dialect, he turned to the fully inflected speech of the Welsh Gypsies descended from Abram Wood. That was in 1894, prior to which its existence had barely been proved. Thirty-two years later, there appeared from the Oxford University Press his massive, scholarly, and, for a philological work, intensely human, "Dialect of the Gypsies of Wales", the 660 closely printed quarto pages of which provide, not only the best account yet published of any Romani dialect, but also, despite a few omissions

imposed by the nature of his subject, the fullest and most accurate exposition available of the phonetics and morphology of the Gypsy language as a whole.

This imposing book, and the series of Welsh Gypsy folk-tales Dr. Sampson published in the *Journal of the Gypsy Lore Society* at intervals during the past twenty-five years, may be regarded as his life work. But he also contributed numerous other papers to the pages of that journal. One of them, read before the British Association in 1923, is a very original and largely successful attempt, based mainly on phonological data, to trace the migrations of the Gypsies on Asiatic soil prior to the date of their first appearance in Europe. In another, written more than forty years ago, he solved the riddle presented by Shelta, the jargon of the Irish tinkers often met with on the English roads; an ancient jargon, invented, as his friend Prof. Kuno Meyer proceeded to show, by the Irish bards.

WE regret to record the death of the Rev. F. Smith, formerly a chaplain in the Royal Navy, which took place at Nottingham, where he had lived since his retirement in 1917. Mr. Smith was best known to archæologists for his advocacy of the existence of early man in Scotland during the interglacial periods of the Ice Age. With the late Dr. Gemmell, of Drummers, Wigtownshire, he had made a large collection of specimens, some of enormous size and of rocks other than flint, which he held showed evidence of man's handiwork and supported his contention. His conclusions and a summary of the evidence on which they were based were embodied in his "The Stone Ages in North Britain and Ireland", published in 1909. A close student of the technique of stone implements, he maintained that the readiness with which the hand adapted itself to the grip of a doubtful artefact was a sure test of genuineness—a view he applied in his "Prehistoric Man and the Cambridge Gravels", published in 1926, in dealing with specimens of which the human origin had not generally been accepted. This winter a part of the collection made by Mr. Smith and Dr. Gemmell is being exhibited in Glasgow.

News and Views.

THE weekly meeting of the Linnean Society held on Nov. 19 was devoted to a series of papers commemorative of Robert Brown, the eminent nineteenth century botanist. In November 1831 he announced to the Linnean Society his discovery of the nucleus of the vegetable cell. The authors of the papers presented were: Prof. F. E. Weiss (president), Mr. J. Ramsbottom, Mr. S. Savage, and Lieut.-Col. J. Stephenson. A number of interesting original documents and prints illustrative of Brown's career were on view. Also, a portrait and a bust of the botanist belonging to the Society were placed, for the occasion, close to the presidential chair. Robert Brown was the son of an Episcopalian minister, and was born at Montrose, on Dec. 21, 1773. Educated there at the Grammar School, he proceeded in 1787 to Marischal College, Aberdeen, entering afterwards the medical faculty of the University of Edinburgh. He was strongly interested in the studies of the pioneer botanists of his time. Visiting London in 1798, he met Sir Joseph Banks, and henceforth botanical research work and allied interests dominated his energies. The recommendation of Banks, in 1801, secured his appointment as naturalist to H.M.S. *Investigator*, commissioned under Capt. Matthew Flinders to conduct a survey of the coasts of Australia. After nearly four years' absence, Brown returned with a collection of some four thousand species of plants, mostly new to science. He did not, however, overlook the demands of zoology.

IN 1805 Brown was appointed librarian to the Linnean Society, thereafter devoting himself in his hours of leisure to the working out of his collections, contributing largely thereby to perfecting the natural method of classification. In 1810 he published the first instalment of his famous "Prodromus Floræ Novæ Hollandiæ". He assisted also in the accounts of various scientific expeditions; for example: Salt's "Travels in Abyssinia", Clapperton's "Expedition to Central Africa", and Strutt's "Expedition to Central Australia". In 1810 Brown became librarian to Sir Joseph Banks and keeper of the collections at his house in Soho Square; afterwards (1827), when the collections were transferred to the British Museum, Brown followed thither in charge of the botanical sections. Brown was president of the Linnean Society from 1849 until 1853. Residing in Banks's old home in Soho, he died there on June 10, 1858, at the age of eighty-five years. At the meeting of the British Association at Oxford in 1832, honorary degrees were conferred by Convocation on Robert Brown, Sir David Brewster, John Dalton, and Michael Faraday. In Brown's case the distinction was that of D.C.L. It was this little group which prompted Keble's allusion to a "hodge-podge of philosophers" as being present in the city. Elected a fellow of the Royal Society in 1811 (Banks, as president, was, likely enough, chief sponsor), Brown was awarded the Copley Medal in 1839 for his discoveries on vegetable impregnation.

ON Dec. 5 occurs the centenary of the birth of Hans Heinrich Landolt, the eminent Swiss chemist whose work formed a connecting link with that of Mitscherlich, Rose, and Bunsen, and who counted among his contemporaries and friends Lothar Meyer, Beilstein, Kekulé, and Quincke. Born at Zurich, he was a descendant of an old patrician family of Switzerland. He entered the University of Zurich and wrote his first paper at the age of nineteen years, and his labours as a chemist did not cease until a week before his death, which occurred on Mar. 15, 1910, when he was in his seventy-ninth year. Leaving Zurich at the age of twenty-two, he studied at Breslau, and thence entered the laboratory of Bunsen at Heidelberg. For twelve years, 1857–69, he was associated with Hofmann

and Kekulé at Bonn, and in 1869 he was made head of a new technical institute at Aix-la-Chapelle. From 1880 until 1891 he directed the newly founded Agricultural College at Berlin and was next appointed to succeed Rammelsburg in the University of Berlin. At Heidelberg, Landolt carried out researches on the electrolytic production of calcium and lithium, and on the gases produced in the newly invented Bunsen burner. At Bonn he studied the influence of the atomic composition of liquids on the transmission of light, at Aix-la-Chapelle he carried out his important work on polarised light, while at Berlin he turned his attention to the determination of melting points, the crystalline structure of substances, and, between 1893 and 1908, carried out his well-known series of experiments on the conservation of mass during chemical reactions. A man of placid disposition, Landolt possessed infinite patience, and in his old age was regarded as a patriarch of physical chemistry. His death took place at Berlin, but he was buried at Bonn, where he had spent some of the happiest years of his life.

SIR CHARLES PEERS, in his address to the annual Congress of Archæological Societies, which was held in the rooms of the Society of Antiquaries on Nov. 17, directed attention to the first session of the Congrès International des Sciences Préhistoriques et Protohistoriques to be held in London in August 1932. He reviewed briefly the circumstances leading up to the decision, taken by representatives of a number of countries meeting at Berne in May last, to found a new Congress after the failure of protracted negotiations for placing the Congress organised by the Institut International of Paris on an international basis. Sir Charles also pointed out that the old International Congress of Prehistoric Anthropology and Archæology, which first met at Spezia in 1865 and held its last session at Geneva in 1912, met in London in 1868, but no congress of prehistoric studies has been held there since that date. The invitation to hold the Congress in London tendered by the Society of Antiquaries and the Royal Anthropological Institute, acting in conjunction with its Joint Committee for Research and Teaching, has received the support of the Royal Archæological Institute and a number of other bodies engaged in cognate studies. The need for an international gathering of this character at regular intervals—the congress will meet normally once every four years—has been felt with increasing urgency for some time ; and this movement towards international co-operation in prehistoric studies, therefore, merits the strongest support among the many circles of widely varied interests with which the local archæological societies are in touch. The range of subjects —geology, palæontology of plants and animals, anthropology, ethnography, folk-lore, and archæology—ensures ample material to occupy a membership of the most diverse character.

ON several occasions the local archæological societies of Great Britain have been invited, through their annual congress, to co-operate in the collection and study of material which, either because it is too widely extended geographically or because it requires local knowledge, is beyond the range of the individual. The work of the Committee on Earthworks is a case in point. At the last Congress, Mr. H. J. E. Peake appealed on behalf of the British National Committee on Folk-Arts and Crafts for information relating to arts and crafts still practised among the people in the countryside, while Dr. G. Herbert Fowler asked the societies to promote a survey of parish documents. Both these matters unquestionably require the attention of local societies, although in the case of parish documents it was pointed out with justice that some county councils already have done much to arouse local interest in these records and thus to ensure their preservation. The urgency of Mr Peake's request must be measured by the fact that it comes almost too late. Although a number of folk-arts and crafts are still practised even now, and some, owing to local circumstances or their special adaptability to local needs, are quite likely to survive for some time, yet the last few years have witnessed rapid strides towards the extinction of many traditional industries and methods. When an attempt was made to institute an ethnographic survey of the British Isles without success some thirty years ago or more, an opportunity was lost which cannot recur.

INDIGNATION is being freely expressed in Australia at the action of the Commonwealth Government in imposing a primage duty of 10 per cent on books imported from abroad, and a further sales-tax of 6 per cent. Almost all importation is from Great Britain, and, apart altogether from direct taxation, the purchaser suffers from an adverse exchange rate of 30 per cent in converting Australian currency into sterling. To educational institutions and scientific societies, and also, of course, to individuals (particularly students), these imposts are a very serious matter indeed. Federal labour ministers have so far shown scant sympathy towards the representations made by universities and other bodies. They plead that the need for revenue outweighs considerations of the burden upon scholarship and knowledge in general, a view which is deplorably short-sighted in any community, but especially so in a country so dependent upon outside sources for its literature as Australia is. Nor is the revenue contention finding justification in experience. In 1929 imports of books and other reading matter from Great Britain and Northern Ireland totalled well over one million pounds in value. For 1931 the indications are that the figure will not reach half a million. The taxes are defeating their own purpose by destroying the source of revenue ; but, apart altogether from that side of the matter, they impose a serious handicap upon literary and scientific development.

THE Friday evening discourse at the Royal Institution on Nov. 20 was delivered by Dr. C. H. Lander, who took as his subject, " Oil and Petrol from Coal ". In Great Britain, where there are no appreciable deposits of natural oil, but where coal is plentiful, the possibility of manufacturing oil and petrol from coal has obvious attractions. Liquid fuels were first made commercially from coal as a by-product in the manu-

facture of gas or coke. The total yield of motor spirit by such processes, however, cannot be pushed beyond some six or seven gallons per ton of coal carbonised. Coal, as compared with oil, is deficient in hydrogen; the problem therefore suggests itself of adding extra hydrogen to the coal substance in order to make up this deficiency, and then, by some means or other, inducing the molecules of the mixture to reshuffle themselves into oil molecules. Some fifteen years ago, Dr. Bergius, in Germany, succeeded in liquefying coal by direct hydrogenation.

SOON after the War, experimental work on the hydrogenation of coal was taken up at the Fuel Research Station, Greenwich, and at a later stage close collaboration was established with the German group. By 1927, Imperial Chemical Industries, Ltd., thought it worth while to explore the possibilities of its commercial exploitation, and a plant capable of dealing with about fifteen tons of coal a day is now in action at its Billingham Works and is producing some 160 gallons of motor spirit from the treatment of a ton of suitable coal. Extra coal is required for hydrogen manufacture and power generation, but, taking all the costs into account, the cost of petrol from the works is of the order of only 7*d.* or 8*d.* a gallon. The complete gasification of coal to hydrogen and carbon monoxide, and the subsequent synthesis of these gases for the production of alcohol and hydrocarbons, was also briefly referred to. Although such processes cannot at present compete with carbonisation or hydrogenation for the manufacture of liquid fuel, they have already become the basis of a large industry for the production of alcohol for solvents.

SPAIN will be the host of chemists from all parts of the world in April 1932, when the ninth International Congress of Pure and Applied Chemistry meets in Madrid. The occasion is one of distinction, for the Congress is the first to be held since the War, and the first to be held under the auspices of the International Union for Chemistry. The seventh Congress of Applied Chemistry was held in London in 1909, and the eighth in Washington and New York in 1912; the ninth congress at Madrid will also be associated with the eleventh Conference of the International Union of Chemistry. While the latter is a delegate conference, the Congress itself offers membership to anyone professing interest in any of its objects, namely, the advancement of chemistry and its applications, and the strengthening of relations between chemists of every nation. Additional importance is lent to the occasion by its official character, the assembly having been placed under the patronage of the Government of the Spanish Republic.

THE three subjects which have been chosen for discussion at the International Congress of Pure and Applied Chemistry are: the Raman effect in connexion with chemical constitution; the high polymers in chemistry; and the chemistry of high temperatures. Invitations to take part in the discussions have been extended to the following: Sir C. V. Raman (Calcutta), Prof. K. W. F. Kohlrausch (Graz), Prof. J. Cabannes (Montpellier), Prof. K. H. Meyer (Ludwigshafen), Prof. A. Staudinger (Freiburg), Prof. W. L. Bragg (Manchester), Prof. C. Matignon (Paris), Prof. O. Ruff (Breslau), Prof. A. Day (Washington). The proceedings will commence with a reception on April 3, and will terminate on April 9, although April 10 is reserved for trips; the principal discussions will take place on April 4, 6, and 8, whilst excursions and other social functions will be held on other days in that week. Meetings of the International Union for Chemistry will be held on April 8 and 9. Incidentally, the congress week will coincide with the holding of interesting festivals and fairs. Applications for membership of the Congress must be sent to the general secretary, Prof. E. Moles, San Bernardo 49, Madrid (8), before Jan. 1, 1932.

PRAGMATISM was the keynote of Mr. Olaf Bloch's presidential address, "The Faith of a Technical Man", delivered to the Royal Photographic Society on Oct. 20. The man of science believes in a real world, and to mix metaphysics and experimental science is fatal. The realisation of his comparative ignorance is characteristic of the modern man of science, and produces a mental attitude which, coupled with logic, imagination, and intuition, is largely responsible for our rapid technical progress. It is important to develop the attitude of fearless inquiry, of freedom from conventional shackles, which enables us to look at facts and problems from the outside. In this educational problem the man of science must play his part. Our political and social organisation has only permitted a tithe of the influence which scientific and technical advances have exercised in industry. The numerous factors involved should not deter the technician from attempting to deal with politics, economics, and public affairs in the abstract and logical way he applies in his own work. Production is already passing rapidly under his control, followed by distribution. In various directions, scientific methods have already been applied to human affairs to some extent, and the successful use of such methods in this field calls for great qualities, and in particular requires an internationalism which does not yet exist. Science, both pure and applied, is a great destroyer of barriers, and the international economic agreements already in force may be the beginnings of far-reaching developments.

MR. BLOCH stated that whether or not human nature can be changed, its outlook can certainly be modified by education, public opinion, or by the application of technical achievements to life so that human nature would have all the appearance of having been changed. Thus the technical advances which have so completely transformed and mechanised the production and even the distribution aspects of industry and agriculture are producing a type of mind which reacts more quickly, is less insular, and more open and willing to face problems in the light of facts rather than of tradition. Fundamentally, technical progress is only justified when accompanied by social, economic, and political progress—amelioration and increased amenities of life, greater security

and more widespread education, knowledge, recreation, etc. At present, the coexistence of a highly organised and increasingly complex productive system with an inert and more or less antiquated social and political system tends to great instability, which can only be removed as we extend our organising powers from production, distribution, and consumption to the social and legislative problems at present so largely unco-ordinated. A wise administration would deliberately and unostentatiously plan to construct a true educational ladder, building up a higher average brain capacity. Race quality cannot be improved by statesmanship alone; the technical man must bring his scientific methods, insist upon their increasing application to the material concerns of life, and manifest his profound faith in the power of mind to compose, arrange, create, and cope with the difficulties and complexities of human affairs.

SIR ARNOLD WILSON contributed an interesting paper on "The Epic and the Tragedies of Civilisation" to the recent Modern Churchmen's Conference, and it has now been reprinted by Basil Blackwell, of Oxford, as a pamphlet. He quotes and criticises Spengler and Houston Chamberlain with good effect, and adds some wise warnings as to the durability and strengthening of civilisation, both in the past and the present, which historians and social reformers would do well to take to heart. Of the former, the most valuable is that we are coming to see that the pervading rule is that the old does not disappear in a cataclysm, as one is apt to think when reviewing the whole process after its completion. The barbarians, for example, did not sweep away the Roman Empire, but partly absorbed it and partly were absorbed. The change is mutual and continuous rather than catastrophic. With regard to the present and the future, Sir Arnold rightly dwells on the supreme importance of the use of leisure, on which, as he says, with the growth of wealth, "mainly depends the maintenance of a civilisation". Following on this he has a weighty passage, suggested by Mr. H. W. Nevinson, on the fundamental importance of the skilled manual worker as the creator of civilisation. It is a view which fits in well with the gospel which Dr. Jacks is never tired of preaching—of salvation by 'making'.

ONE grave omission, however, cannot fail to strike the reader of the brochure, an omission which it shares in common with most of the criticisms and prophecies of the delay of civilisations. Sir Arnold Wilson does not see, or at least does not mention, the transformation effected in the world by the scientific organisation of society in modern times. Wherever science, both as a method of thought and as an agent of mechanical adjustments, is established, society acquires a stability and a power of resistance quite unknown in earlier times. Lord Balfour pointed this out years ago in his presidential address to the British Association, but the literary historian goes on talking as if nothing of the sort had happened. Yet the War, which came after Balfour's address, gave the most striking confirmation. Scientifically organised communities, of which Germany was the leading example, have survived, and Germany is at present the leading country in the world in export trade, and her intellectual life seems as keen as ever. Man might conceivably destroy his present civilisation by persistent internecine warfare, but the task becomes increasingly difficult.

IN the presence of representatives of the Italian Government, an official demonstration took place on Nov. 20 in Italy between Santa Margherita Ligure and Levanto—a distance of 25 miles—of the new Marconi quasi-optical, ultra-short wave radio-telephone system. The wave-length used was only 50 cm., the same as that employed in the previous demonstration recently carried out between Santa Margherita Ligure and Sestri Levante over a distance of 11 miles, corresponding to a frequency of six hundred million cycles per second. The success of the demonstration was all the more complete because, although the range had been increased from 11 miles to 25 miles, the margin in the signal strength was such as clearly to indicate that the apparatus was capable of covering a considerably greater distance. This demonstration is a test of a new practical and commercial radio system which will very shortly be used for public services in Italy. Owing to its simplicity the new system is very moderate in price and in running costs: it will thus soon afford to the inhabitants of many small islands scattered in the Mediterranean a reliable telephone service, with a range at present of about a hundred miles, which they could not, heretofore, enjoy in consequence of the high cost of the submarine cable telephone installation.

THE progressive extension of the grid by the Central Electricity Board has led many dwellers in rural districts of Great Britain to hope that in the near future they may be able to get the electric light at a reasonable cost. In a paper by E. W. Dickinson and H. W. Grimmitt read to the Institution of Electrical Engineers on Nov. 19, the problem of rural electrification was thoroughly discussed. They conclude that if the density of the population in a rural district of about 400 square miles in area be not much less than a hundred, then there is no financial or technical reason why this supply should not be given. Under average conditions, they see no reason why the price should exceed a flat rate of about sixpence per unit, but they advise charging a fixed annual sum and a small charge a unit for the load consumed. If the population be scattered uniformly over the area, electric energy would be more expensive than coal, paraffin, or wood. Fortunately, in Great Britain most of the population is congregated in villages and hamlets. The remainder is located in country residences, institutions, farms, factories, etc., of sufficient size to warrant the capital expenditure needed to form an interlinked system of supply for the whole area. The authors' study of statistics has brought out the interesting fact that any lowering of the price to the consumer results in an increase of revenue. At the higher rates of charge, a given percentage drop

in the price produces only a small percentage increase in the revenue; but at the lower prices the same percentage drop produces a remarkable increase.

THE rapidity with which the number of high-power broadcasting stations is increasing in Europe is causing anxiety to radio engineers. In the spring of 1929 there was only one transmitter in Europe having a power of 50 kilowatts. There are now nearly thirty. Although it is only two years since the European Postal and Telegraph Administration met at Prague and formulated the wave-length plan known as the Prague Plan, based on a nine kilocycles separation between stations, it is now obvious that it needs alteration. It will be remembered that at the opening of the Stuttgart-Mühlacker Station in November 1930 the interference between it and London Regional was very serious. Fortunately it has been possible by experiment to make certain slight modifications in the frequencies of several British stations so as to avoid interference in certain specific cases. In some instances the bands of frequency have been separated by eleven kilocycles. It is obvious that if no limit is fixed to the power radiated from a broadcasting station, several of the channels of communication allotted to countries internationally must be sacrificed. It is because certain nations refuse to consider such sacrifices that no decisive action was taken at the meeting of the International Broadcasting Union (U.I.R.) at Rome in October. We learn from *World Radio* for November that the B.B.C. has carried out a large number of experiments, both in the laboratory and under practical reception conditions, at its receiving station at Tatsfield, to ascertain how interference can be remedied. It appears clear that, beyond a certain point, improving selectivity decreases the quality of the reproduction. Similar results have been obtained by Dr. Van der Pol in Holland. There is little chance of any step being taken in the direction of establishing a new wave plan before the international meeting at Madrid in the autumn of 1932.

AN attempt is shortly to be made by the State Radiological Institute at Prague to evaluate the radioactivity of the atmosphere in different parts of Czechoslovakia. The object of these investigations, which have the support of the Czechoslovak Ministry of Health, is to discover whether there is any noteworthy difference between the radioactivity shown by the atmosphere in the neighbourhood of the spas such as Karlsbad, Marienbad, Poděbrady, Jáchymov (where there are extensive uranium mines and the ore is worked up for radium preparations, etc.) and that of the general countryside and town air. The radioactivity of the atmosphere at the climatic resorts in the Giants' Mountains and the High Tatras will also be studied for comparison. It is suggested that the radium emanation in the atmosphere must exert some therapeutic action, perhaps comparable with that of sunlight or warmth. Indeed, Prof. J. Stoklasa has gone so far as to declare that this radioactivity may play an important rôle in connexion with metabolism, since animal organisms show a distinct radioactive content. The 60-80 gm. of potassium present in an adult exert a feeble β-and γ-radiation. Preliminary measurements, using Gerdien's apparatus, have indicated that the conductivity of the atmosphere at Prague is $0{\cdot}4\text{-}1{\cdot}2 \times 10^{-4}$ electrostatic units, whilst around the west Bohemian thermal spas it varies between $1{\cdot}0$ and $1{\cdot}2 \times 10^{-4}$. At Jáchymov (St. Joachimsthal), in the neighbourhood of the radium extraction laboratories, it is $2{\cdot}4\text{-}2{\cdot}6 \times 10^{-4}$.

ON Dec. 3, 1929, at the invitation of Sir Harold Boulton and Sir James Calder, a meeting was held at the Hotel Metropole, London, for the purpose of inaugurating a Wood Preserving Association. The Association came into being, and the first number of the *Journal of the British Wood Preserving Association* marks the end of the first year of the Association's life. As is to be expected, there is not, for the expert, much original matter in the number; but it is hoped that in the future the scope of the journal will be enlarged to include original articles, reviews of current literature, and an account of the numerous other activities by which the Association is endeavouring to fulfil the purpose for which it has been formed. With Sir Harold Boulton as president, Lord Clinton and Sir James Calder, vice-presidents, and a strong council, the Association should be able to look forward to a very useful future. In addition to the editorial and description of the inaugural meeting, the journal has articles on the preservation of timber by R. S. Pearson, insects injurious to timber by Prof. J. W. Munro, and records of general discussions in the Association on the preservation of estate timber and the preservative treatment of building timber. Perhaps one of the most promising sides of the Association's future possibilities, from the practical point of view, is the setting up of the Technical Committee. This Committee has already had to deal with numerous and varied inquiries. Particularly gratifying, it is said, has been the interest taken in the Association abroad, in the Dominions and Colonies, which has led to several important bodies taking up membership.

WE are informed by Dr. Félix F. Outes, Director of the Museum of Anthropology and Ethnography, Buenos Aires, who is well known to students of the prehistory of America for his writings on the stone age and other aspects of the anthropology of South America, that the Council of the Faculty of Philosophy and Letters in the National University, Buenos Aires, has sanctioned the reorganisation of the Museum, which was formerly known as the Ethnographical Museum, in accordance with a scheme submitted by him at the time of his recent appointment as director. The Museum will now consist of four departments: a Department of Anthropogeography, which will be in the charge of Prof. Romualdo Ardissone; a Department of Physical Anthropology and Human Palæontology, of which a director has still to be appointed; a Department of Archæology, of which the head will be Prof. Francisco de Aparicio; and a Department of Ethnography and Folk-lore, to be entrusted to Dr. Alfred Métraux. The incorporation in the Museum of the Institute of Geographical Research will enhance

its standing and at the same time place it in charge of a large amount of extremely valuable material. The publications of the Museum are also to be reorganised. In future they will be classified into four categories, of which two will be strictly scientific; one will be devoted to 'diffusion' and one to popularisation in the broadest sense of the term.

THE *Veterinary Journal* for October is a special veterinary physiology number and is also of interest from the aspect of comparative medicine. Articles are contributed by Dr. A. S. Parkes on "The Co-ordination of the Reproductive Processes", by Dr. F. W. Lamb on "The Regulation of the Acid-Base Balance of the Body", and by Prof. J. Barcroft on "Stores of Blood". Dr. Piney writes on the reticulo-endothelial system, and Messrs. Crew, Miller, and Anderson contribute a note on the diagnosis of pregnancy in the mare by the Ascheim-Zondek test, which in man is claimed to give correct results in 97 per cent of cases. A total of 390 equine samples have been examined, of which in three cases only the biological diagnosis did not agree with the clinical evidence.

ONE of the largest of the giant redwood trees (*Sequoia sempervirens*) of California is the so-called Palo Alto tree at the town of that name near the south of San Francisco Bay. It is the subject of a brief historical monograph by Miss A. I. Weymouth ("The Palo Alto Tree": Oxford University Press). The author traces the earliest records of the tree back to the first Spanish explorers of California. In 1769, Gaspar de Portola camped beneath it on his discovery of San Francisco Bay, and there are several later records of the tree. Its age is not known, but in 1777 it was already a large tree with a recorded height of 137·5 feet and a ground circumference of the trunk of 15·1 feet. At present the circumference is 23 feet. Miss Weymouth believes it to be the oldest of surviving trees.

A REPORT of Science Service, Washington, D.C., states that a new method of identification has been suggested by Dr. Thomas Poole, of Washington, which may form a useful supplement to finger print and similar methods. The method makes use of X-ray photographs of the bony cavities or sinuses in connexion with the nose. Examination of thousands of pictures of these sinuses shows that in no two persons are the shapes exactly alike, and that once formed, the bony partitions of the sinus cavities never change. The tissues of the body quickly degenerate and disintegrate after death, but bones do not, so if X-ray pictures of the sinuses have been taken during life, identification would be possible long after death.

THE National Research Council of the United States has reprinted from the July issue of the *Journal of the Acoustical Society of America* the "Bibliography of Acoustics of Buildings" prepared under the auspices of the Committee of the Council in charge of the subject, by the chairman of that Committee, Mr. F. R. Watson. It extends to twenty-nine pages, and the great majority of the papers referred to have appeared in the last five years. In many cases a brief statement as to the contents of a paper is made, which is of great assistance to those who use the "Bibliography". The references are classified under the heads: general, acoustics of rooms, and sound insulation.

THROUGH the generosity of Dr. Henry S. Wellcome, a gold medal has been founded to be awarded annually by the Royal Anthropological Institute for the best anthropological research essay. It is hoped that the first award will be made in 1932. Competition will be open to candidates of any nationality.

THE Third International Congress of Sanitary Technique and Urban Hygiene will be held at Lyons on March 6–9, 1932. As on the two previous occasions, when congresses were held at Prague and Milan, the Congress will be associated with an international exhibition which will be open on March 7–20 during, and in the buildings of, the Lyons Fair. Further information can be obtained from the General Commissary of the Congress, Dr. Garin, Rue Ménestrier, Lyons.

THE British Institute of Radiology, incorporated with the Röntgen Society, will hold its Annual Conference on Dec. 2–4, at the Central Hall, Westminster. In connexion with the Conference there will be an exhibition of apparatus, organised by the Associated Manufacturers. The Conference will be opened by the Right Hon. Lord Rutherford, and Dr. A. E. Barclay will deliver the presidential address. Besides several technical papers, two lectures have been arranged—the fourteenth Silvanus Thompson Memorial Lecture by Sir James Jeans, on radiation, and the twelfth Mackenzie Davidson Memorial Lecture by Prof. Dr. Hans Holfelder, on medical, surgical, and radiological treatments of disease. Cinematograph films illustrating experiments on the inflammability of films (Prof. F. Haenisch) and the effects of radium on living cultivated tissues (Dr. R. G. Canti) will be exhibited. Two discussions have been arranged for the last day of the Conference.

MESSRS. W. Dawson and Sons, Ltd. (Rare Book Department), Pilgrim Street, E.C.4, have just issued a new part (N.S. No. 5) of their catalogue of scientific books and serials. It contains many rarities and should be seen by collectors and librarians desirous of adding to their libraries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A sub-editor of the *British Journal of Radiology*—The General Secretary, British Institute of Radiology, 32 Welbeck Street, W.1 (Dec. 8). An assistant in zoology at the Queen's University of Belfast—The Secretary, Queen's University, Belfast (Dec. 10). A Geoffrey Duveen Travelling Student in Oto-Rhino-Laryngology—The Academic Registrar, University of London, South Kensington, S.W.7 (Dec. 31). A professor of mathematics at King's College, Strand—The Academic Registrar, University of London, South Kensington, S.W.7 (Jan. 4). A professor of philosophy at the University College of Wales, Aberystwyth—The Secretary, University College of Wales, Aberystwyth (Feb. 1). A professor of zoology in the University of Calcutta—The Registrar, University, Calcutta (March 31).

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.*]

Light of Glow-worms.

THE letter by Dr. Ramdas and Dr. Venkiteshwaran [1] on the "Spectrum of Glow-worm" will surely arouse interest in the fascinating subject of animal luminescence and stimulate photophysical research on the phenomenon. The writers note that their worm glowed only by night, could be stimulated by shaking, and that the light was apparently under voluntary control. These details I am able to supplement by other observations, which may be of value to research workers who wish to take up the subject.

In June–July 1919 I had an abundant supply of female *Lampyris noctiluca* L. from Looseley Row, Bucks. Their light was eclipsed immediately in sudden disturbance, presumably causing alarm, but could often be enhanced by concussion and always by nipping the luminous organ; though these displays were relatively transient, being succeeded by the negativism characteristic of 'alarm'. The light emitted by larvæ was more readily extinguished and less easily aroused than that of females.

Dissecting out the ventral nerve-cord, I found that crude chemical stimuli (sodium chloride, caustic soda, common acids) were without effect, but that momentary flashes could sometimes be produced by the mechanical stimulus of nipping the cord. Single induction coil shocks, if sufficiently strong, would produce momentary flashes of light, 'break' seeming more efficient than 'make'. Continuous faradisation produced a brilliant light, but my terminals were impromptu makeshifts without attempt at screening, so that I could not be absolutely sure the luminous organ had been affected by nerve-impulse and not by the current directly. Certainly, an even more vivid effect could be obtained by plunging the terminals into the tail of the insect, near or on the organ. It was possible to suspend the tail in fixative (Zenker's fluid, alcohol, formaldehyde, 5-10 per cent), and to keep the organs glowing by faradisation while fixation gradually took place. This was a very astonishing sight, and I have always hoped for an opportunity to extend these preliminary observations into a serious research. The light of isolated and crushed luminous organs could also be observed under the microscope, perhaps as a result of mechanical stimulation of residual nerves and end-organs, but sometimes in such thin smears that the effect seemed purely biochemical.

I also made up three batches to be kept—(1) in absolute dark, (2) with a little diffuse light during the day, (3) in the fullest light that could be applied at all times, namely, full diffuse daylight all day and a 60 candle-power electric light at about 3 yards at night. There were a dozen worms in each batch. At first all three batches kept the hours then current in the field, beginning to glow at 10–11.0 P.M. and ceasing at 1–4.0 A.M. After about the third day the habits of the illuminated batch began to be deranged, and after four or five days they would only glow at irregular intervals or on stimulus by shaking, which, however, was more uncertain than with normal worms. The other two batches kept their hours well until after about a fortnight, when senility and perhaps starvation began to produce their effects, the totally dark batch being the earlier deranged and producing light by day as well as night. I concluded that external light was probably not needed for storage on the lines of chemical phosphorescence, but necessary to simulate natural conditions; at the same time, there was a remarkable automatic regulation of the hours of light which was not primarily dependent on external illumination, but could be upset by unusual conditions of environment.

MICHAEL PERKINS.
5 Little Cloisters, Westminster Abbey,
London, S.W.1,
Oct. 27.

[1] NATURE, **128**, 726, Oct. 24, 1931.

Mercury Line Spectrum in Fluorescence.

IT was found by Füchtbauer [1] that mercury vapour of low density, illuminated by the radiation of a mercury arc, emits all the chief lines of the mercury spectrum in fluorescence. These experiments were extended by R. W. Wood,[2] who found, in accordance with the views of Füchtbauer, that the process is one of stepwise excitation, the mercury atom being raised in the first instance to the $2\,^3P_1$ state by absorption of the resonance line, and next to, for example, the $2\,^3S_1$ state by absorption of 4358. Emission of the visual triplet $2\,^3P_{012} - 2\,^3S_1$ then follows. Wood was able to verify this explanation by using an independent source to supply 4358.

No doubt is here expressed that this is in the main a correct account of what happens under the conditions used by these experimenters. I find, however, that when excitation is *by the resonance line alone*, and the other lines from the original source are suppressed by appropriate filters, it is still possible to observe the emission of these other lines in mercury vapour of, say, 2 mm. pressure. Thus a chlorine filter of 40 cm. thickness is absolutely opaque to the lines 3650, 3126, and 2967. Yet these lines are emitted when the vapour is excited through such a filter. Whatever the process may be by which the vapour is raised to the $3\,^3D_{321}$ state, it cannot be stepwise absorption, because the appropriate frequencies are not there to be absorbed. It is remarkable that the atom is raised to a level of 8·8 volts, whereas the excitation directly applied is only 4·86 volts.

I find, further, that in a rapid current of vapour the emission of these lines continues, even when the vapour has passed out of the region directly illuminated.

Much further work will doubtless be required to interpret these results. They are probably to be connected with the known ionisation of the vapour by the resonance line.

RAYLEIGH.
Terling Place, Chelmsford,
Nov. 17.

[1] *Phys. Zeit.*, **21**, 635; 1920.
[2] *Proc. Roy. Soc.*, A, **106**, 679; 1924.

A Connexion between Fluorescence and Free Neutral Radicals.

MODERN physical theories [1] treat the fluorescence of all substances as the re-emission of previously absorbed radiation during the return of a chemical molecule to a stable form from an activated form, possessing a mean free life of 10^{-8} to 10^{-9} second. Since it has been shown that, in any atom, only the outermost, or valency, electrons are concerned in the absorption or emission of light waves of the visible order of frequency, it follows that fluorescent emission is necessarily concerned with the *re-formation of stable valency bonds* (or possibly stable 'lone-pairs' of electrons) from previously activated molecules.

Now, the photochemical activation of such simple molecules as the halogens has been *thought*, by Bodenstein, Franck, and others, to consist in the separation of the diatomic molecule into free neutral atoms of sufficient energy content either to enter into direct chemical combinations with other free atoms or radicals, or alternatively to initiate 'chain reactions'. The halogen atoms are considered to have an exceedingly short mean free life, comparable in duration with that of a molecule which can absorb light energy and re-emit it as fluorescent radiation. Further, energy of an amount approximately equal to that available on the recombination of atoms to molecules (for example, $2I \rightarrow I_2 + h\nu$) is actually emitted as fluorescence by the halogens under favourable pressure and temperature conditions.

It seems reasonable therefore to suppose that this light-energy emission might be associated with the chemical action of recombination of the neutral free atoms to the diatomic molecules. This speculation may be extended to other cases of fluorescence, and perhaps absorption of light by molecules followed by fluorescent emission might in general be concerned with the dissociation of a covalent bond into free neutral radicals, followed by recombination of these radicals once more. The emission of a fluorescence might then indicate that the dissociation of a covalent bond in a molecule had previously occurred.

For the fluorescence produced by cathode rays, the isolated electrons are obviously the equivalent of the free radicals.

Support for this suggestion is afforded by the following considerations:

(*a*) The fluorescence of sodium and mercury vapours is definitely associated with the neutral diatomic molecules Na_2 and Hg_2.[2] These can obviously be produced only by the association of single atoms.

(*b*) Fluorescent inorganic molecules can dissociate into free neutral radicals, as NO.

(*c*) The well-known inhibition of fluorescence by added substances can only be brought about by those compounds (for example, iodide ion or O_2) which can easily lose *an* electron:[1] these same substances also inhibit photochemical reactions by terminating chain processes, and combine instantly with known free radicals.

(*d*) Only certain classes of organic molecules, possessing aromatic ring systems and of unsaturated structure, are fluorescent,[3] and *all these compounds are capable of yielding free radicals* either by dissociation or by addition of the alkali metals (for example, xanthyls, *meso* anthracene derivatives, metallic ketyls, anils, etc.).

(*e*) All aromatic compounds, even if not otherwise fluorescent, give characteristic Tesla luminescence spectra, the seat of which is the aromatic ring, and which, it has already been suggested, is associated with the tautomerism of the valency bonds between the two specific 'Kekulé' phases.[3] Any such isomerisation, however depicted, must involve fission of valency bonds, with subsequent reunion of momentarily existing free radicals.

Other examples of chemi-luminescence seem capable of interpretation in accordance with the above suggestion, which it is hoped to develop further. The author is indebted to Dr. J. T. Hewitt for encouragement in submitting this speculation for publication.

W. A. WATERS.

University Science Laboratories,
Durham, Oct. 14.

[1] F. Perrin, *Annales de physique*, **12**, 169-275; 1929.
[2] Pringsheim, *Zeit. für Physik*, **38**, 161; 1926.
[3] Kauffmann, "Beziehungen zwischen physikalischen Eigenschaften und chemischer Konstitution".

Matter : Life : Mind.

BEFORE bio-chemists knew much about the chemical contents of a fertilised ovum, and especially before physicists knew anything about the size of chemical atoms, it was possible to think that the whole of the complication of an adult animal was potentially represented in such a cell. I venture to assert that the fertilised germ cell of a higher animal *in no way* contains potentially represented in it, in terms of the nature and configuration of the chemical atoms, even the outline design of vertebrate anatomy, let alone such details as the marvellous structure of the retina of an eye.

All it can possibly be is the material-to-start-on with which some non-material entity begins the work of clothing itself with a physical duplicate of its own non-material nature. This should be evident since the germ cell begins its development by dividing into two, for which its contents first practically go into solution, so there can be left no possible potential representation of the adult creature it will develop into.

The evidence points to the fact that the *energy* such an entity can exert on the germ cell is very minute compared with the energies associated with physical matter. If so, the entity could only manipulate chemical molecules that are in a state of delicate equilibrium, as is the case in the germ cell. Perhaps it can directly do no more than move electrons that are very lightly held in equilibrium. It could thus move matter only as a driver can move a locomotive, namely, by moving the starting handle.

If this is so, we can see why it is necessary that the physical body should be primarily a 'prime mover', since it must itself develop all the energy (minus perhaps a trillionth part) which the creature puts forth through it.

Biology is thus *not* the 'science of life', but only a study of the prime movers with which, in this world, life has to work through. The science of life is psychology, not biology; and psychology has in recent years seen that its fundamental subject matter is the motives and 'intentions to realise the ends they desire to realise' which living beings possess.

ALBERT EAGLE.

The University, Manchester,
Nov. 11.

PROF. BOYCOTT'S significant suggestion (NATURE, Oct. 24, p. 727) that the 'events of life' may be quantitatively out of proportion to the *perceptible* matter makes plausible the existence of *imperceptible* matter. For if we accept the idea of General Smuts, that matter, life, and mind are three grades of the same thing, we are logically entitled to describe that *same thing* by any of these conventional connotations, which become interchangeable terms denoting different aspects or principles of one 'matter', one 'life', or one 'mind'.

Are not these grades, in effect, the old 'kingdoms'—mineral, plant-animal, and man? And are not their outer distinguishing characteristics due to inner modifications of the *same thing*—a universal electromagnetic activity? If photosynthesis be essential to maintain biological existence, 'energy' and 'life' must be the same thing. Again, energy or motion implies that something is moving, however imperceptible. The polar action in chemical 'affinity' is as mysterious and imperceptible *per se* as the *selective* electromagnetic activity of biological organisms, and no less inscrutable than is the power of selection or choice exercised by means of the human brain. In minerals the polarity is superficially stable, and,

therefore, *matter* is prominent; in biological forms the energy-aspect is apparently more active and *life* is more evident; in the human kingdom the selective power functions through a wider gamut than the instinctive intelligence of animals, and *mind* predominates.

As this polar function does not refer to 'size', its matter-aspect must be of a different tenuity than 'matter' so called, and hence imperceptible to us before it is precipitated or condensed into concrete states.

The supposition of an evolution through these grades is as fantastic in the present state of scientific knowledge as the ancient Hermetic axiom, "The stone becomes a plant, the plant an animal, the animal a man, and man a god". Such a process implies interacting *cycles* of evolution producing modifications of the *inner* 'structures' of bodies in the successive grades. The conception of the ancients was that evolution is a progressive functioning of the mysterious polar principle actively *synthesising* more and deeper fields within a single organism. W. W. L.

THE presidential address of Dr. H. H. Dale on "The Biological Nature of the Viruses", in NATURE of Oct. 10, puts clearly one aspect (the pathological one) of substances that may possibly lead to the most notable juncture in contemporary thought. General Smuts—and he is but one of several—adumbrates, in his holism, a synthesis of mental with physical science. The viruses, including as they do the minutest particles to which life is attributed, give promise of leading to such a synthesis. Some appear to be so small that they raise the question whether, in their series, life does not exist in sizes below any protein molecule. This class of questions is at present engaging much attention in America and Germany, and some investigators postulate the hydrogen atom as perhaps a member at the lower end of the series of living things. Dr. Dale, of course, does not consider this point. If such a view should obtain general acceptance, the notable juncture would occur *that the two greatest lines of modern thought—the evolutionary biology of Darwin and the physics of Newton and Faraday—would find a common meeting point in the atom.*

May I presume to mention that I[1] and others have tried to show that directivity and affective feeling are inherent in the processes of evolution. If so, it is fair hypothesis to attribute these to the atom, if ever it is adopted as a member of the series of living things. Dr. Dale, in his acutely logical treatment of the new facts, makes some sound remarks, one of which is: "Let us recognize that the evidence is not perfect, but beware of a merely sterilizing scepticism". (F. d'Herelle, "The Bacteriophage"; Med. Research Council (Gt. B.), "The Viruses"; E. W. Schultz, "The Ultrascopic Viruses", in *Scientific Monthly*, Nov. 1930; H. Busher, "Where Life Begins", *Atlantic Monthly*, July 1930; and authorities cited.) W. D. LIGHTHALL.

McGill University, Montreal,
Oct. 27.

[1] "The Person of Evolution" (Macmillan, 1930), Chaps. iv. and v.

A Two-Dimensional Space Lattice?

ON cooling a warm aqueous solution of dimethylthallium iodide, or on adding a ten per cent solution of potassium iodide, preferably slightly alkaline, to its cold saturated aqueous solution, part of the thallium compound separates on the surface in a regular pattern. Each crystal is equidistant from six others. The size of the pattern varies, being smaller the more rapidly crystallisation is allowed to take place. The effect is not permanent; after about half an hour the arrangement breaks down and the crystals group together in irregular aggregates, which collect at the sides. In a slightly acid solution the regular

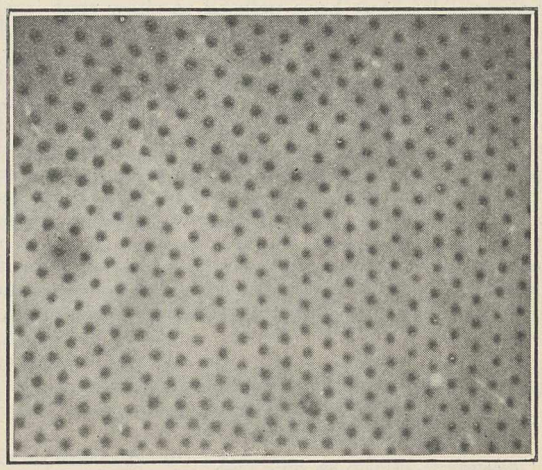

FIG. 1.

arrangement breaks down in a few seconds. I should be glad to know if other similar effects are known, and also to be given an explanation which I am unable to supply.

Fig. 1 is an enlargement of part of a photomicrograph, kindly taken by Dr. W. J. Elford by focusing on to the surface of a small quantity of the solution allowed to crystallise on a microscope slide.

R. C. MENZIES.

Chemical Department,
The University, Bristol,
Oct. 13.

Coagulation of Colloids by Electrolytes.

ALTHOUGH the impurities present in a colloid considerably modify its behaviour as regards coagulation by electrolytes, the importance of this point is still not sufficiently realised by many workers in colloid chemistry. It has been pointed out by one of us (Desai)[1] that a colloid can be made to show either normal or abnormal behaviour towards the dilution rule, namely, that the greater the concentration of a colloid, the greater the amount of an electrolyte required to coagulate it, by varying the amount of the peptising agent present in the colloid by subjecting it to dialysis.

In a recent note in NATURE we (Nabar and Desai)[2] have shown that in the case of colloidal gold the stability as defined by the flocculation value with KCl goes hand in hand with the charge on the colloid when it is subjected to dialysis. Since then we have made measurements of the charge on colloidal ferric hydroxide dialysed and diluted to different extents in the presence and absence of added electrolytes. The following is a summary of the results:

1. On the addition of increasingly small amounts of KCl and $MgCl_2$ the charge first increases and then decreases, the initial increase being greater with the concentrated sol than with the dilute one.

2. The initial increase in the charge is not noticeable with K_2SO_4, even when it is added in very small amounts.

3. With the progress of dialysis, although the charge

first increases and then decreases, the flocculation value with KCl shows a continuous decrease.

4. The charge increases on dilution of the colloid, the increase in charge of a sol dialysed for 2 days being greater than of one dialysed for 10 days—the dilutions in the two cases being the same.

In a paper which has been sent for publication the above results have been utilised to show that in the case of colloidal ferric hydroxide some of the fundamental assumptions made by colloid chemists in explaining their results of coagulation of colloids by electrolytes, namely, that (1) the charge and stability go hand in hand, (2) the charge continuously decreases with the progress of dialysis, and (3) the applicability of the general dilution rule, are justified. The abnormality in any particular case has been explained as being due to the preferential adsorption of the stabilising ions which may be present in an amount greater than that which corresponds to the maximum in the cataphoretic speed-concentration curve of the colloid with the particular electrolyte.

B. N. DESAI.
P. M. BARVE.

Physical Chemistry Laboratory,
Wilson College, Bombay 7,
India, Sept. 25.

[1] *Kolloidchem. Beihefte*, **26**, 384; 1928.
[2] NATURE, **127**, 666; 1931.

Application of the Simonis Reaction to Monohydric Phenols.

IN continuation of the work of Robertson, Sandrock, and Hendry [1] on the condensation of monohydric phenols with esters of acylacetic acids by means of phosphoric oxide, the following results have been obtained: *o*-cresol, *o*-chlorophenol, *o*-bromophenol, *p*-chlorophenol, *p*-bromophenol, and β-napthol on submission to this reaction give rise to 1 : 4-pyrones. Compared with polyhydric and with monohydric phenols, the behaviour of *m*-cresol is interesting. On condensation with ethyl acetoacetate in the presence of phosphoric oxide this phenol yields 4 : 7-dimethylcoumarin, but with esters mono-substituted in the α-position 1 : 4-pyrones are obtained, for example, ethyl α-methylacetoacetate gives rise to 2 : 3 : 5-trimethyl-1 : 4-benzopyrone.

In view of the recent communication of Chakravarti [2] on the application of the Simonis reaction to resorcinol (compare Canter, Curd, and Robertson [3]), it may be stated that the proof of the true nature of the products was first described by Canter in a dissertation submitted in 1930 for the degree of M.Sc. of the University of London.

A. ROBERTSON.

London School of Hygiene and
Tropical Medicine,
University of London,
Oct. 10.

[1] *Jour. Chem. Soc.*, p. 2426; 1931.
[2] *Jour. Ind. Chem. Soc.*, **8**, 129; 1931.
[3] *Jour. Chem. Soc.*, p. 1255; 1931.

Aitken Condensation Nuclei.

INVESTIGATIONS made by Prof. J. J. Nolan [1] and collaborators,[2, 3, 4] as well as Schweidler,[5] Hess,[6] Israel,[7] Wait,[8] and others, point to the importance of the part played by Aitken nuclei of condensation in atmospheric electric processes. It has been shown [2] that some of these nuclei carry single electronic charges, the remainder being uncharged. It has been claimed [2] on theoretical grounds that, under equilibrium conditions, the ratio of charged to uncharged nuclei is substantially a constant.

At the Commonwealth Solar Observatory, situated on Mount Stromlo, ten miles from Canberra, the nuclei have been classified into groups according to their mobilities. To effect this, electrostatic fields have been applied to a current of air passing through a cylindrical condenser and the resultant diminution in nuclei content has been measured with a modification of the original Aitken counter.[9]

Observations, made near the open window of an atmospheric electric hut, gave as a mean of 49 tests:

Nuclei.	Mobility, cm./sec./volt./cm.	Number per c.c.
Intermediate ions [10] N_A .	0·005	975
Large ions [11] N_B .	0·005 – 0·0005	385
Uncharged N_0 .	0·0005	810

Subsidiary tests indicated that the atmospheric small ion did not act as a nucleus in the apparatus, nor did any appreciable fraction of charged nuclei escape precipitation. The results appear to be statistically represented by the equation

$$2N_0 = 1{\cdot}12\ N_A + 1{\cdot}37\ N_B,$$

which does not indicate a constant ratio of charged to uncharged nuclei. The form of this equation was derived theoretically on the assumption that the uncharged nuclei were of two grades, N_α and N_β, the former giving rise, by combination with atmospheric small ions, to intermediate ions N_A, and the latter to large ions N_B. It has been assumed that the small ions were the agents in distributing the charges amongst the nuclei, and any action of the intermediate and large ions was negligible. The above equation indicates that on the average the specific rate of the combination of the N_A nuclei with small ions of opposite sign is 1·12 times greater than that of the small ions with the N_α nuclei, whilst for the $N_B : N_\beta$ equilibrium the corresponding value is 1·37. The average ratio of $N_\alpha : N_\beta$ deduced from these observations is 2 : 1.

Comparison of the N_A counts obtained by the Aitken counter with ion counts given by a Wulf unifilar electrometer attached to a cylindrical condenser indicates that the N_A group of nuclei carry single electronic charges. The mean of twenty observations gives the charge as $1{\cdot}0 \pm 0{\cdot}04$ electronic units.

Further work is proceeding in order to discover whether an equilibrium exists between N_α and N_β.

A. R. HOGG.

Commonwealth Solar Observatory,
Mount Stromlo, Canberra, F.C.T.,
Australia, Sept. 15.

[1] NATURE, **113**, 493; 1924.
[2] *Proc. Roy. Irish Acad.*, **37**, 1; 1925.
[3] *Proc. Roy. Irish Acad.*, **38**, 1; 1928–29.
[4] *Ger. Beit. zur Geophys.*, **25**, 414; 1930.
[5] *Wien. Ber.*, IIa (**133**), 29; 1924.
[6] *Wien. Ber.*, IIa (**138**), 169; 1929.
[7] *Ger. Beit. zur Geophys.*, **26**, 283; 1930.
[8] *Terr. Mag.*, **36**, 111; 1931.
[9] *Proc. Roy. Soc. Edin.*, **38**; 1890–91.
[10] J. Pollock, *Phil. Mag.*, **29**, 514 and 636; 1915.
[11] Langevin, *Compt. rend.*, **140**, 305; 1907.

The Relativistic Opacity Coefficient.

THE recent paper of Prof. Milne [1] on "The Analysis of Stellar Structure" has excited great interest, and several papers by various investigators have appeared on the subject. The knowledge of the opacity coefficient for the different physical states in which matter can exist in the stellar interiors is of importance in these developments. The value of the opacity coefficient for the non-relativistic non-degenerate case was first worked out by Eddington following Kramers' treatment of X-ray absorption. The non-relativistic degenerate case has been recently treated by several authors.

The present note attempts to evaluate the opacity coefficient for the relativistic case. It is to be mentioned here that such a calculation has now been possible from the recent work of Hall and Oppenheimer,[2] and Sauter.[3] Following them the absorption coefficient works out to be in the case of Free-Free transitions

$$K_\nu = \frac{1{\cdot}9 \times 10^{-22} z^3 h^2 c k T}{2m\pi^2 e^4 \nu} \frac{e^{h\nu/kT}}{e^{h\nu/kT}-1} \log \frac{1+A}{1+Ae^{-h\nu/kT}}$$

where A is the degeneracy discriminant and the rest of the symbols have their usual meaning.

When $A<<1$, $K_\nu = \frac{1{\cdot}9 \times 10^{-22} z^3 h^5 c^4}{32 m\pi^3 e^4 k^2 \nu} \frac{n}{T^2}$, and taking the mean after Rosseland the opacity coefficient is

$$K_2 = \frac{1{\cdot}9 \times 10^{-22} z^3 h^6 c^4}{160 m\pi^3 e^4 k^3} \frac{n}{T^3}$$

n denotes the electron concentration.

When $A>>1$, $K_\nu = \frac{1{\cdot}9 \times 10^{-22} z^3 h^3 c}{2m\pi^2 e^4} \frac{e^{h\nu/kT}}{e^{h\nu/kT}-1}$,

and $$K_2 = \frac{1{\cdot}9 \times 10^{-22} z^3 h^3 c}{2m\pi^2 e^4}.$$

For comparison, all the cases are tabulated below. The numerical calculations have been made for the coefficient of opacity K_2 referred to per gram of the material composed of fully ionised iron atoms (μ, mean molecular weight = 2·1). ρ represents the mean density ($\rho = \mu m_H n$).

State of Matter.	Non-Relativistic.	Relativistic.
Non-degeneracy .	$3{\cdot}6 \times 10^{23} \frac{\rho}{T^{7/2}}$	$1{\cdot}1 \times 10^{21} \frac{\rho}{T^3}$
Degeneracy . .	$4{\cdot}7 \times 10^{16} \frac{1}{T^2}$	0·34

It will be seen that the above calculations are only a first approximation. The detailed paper will be published elsewhere.

R. C. MAJUMDAR (Jena),
D. S. KOTHARI (Cambridge).
Universität-Sternwerte,
Jena.

[1] Milne, *M.N.R.S.*, **91**, 4; 1930.
[2] Hall and Oppenheimer, *Phys. Rev.*, **38**, 57; 1931.
[3] Sauter, *Ann. der Phys.*, **11**, 454; 1931.

National Needs.

THE writer, H. E. A., of the leading article under this caption in NATURE of Nov. 14 once more summons scientific workers to do something about public affairs, and to do it quickly. We are to "become militant without delay and in every quarter".

This is most stimulating; but what, precisely, are we to do? There is not a single major issue of statesmanship on which the scientific profession can speak with one voice. A very pertinent example relates to the "wise socialism" which H. E. A. evidently regards as a crucial necessity for mankind. Some scientific workers are socialists—not only 'wise', but *sans phrase*; while others are liberals or conservatives—non-socialists and anti-socialists of unimpeachable respectability.

What can we, as a profession, achieve in the world of statesmanship in face of such radical disagreement amongst ourselves? Even on comparatively trivial issues such as the Dyestuffs Act and the university franchise the profession was notoriously divided. Science is as ambiguous politically as the Christian faith.

Nevertheless, I believe that science has a contribution to make to political life over and above the indirect results of its material discoveries. That contribution is not a policy. It is an intellectual method and a temper of mind. For example, a sufficient acquaintance with scientific method might induce people to think quantitatively about public affairs. It would then be impossible for politicians to talk the sort of rubbish about the pound sterling which most of them talked during the recent election.

The scientific worker, who knows better than anyone else what the method of science means and how successful it has proved, is more concerned than anyone else to see that a due appreciation of that method is part of the cultural equipment of the citizen. This can only be brought about through a new kind of scientific education, differing from the current type in having a definite social and political reference. If he would create and sustain such an educational movement, even at some cost to himself, he would deserve still better of his generation than he does to-day.

But this can no more be described as becoming "militant without delay and in every quarter" than can the efforts of an acorn to grow into an oak.

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Nov. 15.

Derived Early Mousterian (Levalloisian) Implements in the Melt-water Gravels of the Coombe Rock Glaciation.

RECENTLY in these columns [1] I directed attention to the occurrence at Greenhithe, Kent, of flint implements of Upper Palæolithic facies in association with fragments of coarse pottery on an occupation-floor situated some twelve feet below present-day ground-level.

This 'floor' rests upon coarse gravel which overlies Coombe Rock. Both at Greenhithe and elsewhere in the locality I have since recovered from the coarse gravel (the melt-water gravels of the Coombe Rock glaciation) a series of rolled and patinated artefacts of Early Mousterian (Levalloisian) age, consisting chiefly of flakes with faceted butts and tortoise-cores. These specimens will be fully described and illustrated on a future occasion.

The deposits capping the horizon of the occupation-floor are shown on the Geological Survey Map (Sheet IX. N.E. Kent. Scale 6″ to 1 m. geologically surveyed 1920 by Mr. C. E. N. Bromehead) to be "Coombe Deposits", which on page 3 of the Survey Memoir on Dartford (1924) have been classed as "Pleistocene".

Two of my excavation-sites coincide with points specifically detailed by the Survey as:

(1) "10 to 12 feet Brickearth"
and (2) "2 to 12 feet Brickearth".

Thus, what I described as stony loam with 'rafts' of Coombe Rock, brickearth, and sand has been mapped by the Geological Survey under the comprehensive term—Brickearth.

It is of significance that the stony loam of Danes' Dyke, Flamborough Head, Yorks, described by Lamplugh as late-glacial,[2] which I have shown to contain derived artefacts of Upper Palæolithic types, has an officially recognised Pleistocene counterpart in the Thames Estuary.

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Nov. 9.

[1] NATURE, Sept. 26, p. 548.
[2] *Quart. Jour. Geol. Soc.*, vol. 47, p. 410; 1891.

Research Items.

Central Wyoming Pictographs.—Dr. E. B. Renaud of the University of Denver, in a special investigation report to Science Service of Washington, describes two series of pictographs in Central Wyoming not previously visited by archæologists. On a prairie trail 15·5 miles south of Moneta and 77 miles west of Casper numerous pictographs were found on much eroded sandstone cliffs, extending over a district about a quarter of a mile long. The most curious, and in fact unique, pictographs are shields or circles, mostly coloured, the principal shades still discernible being a strong green, a pale orange, and a purplish red. These disks are sometimes grouped in panels of ten or twelve. They represent conventional designs, human and animal figures, usually one in each circle or two or three, one being central and the other two smaller and artistically distributed, or arranged in quarters. For various reasons they cannot have been made less than two hundred years ago, and are perhaps older. In addition to the coloured type of circular pictographs there are many incised figures of men, animals, and conventional designs of the more generally known type of petroglyph. Some are isolated; more often they are grouped in panels. They may be more recent than the coloured pictographs. Among the animals represented are deer or elk, buffalo, antelope, small quadrupeds, others not identifiable, snakes and birds. The turtle is usually coloured, and never appears except on circular pictographs. This is an animal at present non-existent in the region. There are several styles of anthropomorph. One has pointed shoulders and the sexual parts are emphasised; the other, which is rarer, represents human figures with a bigger round face or head, no shoulders, and neck as broad as the body, which is rectangular. The arms are uplifted as in worship. A third type has shield and lance and recalls the type of Sand Creek, south of Laramie. A second group of pictographs, 19 miles south-east of Lander, consisting of realistic figures of men and animals, was also visited.

Marugin Warfare.—Warfare among the Marugin and surrounding tribes of north-east Arnhem Land is described by Mr. W. Lloyd Warner in *Oceania*, vol. 1, No. 4. It is one of the most important of social activities, and without it Marugin society as now constituted could not exist. There are six distinct varieties of warfare, and each has a distinctive name. In an additional form only the women participate. They are (1) a fight within the camp; (2) a secret method of killing; (3) a night attack in which an entire camp is surrounded; (4) a general open fight; (5) a pitched battle; and (6) a ceremonial peace-making fight, which is in part an ordeal. The first is the most frequent, but seldom results in a killing; while the pitched battle, although there have been two only in the last twenty years, has accounted for the death of twenty-nine men. The weapons used are the wooden or stone-headed spear, the throwing stick and the club. No shields are used, the throwing stick serving its purpose. White clay is used as war-paint. The most frequent causes of warfare are the desire to avenge the death of a relative; next, the stealing of a woman; then comes killing by black magic and ritual offences against a clan, such as the illegitimate assumption of a totem emblem, an insult to the clan to which the emblem properly belongs. The underlying principle is that of reciprocity, to inflict on the enemy clan a loss similar or identical with that which has been suffered by the attacking clan. Another belief centred around killing, and a frequent cause of war, is that the spirit of the dead man enters the body of the killer, giving him double strength and actually increasing his bodily size. Hence young men who wish to gain strength go out and kill. The women's fights are frequent. Occasionally more than two women are involved. The weapons used are the ironwood digging-sticks, and bloodshed is always a result.

The Pigmy Right Whale (*Neobalæna*).—In 1890 there were recorded the occurrences at various times of three individuals of this species, limited in distribution, on South Australian coasts, but although the recorder, A. Zietz, stated that photographs and measurements had been taken, no further details were given. The old MS. records and photographs have been hunted out by H. M. Hale, and appear in the *Records of the South Australian Museum* (vol. 4, No. 3, p. 314, 1931). Two of the specimens were males, 9 ft. 1 in. and 11 ft. 2 in. long respectively. Instead of 43 vertebræ, one specimen had 41, another 40, and in one, in place of the typical two lumbar vertebræ, there were three. The longest plate of baleen measured 200 mm. The third skeleton is in the museum at the University of Cambridge. In the 11-foot specimen the small intestine, from pylorus, was 132 feet long, and the large intestine, including 6 in. cæcum, 5 ft. 6 in. The photographs show well the curious elongated body of this rare animal.

A Nematode Parasite of a Lucanid Beetle.—J. R. Christie and B. G. Chitwood contribute (*Jour. Wash. Acad. Sci.*, vol. 21, No. 15, 1931) observations on the life-history of *Chondronema passali* (n. gen.), a nematode which occurs in large numbers in the body cavity of a lucanid beetle, *Passalus cornutus*, common in the eastern States of America. Nearly every beetle examined was infested with large numbers (500-1000) of the worms in various stages of growth; of the relatively few grubs examined about one-fifth were infested. A description is given of the youngest larvæ, about 0·4 mm. long, found in the body cavity and of the last stages found there, which are easily distinguished as males and females, about 3·3 mm. and 3·9 mm. long respectively. In the youngest stages the genital primordium is composed of a large anterior cell and three slightly smaller posterior cells, and an anterior cap cell was present; the subsequent stages of growth of this primordium are briefly described. The parasites enter the beetle as very young larvæ, being probably taken in during the act of feeding; it is suggested that the beetle swallows a female worm with its contained young. The larvæ moult once while inside the parent worm, and another moult probably takes place soon after emergence from the host. The method of exit of the worms from the beetle was not ascertained. *Chondronema* is related to *Atlantonema* and *Tylenchinema*, but is differentiated from all related genera by the fact that the vulva, if it functions at all at the time of copulation, becomes vestigial; it never serves for the extrusion of eggs or larvæ. The larvæ remain parasitic until full grown and the adults are free living.

The Auditory Region in Certain Extinct Mammals.—In the *Bulletin of the American Museum of Natural History*, vol. 62, 1931, Dr. van der Klaauw gives an account of the auditory region as observed in a wide series of extinct mammals, preserved in various collections in the United States. This section, however, forms a comparatively small proportion of the whole paper, not being more than some thirty out of 350 pages. The bulk of the work is devoted to what the author terms a " review of the tympanic region ",

in which he treats, in considerable detail, a great number of questions arising out of an examination of the ear region in general of mammals, living as well as extinct. While there is no summary of results, there is a mine of useful information in the body of the work and a full citation of the literature.

Frost Injury to Plants.—It is natural that the *Canadian Journal of Research*, vol. 5, July 1931, should contain papers upon this subject of very live interest to the Canadian community. R. Newton and W. R. Brown, of the University of Alberta, conclude that dehydration is the basic cause of first precipitation of plant proteins rather than the pressure of the ice crystals, as suggested by Maximow. An exposure of five hours at −7° C. caused maximum precipitation of the proteins of the expressed juice from the leaves of unhardened winter wheat grown in the greenhouse. Sucrose added to the juice acted as a protection against the precipitation, its protective value increasing with concentration up to 8 per cent, a value often attained by hardy varieties of winter wheat in the field. Similarly, sugar protected the proteins against precipitation by acids, bases, or 'salting-out'. This action of sugar seems to be of very considerable significance, although its explanation still remains obscure.

The Melting of Glaciers.—In a note written for Science Service (Aug. 26, 1931), Dr. W. J. Humphreys, of the U.S. Weather Bureau, discusses the melting of glaciers. It is often said that glaciers limit themselves to a moderate thickness because their own weight continually melts them at their base at a rate that increases with the load. He points out that though the melting point is lowered by pressure, an increase of pressure on the bottom layers does not enforce rapid melting, and would not do so, except briefly and to a small extent, even if the initial temperature there were exactly at the melting point. This is because melting requires the supply of much heat, and the very act of melting automatically cools the ice, the further melting of which is controlled entirely by the rate of supply of heat. At the bottom of a glacier even 10,000 feet thick the melting point would only be 4·12° F. below the normal value. In the case of a thick ice sheet, the supply of heat for melting must come almost solely from the earth below, and this is enough to melt only about a quarter of an inch of ice in a year. Thus the limiting thickness of glaciers must be determined mainly not by melting due to excess pressure but by other causes, such as horizontal flow, surface melting, the removal of surface snow by winds, and the reduced precipitation at high levels.

Mixing of Warm and Cold Saturated Air.—The *Memoirs* of the Imperial Marine Observatory, Kobe, Japan, contain papers in English on a variety of scientific subjects, including meteorology. In vol. 4, No. 2, there is a paper dealing with what is, strictly speaking, a problem of ordinary physics, but it is a problem of fundamental importance to meteorology. It is by K. Hidaka, and is entitled "On Mixing of Warm and Cold Saturated Air". The author follows the methods of Von Bezold for calculating the results of such mixing, according to which the two masses are first supposed to mix without condensation so as to give a supersaturated mixture, and then to begin to condense water with liberation of latent heat. This heat, of course, raises the temperature of the mixture. The problem is far from being so simple as might at first sight be supposed, owing to such complications as arise, for example, from freezing or melting of ice, the effect of pressure on the freezing point, and variations in the specific heat of moist air in accordance with the amount of water vapour therein. These are treated mathematically, the final result being a valuable set of tables giving at three different atmospheric pressures (1) the final temperature, (2) the amount of water vapour in 1 kilogram of the mixture at the final temperature, and (3) the amount of water condensed per kilogram, when 1 kilogram of air at temperature t_1° C. is mixed with 1 kilogram at t_2° C., t_1 and t_2 being taken for 5° steps from −30° C. to +30° C. The pressures to which these figures apply are those corresponding with 760 mm., 700 mm., and 600 mm. of mercury under standard conditions (0° C. and latitude 45°). The author proposes to deal in due course with the problem of calculating the results of an admixture of equal volumes instead of equal masses of air at different temperatures.

Changes of Intensity in the Hyperfine Structure of Lines.—A number of discrepancies have occurred in the descriptions of the hyperfine structure of spectra, different observers finding in some instances different structures for the same line. When it has not been possible to explain this by self-absorption, it has usually been inferred that some flaw in technique has existed. An investigation of certain lines of cadmium which is described by H. Schüler and J. E. Keyston in the issue of the *Zeitschrift für Physik* for Sept. 3 now shows that the effect may be real. The lines studied were found to exhibit a difference in the intensities in their hyperfine structures according to the part of the source of light, the spectrum of which was photographed. The line at λ5086, for example, could be produced with either two or three components, the relative intensities in the pair of lines common to both cases being reversed when the third was present. Self-absorption of the light in the source is believed not to be the cause of these changes, and their origin remains completely unexplained. Whatever it may be, however, it has evidently to be taken into account in the investigation of isotopes by this method, and it is remarkable that the hyperfine structure, which is due to the quantised spin of the atomic nucleus, should be so easily influenced by causes external to the atom.

Collision Properties of Protons.—Some measurements of the mean free paths of protons, which are described by C. Ramsauer, R. Kollath, and D. Lilienthal in the *Annalen der Physik* (vol. 18, p. 702), compare in an interesting way with the results for slow electrons. With both types of particles, the mean free path changes considerably with velocity; for protons, there is a maximum in the curve showing the mean free path as a function of the velocity of the proton for four of the five gases studied (argon, nitrogen, hydrogen, and neon), and possibly also for the fifth (helium). The maximum moves to greater velocities with increase in the ionising potential of the gas through which the protons are passing, and at the maximum the mean free path is greater than its kinetic theory value, being four times as large for nitrogen, eight times for neon, and still larger for helium. For greater velocities, the mean free path again decreases, becoming, at least for the diatomic gases and argon, less than its kinetic theory value, but with argon it then passes through a minimum, and there are signs that this will also occur at higher velocities with some of the other gases. The maximum and minimum also occur with electrons passing through argon, but there is no obvious close correlation between the electron and proton curves. The energy of the proton at maximum and minimum points is much greater, and its de Broglie wave-length much smaller, than the corresponding quantities for the electron, only the linear velocities being of the same

order of magnitude. The protons were produced for most of the experiments by bombarding a piece of impure metallic lithium with electrons, and were rendered homogeneous in speed and separated from other ions by magnetic sorting after acceleration in an electric field.

Oxidation of Ethylene.—The slow oxidation of ethylene was studied by Bone and R. V. Wheeler in 1904, who found that formaldehyde was produced as an intermediate product, and Blair and T. S. Wheeler in 1922 showed that acetaldehyde was an oxidation product, in one case half the ethylene oxidised being converted to this product. In two papers in the October number of the *Journal of the American Chemical Society*, Lenher describes extensive experiments on the slow thermal oxidation of ethylene in various types of apparatus. The reaction is mainly homogeneous and of the chain type, the velocity being dependent on the third power of the ethylene concentration and practically independent of oxygen, in agreement with experiments of Thompson and Hinshelwood in 1929. Among the products of reaction at high temperatures and short times of contact, with high ethylene concentrations, is propylene, so that oxygen can activate ethylene to undergo polymerisation. Oxidation products include ethylene oxide and formaldehyde formed in the early stages of the oxidation, and preceding the appearance of acetaldehyde, dioxymethyl peroxide, formic acid, carbon oxides, and water. Hydrogen peroxide is formed in the reaction, probably giving, with formaldehyde, the dioxymethyl peroxide. The paper contains a concise scheme of the mechanism of the oxidation of ethylene, which is obviously much more complex than has previously been supposed.

Synthesis of Anthocyanins.—The *Journal of the Chemical Society* for October contains eight papers by Robinson and several co-workers on the synthesis of anthocyanins. It had previously been shown by synthesis that callistephin chloride is 3-β-glucosidyl pelargonidin chloride, and the first of the present papers deals with the synthesis of 3-β-glucosidyl cyanidin chloride by an analogous method, and the proof that it is identical with chrysanthemin chloride, the latter being probably the same as asterin. The results involve the attribution of the 3-bioside structure to mesocyanin, kerocyanin, and prunocyanin, whilst cyanin is regarded as cyanidin 3 : 5-diglucoside. The second paper describes the synthesis of the four isomeric β-glucosides of pelargonidin chloride. Pelargonenin chloride, the product of the partial hydrolysis of pelargonin, is pelargonidin chloride 5-glucoside. Although pelargonin yields pelargonidin-5-glucoside on hydrolysis, and it might be concluded that the anthocyanin is a pelargonidin 5-bioside, the evidence seems to show that the position 3 does not bear a hydroxyl group. Ferric chloride in dilute solution gives with compounds containing hydroxyl in position 3 a fugitive colour, whilst compounds with hydroxyl in position 3 absent or modified give a relatively stable colour. In the third paper the synthesis of œnin chloride, from the skin of purple-black grapes, is described, and the substance is shown to be identical with 3-β-glucosidyl malvidin chloride. Succeeding papers deal with the syntheses of oxycoccidin chloride (one of the pigments of American cranberries), which is shown to be 3-β-glucosidyl-peonidin chloride ; of 3-β-galactosidyl chloride, believed to be identical with idæin chloride from the cranberry, and the corresponding derivative of peonidin chloride ; and of fisetinin chloride, which has alkali colour-reactions very similar to those of cyanin chloride, thus supporting the constitution of the latter advanced in the first paper. The colour-reactions of fisetinidin and luteolinidin are described, and the evidence is completed for the 3-5-diglucoside constitution of pelargonidin, cyanin, and malvin. The 5-glucoside and 5-lactoside of hirsutidin were prepared, the latter being the first diglucosidic synthetic anthocyanin obtained.

Astronomical Topics.

The Leonid Meteors.—There was no very grand display of these meteors, but a report from Mr. J. P. M. Prentice, of Stowmarket, Suffolk (who is director of the B.A.A. Meteor Section), states that he saw thirty-nine Leonids, of which fifteen were of the first magnitude, between 0^h 40^m and 3^h 30^m on the morning of Nov. 17 ; he thinks that the shower was increasing in strength, so we may hope for more complete reports from North America, where there is an active meteor section under the leadership of Prof. Olivier.

The Rev. W. F. Jameson, of Willesden Green, saw a bright Leonid on Nov. 16 at 11^h 45^m P.M. Mr. Prentice also saw a stray Leonid at 3^h 50^m A.M. on Nov. 14. Some of them have been dispersed to a considerable distance from the main stream.

It is to be feared that the odd quarter-day in the year will bring the rich display into daylight in 1932. This is not certain, however, as the time may be considerably modified by perturbations.

The Faint Outer Satellites of Jupiter.—Prof. M. Wolf notes in *Astr. Nach.*, No. 5819, that an object which he reported last December as a new minor planet (1930 *YC*) proved to be the satellite Jupiter VI. He gives positions of it on six days last winter, extending from Dec. 19 to Feb. 9. He also found images of Jupiter VIII on the plates of Dec. 19 and 20. He made an extended search for Jupiter VII, but without success ; he has not been able to find any observations of this satellite for several years, so it appears to be lost. It will be remembered that Jupiter VIII was lost for many years, until the careful calculations of Prof. Numerov led to its recovery.

It would seem desirable to have some definite plan of observation of these faint satellites, such as has been arranged for the minor planets. This would diminish the chance of their getting lost to observers.

Nagata's Comet.—Although this comet passed its perihelion five months ago it has brightened up unexpectedly, and displayed a short tail on some photographs taken by M. F. Quénisset in October. It has remained low in the evening sky ever since its discovery, but has been assiduously observed in many countries though not in England. The late observations seem to indicate clearly that there is appreciable deviation from parabolic motion, and that the period does not exceed a few centuries. A search through the catalogues has not revealed any comet likely to be identical with it. The comet of 1804 has a distant resemblance, but not close enough to suggest more than the possibility that both were derived from a single parent comet. That comet passed near the earth, and its orbit is known with considerable precision.

No fewer than nine periodic comets are due to pass perihelion in 1932 ; six of these (Grigg-Skjellerup, Borrelly, Neujmin (2), Brooks (2), Kopff and Faye) were observed at their last return, so that their positions should be accurately known. Ephemerides including perturbations by Jupiter, and in some cases those by Saturn also, are contained in the "Handbook of the British Astronomical Association for 1932 ".

The Hakemite Tables of Ebn Jounis.

By J. H. REYNOLDS.

ON Nov. 8, 1929, the last occasion on which the late Dr. Knobel attended a meeting of the Royal Astronomical Society, he presented to the Society a rare copy of the Hakemite Tables of Ebn Jounis, translated by "Citoyen" Caussin, professor of Arabic in the College of France, An XII de la Republique (= A.D. 1804). This valuable and interesting book throws a strong light on the high standard of accuracy in observation which had been reached by the Arab and Egyptian astronomers. At the time the tables were compiled (*circa* A.D. 1000) the semi-barbaric European nations were seldom at peace, either internally or externally, and all learning had suffered grievously from civil disturbances and the neglect and ignorance of the ecclesiastical foundations. In the Near East at that time astronomy and mathematics were considered to be an intrinsic part of the education of Mohammedan princes, and astronomers were therefore often attached to their courts. It is true that astrology and prognostics were the *vera causa* of this princely interest in the majority of cases, but that did not make the observational work of the Arab astronomers any less valuable in the ultimate event.

The original Arabic MS. from which the translation was made was, and still is, in the library of the University of Leyden, and it was lent to the Institut de France by the Dutch Government of the time. There is no record of how it came into the possession of the University of Leyden, but it was undoubtedly a copy of the original MS., transcribed about seven hundred years ago. There were several copies of the work originally in the library of the Alhazar University in Cairo, and it is possible that the Leyden MS. may be part of one of these, as many of the MSS. of the library were scattered and destroyed in the repeated conquests and sackings of Cairo in the Middle Ages. Caussin was of the opinion that the Leyden MS. contained about half of the original observations made by Ebn Jounis, and that there were two volumes.

Besides a long preface, the whole work originally contained eighty-one chapters, the title of each being given in the introduction. The twenty-second chapter is the last which appears in the Leyden MS., so the greater part of the work is unfortunately totally lost to us. The titles of some of the chapters sound sufficiently modern: for example, Chap. iii., On mean time and true (solar) time—how to convert one into the other, and different methods employed by various authors of tables; Chap. x., On chords of a circle, on sines, and how to use them in calculating from the tables; Chap. xi., On the obliquity of the ecliptic, on the dimensions of the earth's shadow, and tables relative thereto; Chap. lxxvii., On radiation from the stars, according to general opinion. Other chapters introduce us to matters which, fortunately, do not affect us to-day: Chap. xv., On arcs diurnal and nocturnal; on fractions of the hour by day and night; on equal and unequal time. Chap. xvi., On the twelve houses of the sun. Chap. lxxxi., On the revolutions of the years of the earth, and on nativities.

Caussin's translation only includes the introduction and the fourth, fifth, and sixth chapters, so there is still ample work to be done in the way of translation by Arabic scholars.

An Arabic MS. in the French Bibliothèque Nationale contains the tables of the sun and moon by this author, amongst various tables taken from the works of the other astronomers. These tables form part of a work entitled "Al zij Almosthal ali", which seems to have been composed in the fourteenth century of our era. Caussin remarks: "Le titre encore plus récent qui est à la tête, l'attribue à Ebn Jounis, apparemment pour lui donner plus de prix. C'est une supercherie dont les Orientaux se servent quelquefois vis-à-vis des Européens qui achètent des manuscrits sans les lire".

Ebn Jounis came of an ancient Arab-Egyptian family. Like many of his contemporaries, he was something of a poet and a musician, as well as an astronomer. The date of his birth is unknown, but he died on May 31, 1008. There seem to have been two editions of his astronomical tables, one written about 990, in the reign of the Caliph Aziz, to whom it was dedicated, and the second, a corrected and extended series of observations, being written in the reign of his son Hakem, and dedicated to him, whence the title of the Hakemite Tables is derived.

Ebn Jounis's observatory was on a rocky spur of the Mokattam Hills near Fustat (Old Cairo), at a place called Birket Alhabash, originally a reservoir on the east side of the Nile, afterwards turned into a garden. This was probably near the old aqueduct to the citadel built by Nasir in 1311, parts of which are still standing.

In one of the Arabic texts there is mention of observations at 'Holwon', to which Caussin adds the following note: "Holwon, quelques lieues au-dessous du Caire, sur le bord oriental du Nil". This is without doubt the present town of Helwân, near which the modern observatory was erected in 1904 under the supervision of Sir Henry Lyons.

Ebn Jounis presupposed in the table a knowledge of Ptolemy's work, and his first aim was to assemble all that related to practical observation, calculation, and the use of tables. His ultimate object was to correct the tables current in his time, and his own observations were therefore of great assistance in the new tables. A quarter of the MS. is devoted to the chronology of the *Hegira*, and is omitted in the French translation, as it is comparatively unimportant. The commencement of the preface is worth translation and reproduction here:

"In the name of Allah, the compassionate, the merciful! The study of the heavenly bodies is not unconnected with religion. By this alone can be known the hours of prayer; the time of sunrise, when he who observes a fast should abstain from drinking and eating; the end of the evening twilight, the term of vows and religious obligations; the time of the eclipses, of which a man should be forewarned, so that he may prepare himself with the special prayer proper for such an occasion.

"The same study is necessary for turning in prayer always towards the Kaaba (Mecca), for determining the commencement of the months, for knowing certain doubtful days, the time for seeding, the budding of the trees, the picking of fruits, the position of one place with regard to another, and for journeying in a definite direction without straying.

"The movement of the heavenly bodies being thus allied to many divine percepts, and the observations made in the time of the Caliph Almamoun [at Bagdad] being already out of date, and containing errors similar to those made aforetime by Archimedes, Hipparchus, Ptolemy, and others, our Lord and master the Commander of the Faithful Abou Ali Almansour al imam al hakem bams Allah (May God bless him, his virtuous ancestors, and his noble descendants), has ordered me to observe anew the heavenly bodies whose movement is more or less in accord, and many

of those whose progress is slow compared with the existing tables.

"First of all I assured myself of the excellency of the instruments with which I made my observations. I constructed them with greatest care, and divided them with the finest accuracy I could command. I spent much time in examining them and verifying their divisions. I compared them one with the other to assure myself of their reliability; and when I had found with certainty the places of the planets, I used, in order to determine their mean motions, the observations of the ancients, since it is in this way alone that such a correct determination can be made."

The principal instruments used by Ebn Jounis were the armillary sphere and the azimuth circle. The larger the diameter of these, the greater the accuracy with which they could be divided. Unfortunately, no details are given as to their dimensions and construction, so we have to fall back on descriptions of such instruments constructed at Cairo after the death of Ebn Jounis and contained in Caussin's notes.

The armillary sphere was a series of rings, the outer and principal one representing the meridian. Then came a movable declination ring pivoted on the poles, containing on its inner edge two other pivots 23° from the poles, and on these pivots were fixed two other rings at right angles to each other, representing the ecliptic and colures. Still another sliding inner ring with sights at the ends of a diameter enabled readings to be taken both in latitude and longitude. These were made up to 2 ft. in diameter and probably more, as the azimuth circle constructed by the order of Alfadel a hundred years later was 200 inches in diameter.

Numerous references are made in the introduction and Chap. iv. to the "Verified Table". This table was compiled by order of the Caliph Almamoun at Bagdad about fifty years before Ebn Jounis worked out his own Tables. Several astronomers were engaged in this compilation, the principal being Jahia ebn Aboumansour. An Arabic MS. of this Verified Table was, and presumably is now, in the library of the Escurial.

Ebn Jounis devotes the whole of Chap. iv. to a comparison between recent observation and calculation by the Verified Table, especially with regard to eclipses of the sun and moon. He was specially critical of tables of the sun's longitude, which he found to be largely in error. He points out that the armillary sphere of Jahia ebn Aboumansour was only divided to 10′ of arc, and was not, therefore, of the accuracy required for close determinations of the sun's place. As an example of the refinement of accuracy attempted by the Arab astronomers, Ebn Jounis cites results obtained for the mean motion of the sun in a Persian year of 365 days. The sons of Moussa ebn Shaker at Bagdad gave this as 359° 45′ 39″ 58‴ 2⁗! The division of the second into sixty thirds, and that again into sixty fourths, and on occasion even to fifths, must come as a great surprise to present-day astronomers, for a fifth was only equal to 0·0004″, a quantity representing less than probable instrumental error even to-day. Of course, the figures given were simply obtained by continuing division.

A list of conjunctions of the planets with each other and with the 'Lion's Heart' (Regulus) are given with considerable detail. One observed by Habash at Bagdad on Oct. 10, A.D. 864, was that of Mars and Venus in Virgo, so close as to appear one planet. "We have obtained their conjunction in this manner in the table Alshemashia by adding to the epicycle of Venus, and to the mean motion of the sun in the table 4° 30′; next deducting from the epicycle of Mars 30′, and deducting the result from the mean motion of the sun."

Some partial eclipses of the sun visible in Cairo were observed with great interest by Ebn Jounis and his friends, who assembled at the Mosque of Aboufaafer Almagrebi for the purpose. One on Dec. 12, A.D. 977, was evidently a great astronomical occasion. The names of many of those in attendance were given, of whom he says: "These persons were instructed without being versed in the practice of judiciary astronomy (prognostics)". The eclipse was first seen when the sun was between 15° and 16° above the horizon. Its greatest phase was estimated at 8 digits (twelfths of the diameter) in magnitude. "When the sun seemed to regain all its brilliancy I found its altitude to be about 33° 20′, all being in agreement as to the end of the eclipse." Next appears a list of determinations of the vernal and autumnal equinoxes, made by various astronomers, commencing with one by Ptolemy in the third year of the reign of Antoninus Pius, at Alexandria. Many observations by Arab astronomers at Bagdad and Damascus, from A.D. 830 to A.D. 851, appear also in the text.

Chap. v. contains various determinations of the sun's mean motion in the Persian year of 365 days, almost all of them being in agreement with a value of 359° 45′ 39″, differing only in thirds. All of the astronomers arrived at their results by dividing the number of solar revolutions by the number of Persian years which had elapsed between the time of their observations and the original observation of Hipparchus. By the same method Ebn Jounis arrived at a slightly larger value—359° 45′ 40″ 3‴ 44⁗. He is especially interested in various estimates of the position of the 'Lion's Heart'. "I am going to give particulars of these differences, so that those who wish to know the science of calculation and observation of the heavenly bodies, by comprehending every difficulty and by seeing how much trouble is involved in arriving at the truth, may be more disposed to excuse errors which escape the notice of persons who give themselves up to this kind of study; and Allah conducts whom he will in the path of exactitude."

The differences in the positions of Regulus were found to range from 3′ to 33′ for the same year by interpolation from various observations made in previous and subsequent years. The Arab astronomers who contributed the results are mentioned individually and their calculated places given in detail.

Chap. vi. is entitled: "On the mean motions of the Verified Table, on its equinoxes, and on the position of its apogees: on the mean motions of the present Table, on its equations and its apogees". This chapter consists entirely of comparisons between various determinations by Ptolemy and others of the mean motions and other elements of the sun, moon, and planets and Ibn Jounis' own results. It is scarcely of sufficient general interest to quote extracts here. Caussin had evidently intended to translate and publish the rest of the Leyden MS., but this unfortunately he never accomplished. He ends the volume by giving various small extracts from other Arabic astronomical MSS., with a computation based on the Tables.

All the way through, the actual Arabic text is given on one page with the French translation on the other. The text is fully annotated with references to Arab astronomers, their instruments, and their methods of observation. Evidently, Caussin was a master both of classical written Arabic and Arab literature, and his work deserves the grateful appreciation of scientific historians.

Forest Gardens.

THE 'forest garden', as it has come to be known, consists of a group of experimental plots of different species of forest trees maintained for the purpose of obtaining statistical data of rate of growth and so forth, under uniform soil conditions. It is a pity that some term more expressive of the real nature of these experimental observation centres is not employed. 'Forest garden' can only convey to the public an erroneous idea of the objects aimed at, whilst even to foresters the use of the term is liable to considerable misunderstanding. In parts of the Continent the term 'forest garden' is applied to the demonstration area attached to a forest school. This area is maintained, partly as a botanical partly as a forestry one, for educational purposes. Groups of plants and shrubs are grown, often in strict botanical divisions; types of different species of trees may be maintained in an arboretum; and, lastly, experimental plots of trees, indigenous and exotic, are grown for the purposes of study and obtaining statistical data so far as the local factors admit. Such a centre is a true forest garden, and is so understood by foresters in many parts of the world.

The nomenclature of British forestry is still in its infancy. It may be suggested therefore that a more appropriate term than 'forest garden' might be decided upon for so important a piece of work as that carried on at the Observation Statistical Centres maintained in the British Isles. These are five in number, and the work inaugurated at each is now made available to the public in "Forestry Commission Bulletin (No. 12), Forest Gardens (1931)". The bulletin has been prepared by Mr. J. MacDonald, research officer (Scotland), partly from notes taken by himself, partly from published data. The vice-chairman of the Forestry Commission (Sir R. L. Robinson), in a foreword, gives a brief history of the forest gardens, five in number: Cockle Park, near Morpeth, Northumberland; Cirencester, Gloucestershire; Abbotswood, Forest of Dean, Gloucestershire; Alice Holt, Hampshire; and Ceiriog, Denbighshire. The areas vary in size from three acres at Alice Holt, where there are only five plots, to fifty acres at Ceiriog, with more than fifty plots and groups. The value of plots of this nature was pointed out by the Departmental Committee on Forestry, the report of which appeared in 1902. At this time only the Cockle Park area existed, planted in 1898–99 by Sir William Somerville, at that time director of the Station. There is considerable variation in the growth of some of the plots owing to the soil conditions of the areas chosen not being uniform. Cirencester plots were planted in 1903–4 and 1904–5, under the supervision of Mr. F. C. McLellan, in connexion with the Royal Agricultural College, Cirencester, thus following Sir William Somerville's example, the Cockle Park areas being designed for the benefit of the students of Armstrong College, Newcastle-upon-Tyne. The conditions at Cirencester are as nearly as possible uniform.

The chief part of the Abbotswood plots was planted under the auspices of the Office of Woods between 1904 and 1909, other plots being added later. The plots are comprised in four series, covering some 43 acres, some being of very considerable interest. The Alice Holt area was also laid out for the Office of Woods by Sir William Schlich and Dr. (now Sir William) Somerville in 1908. The Ceiriog experimental plots comprise the most extensive area and are managed by the Forestry Department of the University College, Bangor. They are the property of the Denbighshire County Council. The planting was commenced in 1907 and has been continued since. The other areas of the same type are those at Bagley Wood, Oxford, and Avondale, County Wicklow, Ireland.

Reference must be made to the bulletin for a detailed description of the different plots on the various areas, the descriptions being accompanied by statistical data, height growth curves, and some excellent photographs. On the whole this brochure is entitled to rank as one of the most interesting bulletins yet issued by the Forestry Commission.

Insect Relations of Plant Virus Diseases.

A MASTERLY review of the present stage of our knowledge of the relations between plant virus diseases and insect vectors has recently appeared. The author is Dr. Kenneth Smith of Cambridge, and the paper is entitled "Virus Diseases of Plants and their Relationship with Insect Vectors" (*Biological Reviews*, vol. 6, No. 3, July 1931, pp. 302-344). A survey of all the virus diseases yet described is first given, and all information as to their insect vectors, if any are known, is brought together. The amount of information passed under review is so large and the conclusions drawn from a consideration of it are so important that it seems advisable to give them in considerable detail.

Biting insects (Coleoptera and Orthoptera) are responsible for the spread of only one or two viruses, and the transfer is considered to be purely mechanical. Sucking insects, on the other hand, transmit many virus diseases, and the aphid *Myzus persicae* Sulz. has been known to spread fourteen viruses. A close relation between the virus and the sucking insect is usually demonstrable. There is a close specificity between the insect and its particular virus or viruses. An insect which becomes disease-transmitting does so only at the end of a short period after its feeding on a diseased plant; it is not, as a general rule, diseased or malformed itself and often retains its power to transmit until it dies. The power of transmitting a virus is not transmitted to the progeny. Male and female seem to have equal facility to become vectors, with the possible exception of the streak disease of maize, where there exists a difference between the sexes. Individual differences between the members of a species or strain exist, and there may be one or two insects which are incapable of transmitting, though all their fellows in a species or strain will spread the disease. The toxicity of an insect's saliva is not correlated with lack of power to transmit a plant virus.

The insect or the plant may be the agent in selecting a virus from a complex. Some viruses can be separated by feeding an appropriate insect on a plant infected with them, whilst a plant may take only one virus from an insect which may be transmitting two or more. The virus can in general be picked up by an insect from any part of the plant, though not always with the same facility. It is possible for an infective insect to feed on a susceptible plant without transmitting disease. A single insect is capable of becoming a vector, and takes from five minutes to six hours of feeding to acquire this faculty, and from two minutes to fourteen hours to transfer virus to a plant. Different symptoms are sometimes produced by needle inoculations from those induced by insect transfer. Insects may transmit virus from a symptomless carrier. Transmission by soil insects is considered to play a very small part in virus transmission.

The whole is an exhaustive treatment of a very complex subject, and is worthy of the attention of all workers on plant virus diseases.

University and Educational Intelligence.

CAMBRIDGE.—Prof. Albert Einstein has been appointed Rouse Ball lecturer for the year 1931–32.

At Magdalene College, Prof. David Keilin, Quick professor of biology, has been elected to a professorial fellowship.

Dr. C. G. Lamb has been re-appointed reader in electrical engineering, and Mr. T. R. B. Saunders has been re-appointed University demonstrator in engineering.

LONDON.—As the result of a consensus of opinion among representative graduates of the University, the Earl of Athlone has consented to be nominated Chancellor of the University. Other nominations have been withdrawn.

MANCHESTER.—At a special congregation on Nov. 20, the honorary degree of LL.D. was conferred upon Prof. E. Fiddes, formerly Ward professor of history, and Prof. F. E. Weiss, formerly Harrison professor of botany, on their retirement from active service and in recognition of their long and distinguished membership of the teaching staff of the University.

ST. ANDREWS.—General the Rt. Hon. J. C. Smuts, president of the British Association, has been elected Rector of the University in succession to Sir Wilfred Grenfell.

DR. J. WARD, senior lecturer in mechanical engineering at the Northampton Polytechnic Institute, London, has been appointed head of the Department of Civil and Mechanical Engineering at the Technical College, Huddersfield, in succession to Mr. J. W. Button, who is about to retire after twenty-four years' service as head of the Department.

IT is announced that the Annual Conference of the Geographical Association will be held at the London School of Economics on Jan. 6-11, 1932. The presidential address will be delivered by Sir Leslie Mackenzie on "A Health Administrator's Attitude to Geography". There will also be a discussion on historical geography, to be opened by Prof. C. B. Fawcett. Other speakers at the discussion will be Dr. J. E. Morris and Profs. F. S. Marvin and E. G. R. Taylor. Lectures are to be delivered by Mr. S. A. S. Hozayen, on the expansion of the Arabs and their contribution to geography; Mrs. H. Ormsby, on the effect of limestones on the human geography of France; Mr. J. Fairgrieve, on the use of films in teaching; Prof. P. F. Kendall, on "How Britain became an Island"; Brigadier H. S. L. Winterbotham, on new developments of the 1-in. map; and Prof. Gerhard Schott (Hamburg), on the relation of the Humboldt current to conditions on the coast of Peru. Several excursions of geographical interest have also been arranged in connexion with the Conference. There will be the usual publishers' exhibition of books, maps, and appliances, and it is hoped to have a demonstration of educational films.

Birthdays and Research Centres.

Nov. 29, 1849.—Sir AMBROSE FLEMING, F.R.S., honorary fellow of St. John's College, Cambridge, Albert Medallist of the Royal Society of Arts, fellow of University College, London, and emeritus professor of electrical engineering in the University of London.

I sent to the Congress of Physicists' meeting in Rome, on Oct. 11–18, a paper describing some researches, made during the present year, intended to ascertain if possible whether the passage of a powerful beam of light or of X-rays through a stream of moving electrons would hinder or assist it. The method adopted was to construct a Fleming thermionic valve with dull emitter filament and two wire network grid anodes, one on each side of the filament. When these anodes were kept positively charged, streams of electrons flowed from the filament to each grid. Hence, if a powerful beam of X-rays was passed transversely across the valve, the photons in this beam moved against the electron stream on one side of the filament and with it on the other. Without entering into details here, it may be said that no sensible change in the electron current on either side was found, even when the X-ray beam proceeded from a hot cathode X-ray tube with a cathode stream of 20 milliamperes. The experiments are being continued.

Nov. 29, 1859.—Sir ROBERT A. HADFIELD, Bt., F.R.S., past president of the Iron and Steel Institute and the Faraday Society; foreign associate of the National Academy of Sciences, Washington; corresponding member of the Paris Academy of Sciences; honorary foreign member of the Royal Swedish Academy, Stockholm.

In no section of science has there been more activity during the last twenty-five years than in metallurgy. In recent research on Faraday's specimens of steels and alloys made a hundred years ago, the modern metallurgist has been able to extract from these specimens (many of them weighing less than an ounce and the largest not more than five ounces) most valuable information, including full composition, by means of some five hundred chemical determinations. All this has been obtained from about 582 gm. of material. I have just completed a volume on Faraday's metallurgical researches. This book deals, among other matters, with his alloys of iron containing high percentages of platinum, rhodium, and palladium, upon which exhaustive tests have been made, showing in the case of the rhodium-iron alloy higher resistance to corrosion than any other known iron or steel alloy.

I am continuing researches made formerly with Dewar and Onnes on the effect of low temperature in increasing tenacity upon some of the iron alloys. A joint research at the University of Leyden has been undertaken by Prof. W. J. de Haas and myself, on the effect which liquid helium produces upon the tenacity of various iron and steel alloys.

One of my present researches is to ascertain whether it is possible to produce steel of high tenacity accompanied by sufficient ductility. Such material would possess about five times the strength of the latest and best mild steel containing about 0·25 per cent carbon. A steel with, say, 150 or 200 tons tenacity, and at the same time not brittle but of tough quality, would be a product of great value.

Nov. 29, 1866.—Prof. E. W. BROWN, F.R.S., professor of mathematics, Yale University, New Haven, Conn.

I am at present trying to make use of knowledge of the methods of treating gravitational problems, chiefly those of the solar system, accumulated during the past forty-five years. Lately this has led to studies in expansions, both literal and numerical, in sums of harmonic terms of various functions, but chiefly of the disturbing function. Methods for abbreviating the planetary theory form another outcome. The most important factor in the development of the gravitational history of the solar system in the remote past and remote future is, I believe, the exist-

ence of resonance relations in all such problems, and a start towards a general theory of resonance has been made. These and other developments, some already published, will be treated in a volume on the planetary theory by Prof. C. A. Shook and myself, which we hope may appear within the next twelve months. An elementary treatment of resonance with special application to the motion of a pendulum has already gone to press.

A difficult satellite problem—the motion of the eighth satellite of Jupiter—is being worked out in conjunction with Dr. D. Brouwer.

The variations in the earth's rate of rotation from year to year are being obtained with the co-operation of Dr. Brouwer and a large number of amateur and professional astronomers all over the world, by means of occultations of stars by the moon. This campaign has led to studies of the records obtained by Mr. A. L. Loomis from his Shortt clocks and oscillating crystal, which it is hoped will be continued.

During the past year a study of the problem of the prediction of an unknown planet by means of its effects on other planets has resulted in the discovery of a criterion which shows quite clearly why the existence of Neptune could be predicted and that of Pluto could not.

Nov. 30, 1858.—Sir JAGADIS C. BOSE, C.S.I., C.I.E., F.R.S., founder and director of the Bose Research Institute, Calcutta.

The results obtained at the Bose Research Institute on conduction of excitatory impulse in plants, such as *Mimosa*, demonstrate the existence of definite conducting channels between the central and peripheral parts of the leaf; direct and indirect stimulation could thus be made to act either in concordance or in opposition, which result in characteristic mechanical responses. The variation of growth induced by the stimulus of light is complicated by several factors, the individual effect of which has been determined. The modifying factors are the quality or colour of light, the energy content of the tissue, and the point of application of stimulus, constituting direct or indirect stimulation.

The characteristic effects of minute traces of indigenous plant extracts on the activity of different organs of the animal are also being investigated. Satisfactory explanation has been found of the method of capture of large quantities of fish by applying traces of certain plant extracts to the water in hill streams. Continuous records, obtained by a special automatic recorder, show that the extract has no poisonous action, but induces inactivation of the respiratory mechanism, death of the fish being due to asphyxiation.

A spectrographic method is being perfected in the Department of Chemistry of the Institute for investigating the proteolytic enzymes of plants.

Dec. 5, 1868.—Prof. A. SOMMERFELD, For.Mem.R.S., professor of theoretical physics and director of the Institute for Theoretical Physics in the University of Munich.

The electron theory of metals is being considered further with the aim of simplifying the wave mechanical treatment, especially for high temperatures. The problem of the continuous X-ray spectrum, advanced in *Ann. der Phys.*, 1931, is being studied in certain details and applied to questions of astrophysical interest. The problem of the scattering of slow electrons, treated by Allis and Morse in *Zeit. für Phys.*, 1931, is being extended to atoms of greater atomic number and to protons. The experimental researches of Dr. Kirchner concerning electron diffraction and the value of e/m are being continued.

Societies and Academies.

LONDON.

Royal Society, Nov. 19.—J. E. Barnard and W. J. Elford: The causative organism in infectious ectromelia. Appendix—filtration experiments with virus of infectious ectromelia. From mice infected with the virus of infectious ectromelia, minute bodies have been obtained, both from characteristic inclusion-bodies and by differential filtration of infective organ extracts, which are shown, in ultra-violet photomicrographs, to be minute, coccoid micro-organisms. Evidence is given that these organisms are the virus. —V. B. Wigglesworth: The extent of air in the tracheoles of some terrestrial insects. In the flea, mealworm, cockroach, and bed-bug, the tracheal endings normally contain fluid, as in the mosquito larva. This fluid is removed after active muscular contraction, but *not* during prolonged fasting under dry conditions. This suggests that the osmotic pressure of the blood of these insects is maintained during life at a more or less constant level (see NATURE, Feb. 28, p. 307).

Royal Meteorological Society, Nov. 18.—J. Edmund Clark, Ivan D. Margary, Richard Marshall, C. J. P. Cave, and L. C. W. Bonacina: Report on the phenological observations in the British Isles from December 1929 to November 1930. Abnormal December and January warmth and excess of sunshine in December 1929 and November 1930 made very partial amends for almost continuous adverse conditions in between, save only in June and the brief spell of glorious harvest weather which ended August. Hence for farm and garden conditions were, as a rule, bad. Spring flowers in southern parts were almost a week late. But the floral isophenes are naturally much nearer normal than in 1929. The corresponding isakairs are early mainly over southern Scotland and north-west Ireland; they are latest in west Ireland, central Highlands, and scattered English areas. Insects and birds were late.—Sir Gilbert Walker and A. C. Phillips: The forms of stratified clouds: Part 1, Experimental. Part 2, Discussion. In continuation of experimental work on vertically unstable liquids by E. H. Weber, Bérnard, Idrac, and Mal an examination was made of the patterns set up in a heated liquid moving along a rectangular trough. As this did not produce vortices with their axes at right angles to the flow, recourse was had to unstable air flowing along a small wind-channel, the motion being indicated by fumes of titanium tetrachloride. By suitable increases of velocity, from zero, the patterns produced were polygons, transverse vortices, crossed vortices, and longitudinal vortices, the resemblance to clouds being more obvious than when liquids were used.—William Dunbar: Eighty years' rainfall at North Craig Reservoir, Kilmarnock. All but one of the dry years occur during the first forty years, while the majority of the wet years occur in the second half of the eighty-year period. The first forty years of the period were drier than the second forty. Comparing the North Craig figures with those of a gauge in the east of Scotland, and with the average for Scotland, it is suggested that the west is becoming wetter and the east drier.

Physical Society, Nov. 20.—Miss F. Lowater: The band spectrum of zirconium oxide. The spectrum has been photographed from λ2600 to λ8800, and bands have been found to extend from λ3200 to λ7600. The most prominent bands have been analysed into three systems, all having the same lower electronic state. Analysis of the remaining bands is in progress. —W. A. Wood: Lattice-distortion of cold-drawn

constantan wire. A method is described for determining the variation in distortion quantitatively as constantan wire is cold-drawn, and the variation across the section of the wire during the drawing. Distortion increases quickly to a steady maximum, which is maintained despite further drawing; orientation does not begin until the maximum distortion appears; just below the surface in the less drawn wires is a region of diminished distortion, but as the wire is further drawn the degree of distortion evens out across the section (this is explained in terms of the action of the die on the surface); the temperature-coefficient of electrical resistance exhibits changes in drawing similar to the variation in distortion, and the two properties are practically proportional.—**F. Aughtie**: (1) A remote electrically recording accelerometer with particular reference to wheel-impact measurements. The instrument was developed for the measurement of the acceleration of the rear axle of a vehicle. It was necessary for the recording to be done remotely in order accurately to phase three records, two of acceleration and one of spring load. A new method of remote recording has been developed for the purpose. —(2) A remote electrically recording load-gauge for wheel-impact measurements. The load-gauge designed for measuring that component of the wheel-load which arises from the spring weight is described. —**E. V. Appleton** and **G. Builder**: Wireless echoes of short delay. An account of a simple method of producing short pulses of radio-frequency energy is given, with notes on its application in the investigation of wireless echoes of short delay. The discussion of sample records and results serves as a basis for drawing conclusions concerning the relative advantages of the frequency-change and group-retardation methods of investigating the ionised regions of the upper atmosphere.

PARIS.

Academy of Sciences, Oct. 19.—**H. Douvillé**: Some examples of evolution. In the course of work on the lamellibranchs, examples of sudden modification involving the appearance of new transmitted characters have been observed. One of the best characterised marks the origin of the Rudists. Other instances of the influence of the mode of living on the constitution of the shell are given.—**H. Vincent**: New researches on the cryptotoxins. The phenomenon of the supersaturation of the toxins by the salicylic ion. The toxin has the property of actively fixing a large quantity of salicylic acid, largely in excess of the inhibiting dose. There is supersaturation of the toxin by the chemical antibody.—**E. Mathias**: The usefulness of long periods of observation of the rainfall in a given place. A direct relation between deforestation and rainfall is proved by two sets of observations at Ambert and at the summit of the Puy-de-Dôme.—**L. Cuénot**: The athrocytary function in the Hirudineæ.—**E. Pinte**: The geometry of Hilbertian space. —**O. Boruvka**: The hypercircumferences and certain parabolic surfaces in four dimensional Euclidian space. —**F. Tricomi**: A differential equation of electrotechnics.—**G. Cerf**: A generalisation of Monge's problem.—**M. Ghermanesco**: The fundamental solutions of the *n*-metaharmonic equation.—**Florin Vasilesco**: The method of the *balayage* and the conductor potential of an ensemble.—**Al. Proca**: First integrals of Dirac's equation.—**D. Riabouchinsky**: The different forms of movements capable of being reproduced by the method of coloured threads between two surfaces, whether parallel or not, sufficiently close together.—**G. Blum**: Measurements of the photochemical energy of the moon obtained during the total eclipse of Sept. 26, 1931.—**J. J. Trillat** and **Th. v. Hirsch**: The diffraction of electrons by a single crystal.—**R. de Mallemann**: Molecular polarisation.—**P. Vaillant**: The constitution of solutions deduced from absorption measurements. From the spectrophotometric examination of a series of solutions of cobalt chloride it is concluded that the optical properties, although independent of the density of the chlorine ions in the medium, are slightly influenced by the simultaneous presence of foreign cations.—**R. Freymann**: The study of some liquid absorption spectra in the infrared by means of a photoresistant cell.—**L. Dubar**: The sensibility of cuprous oxide photoelectric cells, of the type with copper grid. Comparison with the optical absorption and the photoconductivity of cuprous oxide. The experimental results are given graphically and show the variation of the photoelectric current with the wave-length of the incident radiations. The sensibility of these cells falls rapidly as the temperature of the cell rises, the e.m.f., with constant illumination, falling at 60° C. to eight per cent of its value at 15° C.—**N. Thon** and **J. Pinilla**: The deposit potentials of copper in complex solutions of cuprous halides.—**W. Swietoslawski** and **Mlle. L. Wajcenblit**: The ternary heteroazeotrope formed of carbon disulphide, acetone, and water. This contains carbon disulphide, 75·21 per cent; acetone, 23·98 per cent; water, 0·81 per cent, and boils at 38·042° C. under normal pressure.—**J. Wyart**: The crystalline networks of thomsonite and of mesotype.—**Victor Babet**: The geology of the basins of Haut Niari, Bouenza, and Haut Ogooué (French Equatorial Africa).—**Edouard Chatton, André Lwoff**, and **Mme. Marguerite Lwoff**: The infraciliary origin and the genesis of the trichocysts and trichites in the Fœttingeriideæ.—**Ch. Dhéré** and **J. Roche**: The fluorescence and especially the fluorescence spectra of pigments of the urobilin group.—**A. Paillot**: Bacterial parasitism and symbiosis in *Aphis atriplicis*.

SYDNEY.

Linnean Society of New South Wales, Aug. 26.—**T. G. B. Osborn, J. G. Wood**, and **T. B. Paltridge**: The autecology of *Stipa nitida*: a study of a fodder grass in arid Australia. Observations were made on correlation between soil type and the root system, the nature of the seed bed, and the conditions favouring germination of the seed. The influence of grazing has been studied by means of an extensive quadrat system both inside the Reserve and also in the adjacent paddocks, so that it has been possible to compare the entirely protected plants of the Reserve and those outside which have been subject to different intensities of grazing. The results of the investigation show that only by careful control of grazing during drought periods can the population of *Stipa* plants be maintained. In an area that shows degeneration of the plant cover, material benefit to the *Stipa* population is derived by leaving the area ungrazed for one or two years.—**G. H. Cunningham**: The Gasteromycetes of Australasia. (13) The genus *Pisolithus*. In structure this genus is closely related to *Scleroderma*, and is therefore grouped under the family Sclerodermaceæ of the Gasteromycetes. The genus is represented in this biological region by the two species, *Pisolithus tinctorius* and *P. microcarpus*, the former having a wide distribution through the hotter parts of the world, the latter being confined to Australia.—**J. R. Malloch**: Notes on Australian Diptera. A résumé of the known Australian members of the Piophilidæ, description of a new genus of Helomyzidæ, and some data on certain genera of Tachinidæ. The recorded occurrence of *Catharosia* is also dealt with on the basis of the material upon which it was included in the Australian list.

Diary of Societies.

FRIDAY, NOVEMBER 27.

ROYAL SANITARY INSTITUTE (at Town Hall, Sheffield), at 3.
ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 3.15.
DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall), at 3.30.
ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 4.30.
ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.
MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section) (at 36 George Street, Manchester), at 7.
INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.
MANCHESTER ASSOCIATION OF ENGINEERS (at Engineers' Club, Manchester), at 7.15.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.
ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.

SATURDAY, NOVEMBER 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.

MONDAY, NOVEMBER 30.

ROYAL SOCIETY, at 4.—Anniversary Meeting.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.
ROYAL SOCIETY OF ARTS, at 8.—Howard Lecture.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

TUESDAY, DECEMBER 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.
INSTITUTION OF CIVIL ENGINEERS, at 6.
LONDON NATURAL HISTORY SOCIETY (Annual General Meeting) (at London School of Hygiene and Tropical Medicine), at 6.30.—President's Address.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members' and Graduates' Section) (at Borough Polytechnic), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.
INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.
INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.30.
INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.45.
BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College).—Annual General Meeting at 8.15; Ordinary Meeting at 8.30.

WEDNESDAY, DECEMBER 2.

ROYAL SOCIETY OF MEDICINE (History of Medicine Section), at 5.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.
INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.
INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at 20 Hart Street, W.C.1), at 7.
ALCHEMISTS' CLUB (jointly with Glasgow Geological Society) (at Westerlands, Glasgow), at 7.30.
INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Queen's Hotel, Birmingham), at 7.30.
SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.
ROYAL SOCIETY OF ARTS, at 8.
ROYAL PHILOSOPHICAL SOCIETY OF GLASGOW (at 207 Bath Street, Glasgow), at 8.
ROYAL SOCIETY OF MEDICINE (Neurology and Surgery Sections), at 8.30.
ROYAL MICROSCOPICAL SOCIETY (Biological Section) (at B.M.A. House).

THURSDAY, DECEMBER 3.

LINNEAN SOCIETY OF LONDON, at 5.
CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.
INSTITUTION OF STRUCTURAL ENGINEERS (at Hotel Metropole, Leeds), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Nottingham Section) (at University College, Nottingham), at 7.30.
CHEMICAL SOCIETY, at 8.
ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology and Therapeutics and Pharmacology Sections), at 8.
SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group) (jointly with Bristol Section) (at Bristol).

FRIDAY, DECEMBER 4.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.
ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botany Department, Imperial College of Science and Technology), at 2.30.—Discussion on Laboratory Methods as a Means of Testing the Value of Chemical Substances for the Control of Injurious Fungi.
ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir George Birdwood Memorial Lecture.
ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 5.
PHYSICAL SOCIETY (at Imperial College of Science and Technology), at 5.
SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.
INSTITUTION OF ELECTRICAL ENGINEERS (Meter and Instrument Section), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at Engineers' Club, Manchester), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.
JUNIOR INSTITUTION OF ENGINEERS (at Royal Society of Arts), at 7.30.—Dr. S. L. Pearce: Presidential Address.
GEOLOGISTS' ASSOCIATION (at University College), at 7.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.

SATURDAY, DECEMBER 5.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.
GILBERT WHITE FELLOWSHIP (at 6 Queen Square, W.C.1), at 3.

Public Lectures.

FRIDAY, NOVEMBER 27.

LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE, at 5.—Prof. L. Hogben: Genetic Principles in Medicine and Social Science. (Succeeding Weekly Lectures in Michaelmas Term and in Lent Term beginning on Jan. 15.)

SATURDAY, NOVEMBER 28.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss I. D. Thornley: Pilgrims of Medieval England.

MONDAY, NOVEMBER 30.

KING'S COLLEGE, LONDON, at 5.30.—Prof. M. Polanyi: Atomic Reactions. (Succeeding Lectures on Dec. 2 and 4.)

TUESDAY, DECEMBER 1.

UNIVERSITY OF MANCHESTER, at 5.15.—Prof. G. Dawes Hicks: The Philosophy of Religion (Hibbert Trust Lectures). (Succeeding Lectures on Dec. 2, 8, and 9.)

WEDNESDAY, DECEMBER 2.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Prof. H. R. Kenwood: The Health Education of the Citizen.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4.—Prof. F. W. Twort: The Future of Bacteriological Research (Brown Institution Lecture). (Succeeding Lectures on Dec. 4, 7, 9, and 11.)
BELFAST MUSEUM AND ART GALLERY, at 8.—Prof. W. J. McCallister: Adult Education.
UNIVERSITY OF OXFORD.—Prof. Freundlich: The Deflection of Light in the Sun's Gravitational Field (Sumatra, 1929).

THURSDAY, DECEMBER 3.

SCIENCE MUSEUM, SOUTH KENSINGTON (in connexion with Exhibition of Modern Glasses), at 4.45.—J. W. Wilson: Safety Glass.

INSTITUTION OF MECHANICAL ENGINEERS.—J. D. Watson: The Need for More Effective Treatment of Sewage Sludge (Chadwick Lecture).

SATURDAY, DECEMBER 5.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth-Davis: Insect Pests and their Enemies.

Congress and Exhibition of Apparatus.

DECEMBER 2 TO 4.

BRITISH INSTITUTE OF RADIOLOGY (at Central Hall, Westminster).

Wednesday, Dec. 2, at 2.30.—Lord Rutherford: Official Opening.

At 3.30.—Prof. F. Haenisch: Experiments upon the Inflammability of Films (Cinematograph Film).

At 5.—Sir James Jeans: What is Radiation? (Silvanus Thompson Memorial Lecture).

Thursday, Dec. 3, at 10 A.M.—Dr. G. Grossman: Advances in X-ray Engineering with Special Reference to High Potentials.

Dr. A. Bouwers: Economy and Quality in Radiology.

Dr. O. Bloch: The X-ray Emulsion.

W. E. Schall: Power Factor in Radiography.

C. G. Osment: Experimental Radiography Utilising the Gamma Rays of Radium.

At 3.—Dr. R. G. Canti: The Effects of Radium on Living Tissues cultivated *in vitro* (Cinematograph Film).

At 5.—Prof. H. Holfelder: Comparison of Medical, Surgical, and Radiological Conceptions in Relation to the Treatment of Disease (Mackenzie Davidson Memorial Lecture).

Friday, Dec. 4, at 10 A.M.—Discussion: The Radiation Treatment of Leukæmia.

At 11.30 A.M.—Discussion: Lipiodol in the Diagnosis of Inthrathoracic Disease.

At 3.—The Third International Congress of Radiology, Paris, 1931 (Cinematograph Film).

At 5.—Dr. A. E. Barclay: Presidential Address.

Official Publications Received.

BRITISH.

Proceedings of the Royal Society. Series A, Vol. 133, No. A822, October 1. Pp. 351-695+xiv. (London: Harrison and Sons, Ltd.) 18*s.*

The Year's Photography, 1931-1932. Pp. 22+xlvi+75 plates. (London: Royal Photographic Society of Great Britain.) 2*s.* 6*d.*

International Federation of University Women. Bulletin No. 13: Report of the Sixteenth Council Meeting, Wellesley, April 1931. Pp. 43. (London.)

The Smoke Abatement Handbook, 1931. Pp. 48. (Manchester: National Smoke Abatement Society.) 6*d.*

Colony and Protectorate of Kenya. Forest Department Annual Report, 1930. Pp. 27. (Nairobi.) 1*s.*

Tanganyika Territory. Tsetse Research Annual Report for the Year ended 31st December 1930. Pp. iii+48+7 plates. (Dar es Salaam: Government Printer.)

Journal of the Indian Institute of Science. Vol. 14A, Part 5: Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.). Part 12: Ecology of Sandal. By M. Sreenivasaya and S. Rangaswami. Pp. 59-65. (Bangalore.) 8 annas.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 50: The Poisonous Action of Ingested Saponis. By Prof. Alfred J. Ewart. Pp. 28. Pamphlet No. 20: The Identification of Wood by Chemical Means, Part 1. By H. E. Dadswell. (Division of Forest Products, Technical Paper No. 1.) Pp. 16. Pamphlet No. 21: The Density of Australian Timbers, a Preliminary Study. By H. E. Dadswell. (Division of Forest Products, Technical Paper No. 2.) Pp. 16. Pamphlet No. 22: The Chemistry of Australian Timbers. Part 1: A Study of the Lignin Determination. By W. E. Cohen and H. E. Dadswell. (Division of Forest Products, Technical Paper No. 3.) Pp. 27. (Melbourne: H. J. Green.)

Straits Settlements. Annual Report of the Education Department for the Year 1930. By Dr. R. O. Winstedt. Pp. ii+67. (Singapore: Government Printing Office.)

Anthropological Bulletins from the Zoological Survey of India. Bulletin No. 1: A Report on the Human Relics recovered by the Naga Hills (Burma) Expedition for the Abolition of Human Sacrifice during 1926-27. By Dr. B. S. Guha and P. C. Basu. Pp. 68+22 plates. (Calcutta.) 1.12 rupees; 3*s.*

Union of South Africa: Department of Mines and Industries: Geological Survey. Memoir No. 27: A Bibliography of South African Geology for the Years 1926 to 1930 (Inclusive). Author's Index. By Dr. A. L. Hall. Pp. 160. (Pretoria: Government Printing Office.) 5*s.*

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 1, No. 4: The Electric Field in Terrestrial Magnetic Storms. By A. H. R. Goldie. Pp. 143-177. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 4*s.* 6*d.*

Memoirs and Proceedings of the Manchester Literary and Philosophical Society, 1929-30. Vol. 74. Pp. iv+111+lii. (Manchester.) 12*s.*

Bradford Education Committee. Journal of Research of the Bradford Technical College: a Series of Papers dealing with Investigations undertaken by Members of the Technical College, Bradford. Vol. 1, 1930. Pp. xii+295. (Bradford.)

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1931; with Appendices. Pp. 45. (London: H.M. Stationery Office.) 9*d.* net.

Transactions of the Institution of Chemical Engineers. Vol. 8, 1930. Pp. 232. (London.)

The Scientific Proceedings of the Royal Dublin Socitey. Vol. 20, N.S., Nos. 8-12: Award of the Boyle Medal to Sir John Purser Griffith; A Study of Bacteria belonging to the Sub-genus *Aerobacter*, by M. Grimes and A. J. Hennerty; Report of the Irish Radium Committee for the Year 1930; On a Method of distinguishing the Seedlings of Swedish Turnip (*Brassica napus* L. var. *Napobrassica* (L.) Reichb.) from those of Rape (*Brassica napus* L. var. *Biennis* (Schübl. et Mart.) Reichb.), by M. J. Gorman and A. J. Hennerty; The Influence of the Work of Sir William Rowan Hamilton on Modern Mathematical Thought, by Prof. A. W. Conway. Pp. 85-128. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 3*s.*

The Journal of the Institution of Electrical Engineers. Vol. 69, No. 418, October. Pp. 1189-1328+xx. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

FOREIGN.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol. 19: Pour l'année 1929. Pp. 81. 3.25 kr. Rapports et procès-verbaux des réunions. Vol. 74: Procès-verbaux (Mars 1931). Pp. 203. 7.75 kr. Vol. 75: General Marine Physiology; Conditions of Growth of Phytoplankton. Reports of the Proceedings of a Special Meeting held on March 27th, 1931, at Copenhagen. Pp. 70. 2.75 kr. Vol. 76: The Mixing Question, viewed Theoretically and Practically, together with a Consideration of Internal Waves. Reports of the Proceedings of a Special Meeting held on March 27th, 1931, at Copenhagen. Pp. 62. 2.50 kr. (Copenhague: Andr. Fred. Høst et fils.)

Bulletin of the National Research Council. No. 83: A Compendium of the Statute Law of Coroners and Medical Examiners in the United States. Issued under the Auspices of the Committee on Medicolegal Problems. By George H. Weinmann. Pp. 240. 3 dollars. Reprint and Circular Series of the National Research Council. No. 97: The Committee on State Archaeological Surveys of the Division of Anthropology and Psychology, National Research Council. By Carl E. Guthe. Pp. 9. 15 cents. No. 98: Report of the Committee on Sedimentation, 1929-1930. Pp. ii+97. 1 dollar. No. 99: Bibliography of Acoustics of Buildings. By F. R. Watson. Pp. 31. 50 cents. No. 100: In Quest of Glacial Man; a Plan of Cooperation between Excavators and the Representatives of the Sciences of Man and of the Earth. Prepared by Madison Bentley. Pp. 20. 40 cents. No. 101: Doctorates conferred in the Sciences by American Universities, 1930-1931. Compiled by Callie Hull and Clarence J. West. Pp. 55. 50 cents. (Washington, D.C.: National Academy of Sciences.)

Journal of the Faculty of Science, Hokkaido Imperial University. Series 2: Physics. Vol. 1, No. 2: Further Studies on the Striated Electric Discharge Figure. By Tadasi Itoh. Pp. 77-85+2 plates. Series 4: Geology and Mineralogy. Vol. 1, No. 2. Pp. 113-255+18 plates. (Sapporo.)

Abisko Naturvetenskapliga Station. Observations météorologiques à Vassijaure. 6, 1911. Exécutées et rédigées par Fritz Hallberg. Pp. iv+68. 7, 1912. Exécutées et rédigées par Fritz Hallberg. Pp. iii+66. (Stockholm.)

Philippine Earthquake Epicentres (1920 to 1929) North of Latitude 14° 30′. By the Rev. William G. Repetti. Pp. 69-95. (Manilla: Bureau of Printing.)

Journal of the Federated Malay States Museums. Vol. 8: Results of an Expedition to Korinchi Peak, 12,400 ft., Sumatra. Part 3: Invertebrates. Pp. 205-225. (Kuala Lumpur.)

Federated Malay States. Annual Report of the Education Department for the Year 1930. By Dr. R. O. Winstedt. Pp. ii+58. (Kuala Lumpur: Government Press.)

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 14, No 3, May. Pp. 79-130. 1.20 yen. Series B, Vol. 6, No. 4, June, Article 6: Über die Beeinflussung des Wachstums des Mesokotyls und des Koleoptile von *Avena*-Keimlingen durch das Licht. Von Hideo Hamada. Pp. 161-238. (Tokyo and Kyoto: Maruzen Co., Ltd.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 7, No. 3, September, Research Papers Nos. 348-360. Pp. 419-615. (Washington, D.C.: Government Printing Office.)

Bulletin of the University of Wisconsin. Serial No. 1760, General Series No. 1534: A Method of making Short Traffic Counts and Estimating Traffic Circulation in Urban Areas. By Prof. Franz A. Aust, Prof. H. F. Janda, assisted by John R. Campbell and Robert S. Harrison. Pp. 57. (Madison, Wis.)

Proceedings of the United States National Museum. Vol. 79, Art. 17: A New Species of Trematode of the Family Heterophyidae, with a Note on the Genus Apophallus and related Genera. By Emmet W. Price. (No. 2883). Pp. 6. (Washington, D.C.: Government Printing Office.)

CATALOGUE.

The Cannon House Catalogue of Scientific Books and Serial Publications (Transactions, Journals, Periodicals). (N.S. No. 5.) Pp. 96. (London: Wm. Dawson and Sons, Ltd.)