



SATURDAY, SEPTEMBER 10, 1932

CONTENTS

	PAGE
Problems in the Advancement of Archæology	377
The Biology of Snakes and Amphibia. By Hugh B. Cott	379
A Physiologist looks at Wild Animals. By Dr. John R. Baker	380
Artificial Resins. By E. F. A.	381
The Enjoyment of Nature	382
Short Reviews	383
Radio Observations during the Total Solar Eclipse of Aug. 31	385
Current Constructive Theories in Psychology. By Prof. Beatrice Edgell	388
Obituary:	
Mr. E. Edser	391
News and Views	392
Letters to the Editor:	
Altitudes to be Reached by Air Pilots by Breathing Oxygen.—Sir Leonard Hill, F.R.S.	397
The Practice of Dental Mutilation.—Prof. G. Elliot Smith, F.R.S.	397
Ionisation by Positive Ions.—Prof. J. S. Townsend, F.R.S., and F. Llewellyn Jones	398
Polarisation of Echoes from the Heavyside Layer.—T. L. Eckersley	398
Evidence of a Penetrating Radiation from Thunderstorms.—Dr. B. F. J. Schonland, O.B.E., and J. P. T. Viljoen	399
Viscosity of Nitrobenzene.—A. Van Itterbeek	399
Orienting Power of the Nitroso-Group and the Formula of Nitrosobenzene.—Dr. R. J. W. Le Fèvre	400
Constitution of the Keratin Molecule.—Dr. Claude Rimington; Dr. J. B. Speakman	401
Preparation of Methyl <i>d</i> -Galacturonide.—Prof. Karl Paul Link	402
Prolongation of Pregnancy.—Dr. A. M. Hain	402
Nuclear Magnetic Moments.—Dr. S. Tolansky	402
New Infra-Red Bands Photographed in the Absorption Spectrum of Acetylene.—Dr. W. Lochte-Holtgreven and E. Eastwood	403
Nuclear Structure.—Dr. Harold C. Urey	403
Oogenesis in the Indian Earthworm.—U. S. Sharga	403
Research Items	404
Astronomical Topics	406
The New Botanical Building at the University of Toronto	407
Plant Products of the British Empire	408
Electricity Supply in New York	408
University and Educational Intelligence	409
Calendar of Geographical Exploration	409
Societies and Academies	410
Forthcoming Events	412
Official Publications Received	412

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.

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Telephone Number: City 1266

No. 3280, Vol. 130]

Problems in the Advancement of Archæology

IT is some time since anyone so closely identified with field archæology as Dr. Randall-MacIver has presided over 'Anthropology' at an annual meeting of the British Association for the Advancement of Science. It was, therefore, not without wisdom that Dr. Randall-MacIver elected to make in his presidential address a comprehensive survey of the practical problems and relations of archæological science as it stands to-day, rather than to deal with the results of recent research or of some specific investigation. Yet more than the mere passing of time called for some pronouncement on general principles in matters which have seemed to him to require comment. In the last decade archæological method and technique have developed rapidly; while the range of archæological activity has been extended enormously in many directions both in time and space. Areas which were once regarded as widely separated and studied in isolation, are now often viewed as links in a single chain. No longer can the methods and aims of archæological investigation in any country be regarded as of little concern to those who stand outside the national boundary. The field of archæological studies, in fact, has undergone, and is still undergoing, a process of unification which gives a peculiar significance to any pronouncement on the organisation and administration of research which is put forward with the authority of a presidential chair of a section of the British Association.

Dr. Randall-MacIver admitted that to some extent he had been influenced in his choice of subject by the example of his predecessor in the chair. Prof. Radcliffe-Brown last year, it will be remembered, reviewed the methods of field work in ethnography and its relation to the problems in synthesis of the comparative worker. The two branches of investigation in the field have this in common, that they now make heavier demands than ever before on the technical equipment of the investigator. The development of both ethnography and archæology owe much to the amateur; but in neither does investigation stand any longer at the stage at which the field notes or the rough spadework of the passing traveller are likely to make any contribution of lasting value to the respective branch of science in which he is interested. At best they may point the way to the skilled and trained investigator. This is not a question of amateur *versus* professional—it is to be hoped that research in Great Britain, which owes so much to

the amateur, will never be debarred to him—but of the trained man, amateur or professional, against the untrained.

In laying it down as a principle which should be universally recognised, that none but a properly accredited and trained archæologist, approved and supported by a group or committee of experts, should be permitted to excavate any site whatsoever, Dr. Randall-MacIver opens up a whole nexus of problems that confront modern archæology and its future development.

The more recent legislation for the protection of ancient monuments in Great Britain admittedly represents a great advance, and has gone some way towards ensuring the skilled excavation of valuable sites. On the other hand, the British Parliament is still sufficiently individualistic in its way of thinking to admit private rights of ownership which are not always in the best interests of the community in the long run, especially when they endanger evidence which might be invaluable to the future archæologist and historian.

Dr. Randall-MacIver's suggestion that part of a site upon which excavations are being made, or are in contemplation, should be set aside for future investigation, after some more or less lengthy period has elapsed, in the light of more fully developed knowledge—a suggestion, by the way, which was made by Sir Flinders Petrie some years ago—is a counsel of perfection which perhaps few investigators would have the strength of mind to follow without the restraint of superior authority behind them. That all, however, are not without some measure of self-denial in the face of posterity is indicated by the recent example of Mr. Alexander Keiller, at Windmill Hill, who, as recently announced, has reserved part of his valuable Early Bronze Age site for a future generation.

The practice of different countries in relation to their ancient monuments is far from uniform. Nor can it be said that vigilance is exercised everywhere in an equal degree in securing the observance of regulations. In some cases legislation, excellent in intention, fails in its object through laxity in translating its provisions into action. France, for example, would appear a case in point, at least until recently, according to the statement of French archæologists themselves. In this connexion, and in addressing a warning of the dangers ahead to those countries in which archæological investigation has scarcely attained the stage even of infancy, Dr. Randall-MacIver has two interesting suggestions to offer. One, an international question, is the formation of something in the nature of an archæo-

logical Court of Appeal—a scientific League of Nations; and the other, a concern of each country individually, but of enormous moment to archæological science at large, deals with control of the sale of antiquities—one of the strongest incentives to the private owner's destructive activities. Both classes of problem are difficult enough, though on paper it is perhaps the lesser which presents the greater difficulty in the tangle of conflicting interests impeding any straightforward solution.

It is not to the purpose here to enumerate or discuss the many problems of State regulation of archæological investigation on a nationalist basis. They are many and varied. That, in the interests of the advancement of archæological science, uniformity in dealing with them, according to the most advanced knowledge of the day, is urgently demanded, is a matter of common opinion in archæological circles. The suggestion of an archæological League of Nations, perhaps, may have reminded some of Dr. Randall-MacIver's audience of the relation of the League of Nations to matters other than political, and of the existence of a Committee for Intellectual Co-operation. On the other hand, a body less cumbrous to move and in closer touch with the actual situation in many, if not all, of its aspects, is the recently inaugurated International Congress of Prehistoric Sciences, which, although it will come into existence at intervals only, has provided, by the institution of research committees, a machinery for at least the initial stages of exploration of the problem.

The difficulty of dealing with the sale of 'curios' to the collector lies at the root of the greater number of the unauthorised or unskilful exploitations of the sites of antiquity. Were it possible to divert the stream of gold which pours into the pockets of the unscrupulous dealer, much of the destruction of valuable evidence which goes on, especially in the East, would cease automatically. On the other hand, the institution of official 'curio' shops for the sale of museum duplicates on the lines of that in Egypt, to which Dr. Randall-MacIver referred, to be effective would have to be a monopoly, and while it certainly would add materially to the revenue of the museums, which are never—at least, on the basis of their own calculations—liberally financed, would open the way to a number of abuses which it would be difficult to check. In Great Britain, the more liberal law of treasure trove, a genuine, if restricted, interest in the origin and history of finds among the artisan and agricultural classes, and the system of the loan of duplicates by the museums, meet the more serious

difficulties which Dr. Randall-MacIver has in mind. It must be admitted, however, that only rarely in Great Britain do we find antiquities of sufficient intrinsic value or of such obvious interest as to tempt the unscrupulous. But Great Britain's support, if only through the wide geographical distribution of her archæological interests, would be a potent factor in securing action on a common basis in those countries in which the question is one of more vital concern. May we add that the creation of a conscience in the collector offers a field for missionary effort to the ardent archæologist.

Dr. Randall-MacIver is no respecter of persons in his criticism, and he does not hesitate to chide the museums which press their excavators for impressive specimens to add to their collections, without thought of the value of the insignificant (in the museum display sense) for the purposes of science. In this matter we should perhaps recognise extenuating circumstances for those museums which must depend for their existence on the generosity of subscribers.

In connexion with museum excavations, reference was made to what, from the archæologist's point of view, is an evil almost equally grave—the delay in publication of results, a fault to which not archæological institutions alone are prone. It is impossible to say how far delay in making available material for comparative study may have hampered advance in archæological studies. The example of Sir Flinders Petrie, who for many years has made it an invariable rule to publish his results within the shortest time possible after his return to England in each year, shows that this is no impossible ideal, in so far as nothing more than a record of facts observed is required of the excavator in the first instance. A time limit for initial publication might well be a condition of any permit to excavate.

Dr. Randall-MacIver's presidential address raises so many points of broad general, as well as specialist, interest, that the commentary might well outrun the text in length, and yet not be exhaustive. Nothing, for example, has been said of his views on the relation of archæology as a science to other branches of the study of man. Yet to the archæologist of the future this offers both a guide and a warning. Unless the study, one of well-defined and rigid limitations in method, be followed in the spirit which Dr. Randall-MacIver advocates, a spirit of liberal co-operation with other disciplines, it risks a specialisation as arid and as sterile as the antiquarianism it has superseded. Of this, however, with our present school of workers in the field, there is little danger.

The Biology of Snakes and Amphibia

(1) *The Biology of the Amphibia*. By Dr. G. Kingsley Noble. (McGraw-Hill Publications in the Zoölogical Sciences.) Pp. xiii + 577. (London: McGraw-Hill Publishing Co., Ltd., 1931.) 30s. net.

(2) *Snakes of the World*. By Dr. Raymond L. Ditmars. Pp. xi + 207 + 85 plates. (New York: The Macmillan Company, 1931.) 30s. net.

(1) **I**N recent years marked changes have taken place in the outlook of biologists. Zoology must inevitably rest upon a foundation of morphology and classification; yet it is being increasingly realised that the study of animals demands for its development more fertile ground than is presented by the facts of anatomy and phylogeny. The living animal is a side of zoology which dominates to-day. Dr. Kingsley Noble strikes a distinctively modern note in the work under notice in directing attention to the physiological aspect of the subject, and he has been successful in covering the dry bones of anatomy with living flesh.

Part I. (458 pages) gives a well-balanced picture of the structure, physiology, and ecology of the various groups of Amphibia, which are considered in relation to one another and to their environment. The opening chapters deal with general problems—amphibian ancestry, the mechanics of development, evolution, and adaptation. The reader will early realise that within the limits of the class the wide variety of modifications in larval and adult forms is remarkable: members of various families have taken independently to the land for breeding purposes, and we find unrelated forms adapted respectively for crawling, swimming, leaping, burrowing, climbing, parachuting—examples of convergence which have in the past done much to confuse systematists in their attempt to arrive at a natural classification. Yet, as Dr. Noble shows in a survey of life histories (Chap. iii.), larval modifications and nursing habits frequently serve as an important guide to the affinities of species: thus the closely related *Phyllobates* and *Dendrobates* (formerly placed in separate families) are the only genera in which the males are known to carry the tadpoles on their backs.

A series of chapters on the structure and function of the vascular, digestive, nervous, and other systems considers each in some detail. Here there is a good section on the endocrine glands, embodying the result of much recent research on the important rôle played by hormones in the physiology of development, and it is interesting to note the

practical value to zoologists of the gonad-stimulating pituitary secretion, which "provides a ready means of obtaining embryological material at any time of the year". The four chapters on amphibian behaviour and ecology, written in an easy style, are informative and stimulating.

Part II. (85 pages) deals with the classification of Amphibia. Here there is a clear discussion of the mutual relationships of genera, free from an overwhelming mass of systematic detail; students who wish to pursue further this aspect of the subject are referred to the concluding bibliography of comprehensive taxonomic works. We have noticed a number of misprints, "blut", "tadpones" (p. 132), "inhabiti monguntain" (p. 167), "grog" (p. 407); and in the full index there is no reference to the treatment of neoteny on p. 294. Extensive bibliographies (of which there are some 58 pages) add much to the usefulness of the book, and the well-produced text-figures, many of them new, attain a high standard of excellence. Dr. Noble is to be congratulated upon the remarkable range of fact and theory which he has assembled in these pages, and the publishers upon a valuable addition to their "Publications in the Zoological Sciences".

(2) Snakes have claimed the attention of man from earliest times. Yet few groups of animals are so little understood by the layman, and few have been more indiscriminately persecuted. This book will help to clear away the prejudice and unreasoning hatred so generally directed against these reptiles, the majority of which are harmless to man, and many of which (by the destruction of rodents) are of economic value. Dr. Ditmars, who as curator of reptiles in the New York Zoological Park has had unique opportunities of studying the habits of serpents, combines the knowledge of a trained herpetologist with the experience of a field naturalist. He writes of snakes with authority, and the descriptions of his pets, both as captives and in Nature, are lively, informative, and intimate.

Dr. Ditmars assumes in his readers no previous acquaintance with the group. The book opens with several introductory chapters on distribution, habits, and classification. There is an interesting account of "The Giant Serpents". It is perhaps comforting to learn from an authoritative source that, in spite of the numerous reports of larger specimens, the record *proved* measurement of *Python reticulatus*—the world's longest snake—does not exceed 33 feet. Chapters vii. and viii. deal with the harmless species of the New and Old

Worlds, followed by an abbreviated account of the Opisthoglyph (rear-fanged) snakes.

The remaining, and main, portion of the book is devoted to the appearance, habits, and distribution of poisonous species. These chapters contain some useful information on the treatment of snake-bite and on the physiological effect of specific poisons. The zoogeographical arrangement here will be especially appropriate in the hands of sportsmen, field naturalists, agriculturists, explorers, and others to whom a knowledge of these creatures is a matter of great practical value. It is perhaps unfortunate that the American species receive more than their share of attention; thus the Old World harmless snakes (Colubrinæ) are condensed into less than half the space devoted to those of the New World, and no mention is made of the commonest tropical and South African genera, such as *Boodon*, *Chlorophis*, and *Philothamnus*.

The book is well got up, and 160 splendid photographic reproductions, mostly from living specimens, are valuable as an aid to identification, and will repay careful study. They testify to the author's skilful technique as a photographer, and the portrait of a King Cobra (Plate 38) has high pictorial merits. HUGH B. COTT.

A Physiologist looks at Wild Animals

Emigration, Migration, and Nomadism. By the late Walter Heape. Edited with a Preface by Dr. F. H. A. Marshall. Pp. xii + 369. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin Marshall, Ltd., 1931.) 12s. 6d. net.

DR. F. H. A. MARSHALL has edited and prefaced this posthumous work by the distinguished authority on the sexual cycle, Walter Heape. Few books cast a wider net for readers than this. The physiologist, the natural historian, the ecologist, the anthropologist, the psychologist, even the alienist, are concerned with the subjects treated. Yet how many of these, except the physiologist, will get past the first chapter? And how many physiologists will read the rest?

Many who would find the rest of the book of absorbing interest will be dismayed by this first chapter, for it includes many technical words which could have been avoided in a book of such wide appeal. Further, it is perhaps the most speculative part of the book, and was written before the author was acquainted with the work of Evans and others on vitamin E. The author foreshadowed the discovery of this vitamin. Recent research seems to show that he laid too great stress on nutrition as

a factor in the control of breeding seasons. It is true that certain of the higher animals do not breed in the absence of vitamin E, but evidence is not yet forthcoming that it is the absence of this factor in the non-breeding season which causes them not to reproduce.

There has been surprisingly little research on the actual cause of breeding seasons, presumably because the research must be physiological, and physiologists are mostly concerned with man and with animals which do not have breeding seasons in laboratories. Rowan and Bissonette have, however, shown the importance of light as a controlling factor in the reproduction of birds, and other workers have obtained similar results with mammals. This recent research makes it probable that Heape has exaggerated the importance of the nutritional factor in the control of reproduction, despite the fact that in certain cases (as in sheep) food does play a part.

A wealth of natural history observations has been brought together in this book, bearing on the large-scale movements of animals. The author differentiates clearly between migration, which is a purposeful movement followed by a return, and emigration, which is the useless mass movement of the lemming and springbuck followed, not by return, but by death. The importance of territory in animal life is stressed. Eliot Howard's concept of the importance of territory in bird life is extended to almost the whole animal kingdom.

Heape saw clearly that if animals are machines, then they are vastly more complicated and unreliable and individual machines than most biologists are prepared to admit. The reader finds himself confronted with the problem of whether butterflies may be hysterical in certain circumstances, and animals are throughout regarded in a frankly anthropomorphic way. Heape does not hesitate to compare the movement of a pack of wolves with that of a nomadic tribe of men. Writing of birds, he says, ". . . it would seem to be clear that migration is not solely a matter of habit, or of instinct; reason may exert a part in it, and intelligence be accorded a more prominent place in the ordering of migratory movement than is generally accorded".

One cannot fail to be reminded of Elton's outlook, and to regret that Heape was not acquainted with his work. Especially is this so when the author is dealing with the periodicity of abundance in animals. Dr. Marshall has to some extent made good this defect, by giving brief accounts of Elton's work in footnotes. Heape thought that the regu-

larly periodical emigrations of the lemming were due simply to overcrowding and scarcity of food. He overlooks the fact, pointed out by Elton, that animals may show the same periodicity on both sides of the Atlantic. Some unknown factor must evidently be at work. Otherwise, although widely separated animals might have a periodicity of approximately the same time-interval, they could not be expected to keep step in Canada and northern Europe.

The reader must be prepared for speculation if he is to enjoy the book. Even the most speculative will have qualms about a long description of the start of a butterfly emigration, which, as the author frankly admits, is only a phantasy. Many readers could advantageously skip large parts of the book, in which rather fragmentary information is given about a large number of species after a full and valuable discussion of a phenomenon of emigration, migration, or nomadism in the few forms on which much is known. The fragmentary parts might have been printed in small type, or placed in appendices, where they would no doubt have been valuable to a few, without taxing too heavily the skipping capacity of the majority.

The author's object in writing the book was to stimulate wider research on the comparative physiology of the reproductive system. If zoologists can be made to take an interest in function, or physiologists in wild animals, then his object will be achieved.

JOHN R. BAKER.

Artificial Resins

Artificial Resins. By Prof. Johannes Scheiber and Dr. Kurt Sändig. Translated from the German by Dr. Ernest Fyleman. (The Specialists' Series.) Pp. vii + 447. (London: Sir Isaac Pitman and Sons, Ltd., 1931.) 30s. net.

AMBER for decorative purposes, shellac in the electrical industry and for gramophone records, copals for varnishes, rosins in soaps: all are natural resins. The importance of the part they play in the daily economy of the world is obvious; indeed, at least half a million tons of them are used annually. Latterly, they have been supplemented and even substituted at a rapidly increasing rate by substances made artificially by the systematic exploitation of numerous organic chemical reactions. Such products have many new economic potentialities, particularly since, with increasing experience, the control of the reactions which produce them becomes more accurate, so that the possibility is offered of varying their properties

widely and of increasing desirable qualities to a degree impossible with natural products. Already some forty thousand tons of synthetic resins are produced annually.

The book before us is a careful translation from the German, in which the authors' meanings have been reproduced as accurately as possible. Perhaps in consequence we find it somewhat involved in style and far from easy reading, even when allowance is made for the difficulties of the subject.

The first half is devoted to a general theoretical discussion of the various known forms of chemical polymerisation and condensation. The treatment will be found to be complete and of value to the now numerous workers in this field. The latter portion deals with the practical aspects of resin manufacture, discussing in turn the coumarone and aldehyde resins, the phenol-aldehyde resins, and the urea-formaldehyde condensation products. This section contains full references to the literature. Experts will find blemishes here and there, but they will readily pardon these in view of what is, after all, the main value of the book—its wealth of suggestive ideas.

The power of many organic substances, and of aldehydes in particular, to take part in chemical condensations has long been used in effecting chemical syntheses in the laboratory, where the aim has usually been to restrict the reaction to the formation of simple compounds and to avoid the production of resins. In the new industry, however, the formation of such resins is encouraged by working under conditions suitable to give products of complex and largely unknown constitution, but which under proper control are uniform from batch to batch. At first the practical operations were largely based on guesswork and experiment, but now the behaviour of the various types of unsaturated groupings is becoming understood, as is also the mutual influence of various radicals on them.

Looking ahead, there appears to be no boundary to what the synthetic resin industry may in time accomplish. Some enthusiasts even predict that our future furniture will be constructed from resins obtained by condensing formaldehyde, made from coke, with the phenolic constituents of low temperature tars, and that such material may largely replace wood in internal work. The wireless and gramophone industries are being largely built up on these resins. It is to be hoped, therefore, that the manufacture of all types of them will not be neglected in Great Britain.

E. F. A.

The Enjoyment of Nature

The Open Air Year: an Anthology of the Seasons selected from The Times. Pp. xii + 242 + 20 plates. (London: *The Times* Publishing Co., Ltd., 1932.) 7s. 6d.

TO this volume of papers reprinted from the *Times*, Viscount Grey of Fallodon contributes a singularly happy introductory essay which in itself supplies unity or harmony to the book. There is probably little or nothing in the papers which is not already well known to specialists in the various subjects. There are, however, many things in this book about common country objects which, as Viscount Grey points out, are not common knowledge even to dwellers in the country, and perhaps still less to that increasing body of the public which is interested in outdoor Nature. In an attractive style and with a literary charm that is in no way inferior to that of such writers and observers as Richard Jefferies or W. H. Hudson, they convey a good deal of accurate scientific knowledge which should enable the visitor to any of the places or scenes described to discover and enjoy aspects of which he was previously unaware. The book is a worthy companion to Cornish's "Wild England of To-day" or Edmund Blunden's more recent sketches, "The Face of England".

In the true sense of the word, we have in this book popular science of a high order, and the reflection occurs in passing that the popular knowledge of physical as well as of outdoor Nature or natural science might well be encouraged by its exposition on similar lines. The writings of T. H. Huxley alone afford sufficient evidence that the accurate but lucid exposition of the more scientific aspects of biology is not too herculean a task for human powers. There are few more urgent needs at the present time than for first-class expositors in every branch of science who can link together as felicitously as in this book the accurate description or analysis of scientific observations or facts with a literary skill which has an intrinsic popular appeal.

In the introduction to which we have already referred, Viscount Grey, commenting on an observation in the essay "The Flame of Autumn", that the colours of autumn leaves cannot be robbed of romance by being harnessed to some utilitarian purpose, is moved to the reflection that the utilitarian purpose is secondary in the design of Nature, and to emphasise both the infinite beauty of the world and, separate from but inseparably connected with this, the power of man to perceive this beauty and to be moved by it. It is at least possible that our

present lack of the needed expositors in many branches of science is due to loss of this vision of beauty through the concentration on analytical or synthetic methods. It is only when we are able to perceive and respond to the beauty of our subject and to see it in some true perspective that we can expect to receive the power to expound to others, in language understood by all, the vision vouchsafed us, or the results obtained and the methods by which they were obtained. So far as outdoor Nature is concerned, volumes such as that under review, in kindling this vision and love of beauty, may also assist in the formation of a public opinion intelligent and strong enough to secure the action which in so many quarters is sadly needed, if serious depletion of the flora and fauna of our countryside is to be prevented and its beauty spots secured from irreparable damage in the local interests of some supposed utilitarian or business scheme.

Short Reviews

Biologie des Radiums und der radioaktiven Elemente. Von Prof. Dr. Julius Stoklasa. Unter Mitwirkung von Dr. Josef Pěnkava. Band 1: *Biologie des Radiums und Uraniums.* Pp. xiv + 958. (Berlin: Paul Parey, 1932.) 74 gold marks.

SEVERAL books have been written on the biological effects produced by the radiations from radioactive bodies, and they have presented the chief characteristic changes in living things in the relationship of such changes to the main issues of radiological treatment. It is fairly generally admitted now that although the main effect of the radiations is a direct one upon the tissues immediately irradiated, other effects are produced in an indirect way which may be of great importance in the final result of any radiological exposure. The aim of the authors in this exhaustive work (another volume is foreshadowed) is to present these biological effects from an entirely different point of view, and about two-thirds of the present volume is devoted to the description of elaborate methods of estimating the effects of the rays on vegetable life. It is only when p. 640 is reached that the animal kingdom receives attention, and even in this section the authors give their fullest consideration to the types of biological change that are most conspicuous in plant life, namely, those which regulate respiratory exchange.

Many of the experimental methods described in the dominant section of the book have been devised by one of the authors, and they leave the reader with little doubt of the profound effect which can be produced by radioactivity on young plants and seeds. The literature of a few years ago on this subject revealed acute differences of opinion among experimenters as to whether the radiations could stimulate cell life, and the authors have done a great service in getting together a comprehensive series of tests which serve to show how many factors involved in the processes of normal growth have to

be taken into consideration before the term stimulation can safely be applied to any particular phase of the growing organism.

The book is a most careful compilation and should prove to be of great use as a reference book on these particular biological effects, even though there is very little direct reference to their significance in modern radiotherapeutic methods.

Dynamics of Airplanes and Airplane Structures.

By Prof. J. E. Younger and Prof. B. M. Woods. Pp. xiii + 263. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 17s. 6d. net.

THIS is distinctly an American students' textbook that has no counterpart in Great Britain. It is obviously the work of skilled mathematicians, who have applied their knowledge to the investigation of some of the peculiar problems of the aeroplane. They have evidently treated their subject *multum in parvo*, and have rigidly resisted the temptation to stray from the application of mathematics to the problems before them, into the more philosophical outlook, which is so often the case with books of this description. The reader's taste will decide whether or not this is an advantage. This narrow outlook is not an ideal training for the student, but on the other hand it must be admitted that the authors do 'deliver the goods' and in a volume of reasonable size. Judged from the point of view of the English educational system, it is recommended for reading to a student who, having already studied the fundamentals of aeronautics, will benefit by approaching the subject from a somewhat different point of view, before taking up the deeper detailed investigations, as published in monographs such as the Aeronautical Research Committee Reports and Memoranda.

The text is divided into three parts. Part 1, "Simple Dynamics of Airplanes", deals with mathematical principles, and uses the aeroplane for the provision of illustrative examples. Part 2, "Advanced Dynamics of Airplanes", treats the various aspects of the machine in flight, including a useful study of stability. Part 3, "Special Problems", deals with special problems such as dynamic loading, periodic oscillations, vibration, flutter, etc., all of which are handled according to the most modern accepted theories.

The book has a useful decimal system of reference, both in paragraphing and numbering of formulæ, which makes cross-reference particularly easy. The index refers to page numbers.

Mendelism and Evolution. By E. B. Ford. Pp. xii + 116. (London: Methuen and Co., Ltd., 1931.) 3s. 6d. net.

THIS little book presents with great clearness and precision the actual position of modern genetics in its relation to the problem of evolution. It represents a review of the whole field of the subject and of the most important theories developed around it in recent years. Each aspect of the problem is considered with reference to a wealth of data, which should prove invaluable to students who have not

the time to collect for themselves the information rather widely scattered in the literature of the science, and necessary to obtain a grasp of the present state of the problem.

In a preliminary chapter the fundamental laws of the particulate theory of inheritance are crisply and clearly set forth, for which those who have not made a study of genetics will be grateful. The interaction of heredity and environment is then considered, with special emphasis on the internal environment provided by the gene complex. This is aptly followed by a review of the theory of the evolution of dominance and recessiveness. The question of the rôle of the cytoplasm in inheritance is well handled, and the adequacy of Mendelian inheritance to sustain the processes of evolution is demonstrated. The importance of geographic and also of genetic isolation with regard to the origin of species is well illustrated. Mr. Ford has, in fact, treated a very many-sided subject in a remarkably thorough and satisfying manner. A glossary which includes all technical words not explained in the work itself places this excellent book fully within the appreciation of the layman.

Chemistry in the Service of Man. By Prof. Alexander Findlay. Fourth edition. Pp. xviii + 355. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1931.) 6s. net.

WRITERS have called this a chemical age: it is certainly a period of chemical evolution, and side by side with a rapid advance in the science of chemistry there is great progress in its application to material things. Every layman participates in the benefits, and it behoves most of us to have some understanding of the how and the why of them. The conversation books of a former generation taught us in an entertaining way of the fruits of the earth and even of chemistry: to-day they are replaced by such books as that of Prof. Findlay, now in its fourth edition. He has somehow achieved the task of compressing everything into a very small compass, and yet produces a book which is eminently readable by an average person who seeks to enlarge his curiosity after the works of Nature. It is a book which should be widely read: in a more enlightened age one would expect a long notice of it to be treated as a feature by the literary reviews—surely a knowledge of what things are is of more importance than the history of a particular period, or the life of an eminent statesman, soldier, or courtesan? E. F. A.

Handbuch der Pflanzenanatomie. Herausgegeben von Prof. K. Linsbauer. Lief. 27. Abt. 1, Teil 2: *Histologie.* Band 4: *Die Epidermis.* Von K. Linsbauer. Pp. viii + 284. (Berlin: Gebrüder Borntraeger, 1930.) 29-40 gold marks.

THE section of this handbook upon anatomy that deals with the epidermis has been written by the editor of the series and might serve as a very good example of such encyclopædic work at its best. The epidermis is considered from the point of view of the morphology and detailed structure of the individual cells, with special sections upon the thickening and pitting of the wall and of the wavy

contours that characterise the anticlinal wall in many cases, etc.

The chemistry of these membranes—slime formation, lignification, the nature of the cuticle and of wax excretions—receives very adequate attention.

The protoplasm of the epidermal cells and the various inclusions that have been reported are fully dealt with. The development and regeneration of the epidermis are adequately treated, so far as is permitted by the lack of attention these problems have had up to the present. The function of the epidermis leads to a full treatment, as an absorbing system, of the root surface and of the root hairs, but such physiological subjects, as also theories of light perception by epidermal cells, are only considered so far as they have led to re-examination of structural features of epidermal tissues. The root hair receives much attention when considering the epidermis as an absorption system, but the epidermis as a protection against evaporation receives less attention, and the problem whether hairs on the shoot epidermis hinder or help evaporation is left alone. Stomatal apparatus is evidently excluded from the scope of the monograph.

Studies on the Genus Pythium. By Velma Dare Matthews. Pp. v + 136 + 29 plates. (Chapel Hill, N.C.: University of North Carolina Press; London: Oxford University Press, 1931.) 13s. 6d. net.

MISS V. D. MATTHEWS' book gives a very complete account of the genus *Pythium*. The author collects information of the methods and media for culture, discusses distribution and habit, the production of mycelium, sporangia, conidia, zoospores, and sexual organs, and considers taxonomic characters. The genus *Pythium* is taken as it was originally established by Pringsheim, though its vicissitudes since that time are also enumerated. A key to the species is given, and each one is described in detail, with such physiological characters as are known. The host-range is also enumerated, and the book includes twenty-six plates of line drawings and an extensive bibliography. The academic or economic mycologist will find the book a useful work of reference.

Agricultural Policy in South Africa. By Prof. H. D. Leppan. Pp. 101. (Johannesburg: The Central News Agency, Ltd., 1931.) 6s.

PERHAPS the chief interest of this book is the summary of the natural conditions in South Africa: the accounts of the soil, climate, water problems, and others. Few countries in the world are more interesting to students; within a comparatively short range one finds the moist temperate climate of the southern part of Cape Province, the semi-arid conditions of the Karroo, the desert of Griqualand, the open steppe-like country of the veldt, and the tropical luxuriance of northern Natal. Farther north comes the park-like country that stretches away to the equator and beyond. All these natural features react on the agriculture and bear on the agrarian policy best suited to the country. The author's discussion will be found of interest, even to those not particularly concerned with the agricultural industry.

Radio Observations during the Total Solar Eclipse of Aug. 31

THE radio observer of eclipse phenomena is subject to one important limitation which at once denies him the most spectacular successes and safeguards him from the most acute disappointments of the optical observer. He cannot make direct observations on the solar phenomena, but is restricted to a sort of indirect photometry of the ionosphere, a region already subject to such wide and ill-understood variations that no completely conclusive determinations are likely and no fully satisfactory control observations possible. At best, then, the agreement between the temporal sequence of radio phenomena and the sequence predicted from theories of the media will give strong support to one of the competing theories; at worst, a correlation of substantial magnitude will be submerged in random variations.

The eclipse of Aug. 31 was ill-situated, in place and time, for the mitigation of these difficulties. The line of optical totality did, indeed, fall happily for detailed observation, but totality was reached at a time of day when the diurnal curve of ionisation density in the ionosphere was already likely to be falling steeply, so that the temporary withdrawal of the ionising effect of ultra-violet light could only make the existing slope steeper, and the renewal of the effect could only be referred to a lower datum point. The centre line of the anticipated particle eclipse¹ was likely, on any probable assumptions of particle velocity, to lie mainly over the ocean, and the only observing stations near the centre line (computed from the most probable velocity) were the necessarily under-manned and under-equipped Polar Year stations on the eastern coast of Greenland. These stations were still more heavily handicapped than were the American stations by the steeply falling diurnal curve, while western European stations were near the very sunset limit of eclipse, and consequently observed in the unstable and variable conditions which have, from the earliest days of radiotelegraphic observation, been known to characterise the sunset period.

The crucial problem to be examined was, of course, the discrimination between ultra-violet light and corpuscles as ionising agents for the two main regions of the ionosphere. There was substantial agreement that the Appleton region, above 200 km., probably owed most of its ionisation to ultra-violet light, but while Chapman inclined to the view that the Kennelly-Heaviside region, at about 100 km. height, was ionised by neutral solar corpuscles, Appleton and Naismith "accept ultra-violet radiation as one of the causes, if not the chief cause, of the ordinary diurnal replenishment of the ionisation in Region E" (the Kennelly-Heaviside region), and "regard the solar stream of neutral particles as causing the extraordinary effects on abnormal days". It may be remarked that further theoretical development of this view would appear to be necessary to account for the remarkably limited single range of height within which these mixed agencies develop maximal ionisation density.

Further work must also take account of the redistribution in the horizontal of that ionisation which results from the injection of ionising agents into regions outside the vertical column of ionosphere directly sampled by the modern technique of short-base echo sounding. The replenishment of ionisation in the Kennelly-Heaviside region after sunset, noticed by Appleton and Naismith² in England, by Schafer and Goodall³ in the United States, and by Ranzi⁴ in Italy, may possibly be referred to this horizontal redistribution.

The radio observations made in connexion with the total solar eclipse of Aug. 31 were of three kinds. The first and most directly interpretable class contained short-base echo experiments designed to give direct evidence of the state of ionisation vertically above the experimental stations. These stations were, in some cases, existing research establishments, but the Canadian authorities set up special stations at points vertically under the lines of optical totality for the two principal regions (these lines lying somewhat south-west from the line of totality at ground level), and Canadian and United States expeditions also proceeded to points as far eastward as were conveniently attainable on the American continent, in order to sample the particle eclipse. The second class of observation was made on long distance signals specially emitted for the purpose on frequencies and trajectories chosen to enhance the relative importance of one or other of the ionised regions in its normal and 'eclipsed' states. The collaborations amongst the American Telephone and Telegraph Company in the United States and the Post Office and Department of Scientific and Industrial Research in Great Britain, and between the British and Canadian Marconi Companies, belong to this category. The third class of observation dealt with the quality of reception of signals normally available, and included the considerable body of amateur collaboration in two continents, the results of which will doubtless become available at an early date.

It need scarcely be said that detailed observational results and considered conclusions are not yet available for discussion. But by the courtesy of the many authorities concerned the preliminary data, specially communicated for publication in NATURE, may be summarised here. The data will be taken in geographical order, from the eastern fringe of the particle eclipse to the western fringe of the optical eclipse.

Dr. Van der Pol, observing at Eindhoven, was so situated that the particle eclipse (here regarded as an eclipse of 1600 km./min. particles) was partial only, and was overtaken halfway through by the incidence of ground sunset. It was, then, not surprising that in such unfavourable geographical conditions no marked anomaly in Kennelly-Heaviside layer conditions was observed during the eclipse.

The two stations of the Department of Scientific and Industrial Research, namely, the Polar Year station established, in co-operation with the British

National Polar Year Committee and the Norwegian Committee for Cosmic Physics, at Tromsø, and the Radio Research Station, Slough, were, despite their geographical separation of 1330 miles, similarly situated in respect of the particle eclipse, which ended about the time of local sunset at both stations. Prof. Appleton's station at King's College, London, and Mr. J. A. Ratcliffe's station at the Cavendish Laboratory, Cambridge, both working, as always, in close co-operation with Radio Research Station, formed with Slough a group of stations thus unfavourably situated in south-east England, each of which undertook a distinct section of a single observational programme of short-base echo work. The Post Office stations at Dollis Hill, Baldock, and Cupar, and the Slough station, participated similarly in a single programme of organised observation on trans-Atlantic radio channels.

The Tromsø observations were complicated by the fact that the ionosphere was in the process of

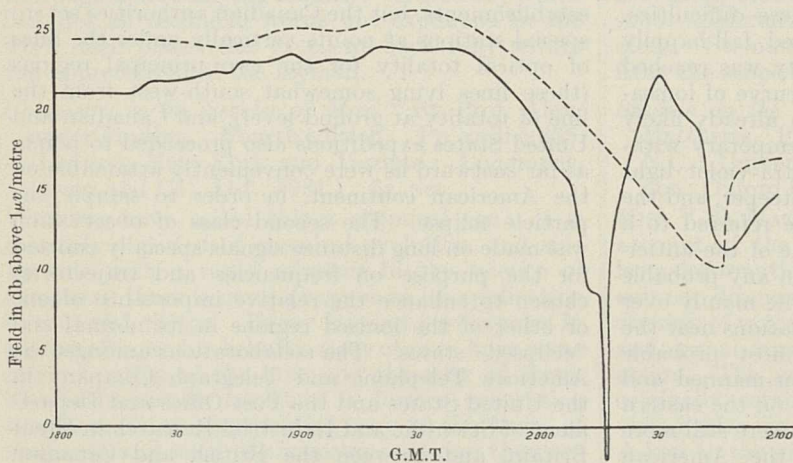


FIG. 1.—Field strength measurements taken at Cupar Radio Station on 60 kc./sec. of Rocky Point, U.S.A., transmissions. — — — — Aug. 30; — — — — Aug. 31.

recovery from a severe magnetic disturbance. Had the station been farther from the sunset fringe, this magnetic disturbance might have been of importance in the study of the particle eclipse, but the general result of the superposed conditions was that, on a preliminary survey at least, the Tromsø record gives no suggestion of eclipse effects.

The results from Cambridge, London, and Slough may conveniently be considered together. Cambridge and London, concentrating special attention on the Appleton layer, agreed in showing that the ionisation density in this layer increased between 1800 and 1900 G.M.T., suggesting that any effect of the particle eclipse on this layer was (1) over before 1815, (2) absent, or (3) overlaid by another cause of increased ionisation density. A notable decrease of ionisation observed by London about 1700–1720 might have supported (1), suggesting the eclipse of unexpectedly slow particles of low penetrating power, but the occurrence of a similar effect of less magnitude, on the succeeding control evening, was against this interpretation. On the other hand, Cambridge found that the elec-

tron density in this layer fell to a selected critical value, low enough to permit the escape of 70 metre waves, nearly an hour earlier on the eclipse date than on each of the adjacent control days. This time of critical value was confirmed by London. A slight rise in the effective height of the Appleton layer was observed at Cambridge at 1830 on Aug. 31. There are here two very slender suggestions that the cutting off of the corpuscular ionising agent permitted recombination to bring about an exceptionally early night condition, and increased the height to which it was necessary to proceed before finding a particular ionisation density.

Slough concentrated attention especially on the Kennelly-Heaviside region, about which Cambridge and London were able to supply confirming evidence. It is firmly established by the combined data that the ionisation density in this layer was notably lower in the late afternoon of Aug. 31 than on Aug. 30 or Sept. 1; the equivalent electron density being about 2×10^5 electrons per c.c. on both control days. At 1815 on Aug. 31 the value of 2.5×10^5 was momentarily attained, but in general the value lay below 2.0×10^5 . At 1851 the density was below 0.6×10^5 , at 1905 this value was exceeded, and from 1940 to 2030 the average density was of the order of 1×10^5 . There is, then, definite evidence of a relatively low ionisation density at the time of the particle eclipse, followed by a notable rise. This low density at 1830 has no counterpart on the control days, but the rise between that hour and 1900 is paralleled by the events of Aug. 30.

The British observations on trans-Atlantic signals were made on frequencies of 13,390 kc./sec. (wave-length 22.4 m.), 8665 kc./sec. (34.7 m.), and 60 kc./sec. (5000 m.) emitted from the stations of the American Telephone and Telegraph Co. at Laurenceville, of the General Electric Company at Schenectady, and of the American Telephone and Telegraph Co. at Rocky Point respectively. The 13,390 kc./sec. channel was watched at Baldock and Cupar, and the ray angles and state of polarisation were measured at Slough; the 8665 kc./sec. channel was watched at Slough; while the 60 kc./sec. channel was watched at Dollis Hill, Baldock, and Cupar.

It may be said at once that on the higher frequencies, no phenomena were observed which lay outside the normal range for the average afternoon; the impossibility of isolating any eclipse event on these channels is emphasised by a very great contrast in behaviour from one control day to another. A complete fade-out between 1951 and 2000 G.M.T. on Aug. 31 was observed on the 13,390 kc./sec. channel, but, as just indicated, no special significance can be attached to it.

The 60 kc./sec. channel, however, is subject to a

very much smaller range of normal variation, and the fact that this frequency range must involve the Kennelly-Heaviside region as an important element in propagation gave it an especially important place in the programme. Dollis Hill and Baldoek did not observe any important anomalies on the eclipse date or on the control days. Cupar, on the other hand, experienced a complete fade-out between 2015 and 2018 G.M.T. on Aug. 31, followed by a recovery to a relatively high signal level at 2030. This sequence of phenomena was the only departure from a very close similarity between the variation curves for Aug. 30 and 31, as shown in Fig. 1. A complete fade-out of this type is such a rare event on the 60 kc./sec. channel that it is certainly significant, and the time of its occurrence, although somewhat surprisingly early, is so close to the time of minimum illumination of the lower ionosphere over the early part of the trajectory, that it may be concluded with some confidence that we have definite evidence of an ultra-violet eclipse effect on the Kennelly-Heaviside layer.

Details of the observations made by the Dutch and French Polar Year parties at Angmagssalik and Scoresby Sound respectively are, unfortunately, not yet available.

The Canadian joint observations are summarised in a special communication kindly cabled by Prof. A. S. Eve. The special expeditions sent to Vanleek Hill, Ontario, and to Kingston, Ontario, under the direction of Dr. J. T. Henderson and Dr. D. C. Rose respectively, report distinct losses in the ionisation of both the Kennelly-Heaviside and Appleton layers during the period of optical eclipse. The special expedition to Corner Brook, Newfoundland, also under the direction of Dr. Henderson, gives supporting evidence.

The observations at all three Canadian stations give no indication of any effect of corpuscular eclipse. The Nova Scotian expedition of the U.S. Bureau of Standards had not reported at the time of writing.

The Northern Electric Company found no intensity change in 500 metre signals between Ottawa and Montreal, while the Canadian Marconi Company found no definite changes which could be ascribed to the eclipse in 22-37 metre transmissions across the Atlantic.

Observations at the Bureau of Standards, Washington, revealed effects on both Kennelly-Heaviside and Appleton regions. The methods adopted enabled a measurement to be made of the critical frequency just capable of penetrating each region at vertical incidence. Penetration of the lower region would be indicated by a sharp change in the retardation time of the radio echo, from that corresponding to the lower region to the much higher value corresponding to the upper region. Penetration of the upper (and more highly ionised) region would be indicated by the absence of an echo on the relatively high frequency which had first penetrated the lower region without measurable reflection, but had still, below the critical value, been reflected from the Appleton region. The Bureau of Standards reports that the conclusions to be drawn from the

observed effects on the Appleton layer are still under consideration. For the Kennelly-Heaviside layer, however, the critical frequency of penetration was lower by about 1000 kc./sec. at the end of optical eclipse than before and after eclipse. The minimum critical frequency was reached about five minutes after the maximum of partial optical eclipse at Washington. This decrease of critical frequency indicates that the partial ultra-violet eclipse at Washington, with a duration of about an hour and a half, was accompanied by a very slightly lagging reduction of something between 35 and 60 per cent in the density of ionisation in the Kennelly-Heaviside region.

The provisional conclusions to be drawn from this assembly of data may now be summarised.

Optical Eclipse.—The evidence from the U.S. Bureau of Standards, National Research Council of Canada, and British Post Office establishes beyond any doubt the importance of ultra-violet light as a principal ionising agent for the Kennelly-Heaviside layer.

The evidence from Canada establishes a similar ultra-violet effect for the Appleton region, and the Bureau of Standards data probably support this evidence.

The evidence from European short-base echo stations was not expected to bear on the optical eclipse, nor does it do so.

Particle Eclipse.—No evidence is yet available from the only stations even moderately favourably situated for observations on the effects of the particle eclipse.

The Canadian and United States stations, unfavourably situated in place (and the Dutch station, unfavourably situated in place and time), show no effects at all suggestive of particle eclipse.

The British stations, unfavourably situated in time, give very slight suggestions of effects from the eclipse of particles of velocity somewhat below the 1000 miles per minute assumed in the computations of track and time.

In the light of all available evidence, weighted according to situation, the significance of ultra-violet light as a principal ionising agent for the ionosphere as a whole is established; the possible significance of neutral corpuscles is not established, but is not wholly excluded; it remains to be tested under more favourable conditions and in the light of our rapidly growing knowledge of the climatology of the ionosphere.

This discussion opened with a summary of the defects, in time and place, of the 1932 eclipse from the point of view of ionospheric observation. It may appropriately close with an indication of the merits of a 1933 eclipse? Chapman has shown that the student of the ionosphere is less interested in the distinction between total and nearly total eclipse than is the astronomer. The annular eclipse of Aug. 21, 1933, is of sufficient magnitude in respect of ionisation effects, and it has the overwhelming advantage that maximum eclipse for light and for particles alike can be observed in inhabited land areas at times when the diurnal curve of ionisation

density in the ionosphere is rising comparatively slowly or is near a stationary point: that is, the optical eclipse might be observed in the morning, but well after sunrise, the particle eclipse near noon. The low latitude of the eclipse track suggests another considerable advantage, the eclipse phenomena unrolling at such a low speed that the cumulative effects on ionisation may well outweigh the 7 per cent defect in magnitude of the eclipse. It would appear most desirable that an adequate organisation should be worked out for observations on the optical eclipse near Delhi, with corresponding observations on the particle eclipse.

The Superintendent of the Radio Research Station, Slough, would be grateful for information

as to the station of origin of pulse signals on a frequency of 3.56 mc./sec. (pulses at 50 per sec.) which were accidentally observed at Slough during the control experiments for the eclipse. The pulse signals ceased at 2020 G.M.T. on Sept. 1 and at 2100 on Sept. 2. The echo pattern, showing marked magneto-ionic splitting, was recorded simultaneously with that from local pulses; the comparison of distance and direction data might yield useful results.

¹ Appleton, *Observatory*, March 1932.

Appleton and Naismith, *Proc. Roy. Soc., A*, **137**, 36; 1932.

Chapman, *Mon. Not. Roy. Ast. Soc.*, **92**, 413; 1932.

Miller, *Mon. Not. Roy. Ast. Soc.*, **92**, 421; 1932.

Appleton and Chapman, *NATURE*, **129**, 757, May 21, 1932.

² Appleton and Naismith, *loc. cit.*

³ Schafer and Goodall, *Proc. I.R.E.*, **20**, 1131; 1932.

⁴ Ranzi, *NATURE*, **130**, 368, Sept. 3, 1932.

Current Constructive Theories in Psychology*

By Prof. BEATRICE EDGELL

ON Aug. 29 there occurred the tercentenary of one who is often called 'the father of English psychology', John Locke, 1632-1704. His "Essay concerning Human Understanding" is primarily a theory of knowledge, not a system of psychology, but none the less there is much of psychological interest in the Essay, and it has had a profound influence on empirical psychology in the eighteenth and nineteenth centuries. We may regard it as a misfortune that what he described as a "historical plain method" should have been interpreted as a genetic study, and that his doctrine of simple and complex ideas should have been translated into a doctrine of psychological elements and compounds; but such has been the case. Historians trace a straight line of descent from the Essay of Locke to the "Analysis of the Phenomena of the Human Mind" by James Mill, and thus claim Locke as a founder of the Association school.

It may seem a far cry from 1632 to 1932, but I want to consider some of the differing constructive theories of learning and knowledge offered by the psychologists of to-day in the light of the unreconciled methods and principles which find expression in the Essay.

We find first and foremost in the Essay a confusion of logical and psychological analysis; secondly, we find a theory that attributes the union of discrete ideas to their accidental association in time, introduced as an afterthought to the theory that ideas are united by the perception of their connexion or repugnancy.

To begin with the confusion of logical with psychological analysis. As Prof. Gibson has pointed out in his book "Locke's Theory of Knowledge", at the time at which Locke was writing, the distinction between the elements of knowledge attainable by logical analysis and the simple beginnings of knowledge attainable by genetic study was a distinction which it was wellnigh impossible for a writer to draw. Growth and development were conceptions which had a very different colour-

ing from what they have for us to-day. They were, moreover, conceptions which had no literal application to knowledge. Knowledge for Locke was a structure the validity of which could be tested by taking it to pieces. Just as a logical analysis of the ultimate items into which, say, a building could be resolved and an inquiry into the material out of which it arose might lead one to much the same catalogue of stones and beams, so a logical analysis of knowledge into its elements seemed to have the same issue as an inquiry into the beginnings of knowledge. That which is simple in its content is easily confused with that which is simple in its origin. It is this confusion which lays Book II. of Locke's Essay open to much misunderstanding. Having in Book I. denied that mind is possessed of ideas at birth, and having claimed that all knowledge is founded upon, and derived from, experience, Locke seems by his account of the 'simple ideas' of sensation and reflection and of the 'complex ideas' built upon them to be offering a psychological constructive theory of knowledge.

There is much of great psychological value in this second book: Locke's frequent appeal to concrete illustrations, his references to children and animals, the famous citation of Molineux's problem whether a man whose sight was only restored to him in adult life would be able to distinguish by sight between a sphere and a cube. The book also contains his striking chapter on retention, vivid through its analogies but of paramount importance for psychology by reason of the statement added in the second edition: "This laying up of our ideas in the repository of the memory signifies no more but this, that the mind has a power in many cases to revive perceptions which it has once had, with this additional perception annexed to them, that it has had them before, and in this sense it is that our ideas are said to be in our memories, when indeed they are actually nowhere; but only there is an ability in the mind when it will to revive them again, and as it were paint them anew on itself, though some with more, some with less difficulty; some more lively, and others more

* From the presidential address to Section J (Psychology) of the British Association, delivered at York on Sept. 5.

obscurely" (II. x. 2). Here there is a glimpse of a conception which might have done much to correct the atomism encouraged by the 'blank paper' and 'cabinet' metaphors in other passages.

When mind is compared with an empty cabinet which is furnished by the simple ideas of sensation and reflection, simple ideas are being treated as the psychological origin of knowledge. When, on the other hand, Locke tells us that simple ideas are unanalysable, are not distinguishable into different ideas, and are those in which men agree when they clear away verbal misunderstanding, we have simple ideas as the materials of knowledge in the logical sense. If we look at the simple ideas listed together, we find the same confusion: the items 'colour', 'sound', 'pleasure', 'pain' might be interpreted as psychologically simple, but what of the items 'existence', 'unity', 'power', 'succession'?

In his account of complex ideas, Locke starts with what purports to be a psychological account of how they are formed—namely, the operations of compounding by putting together several simple ideas, and of abstracting by "separating them from all other ideas that accompany them in their real existence". These operations are set side by side with the operations of comparison and seeing relations. Locke holds that such operations are not present in animals. The complex ideas of animals are apparently combinations of simple ideas given to, not made by, the animal. "They take in and retain together several combinations of simple ideas, as possibly the shape, smell and voice of his master make up the complex idea a dog has of him, or rather are so many distinct marks whereby he knows him; yet I do not think they do of themselves ever compound them, and make complex ideas" (II. xi. 7). These operations of mind in building complex ideas are never brought into clear relation with the operation which constitutes knowledge—namely, "perception of the connection of and agreement, or disagreement and repugnancy, of any of our ideas". Cutting across his attempted psychological account of how complex ideas come to be formed, Locke gives a logical classification of complex ideas according to the nature of their object or reference: there are ideas of modes, of substances, and of relations. In this we have another example of the confusion of the psychological and the logical point of view, or shall one say of transition from one to the other without any realisation of the change in outlook?

No orthodox psychologist from the time of Wundt onward would have admitted for a moment that his acceptance of sensations as psychological simple elements was due to logical analysis. He would have declared that it was due rather to the analysis of physiological events, namely, the simple stimulation of a sensory receptor and the resultant excitation of the central nervous system.

I question whether any psychologist who sets out from simple sensations is really determined by a search for what is primitive in experience. That we do not experience simple sensations as such is, of course, admitted on all hands; when treated as elements they are often said to be reached by

'hypothetical' analysis. What I want to suggest is that such analysis is the outcome of logic, not psychology. The method implies that perceptual knowledge is a structure, the logical analysis of which will yield the bricks out of which it is made. This is a teaching derived from Locke's Essay. The use to which the Association school put Locke's theory of association rests on this doctrine. The theory is given in a section added to the fourth edition of the Essay, and was put forward as a theory to explain strange aversions and likings, prejudices and errors. It is never put on a level with the synthetic processes of knowledge wherein there is perception of a relationship between ideas. Association is thus primarily a way of uniting items which are discrete and have no intrinsic connexion with one another.

Gestalt psychology to-day is never tired of proclaiming itself as a revolt from associationism. Even if we believe that associationism in pure psychology is dead, how far may it, nevertheless, be true that *Gestalt* is fighting a present-day attitude of mind which had its historical foundation in Locke's confusion of logical analysis with an inquiry into psychological genesis?

Gestalt psychology would claim that no constructive explanation can be satisfactory which sets out from such elements as sensory events or reflex responses, and attempts to build up the experienced phenomena of human awareness and behaviour by the synthetic method. Perceptual awareness of a situation and responsive behaviour must, on its view, be taken *in toto*. The explanation of why just 'this' is perceived rather than 'that', must be sought in the physical constitution of the immediate environment and in the total condition of the organism. The school sets itself the task of studying the conditions in the stimulating situation which determine the perception of this pattern rather than that. It is always the pattern or configuration as a whole which has to be explained. Much experimental work has been done and valuable information obtained, particularly in the field of visual perception.

Whereas for the 'orthodox' school—if there is still a school capable of claiming this adjective—'meaning' in the form of memory images, actual or potential, comes in as an ingredient in the complex perception of an *x*, for *Gestalt*, meaning may lie in the nature of the sensory pattern or total organisation. To take an example, size or shape perceived in indirect vision is not 'apparent' size or shape modified by the memory of 'real' size and shape; the size or shape actually perceived is due to the sensory pattern of the whole field.

It is 'organisation' which for *Gestalt* replaces the conception of association. The so-called association of contiguity is never mere collocation in time or space. It is always an instance of organisation. "Organisation is not at all an aggregation of indifferent material. . . . If association is a consequence of organisation, it must also depend upon the mutually relative properties of what is or shall be organised" (Köhler, "Gestalt Psychology", p. 211).

When we turn to the question, How do organisations arise? we may not be wholly satisfied with the answers at present forthcoming. There are the sensory organisations or patterns the conditions of which are being experimentally investigated. Here the relative importance of the environmental and the intra-organic factors stands in need of elucidation. Descriptive terms such as 'closure', 'nearness', 'pregnancy', 'symmetry' summarise the present formulations of experimental findings. There are also the organisations said to be created intentionally. Here the 'self' and 'attitudes' are called in as explanatory concepts, and with them we pass over into a speculative region of tensions and dynamic relations in the brain field, a somewhat misty region in our present state of knowledge.

The contemporary representatives of Locke's doctrine of association are the behaviourists. According to this school, man is born with certain native responses to definite conditions in his environment: his unconditioned reflexes. He 'learns' or acquires new responses when an original response is extended to a different situation or when an original situation is made to evoke a different response.

This acquirement is the result of 'conditioning'. All conditioning depends upon the temporal arrangement of the factors in the stimulating situation and upon the structure of the animal's nervous system. Conditioning is a scientific formulation of the facts noticed by Locke as association. "Custom settles habits of thinking in the understanding, as well as of determining in the will, and of motions in the body: all which seems to be but trains of motions in the animal spirits, which, once set agoing, continue in the same steps they have been used to; which, by often treading, are worn into a smooth path, and the motion in it becomes easy, and as it were natural . . . and are therefore called so, though at first they had no other original but the accidental connexion of two ideas, which either the strength of the first impression, or future indulgence so united, that they always kept company together in that man's mind as if they were but one idea" (Essay, II., xxxiii., §§ 6 and 7). In the language of behaviourism, such a man is 'conditioned' to respond to the second idea as he originally did to the first. As in associationism the complex phenomena of mind were constructed from the simple ones by association, so in behaviourism all the complex phenomena of human behaviour are constructed from the simple units of reflex responses by conditioning. Behaviourism presents us with a tidy system wherein everything hangs together. The whole of man's thought (speech) and conduct is theoretically capable of being explained deductively from his original reflexes subject to conditioning.

There are other contemporary schools wherein association figures as a great principle of linkage, but in each of them some condition over and above bare sequence is recognised. In the psychology of Prof. McDougall, association by bare contiguity has a place, but he also lays great stress on the

learning that implies a thread of purposive interest. The *a*, *b*, and *c* that are associated together are members of what Prof. Stout terms a 'conative unity'. This interest would be an essential feature in the experience acquired in working out any instinctive tendency. Membership of a purposive whole is in principle a radical departure from association by temporal contiguity.

In psycho-analysis there is again great emphasis on association and its opposite, dissociation. The old forms of association, contiguity and similarity, are retained, and much use is made of them in explaining transference, trains of ideas, complexes, but the operation of association links appears to be completely controlled by instinctive and emotional dispositions. The machinery of association is the same as in the older doctrines, but the levers are operated by forces which lie quite outside the ken of association psychology.

Association figures also in the motor theory of consciousness, and here it would seem to be more after the old pattern. All association is between movement systems. Contiguity and similarity must be interpreted as contiguity and similarity between the systems of incipient and overt movements involved in the associated ideas.

We have said that Locke left his afterthought, his union of ideas by association, unreconciled with, or unrelated to, his account of knowing. Knowledge is the perception of the connexion of and agreement, or disagreement and repugnancy, of any of our ideas. In Book IV. he gives us a classification of the kinds of connexions and repugnancies we thus perceive: identity, relation, co-existence or necessary connexion, real existence. It would be out of place to go into the details of each class. What is at once apparent is that in all varieties of knowing the knower is perceiving some kind of relation between his ideas. They are synthesised or united in virtue of a perceived agreement or repugnancy.

If we turn to contemporary psychology, we may compare this doctrine with the principles of cognition laid down by Prof. Spearman. Prof. Spearman calls his qualitative principles of cognition 'noegenetic'. He claims that they and they alone are generative of new items in the field of cognition. Familiar as these principles may be, I will venture to quote the second and the third. The second is the principle of the eduction of relations: "The mentally presenting of any two or more characters (simple or complex) tends to evoke immediately a knowing of relation between them". The third is the principle of the eduction of correlates: "The presenting of any character together with any relation tends to evoke immediately a knowing of the correlate character". These two principles make the knowing of relations the basic fact of cognition. They are the key to intelligence.

Prof. Spearman would agree with *Gestalt* psychologists in stressing organisation. He differs from them by regarding organisation as dependent upon perceiving characters as related. All organisation or synthesis depends ultimately upon cognised relations. He thus denies sensory organisations as

simple data. By his second principle he necessarily repudiates association in the Lockian sense. Although he keeps the names of the old laws of association, contiguity and similarity, he states explicitly that "quasi-mechanical reproductive adherence has its source in the noetic coherence". In principle, reproduction by association and the eduction of correlates are akin. The distinction is that in reproduction the relata have already been related in past experience, the organisation is old, whereas in eduction of correlates the educed correlate is new. It is this aspect of his third principle in creating new knowledge that Prof. Spearman wishes to stress, and it is just this stress that differentiates his principle from that of relative suggestion advocated by Thomas Brown in his "Philosophy of the Human Mind", 1820. Whether such a distinction of 'old' and 'new' is one that can be drawn in any absolute sense is a question that need not be raised in this connexion.

Locke left us with unreconciled methods and principles, and in connecting these with differing schools in contemporary psychology, I may seem to be emphasising divergencies of doctrine. Indeed, I may seem to be giving support to the gibe that to-day there is no psychology, only a collection of psychologies. By many this is thought to be a sure sign of decadence. At first sight there is much in the present situation which may give rise to a sense of disappointment to those of us who belong to the older generation. The present century opened full of hope—psychology was emerging as a new science. It was being recognised as some-

thing distinct both from philosophy and from physiology. It was rapidly developing a technique of its own. All was 'set fair' for the growth of the 'new' psychology. It is true there were schools in a very limited sense. There was Leipzig, Göttingen, Paris, Harvard, Cornell, etc., but the lines of cleavage represented, say, at the Paris Congress of 1900, were but deep furrows in a common experimental field. To-day the schools appear to be separated by unbridged gulfs. Yet it is little more than fifty years since Wundt opened his laboratory in Leipzig, and fifty years is a brief interval in historical retrospect.

Is the present division of theory really a bad sign? Does it indicate the 'petering out' of the spirit which animated the workers from 1879 to 1900, or is it a sign of vigour? I believe there are good grounds for believing the latter alternative. Prof. Woodworth, in his book "Contemporary Schools of Psychology", declares, "all the schools are emphasising something that demands emphasis and serve a useful function in the progress of psychology". The methods and principles which find a place in Locke's Essay may demand for their reconciliation, not resolution but increase of knowledge, to enable us to mark out their respective spheres.

If Prof. Woodworth is right, we need reject no 'psychology' as false, but rather consider how far its particular teaching serves to explain certain aspects of complex human phenomena. This thesis can be illustrated by applying it to the data of experiments on recall.

Obituary

MR. E. EDSER

MANY students of physics, as well as numerous friends in the world of applied science, will regret to learn that Mr. Edwin Edser died on Aug. 17, at sixty-six years of age, after a long period of acute suffering bravely borne. He was one of the most unassuming of men, yet everyone who knew him appreciated the breadth and depth of his knowledge of all branches of physics, and his clear understanding of fundamental principles used either in theory or in practice.

Mr. Edser was a student at the Royal College of Science, South Kensington, and obtained his associateship in physics in 1892, being top of the list. After a year of research he was appointed demonstrator in physics at the College, under Sir Arthur Rücker, and in 1895 became lecturer in physics and head of the mathematical department of the South-Western Polytechnic, Chelsea. Later, he was lecturer in physics at Woolwich Polytechnic, and from 1903 until 1914 was head of the Department of Physics at Goldsmiths' College, University of London.

While at the Royal College of Science, Mr. Edser carried out some notable pieces of research and was associated with Sir Arthur Rücker in an important paper on the objective reality of combination tones, read before the Physical Society in March 1895. The question of the objective exist-

ence of summation tones as distinguished from supposed beat tones, which had previously been the subject of much controversy, was proved conclusively by the experiments and results described in this paper.

Mr. Edser was an ingenious experimenter, and so long ago as Aug. 17, 1893, he contributed an article to NATURE upon a simple arrangement of apparatus devised by him to illustrate Michelson's method of obtaining interference bands. The use of this apparatus in connexion with experiments on change of phase of light after reflection at a silver surface was described by him in an article in NATURE of Sept. 23, 1897. Mr. Edser was probably one of the earliest experimenters in Great Britain to make use of the principle of Michelson's interferometer, and he applied it to investigate the effect of movement in liquids upon the velocity of light. He also used the instrument in an investigation with Mr. S. G. Starling on the effect of the electric discharge upon the velocity of light. In a paper read before the Royal Society in 1898, Mr. Edser developed Maxwell's electromagnetic theory of light so as to include dispersion, metallic reflection, and allied phenomena.

In a letter to NATURE of May 2, 1912, concerning peculiar shadows cast by leaves during the partial solar eclipse of April 17, 1912, Mr. Edser made the

interesting observation that where a leaf was isolated from the bulk of the foliage, its shadow took the form of a crescent, thus actually being a negative image of the visible portion of the sun during its partial eclipse. In his inimitable way, he immediately devised a laboratory experiment to illustrate the phenomenon, and thus showed that when light from an extended source throws the shadow of a small object on a screen, under such conditions that the umbra of the shadow is not formed, then the shadow is the negative inverted image of the source of light.

Mr. Edser's textbooks on heat, light, and general physics are very widely known. He took special pains to make all his explanations as clear as possible, and many of the experiments described in his books were original and required only the simplest apparatus. When his textbooks were written, few science students of the standard for which they were intended were familiar with advanced mathematical methods, so the calculus was not used in them, and therefore some of the proofs now appear cumbrous from a more modern point of view. He was, however, very successful in presenting difficult parts of his subjects without making large demands upon the mathematical knowledge of students, though he was himself a good mathematician.

Since 1915 Mr. Edser's work was mainly concerned with the physical problems involved in flotation processes of mineral separation. One of his colleagues of Minerals Separation, Ltd., writes as follows:—"Much of his work in the investigation of the complex phenomena of flotation was published in the 'Reports on Colloid Chemistry'

of the British Association, his more important contributions being 'The Concentration of Minerals by Flotation' (Fourth Report, Coll. Chem., Brit. Assoc. Rept., 1922) and 'Molecular Attraction and the Properties of Liquids' (*ibid.*). From the latter the following conclusions he arrived at may be quoted: 'Of the energy which represents the surface tension of a liquid 94% is located in the surface layer one molecule diameter in thickness, while the remainder is located at a greater distance from the surface'. And in respect of the Law of Molecular Attraction: 'Two molecules attract each other with a force that varies inversely as a power of the distance separating them, and this power must be higher than the fifth. In all liquids the result of analysing the experimental data is to indicate that the molecules attract each other inversely as the *eighth* power of the distance separating them, but mercury is not in good agreement with this law.' Some could have wished a wider audience for these papers than their present (virtual) burial place affords."

In several respects, Mr. Edser represented the best type of product of the physical laboratories of the Royal College of Science and the stimulating influence of Sir Arthur Rücker and Prof. C. V. Boys. He was not only fertile in ideas, but also skilful in all laboratory arts, and able therefore to devise and construct simple and effective apparatus to test or demonstrate them. Withal he was a delightful companion, an artist of considerable merit, and of catholic literary taste; and his memory will long be cherished with affection by a wide circle of friends.

News and Views

Report of Council of the British Association

THE report of the Council of the British Association, adopted by the General Committee at the York meeting, included several matters of particular interest. The period of the presidency, for example, now coincides with the calendar year instead of extending from one meeting to the next. The nomination of the new president is made known, however, on the first day of the annual meeting, and the General Committee accepted the recommendation of the Council that Sir Frederick Gowland Hopkins, president of the Royal Society, should be the president of the Association next year, when the meeting will be held at Leicester on Sept. 6-13. A notable change of policy with regard to allocations of grants to research committees was brought before the General Committee. For many years these grants have been made on a year-to-year consideration of available balances and have amounted to about £1000 annually. The general treasurer, Sir Josiah Stamp, in a memorandum upon the financial position and outlook of the Association, pointed out the weakness of this system and suggested that, for a time at least, not more than £400 should be expended annually from general funds on grants for research, and that an annual sum of £500 should be placed to a contingency fund. This recommendation was approved by the Council, which

is of opinion that the true function of the Association, in making grants to research committees, is the initiation of particular pieces of research rather than their quasi-permanent endowment. In addition to the grants made from general funds at the annual meetings, the Council can deal at any time with applications for grants from the Caird Fund. Prof. J. L. Myres retires from the office of general secretary of the Association, which he has held since 1919, and the Council records its deep sense of gratitude for his devoted services. The two general secretaries are now Prof. P. G. H. Boswell and Prof. F. J. M. Stratton. The new members of Council are Sir Henry Dale, Dr. Allan Ferguson, Prof. R. B. Forrester, Dr. H. S. Harrison, Sir John Russell, and Prof. F. E. Weiss.

Social Consequences of Scientific Discovery

THE concern for the social consequences of the application of scientific discoveries which has been voiced by Dr. L. P. Jacks in a series of recent articles was reflected in several of the addresses and discussions at the recent British Association meetings. Dr. Jacks suggests that, instead of lending itself to the creation of endless desires, science might regard its task of giving man control over the forces of Nature as sufficiently advanced for the time being and turn its attention to the equally important task of assisting man to control himself. Recognition of this necessity was as explicit

in Sir Alfred Ewing's presidential address before the British Association as in the forceful address delivered by Prof. Miles Walker to Section G (Engineering), which referred frankly to the hampering of developments by vested interests and the middleman, as well as to the value of the contribution to the improvement of the lot of mankind made by those who possess the power of devoting their whole energy to the execution of sound, practical, and beneficent projects for the sake of those projects themselves and not primarily from selfish motives or in pursuance of some irrational prejudice. Long after science has shown the way to make things better for the people, unintelligent control and stupid prejudice preserve the old evils and prevent the spread of better ways. If effective action is to be taken, now that in so many fields physical science has instructed man how to control and eliminate waste, the human sciences must show him how to control the waste forces of his own nature.

As an example of the potentialities, Dr. Jacks and Prof. Miles Walker both refer to Lord Baden-Powell's discovery of how the play-hunger of the young human animal, his love of adventure and fun, his sporting instincts, and even his devilries, can be used by skilful hands for the development of self-control, self-respect, courage, loyalty, discipline, good fellowship, responsibility, and competence. This is a great discovery, to be ranked with any of the achievements of physical science, and is a token of what may be possible when we really address ourselves to the development of the social sciences. The picture Prof. Miles Walker draws of the State as controlled by the engineer, with the elimination of waste at its source, the control of production, improvement of distribution so as to secure the manufacture of things men want and their distribution in the simplest way with the minimum addition to the cost, involves drastic curtailment of competition and perhaps a profound change in our social habits and attitude towards buying and selling. In insisting on technical knowledge and administrative ability as a qualification for public office, he is, however, expounding a doctrine freely voiced in *NATURE* for many years, and the proposed experiment of a small, relatively self-supporting community is one that should not be without appeal to scientific workers. The time is opportune for courageous and adventurous experiment. The world has yet to receive an object-lesson in the high standard of life which should be possible by good organisation and modern methods, where prejudice and incompetence are no longer allowed to deny to society the benefits of leisure or material possessions with which the application of scientific discoveries would endow them.

Political Economy and Unemployment

THE confusion which exists in many minds between creative science and mechanical science is apt to obscure the contribution which creative science makes towards the solution of the unemployment problem, a contribution which, under modern conditions, is the more important because so many of the new industries, which fundamental scientific discoveries have created, minister to the increasing leisure needs

of mankind. The escape of output from limitations of human effort, resulting from power production, has economic consequences which are already so far-reaching that, in the physical sphere, creative science can do little more than mitigate the severity of unemployment, and Mr. H. R. Leech, of 10 Dale Street, Runcorn, has rightly directed our attention to the necessity for original and creative research in that most uncreative of sciences—political economy. It is only as political economy and all the related so-called human sciences are placed on a firm scientific foundation, and as scientific methods are rigorously applied to the analysis of the problems of distribution of leisure and goods with which we are confronted in the age of incredible abundance which science has given us, that we can expect to solve an unemployment problem of the present magnitude. When impartial solutions have been mapped out by scientific methods, there will still remain for scientific workers and others the moral responsibility of seeing that those solutions are applied, and that the profusion with which science has now endowed mankind is no longer permitted to exist side by side with such widespread unemployment, poverty, and distress.

Scientific Research and Industry

THE Committee appointed in March 1931 by the Economic Advisory Council to examine the project for promoting new industrial development in Great Britain by establishing a central national research organisation independent of existing Government and private organisations, has just issued its report. This gives a survey of the existing organisation of industrial research in Great Britain and an analysis of the arguments for a new national research organisation, as well as of proposals for a development fund for the Department of Scientific and Industrial Research, a compulsory levy for support of research associations, and the preparation by Government of scientific digests. The Committee is satisfied that the existing Government organisation for the promotion of industrial research is efficient and sufficiently flexible to enable it to develop along the lines required to meet the changing needs of industry. The formation of a new national research organisation would cut right across the existing organisation of the Department of Scientific and Industrial Research, and, by causing confusion of purpose and distraction of effort, would be likely to injure rather than forward the cause of scientific research in British industry.

Research Development Fund

THE Committee considers it is highly desirable that the Government should have at its disposal a small fund for research development, and that provision should be made for its continuance when the balance of the fund at the disposal of the Advisory Council for Scientific and Industrial Research is surrendered to the Exchequer at the end of the current year. The Committee refers to evidence received as to the value of the services rendered to industry by the research associations, and trusts that it will be possible for the Government to continue to provide sufficient financial assistance to secure their efficient functioning until industry

is in a position to bear the whole of their cost. At the same time it is considered that if an industry can produce a practicable scheme, Government assistance in obtaining Parliamentary powers for a compulsory levy should be forthcoming. We hope to discuss this Report in more detail in due course.

Liebig and Faraday at York

It is one of the benefits of international intercourse that visitors to a country often record in their letters and diaries their impressions and memories of men and institutions, for which we cannot be too grateful. From these records we get those glimpses of the past which often escape the historian. Thus from the memoirs of Bishop Taylor of Norwich we can picture the aged Haüy—who looked like a man picked out of a crystal—lecturing at the Jardin des Plantes, where, “as everywhere also, the utmost liberty is shown to all, but to Englishmen particularly your country is your passport”; while from the letters of Helmholtz we see Tait “a particular form of savage” at St. Andrews, where, devoted to golf, he could only be brought to talk of rational matters on a Sunday. Of all the men of science who visited England in the early days of Victoria, none was better known than Liebig, who was at York for the 1844 meeting of the British Association, and afterwards toured Great Britain in the company of Playfair, Daubeny, and Dean Buckland. After his return to Giessen, Liebig wrote a charming letter to Faraday, which was long treasured by the late George B. Buckton, and which through the kindness of Miss A. M. Buckton was published in full in the *Times* on Aug. 31. During this year’s meeting of the British Association the letter has been on exhibition, and Miss Buckton proposes to send it to General Smuts, as a contribution to the newly built Witwatersrand Library. It is stated in the *Times* that the letter has hitherto been unpublished, but perhaps it should be pointed out that it was printed in W. A. Shenstone’s “Justus von Liebig, his Life and Work”, published by Messrs. Cassell and Co. in 1901. While Liebig’s letter contains an interesting view of British science at the time, Frank Buckland has left us an equally interesting contemporary account of the happy surroundings in which Liebig lived and worked at Giessen.

Founders of the Royal College of Chemistry

THE memory of Liebig is also revived by an article, accompanied by a reproduction of a daguerreotype of five of his assistants, contemporaries in his laboratory at the University of Giessen, all of whom were pioneers of chemistry, which appears in the *Times* of Sept. 5. Three were German—Hofmann, Fresenius, and Will—and two were English—Gardner and Bullock, who were associated in 1845 in the foundation of the Royal College of Chemistry, of which Dr. Gardner was secretary and Hofmann the first professor of chemistry. That three of the chemists associated with the Royal College of Chemistry in its early days should be included in a single photograph will be of special interest to past and present students of the Royal College of Science, its lineal descendant. “Ninety years ago”, says the writer of the article,

explaining the picture, “five young men met for a solemn function. . . . They met to be photographed.” He gives a list of the distinguished chemists trained by Hofmann at the College, of whom Prof. H. E. Armstrong survives.

The Chinese Earthquake of Aug. 14

AN earthquake of considerable severity occurred in the south-west of China at about noon (Chinese time) on Aug. 14, and was registered by seismographs throughout the world. From the records at six observatories, the officials of the U.S. Coast and Geodetic Survey place the epicentre in about lat. 27° N., long. 103° E. (Wire Report of Science Service, Washington, D.C., Aug. 16). This point lies near the northern boundary of the province of Yunnan, about seven hundred miles to the south of the province of Kansu, in which the destructive earthquakes of 1920 and 1927 occurred. Kansu is a thickly populated province, and it is possible that some thousands of lives may have been lost, though weeks may elapse before news reaches us from the central district. From the beginning of the sixteenth century, it has been visited by twenty disastrous earthquakes, by one of the latest of which, in 1888, about five thousand persons were killed. According to Mr. N. F. Drake (*Amer. Seis. Soc. Bull.*, vol. 2, pp. 40-91; 1912), the province of Yunnan is one of the most important earthquake districts of China. He represents the relative seismicities of the four principal districts—Fukien, Kansu, Chihli, and Yunnan—by the numbers 100, 98, 94, and 91.

The Rubber Industry in Malaya

THE rubber industry of Malaya is passing through the most critical period which it has yet experienced, so that the issue of a special rubber number of the *Malayan Agricultural Journal* (vol. 20, part 5) is of particular interest. The recent decision against compulsory restriction of rubber growing, though a disappointment to many, has, by removing the element of uncertainty, enabled the estates to frame their policy more clearly. Under-consumption rather than over-production is the cause of the present crisis, so that it is hoped to rectify matters by more intensive production on areas actually in tapping, and by improving the liaison between the scientific investigator and both producer and consumer. Already great reductions have been effected in the cost of production. Factory improvements, such as the construction and installation of batteries of light sheeting machines in cascade or file formation instead of in line, have facilitated and accelerated the handling of the coagulum, and more rapid methods of drying and smoking have been evolved. Economy has also resulted by the use of treated hessian for packing in place of the usual wooden chests. Considerable increase in the export of latex continues, and the extended application of this form of product to new uses is a hopeful sign of development on at least one side of the industry. Every effort is being made to study the best methods for growing and manuring the crop and for controlling the various diseases and insect pests which attack the rubber plant, so that when the industry

emerges from its present difficulties it seems reasonable to believe that a standard of efficiency of production will have been achieved such as was undreamt of in the prosperous time which formerly prevailed.

Briquette Method of Reafforestation

A SOMEWHAT novel method of sowing tree seeds is alluded to by Prof. Svend Heiberg, of the Department of Sylviculture of the New York State College of Forestry at Syracuse, in a Science Service Bulletin, dated June 29. Prof. Heiberg has been studying forestry methods in Europe, and was interested in a new type of seed-sowing developed in Norway which he terms "planting forests by the brick instead of by the tree". The seed bricks or briquettes are made of good soil and are $1\frac{1}{2}$ in. \times $1\frac{1}{2}$ in. in size. Three or four seeds are placed at one end, near the surface. The briquette is then dipped in paraffin wax, except the side in which the seeds have been placed. The result is an easily transported product, which can be placed in the ground by means of a special tool designed for the purpose. A machine can turn out 16,000 briquettes in a day. Prof. Heiberg suggests that the idle lands of the United States may be reafforested by planting briquettes instead of trees. He has been experimenting with this new system of planting or sowing at the College, but has not yet had time to decide upon its successful possibilities. He realises that the method would only be practicable on bare land free of heavy weed growth. In the absence of any figures of cost and of data of success achieved, it is not possible to compare the cost of the method with ordinary broadcasting or patch sowing; but Prof. Heiberg is probably correct to a point in stating that "In the reafforestation of comparatively clear fields the briquette system will do away with tree nurseries. It has other important advantages. It permits the root system to develop normally and also avoids disturbance of the roots at the time of planting"—though these latter apply to all tree seed-sowing.

Tuberculosis in Cattle

THE eradication of tuberculosis from cattle herds is the subject of a recent article by James Mackintosh (*J. Roy. Agric. Soc.*, vol. 92), who, besides describing the steps already taken in England and other countries to reduce the incidence of this disease, offers some practical recommendations as to how it may be more effectively stamped out. Although eradication by means of vaccines designed to confer immunity is still in the experimental stage, the testing and separating of reactors from non-reactors has met with success in northern European countries and seems to be the most hopeful method for adoption in Great Britain. Greater uniformity is, however, desirable in the application and interpretation of these tests. The measures taken under the Tuberculosis Order, 1925, to destroy all animals suffering from 'open' tuberculosis having failed to attain their object in time to be of real value, amplification of the order is recommended so as to ensure a general systematic inspection of cattle, by means of which tubercle-free beef and dairy herds may be built up, with a possible development in the future of definite 'accredited' areas. In this respect the Milk (Special Designations)

Order has been of definite use by providing the only official recognition in Great Britain for herds which have been tested and contain no reactors. The practicability of such a scheme as that issued by the National Veterinary Medical Association is made evident, and the cost, if shared by the State, the local authorities, and the farmer, should not be heavy, whereas the benefit to the cattle industry and the community in general would be very considerable.

Cockles of the Thames Estuary

IN the *Southend Standard* for Aug. 4 and 11, Mr. Laurence Wells describes the local cockle industry, and has collected much valuable information ("The Cockle Industry of Leigh." Part I., "Early Use of the Cockle as Food and the Rise of the Industry at Leigh-on-Sea". Part II., "Natural History, Distribution, and Economics"). The natural knowledge of the fisherman is extensive. From experience and from observation he has acquired an intimacy with the ways of the cockle which would put many a naturalist to shame. Spawning time, free-swimming larvæ and the effects of the weather on them, their growing stages, and the strange sounds made by the young under the sand are all known to them. To the different parts of the animal he gives special names. He knows that if conditions are unfavourable the cockles may migrate to more pleasant surroundings. Cockles have been collected at Leigh for more than 150 years. To-day the industry is thriving and affords work for a number of men and women. The sandbanks and flats of the Thames estuary afford a habitat admirably suited to the needs of these bivalves, from Shoebury Sands for the whole length of the Maplin and Foulness Sands, known collectively as the "Maplins". The Leigh men also work along the Kent side as far as the Whitstable Flats; for 60,000 cwt. of cockles, minus the shells, are demanded from them annually, valued at £11,000. The boats are of a special design and peculiar to Leigh. The cockles are collected with a special rake and are cooked, according to law, in a steam oven, before being sent to market. Apart from the sale of the cockles themselves, there is a thriving industry in by-products from the shells. A complete account of the cockle, both historical and biological, is given in Mr. Wells's interesting article.

Electric Power and Village Industries

THE 'Sofina' (Société Financière de Transports et d'Entreprises Industrielles) controls a large number of industrial undertakings in all parts of the world. In its third annual report, interesting data are given of the rapid increase in the rate of the substitution of small electric motors in place of hand power in certain districts in France. In the St. Etienne district, for example, the small workshops have increased more than fifty times during the last seven years. The number of looms in 1925 was 214, but it has now increased to more than 11,000. In the Roanne district, the number of family weaving workshops has trebled in nine years. Home workshops for machining cycle parts have increased greatly all over France. It is pointed out that this substitution has enabled the

family workshop to compete against the large factory. In the Jura department, communal workshops have placed four hundred electric lathes at the disposal of the woodworkers. This utilisation of electric power by cottages has an effect in keeping the country dwellers from drifting to the larger cities, and thus mitigates some of the social problems which many nations are finding so difficult at the present time. In Great Britain, the transmission system—the grid—will soon supply cheap electric power to several country districts. In these districts it will be possible to establish suitable village industries on a commercial basis. In time this should have the effect of easing the economic crisis. Probably training schools for craftsmanship will have to be established. If electric power is sufficiently cheap, small electric motors should enable the weaving industries to flourish in villages.

Studies of Geophysical Methods, 1928 and 1929

THE Geological Survey of the Canadian Department of Mines has published, as *Memoir 165* (Ottawa, pp. 225; 1931, 45 cents), a valuable account, under the above title, of an impartial investigation of various methods of geophysical prospecting. Electrical methods were applied in 1928 to the Abana mines property, Quebec, by generous permission of the owning company, and three electrical prospecting companies accepted an invitation from the Geological Survey to demonstrate their methods on this comparatively suitable deposit; the work was done at their own expense, under the observation of officers, both physical and geological, of the Survey. The geological, electric, and magnetic surveys showed that the physical conditions existing in the Abana mineral deposits are complex, but that, nevertheless, the magnetic and electric methods of prospecting, when used intelligently, are feasible and productive of valuable results. The work in any new area must still be to a large extent an original research, requiring the use of highly trained and skilled men. Further work on the Abana property, and elsewhere, was done in 1929, partly in co-operation with the U.S. Bureau of Mines and (in gravity work) with the Dominion Observatory of Canada. At the Errington Mine, Ontario, an area was met "for the first time" where, in the present state of our knowledge, geophysical methods were of small avail, and where the diamond drill under the direction of geologists and mining engineers was the sole guide to further discovery.

Actinometric Bibliography

THE Association of Meteorology of the International Union for Geodesy and Geophysics, at its Stockholm meeting in 1930, gave a subvention for the preparation of a bibliography, or rather a series of short abstracts, of papers on actinometry. These are prepared under the supervision of M. Wehrlé, secretary of the Association, at the French National Meteorological Office, by M. Volochine; where possible, the abstract is provided by the author, and English, French, and German versions of the abstracts are available, at the choice of subscribers. Each abstract is on a single leaflet, of convenient size for binding; the leaflets are well reproduced by litho-

graphy from typescript. The normal annual number of leaflets will be 300-400, but the bibliography is to be retrospective, covering the last thirty years; this work, involving about 2000 leaflets, being planned to occupy about two years. The leaflets are to be sent to subscribers in packets of fifty. Subscriptions are invited, though the amount of subscription will not be fixed until the demand for the leaflets is ascertained; it is expected, however, to be about 120 francs per year (for 400 leaflets), and 600 francs for the retrospective bibliography (for 2000 leaflets). Intending subscribers should write to M. Wehrlé, at l'Office Nationale Météorologique, Paris.

Turquoise Mosaic Plaque from Chichen Itza

A MOSAIC plaque of turquoise and jade, it is announced by Science Service, of Washington, D.C., has been discovered under the Castillo mound, in the ruined city of Chichen Itza, Yucatan. This announcement recalls the discovery, also at Chichen Itza, of a similar plaque—one of the most remarkable objects of the art of the ancient Mayas ever found—which was made in 1928 by an expedition sent out by the Carnegie Institution of Washington. This plaque was made of turquoise mosaic on a foundation of wood, which had perished. The services of a museum expert were requisitioned from New York for its removal. The operation of salvage, which necessitated the improvisation of a special technique on the spot, took three months to complete. The plaque was exhibited for the first time at the International Congress of Americanists which met in New York in September 1928. The plaque which has recently been found is described as a mosaic of turquoise and jade, and, like the preceding find, is on a foundation of wood, now decomposed. It lies in a stone box under a number of fragile articles not yet removed. The tomb under the mound appears to be a secondary burial, and turquoise spearheads may indicate that the occupant was a warrior.

Announcements

THE Alexander Pedler Lecture of the British Science Guild will be given this year, under the joint auspices of the Burton-on-Trent Natural History and Archaeological Society and the Guild, at Burton-on-Trent on Nov. 4, by Prof. F. T. G. Hobday, principal and dean of the Royal Veterinary College, London. Prof. Hobday's lecture will be entitled "Animals as a National Asset and Responsibility". The Norman Lockyer Lecture of the Guild will be delivered on Nov. 22 by Sir Frank E. Smith, secretary of the Department of Scientific and Industrial Research.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in electrical engineering at the Leicester College of Technology—The Registrar (Sept. 12). A lecturer in physiology for education students at the University of Leeds—The Registrar (Sept. 15). A lecturer in physical chemistry at Auckland University College, University of New Zealand—The Secretary of the Universities Bureau of the British Empire, 88A Gower Street, W.C.1 (Oct. 10). An assistant bacteriologist at the Royal Institute of Public Health—The Secretary, 23 Queen Square, W.C.1.

Letters to the Editor

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

Altitudes to be Reached by Air Pilots by Breathing Oxygen

SCHROTTER (1904)¹ gives the following figures :

Altitude.	Pressure.	Tension of Oxygen if Pure Oxygen were breathed.
11,000 m.	190 mm. Hg.	25 per cent of an atmosphere.
14,500	127	16.6
17,000	93	12.5
20,000	76	10

At normal atmospheric pressure, most people can bear a reduction of oxygen from 21 to 12.5 per cent of an atmosphere without distress, but if the tension of water vapour in the lungs is, as assumed by Schrotter, 47 mm. of mercury, and that of carbon dioxide 30 mm. Hg, a total pressure of 77 mm. Hg, then at 17,000 m., where the pressure is 93 mm. Hg, the tension of oxygen, even when pure oxygen is breathed, must be far too low to support life, namely, $93 - 77 = 16$ mm. Hg. Argyll Campbell found that animals could live when the tension of oxygen in the lungs fell to 50 mm. Hg, but degeneration of the heart and other organs resulted on prolonged exposure to this tension, which is one-third of the normal, and corresponds to that at the top of Everest. We know how very distressed the best climbers became on reaching 28,000 feet; two lost their lives, never returning from their final effort to reach the top.

On repeatedly exposing 4 mice, 7 rats, 2 guinea-pigs, 1 rabbit, and 2 goats in chambers to oxygen (about 98 per cent) and evacuating the chambers, I found all these animals to be not distressed when kept for five minutes or more at a pressure of 100 mm. of mercury, but to be uncomfortable at 90 mm. Hg, and prostrated, or convulsed, at 85-70 mm. Hg. The experiments were carried out in special chambers and with vacuum pumps and animals (goats) kindly placed at my use by Sir Robert Davis at the works of Messrs. Siebe, Gorman and Co., Ltd.

Very conclusive evidence was obtained from the two goats. When the pressure sank to less than 100 mm. Hg, each goat licked its lips and moved a little as if uneasy; at about 90 mm. Hg each lay down; at about 84 mm. Hg a convulsive movement due to want of oxygen was apparent. All the animals recovered at once on letting in more oxygen and raising the pressure.

It is clear from these experiments that the total tension of water vapour and carbon dioxide in the lungs must be considerably lower than that assumed by Schrotter, at any rate at low atmospheric pressures. The tension may be reduced by better ventilation of the lungs. Haldane says the tension of carbon dioxide in the lungs may be halved at 35,000 ft., but he assumes the tension of water vapour to be 47 mm. Hg. This scarcely can be the case.

Schrotter put the limit of altitude attainable by air pilots with the help of breathing apparatus at 11,000 m. or a little above this figure. These animal experiments show that, given an efficient oxygen breathing apparatus and an hour, say, spent in breathing oxygen before the climb in order to wash out nitrogen from the body, a pilot might attain certainly to 50,000 and perhaps even to 55,000 ft. A pressure of 95 mm. Hg corresponds, according to

Schrotter's figures, to 55,800 ft., and all the animals withstood decompression to this figure without serious signs of discomfort. It is noteworthy that Paul Bert (1878)² records that a sparrow decompressed in 92 per cent of oxygen fell over as if dying when the pressure was lowered to 75 mm. Hg.

LEONARD HILL.

¹ Schrotter, "Die Sauerstoff in der Prophylaxe und der Therapie", 1904.

² Bert, Paul, "La Pression barométrique" (1878).

The Practice of Dental Mutilation

IN NATURE of Aug. 20, p. 268, reference is made to a letter published in the August number of *Man* in which I state that the earliest evidence I could find of evulsion of teeth and other dental mutilations in Nubia could not be pushed back before about 300 B.C.

I have no reason for modifying that statement. Nevertheless, as Dr. Wilfrid Jackson reminds me in a personal letter, I overlooked the fact that there is evidence from other places to suggest that the practice of dental mutilations may be very much more ancient than the Nubian record suggests. In October 1914, Dr. Jackson published an article entitled "Dental Mutilations in Neolithic Human Remains",¹ in which he quotes evidence which seems to establish the fact that during the Neolithic period evulsion of the teeth was practised in North Lancashire and North Wales. Moreover, in this article he cites information suggesting the possibility of dental mutilations at the time of the Egyptian Middle Kingdom (about 1800 B.C.) on the basis of a skull of the twelfth dynasty in the Manchester Museum. Moreover, Dr. Douglas Derry describes a case which, so he claims, reveals dental mutilation in a late pre-dynastic skull from Lower Egypt, found by Sir Flinders Petrie. In view of this information, it is clear that I must modify the statement which I made on the basis of the Nubian evidence. The addition of fifteen (and possibly thirty) centuries to the antiquity of the practice of removing the teeth, if the somewhat sketchy data should be confirmed, will prepare the way for the elimination of certain difficulties in interpreting the evidence obtained by Miss Dorothy Garrod in the skeletons from Palestine regarded by her as mesolithic.

Dr. Wilfrid Jackson directs my attention to an article by Prof. Yoshikiyo Koganei² on the occurrence of dental mutilations in so-called stone-age Aino remains from the shell-mounds of Japan. I have the less excuse for forgetting this fact because two years ago, during my visit to Tokyo, Prof. Koganei showed me the actual specimens.

While none of the evidence which escaped my memory when I was writing my letter to *Man* is quite conclusive, its cumulative effect is to raise the possibility that the practice of evulsion of the teeth may be much older than I assumed to be the case.

In drawing inferences from sporadic instances of the absence of incisor teeth, the fact should never be overlooked that such deformations may easily be produced as the result of disease or accidental injuries inflicted by a process no more lethal or culturally significant than prize-fighting. In fact, it is doubtful whether the instances attributed to the Egyptian pre-dynastic period and Middle Kingdom are of any real significance as evidence of a cultural practice, and Dr. Wilfrid Jackson's Neolithic examples may possibly come into the category of accidental injuries.

G. ELLIOT SMITH.

Aug. 30.

¹ *J. Anat. and Physiol.*, vol. 49, p. 72; 1914.

² *Mitt. d. mediz. Fakultät d. Kaiser. Universität zu Tokyo*, Band 28, Heft 3; 1922.

Ionisation by Positive Ions

In recent years many theories of discharges in gases have been proposed which do not afford a consistent explanation of the principal properties of currents obtained in gases under various conditions. According to a theory which has been much advocated,¹ it is said that atoms of the gas are not ionised by single impacts of electrons in discharges at pressures greater than that corresponding to the minimum sparking potential, since the electrons lose their energies in producing metastable atoms and therefore cannot attain the ionising potential. So far as the action of electrons is concerned, it has already been shown that this theory of collisions is inconsistent with the ordinary properties of glow discharges.²

Recent theories³ also involve unsatisfactory hypotheses with regard to the action of positive ions in contributing to the conductivity.

In these theories it is maintained that atoms or molecules of a gas cannot be ionised by the collisions of positive ions unless the kinetic energy of the ions is of several thousand volts. Thus if the ionising potential of an atom be 10 volts, a hydrogen ion would require an energy of at least 4500 volts in order to ionise the atom.⁴ It has therefore been concluded that in discharges where the potentials between the electrodes are less than a thousand volts, the action of the positive ions in contributing to the conductivity is limited to the liberation of electrons from the negative electrode, and in order to explain the corona discharge it was found necessary to assume that the emission of electrons from the electrode is independent of the energy of the positive ions acquired by moving under the electric force in the gas. The objections to these hypotheses as a basis of a general theory of discharges have been pointed out.⁵

The modern theories thus differ from the well-known theory of the disruptive discharge which was deduced from experiments made some years ago in the Electrical Laboratory, Oxford.

In this theory, in order to reconcile the results of the experiments on currents between parallel-plate electrodes with experiments on the corona discharges, it is assumed that molecules or atoms of the gas are ionised by the collisions of positive ions in discharges maintained by potentials of a few hundred volts, where a small proportion of the ions acquire energies of about twenty volts. When the electric force is small and the gas pressure is large, the rate of ionisation due to positive ions is very small, but it is increased when the force is increased or the pressure reduced. Thus the ionisation increases with the kinetic energy acquired by the positive ions in moving under the action of the electric force.

We have recently made direct experiments to determine the effects of positive ions in hydrogen, the apparatus being designed so that it was possible to separate the effects of the liberation of electrons from the negative electrode from the effect due to the ionisation of atoms of the gas. We find that the number of electrons generated by positive ions in a current between parallel plates depends on the electric force and on the pressure of the gas. There is a large increase in the number of electrons thus generated, corresponding to a small increase in the force with forces of the order of 100 volts per centimetre and pressures of the order of half a millimetre. Also with copper plates 2 cm. apart the number of electrons liberated from the negative electrode is small compared with the number of molecules of the gas that are ionised by the impacts of the positive ions.

These experiments show that the energies of the positive ions in the collisions in which molecules are ionised are of the same order as that of the electrons,

so that the velocities of the positive ions in these collisions are of the order of one-hundredth of the velocities of the electrons.

These results therefore confirm the earlier theory of disruptive discharge, given in the treatise "Electricity in Gases".

J. S. TOWNSEND.
F. LLEWELLYN JONES.

Oxford, Aug. 18.

¹ T. R. Merton and J. G. Pilley, *Proc. Roy. Soc., A*, **107**, 411; 1925. R. d'E. Atkinson, *Proc. Roy. Soc., A*, **119**, 335; 1928.

² J. S. Townsend and S. P. McCallum, *Phil. Mag.*, **5**, 695; 1928. *Proc. Roy. Soc., A*, **124**, 533; 1929.

³ J. Taylor, *Proc. Roy. Soc., A*, **14**, 73; 1927. K. Zuber, *Ann. Phys.* (12), **6**, 665; 1932.

⁴ Sir J. J. Thomson, *Phil. Mag.*, **48**, 1, July 1924.

⁵ J. S. Townsend, *Phil. Mag.*, **45**, 444, March 1923. L. G. H. Huxley, *Phil. Mag.*, **3**, 1056, and **4**, 899; 1927.

Polarisation of Echoes from the Heaviside Layer

ONE of the most fruitful methods of investigating the Heaviside layer is that originated by Breit and Tuve, in which a series of short impulses of the order of 0.2 of a millisecond in duration are transmitted and the direct ray and echoes reflected at nearly normal incidence are observed at a neighbouring station. The echo patterns observed are often very complex and it has been found that a single *F* layer echo, say, is often split into two fairly closely spaced components. This has been attributed by Appleton to the double refraction suffered by a ray in passing through the ionised regions of the upper layer.

The double refraction is caused by the earth's magnetic field. According to the theory, these two components should be oppositely circularly or elliptically polarised. A complete proof that the splitting of echoes is due to double refraction should involve a demonstration of this fact. A recent experiment, in which this result is clearly demonstrated, constitutes a striking proof of the magneto-ionic theory of radio transmission.

For the purpose of determining the state of polarisation of the downcoming waves, two separate vertical tuned loop aerials perpendicular to each other, as in a Bellini-Tosi direction finder, were used at the receiving end. These were coupled in the usual way to a search coil which fed the receiver. The output of this actuated a cathode ray oscillograph in the normal way for demonstrating the echoes. The object is to use the double frame as a polarimeter. This can be achieved as follows: The aerial is set so that the angle between the two frames is bisected by the incoming direct or surface ray. The aerials are then tuned so that the currents in the two are in phase with the e.m.f.'s, which are also in phase. The search coil of the goniometer can then be set at 45° so as to receive no signal. The aerials are then mistuned, one being increased in natural period and the other reduced. When the e.m.f.'s in the aerials are in phase, the resultant is a rotating field in the goniometer and no position of balance can be found.

Consider a ray returned from the Kennelly-Heaviside layer: if this is circularly polarised, then the e.m.f.'s in the two frames will be 90° out of phase. If the mistuning of the aerials has been properly carried out so that the current in one is advanced 45° on the e.m.f. and retarded 45° in the other, then, when the e.m.f.'s are 90° out of phase, the currents will either be in phase or 180° out of phase, according to the direction of circular polarisation. It follows that for a circularly polarised wave a balance can be obtained with the pointer of the goniometer either at +45° or -45°, according to the direction of circular polarisation.

Let *A* and *B* in Fig. 1 represent the components of

the split echo represented on the oscillograph screen in the usual way. Then, when receiving with this polarimeter aerial, *A* will be enhanced and *B* reduced to zero and vice versa, according as the goniometer search coil is switched, say, from a +45° position to a -45° position, and the pulses *A* and *B* will 'see-saw' as the search coil of the goniometer is rapidly switched from +45° to -45°.

In testing this arrangement, the expected results were immediately shown in a most striking way. The transmission was on a 60 m. wave from Writtle, near

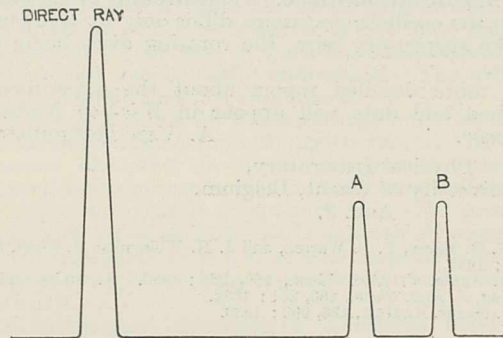


FIG. 1.

Chelmsford, to Broomfield, at a distance of 2.8 km., in which a series of pulses at a frequency of about 100 a second were sent out.

Split echoes were observed in the *F* layer reflections. With the aerials set up in the proper manner, switching the goniometer coil obliterated, in turn, first *A* and then *B*, producing the 'see-saw' effect expected. The results prove quite definitely that the two components are polarised in opposite directions. A knowledge of the adjustments made enables us to state that the most bent echo *A* is right-hand circularly polarised, looking along the ray in the direction of transmission, and the least bent echo *B* is left-hand circularly polarised. The arrangement enables one to examine the polarisation of each echo individually. So far as we have observed, the daytime echoes are normally right-hand circularly polarised.

This is in accordance with the view that in daytime on this wave the attenuation of the echo occurs mainly in the *E* layer, where according to theory the attenuation of the left-hand polarised ray should be more than twice as great as the right-hand polarised ray. This conclusion is confirmed by the observation that *F*₂, that is, a double reflection from the *F* layer, appears before the left-hand circularly polarised *F*₁. The arrangement should be of great help in interpreting the complex echoes that are often observed.

T. L. ECKERSLEY.

Research Laboratories,
Marconi Works,
Chelmsford, July 18.

Evidence of a Penetrating Radiation from Thunderstorms

WE have recently carried out experiments which suggest that a penetrating radiation is emitted by charged thunderclouds. In the arrangement used, one pen of an electric chronograph was actuated by a Geiger-Müller counter, another pen by a chronometer marking half-seconds, and a third by the atmospherics received from lightning flashes on a two-valve amplifier. The records have been examined to see whether the kicks of the counter and the flashes showed any significant time relations.

It appears that, during certain distant storms, the number of coincidences between counter-kicks and flashes is considerably more than can be ascribed to chance. Analysis of the distribution of counter-kicks in time around flashes shows that the number of kicks occurring in the particular interval of $\frac{1}{100}$ sec. which is centred on a flash exceeds the chance expectation by a factor which in the case of seven different storms varied from 3.3 to 11.4. In one case in which the counter was completely shielded by 20 cm. of iron the factor was 8.0.

Precautions were taken and tests were made to exclude spurious coincidences due to the interaction of the atmospheric and the counter amplifiers with each other, or to the direct action of the atmospheric Hertzian wave upon the counter amplifier. The seven storms which gave systematic coincidences were all at distances of 30-60 km. away; overhead storms did not show them. The results thus indicate that a thunderstorm emits some form of penetrating radiation at the moment of occurrence of a lightning flash, that this is emitted upwards and not downwards, and is received at distant points by some action such as that of the earth's magnetic field upon electrified particles.

To examine whether thunderclouds can produce such radiation *before* they are discharged by lightning, we have analysed the records of 21 distant thunderstorms (3200 flashes). The number of kicks of the counter was determined in the intervals 1, 2, and 5 sec. before and after the occurrence of each flash. The storms which gave systematic coincidences also show an excess of the order of 10 per cent in the forward as compared with the backward intervals. The probable error in the total count was 3 per cent. The other storms, which did not give systematic coincidences, show no significant effect here either, for they give a forward defect of 1 per cent while the probable error in the count is 2 per cent.

The geographical distribution of the storms which showed these effects is not easy to determine with certainty since what has been referred to as a storm is actually a record of several storms in different places. What information we have on this point suggests that the effective storms lay to the east of the meridian through the station.

Observations on overhead thunderstorms provided further evidence of the screening effect on the ordinary fine weather penetrating radiation which has already been reported by one of us.¹

The experiments were made at the University of the Witwatersrand, Johannesburg. We wish to thank Prof. H. H. Paine for many kindnesses and to acknowledge the financial assistance of the South African Research Grant Board.

B. F. J. SCHONLAND.
J. P. T. VILJOEN.

University of Cape Town,
July 20.

¹ Schonland, *Proc. Roy. Soc., A*, 130, 37; 1930.

Viscosity of Nitrobenzene

WITH the intention of carrying out measurements of the viscosity of liquids, we have studied recently different experimental methods, and have come to the conclusion that, for relative measurements, the oscillating disc method permits of very great accuracy. Therefore we determine first the logarithmic decrement by registering the oscillations on bromide paper. The amplitude of the deflections could afterwards be measured with no great difficulty to 0.1 mm.

It seemed to us of great interest to investigate

nitrobenzene in the temperature range from 20° down to 6° C. by this experimental method. Besides the great relative accuracy obtainable with our method, there is another advantage; during the whole of the measurements, the liquid under examination remains completely separated from the atmospheric air. So we possess a rigorous control of the purity of the nitrobenzene during the measurements. We know from recent work published by other investigators that this precaution is absolutely necessary.

A few months ago, measurements with the same object were made by Massy, Warren, and Wolfenden.¹ They used the capillary stream method. The authors mention that in spite of the precautions taken, it was quite impossible to prevent the nitrobenzene from absorbing a small quantity of water.

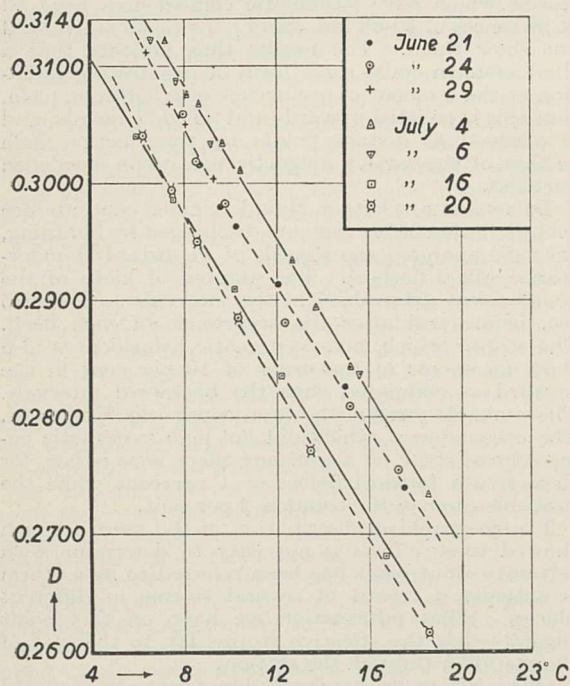


FIG. 1.

In consequence of the great accuracy of our method (0.05 per cent determined from the average error of the observations), we think it desirable to communicate our results. The experimental data are shown graphically in Fig. 1. The logarithmic decrement D has been plotted as a function of the temperature.

The measurements were made with two different oscillating systems (wire with different length). The points of the upper pair of curves correspond to the first oscillating system, those of the lower curves to the second one. Each point of the curve represents the average of about seven observations. The full lines correspond to the pure nitrobenzene,* while the broken curves correspond to nitrobenzene which was not absolutely pure and contains essentially water (m.p. $5.32 \pm 0.02^\circ$).

The curve shows clearly, in both series of measurements, that for pure nitrobenzene the curves are straight lines with no discontinuous transition point. This result is in agreement with that obtained by Massy, Warren, and Wolfenden (*loc. cit.*), and also with the results established recently by other investigators, who measured other physical properties.

* This nitrobenzene was furnished by the Bureau Intern. d. Etalons physico-chimiques of Brussels. The melting point was guaranteed to be 5.70° (we found $5.70^\circ \pm 0.02^\circ$ on a normal thermometer verified by the Physikalisches Reichsanstalt).

For the impure nitrobenzene, the curves appear to be composed of two different straight lines, which cut each other in the neighbourhood of 9.6° . This experimental result agrees also with the suggestion put forward by other investigators and specially by Smits and Gerding,² that the phenomenon observed by Mazur³ must be attributed to insufficient drying of the nitrobenzene, so that in the neighbourhood of 9.6° the nitrobenzene loses its absorbed water.

Finally we wish to direct attention to the parallelism between the straight lines corresponding to the pure and impure nitrobenzene. This can easily be explained since the oscillating systems differ only by the length of the suspensory wire, the rotating discs being the same.

A more detailed report about the experimental method and data will appear in *Wis- en Natuurk. Tydschr.*

A. VAN IITERBEEK.

Physical Laboratory,
University of Ghent, Belgium,
Aug. 3.

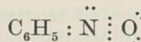
¹ N. B. Massy, F. L. Warren, and J. H. Wolfenden, *J. Chem. Soc.*, 8, 91; 1932.

² A. Smits, *Z. phys. Chem.*, 160, 225; 1932. A. Smits and H. Gerding, *Z. phys. Chem.*, 160, 231; 1932.

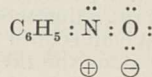
³ J. Mazur, *NATURE*, 126, 993; 1930.

Orienting Power of the Nitroso-Group and the Formula of Nitrosobenzene

THE nitroso-group in an aromatic nitroso compound appears to be chemically abnormal. Thus, in the case of nitrosobenzene, failure¹ to prepare salts or coordination compounds in which the nitroso-nitrogen acts as a donor atom, shows the accepted formula (1), with a tervalent nitrogen atom, to be incorrect. Equality of the value of the dipole moment



(1)



(2)

for this substance with that for nitrobenzene would indicate (2) as a possible formula, in which case the nitroso-group should be *meta*-directing in aromatic substitution reactions.

The available facts bearing on the orienting power of the nitroso-group are these: polymerisation of nitrosobenzene by sulphuric acid yielded not *meta*- but *para*-nitrosodiphenylhydroxylamine.² Nitrosobenzene has been *para*-nitrated³ in carbon tetrachloride and chloroform, and *para*-chlorinated or brominated in carbon disulphide,⁴ chloroform,⁵ benzene,⁶ and ether.¹ I suggest that all published experiments on the bromination in acetic acid solution⁷ (the significant products of which have been bromoazoxybenzenes) also fall into line, because (1) these substances are not obtained from azoxybenzene and bromine under otherwise identical conditions,¹ (2) autodecomposition of mono- and dibromo-nitrosobenzenes is to be expected and should lead *inter alia* to bromoazoxybenzenes, and (3) qualitative indications have been obtained that the recovered nitrosobenzene contains traces of the *para*-bromo-derivative.¹

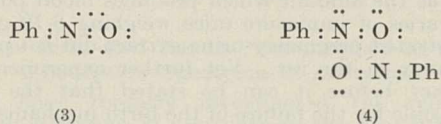
Thus the nitroso-group appears to be *para*-directive, in conformity more with (1) than (2).

The nitroso-group has a strong labilising action on halogen atoms situated in the *para* position,⁶ but its orienting nature cannot be inferred from this fact. Halogen activation and *meta* substitution are caused by the substituent radical in two separate ways: in the former a $-T$ effect (entirely absent during a substitution reaction) called up by the anionoid reagent, and in the latter a $-I$ effect accompanied by the

impossibility of +T effects. The nitroso-group exhibits probably the strongest -T effect yet recorded, but differs from nitroxyl, which can activate the halogen in *para*-halogenonitrobenzenes by virtue of the -T mechanism (alkaline reagents), but which directs an entrant nitro-group into the *meta* position of nitrobenzene by reason of the permanent -I effect, in that, by not possessing an ionic positive charge, +T effects with the appropriate reagent will occur much more readily. *Para* substitutions take place by valency redistributions of this type occasioned by cationoid reagents; thus the direct *para* bromination and nitration of nitrosobenzene on one hand and the labilisation of bromine in *para*-bromonitrosobenzene on the other can be easily understood. The nitroso-group is unique but not anomalous.

A correct formula for this substance must, however, indicate more than (1) and (2) together show. Nitrosobenzene, like other Ar-nitroso compounds, possesses properties reminiscent of an odd electron molecule—for example, in some compounds the -NO group is apparently paramagnetic—and qualitatively resembles a free diarylamino-ion⁸ in several respects. It thus is a case where ordinary chemical formulæ become inadequate.

A formulation involving a 3-electron bond has been implicitly stated by Pauling⁹ which is satisfactory for unexcited nitrosobenzene (intermediate between (1) and (2)), which thus becomes (3)—which will, like the blue free diarylamino-radical, not only polymerise readily to a colourless dimeride (4) containing tercovalent nitrogen, but also will in different



reactions exhibit opposite polarisations according to the requirements of the reagent. Incidentally, on these formulæ, both mono- and di-meric forms should produce *para*-substitution products, although the latter more easily than the former.

Pauling's arguments applied *mutatis mutandis* to the arsinoso-radical show that arsenic should be normally tercovalent, and that therefore no special analogy with the nitroso-group can be expected. An examination of 4-arsinosodimethylaniline has confirmed this.

R. J. W. LE FÈVRE.

The Ralph Forster Laboratories of
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University College,
London, W.C.1.

¹ Unpublished experiments.
² Bamberger, Büsdorf, and Sand, *Ber.*, **31**, 1513; 1898.
³ Ingold, *J.C.S.*, 516; 1925; and Bamberger, *Ber.*, **30**, 512; 1897.
⁴ Ingold, loc. cit.
⁵ Ham, *Dissert.*, Zurich, 29; 1904.
⁶ Le Fèvre, *J.C.S.*, 810; 1931.
⁷ Hammick and Illingworth, *J.C.S.*, 2363; 1930.
⁸ Wieland, "Die Hydrazine", Stuttgart, 71; 1913.
⁹ Pauling, *J. Amer. Chem. Soc.*, **53**, 3234; 1931.

Constitution of the Keratin Molecule

IN dealing with my¹ comments upon their communication² under this title, Speakman and Hirst³ describe as erroneous my statement that "the guanidine group of arginine does not . . . yield nitrogen with nitrous acid under the usual conditions". By "usual conditions" I naturally imply those generally adopted in determinations of amino-nitrogen in the course of protein analysis as described by van Slyke,^{4 5} that is to say, contact between acid nitrate solution and amino-body at room temperature, for 3-5 minutes in the case of mono-amino acids and

for ½-1 hour in the case of the hexone bases or proteins. Under these conditions the guanidine group of arginine is practically unaffected. The work of Plimmer⁶ to which Speakman and Hirst refer is, of course, well known to me, and in that paper it is stated that any error introduced by reaction of the guanidine group of arginine in a 1-hour determination is inappreciable. With longer reaction times, correspondingly greater decomposition does occur.

In connexion with my second point concerning the importance of taking into account the amide nitrogen of wool in the calculations originally put forward by them, Speakman and Hirst have restated their case by assuming that all the arginine and lysine in wool is combined with glutamic and aspartic acids, and demonstrating that an excess of these acids would still be available to combine with 0.4 per cent of amide nitrogen.

The total amide nitrogen of wool, as determined by Marston,⁷ is 1.2 per cent. No less than 0.8 per cent is thus left unaccounted for.

Speakman and Hirst consider that Abderhalden's figures for the proportion of dicarboxylic acids is low, but such a discrepancy would require that, in terms of glutamic acid, the figure at present accepted (12.9 per cent) is inaccurate by no less than 40 per cent in terms of weight, by 8.4 grams per 100 grams of wool. As I pointed out in my previous comments, Abderhalden and Voitinovici's⁸ analysis of wool is the only complete one which is available, and I am glad to see that fresh determinations of aspartic and glutamic acids are being made in the University Laboratories at Leeds. Reliable data upon the composition of wool are sadly needed. Until these results are available, it is scarcely profitable to indulge in further speculation, although, considering the relative ease of the determination of the two dicarboxylic acids, either separately or together, I am surprised at the confidence with which Speakman and Hirst prophesy that errors of such magnitude as 40 per cent will be found in the figures we already possess.

CLAUDE RIMINGTON.

Onderstepoort Veterinary Research Laboratory,
Pretoria, South Africa,
July 13.

¹ Rimington, *NATURE*, **129**, 580, April 16, 1932.
² Speakman and Hirst, *NATURE*, **128**, 1073, Dec. 26, 1931.
³ Speakman and Hirst, *NATURE*, **129**, 938, June 25, 1932.
⁴ Van Slyke, *J. Biol. Chem.*, **9**, 185; 1911.
⁵ Van Slyke, *J. Biol. Chem.*, **10**, 15; 1911-12.
⁶ Plimmer, *Biochem. J.*, **18**, 105; 1924.
⁷ Marston, Council of Sci. and Ind. Res., Commonwealth of Australia, *Bulletin* 38; 1928.
⁸ Abderhalden and Voitinovici, *Z. Physiol. Chem.*, **52**, 368; 1907.

DR. RIMINGTON has no new point to raise. Originally, he had two difficulties, one of which has apparently been eliminated by my reply to his earlier communication. As regards the second, his difficulty has been reduced to a doubt whether re-determination of the glutamic and aspartic acid content of wool will give a sufficient increase to account precisely for the amide nitrogen as well as arginine and lysine. Even this doubt must disappear in the light of Jones and Moeller's¹ determinations of aspartic and glutamic acids in various proteins. These authors state that "new determinations of these amino acids have been made in a number of typical proteins, and invariably higher results for aspartic acid were obtained than those previously obtained by the ester method. In several cases from 4 to 9 times as much was found."

J. B. SPEAKMAN.

Textile Chemistry Laboratory,
University, Leeds,
Aug. 12.

¹ Jones and Moeller, *J. Biol. Chem.*, **79**, 429; 1928.

Preparation of Methyl *d*-Galacturonide

A PRACTICAL method for the preparation of methyl *d*-galacturonide from the commercially available polygalacturonide derived from citrus pectin¹ has been developed in my laboratory by Mr. Sam Morell.

On heating this polygalacturonide (C₆H₈O₆)_n with absolute methyl alcohol containing dry hydrogen chloride, the glycosidic linkages are partially severed and the simultaneous formation of the methyl ester of methyl *d*-galacturonide occurs. The latter crystallises as the monohydrate, C₆H₁₁O₅COOCH₃ · H₂O, m.p. 138-140°; (α)_D²⁵ = +124.1 in water where *c* may vary from 1-4 per cent; no mutarotation. The methyl ester can be converted in excellent yields over the barium salt (C₆H₁₁O₅COOBa_{1/2}) to methyl *d*-galacturonide which crystallises as the dihydrate C₆H₁₁O₅COOH · 2H₂O, m.p. 112-114°; (α)_D²⁵ = +127.6 in water where *c* may vary from 2-3 per cent; no mutarotation. In a private communication, Prof. Felix Erlich, of Breslau, Germany, has informed me that the polygalacturonide used in these experiments is identical with the tetragalacturonide "a" C₂₀H₂₈O₁₆(COOH)₄ that he isolated first from beet pectin and afterwards from the pectin of various fruits.² The details of this work will be published elsewhere.

KARL PAUL LINK.

Biochemistry Research Laboratory,
Department of Agricultural Chemistry,
University of Wisconsin, Madison, U.S.A.

¹ Link, K. P., and Dickson, A. D., *J.B.C.*, **86**, 491; 1930. Link, K. P., and Neddin, R., *ibid.*, **94**, 307; 1931.

² Erlich, F., and Schubert, F., *Biochem. Z.*, **168**, 263; 1926; **169**, 13; 1926; **212**, 162; 1929. Also, *Ber.*, **62**, 1975; 1929.

Prolongation of Pregnancy

RECENT experiments upon rats demonstrate that pregnancy can be prolonged by 4-10 days by any of the following treatments: implantation of anterior pituitary tissue (cattle), the injection of an alkaline extract of that gland, and of extracts of human pregnancy urine prepared by precipitation with barium-alcohol and/or phosphotungstic acid. Judged by the maternal weight curve, full development of the foetus was reached at normal term, but the birth mechanism failed. Where pregnancy was prolonged for more than 3½ days, the foetuses were invariably still-born; in several instances parturition was protracted for 12-70 hours. Since the ovaries of such animals were found, on biopsy, to be highly luteinised, prolongation was thought to be due to the persistence of the corpora lutea formed as the result of the treatment administered. Such was the view of Teel¹ and of Levin, Katzman, and Doisy.² There are, however, certain indications that another factor besides the corpus luteum is concerned in maintaining the conditions of pregnancy.

(1) Expulsion of a part of the uterine contents occurred in animals the ovaries of which were highly luteinised and in which no enlarged follicles were found on histological examination. The same ovarian structure was associated, in other cases, with a continuance of pregnancy.

(2) In 2 rats in which pregnancy had already been experimentally prolonged by 2 days, laparotomy showed the ovaries to be a mass of large follicles with no corpora lutea present; in one, 8 live foetuses were *in utero*; in the other, parturition did not take place until 46 hours later. In a third rat in which this ovarian condition was observed at term, pregnancy continued for 5 days (until the 27th day) and the maximum weight of the mother was reached on the 26th day.

(3) Pregnancy continued for 3, 4, and 5 days respectively after both ovaries had been removed on the 22nd day of pregnancy (that is, normal term) in 3 rats which had been injected with a gonadotropic extract of human pregnancy urine; and underdeveloped fetuses were born on the 21st and 23rd days in a rat similarly injected and bilaterally ovariectomised on the 16th day of pregnancy. Two others littered 46 hours and 55 hours respectively after ovariectomy.

The evidence suggests that a factor exists which may act upon the uterus independently of the ovaries, and preliminary experiments point to its origin in the anterior pituitary. An extract rich in growth hormone, prepared after the prescription of Van Dyke³ and held by the latter to be free of gonadotropic hormone, caused pregnancy to be prolonged 4-6½ days when administered on or after the 11th day. It is to be noted that Schockaert⁴ reports an effect on testicular development in the male duck and, in our own controls, when the growth hormone from as much as 2 grams of anterior lobe tissue was injected, numerous blood points formed in the ovaries of immature mice, but was without macroscopic effect on the ovaries of immature rats. This amount caused a prolongation of pregnancy in rats, as described. On the basis of the rat-unit being equivalent to 4 M.U. (Laqueur and de Jongh⁵), the effect on the pregnant rat was obtained at a lower level than that at which the immature mouse ovary reacted. The 4:1 ratio has, however, been disputed by d'Amour, Gustavson *et al.*⁶ and by Coward and Burn⁷; it is, therefore, worthy of note that even 4 M.U. (taking a 'mouse unit' as the amount which produces blood points in the ovaries of immature mice weighing 8-10 gm.) of concentrated pregnancy urine extract did not prolong pregnancy in the rat. Yet further experiments are necessary before it can be stated that the factor responsible for the failure of the birth mechanism was not that which gave rise to the typical ovarian reaction; such experiments are being carried out. Since the existence of growth hormone in human pregnancy urine has been denied (Evans and Simpson⁸), this factor appears to be precluded.

At the present stage of the experiment, the indications are in favour of the existence of some substance, possibly in the anterior pituitary, and probably identical with neither gonadotropic nor growth hormone, which exerts an inhibiting effect upon uterine motility. That such may be the *modus operandi* of the unknown substance is indicated by Reynolds,⁹ who induced a state approximating to complete quiescence in the oestrin-activated uterus of castrated rabbits by a single intravenous injection of pregnancy urine extract.

A. M. HAIN.

Institute of Animal Genetics,
University of Edinburgh, Aug. 4.

¹ Teel, *Amer. J. Physiol.*, **79**, 170; 1926.

² Levin, Katzman, and Doisy, *Proc. Soc. Exp. Biol. and Med.*, **28**, 873; 1930-31.

³ Van Dyke and Wallen-Lawrence, *J. Pharm.*, **40**, 413; 1930.

⁴ Schockaert, *Anat. Rec.*, **50**, 389; 1931.

⁵ Laqueur and de Jongh, *J. Amer. Med. Assoc.*, **91**, 1169; 1928.

⁶ Becker, Mellish, d'Amour, and Gustavson, *J. Pharm. Exp. Ther.*, **43**, 693; 1931.

⁷ Coward and Burn, *J. Physiol.*, **63**, 270; 1927.

⁸ Evans and Simpson, *J. Amer. Med. Assoc.*, **101**, 1337; 1928.

⁹ Reynolds, *Amer. J. Physiol.*, **100**, 545; 1932.

Nuclear Magnetic Moments

As a possible explanation of the anomalous *g*(I) factors of nuclear magnetic moments found in heavy and in light elements respectively by McLennan, McLay, and Crawford,¹ and by me,² it was suggested in both these papers that an orbital motion of some of the nuclear protons might fit the observed facts.

The recent important radioactive work proving the existence of the neutron affords, however, what may possibly be considered as an alternative or as an additional consideration. Bartlett³ has shown that, starting with a helium nucleus, the continual successive addition of neutron, proton, neutron, proton, etc., up to O¹⁶, and then neutron, neutron, proton, proton, etc., up to A³⁶, accounts exactly for all the existing isotopes; only He⁵ is predicted also, but this has not yet been observed. It appears evident that α -particles, neutrons, and protons are the constituent elements of atomic nuclei. It is therefore quite possible that both neutrons and protons contribute to the production of nuclear spin. If the spin g factor of the neutron differs considerably from that of the proton, then 'anomalous' $g(I)$ factors will arise, for in one atom the nuclear spin may be largely due to protons, and in another due to neutrons.

The observations of McLennan, McLay, and Crawford may possibly be explained entirely by this alone, that is, providing the g factors are actually different; but the whole group of $g(I)$ factors, all anomalously too small, found by me in the lighter elements, is more difficult to account for. Perhaps orbital motion and variable g factor both contribute to the production of the observed anomalies.

S. TOLANSKY.

Imperial College of Science,
South Kensington, London, Aug. 15.

¹ J. C. McLennan, A. B. McLay, and M. F. Crawford, *Proc. Roy. Soc. A*, **133**, 652; 1931.

² S. Tolansky, *Z. Phys.*, **74**, 336; 1932.

³ J. H. Bartlett, *NATURE*, **130**, 165, July 30, 1932.

New Infra-Red Bands Photographed in the Absorption Spectrum of Acetylene

We have recently investigated the vibration-rotation spectrum of acetylene in the near infra-red. This absorption spectrum has been photographed in the first order of the 21 ft. Rowland concave grating which has been recently set up in a Runge-Paschen mounting. Various lengths of absorbing gas have been used, namely, 3, 6, and 9 metres, at atmospheric pressure. Employing the new Kodak zenocyanine infra-red plates, we have been able to extend our investigations beyond 1 μ .

In addition to the two bands at $\lambda\lambda 7887$ and 8622 A., which have been previously reported by Mecke¹ and also by Badger,² two further bands have been obtained situated at $\lambda\lambda 10164.8$ and 10369.8 A. units respectively, all bands being entirely resolved and showing alternating intensity in the lines. The first three of these bands are of approximately the same intensity, and all are far weaker than the band at 10369.8 A., whilst the band which Mecke reports at 7956 A. could not be detected.

The 10369.8 A. band is interpreted as the third harmonic of the fundamental frequency ν_3 (notation after Dennison³). It possesses strongly developed P and R branches and a weak line near the origin (very weak Q branch?). A few rotational lines appear to be split up into very narrow doublets, a point which is being investigated further. The general appearance of the band is closely analogous to that of the 3μ band, in which case also there is evidence of the existence of a weak line near the origin.

The other bands quoted above are interpreted as $\nu_1 + 3\nu_3$ (8622 A.), $\nu_2 + 3\nu_3$ (7887 A.), and $\nu_3 + 2\nu_2$ (10165 A.). Again P and R branches are strongly developed, but no Q branch or doubling could be seen in any of these bands.

The present interpretation of the bands agrees with the theory of Dennison³ that only odd integral multiples of the optically active frequencies can be seen

in the spectrum, and that the combinations must involve at least one of these frequencies.

Full details of the present investigation will be published later.

W. LOCHTE-HOLTGREVEN.

E. EASTWOOD.

Physical Laboratories,
University of Manchester, July 28.

¹ K. Hedfeld and R. Mecke, *Z. f. Phys.*, **64**, 151; 1930.

² R. Badger, *Phys. Rev.*, **35**, 1433; 1930.

³ M. Dennison, *Rev. Mod. Phys.*, **3**, 280; 1931.

Nuclear Structure

UNDER the above title, Mr. James H. Bartlett, jr.,¹ has indicated a simple regularity in the known nuclei of low atomic number, without being aware of the fact that I pointed out these regularities about a year ago.² He states: "The purpose of this note is to point out regularities for elements of low mass, and to suggest a possible building-up principle for such elements". The discussion of the next two paragraphs has been completely covered in the paper referred to above. The diagrams were made on the basis of building nuclei from protons and electrons, but the text pointed out that the building could be made from protons and neutrons very simply. This regularity was one fact which induced Dr. F. G. Brickwedde, Dr. G. M. Murphy, and me³ to look for an isotope of hydrogen of mass 2, as stated in our paper. Moreover, in this paper we directed attention to this simple regularity among nuclei of low mass, and reproduced the proton-electron plot on page 14. It is only necessary to interpret each diagonal unit as the addition of a neutron and each vertical unit as the addition of a proton to secure the regularity pointed out by Mr. Bartlett.

I suggested further regularities beyond A³⁶. The regularity postulates the existence of many more nuclei than are observed, and it is, of course, a question as to whether these nuclei will be observed or not. There seems to be no particular reason at the present time for withdrawing the suggestions made, however.

HAROLD C. UREY.

Chemistry Laboratory, Columbia University,
New York, Aug. 16.

¹ *NATURE*, **130**, 165, July 30, 1932.

² *J. Am. Chem. Soc.*, **53**, 2872; 1931.

³ *Phys. Rev.* **39**, 164; **40**, 1; 1932.

Oogenesis in the Indian Earthworm

RECENTLY my attention was directed to a paper by Vishwa Nath¹ on the shape of the Golgi apparatus in the eggs of the Indian earthworm, *Pheretima posthuma*. Unfortunately, Nath has apparently not seen my paper² on the same animal (*Pheretima posthuma*), in which I discussed the shape, origin, and structure of Golgi elements and mitochondria as observed in the oogenesis of this animal. Tests with osmic acid on fresh ovary or the usual fixed preparations failed to reveal the presence of either neutral fat or yolk; although in certain preparations swollen bodies resembling fat were found which were later on revealed as artefacts. The Golgi elements were of the usual spherical type with a definite osmiophilic thick rim and a clear transparent core inside. Prolonged osmication made the vesicle blacker. The mitochondria were granular and not filamentar. It is obvious, therefore, that Dr. Nath has completely confirmed my original findings.

U. S. SHARGA.

Rothamsted Experiment Station,
Harpenden, Herts, Aug. 18.

¹ Nath, Vishwa, "Studies on the Shape of the Golgi Apparatus: (11) Observations on the Fresh Egg of the Indian Earthworm, *Pheretima posthuma*", *Quart. J. Micr. Sci.*, **73**, 477; 1930.

² Sharga, U. S., "Cytoplasmic Inclusions in the Oogenesis of *Pheretima Posthuma*", *Alld. Univ. Stud.*, **4**, 177; 1928.

Research Items

Cars of the Gods.—The ceremonial car in prehistoric times and its modern survivals are fully illustrated and studied by Dr. R. Forrer in *Préhistoire*, No. 1. In tracing its various forms and analogies, the author propounds a new theory of the origin of the wheeled cart. According to his view, it was derived from the conceptions of the character and qualities of the sun held by man at the beginning of the age of metal. The sun was then regarded as a revolving disc, which was imitated for magical purposes by a wheel or disc. This wheel was made to revolve first by being thrown in the air, then by being attached to a forked stick, which was used to wheel it about. From this developed the two, three, and four or six-wheeled vehicle, which was used for religious processions and was afterwards put to secular uses. The theory is supported by illustrative examples drawn from rock-paintings, grave furniture, vase paintings, and other material. In the course of time, the solar car of the spring festival was associated with models or miniatures. The occupants of the sacred car take various forms, not only that of deities, but also of symbols, such as the sacred pillar, which appears in an early cuneiform inscription from Boghazkeui, or a sacred bird or animal. There are examples in which the car bears a cauldron, which served as both a fertility and a rain charm. These developments appear in the Bronze Age, and by the Iron Age had spread all over Europe and even beyond. By the Hallstadt period, the ceremonial car was gradually disappearing in Europe, no doubt owing to the spread of other religious ideas. It would appear that it was the car rather than the deity that brought benefit to mankind, and it is the important element in the rite. As, however, the idea of anthropomorphism developed, the divinity assumed first place. The importance of the car wanes, while its secular uses extend.

The Northern Paiute.—In a report on the Northern Paiute of Fort Bidwell, Surprise Valley, north-eastern California (*Univ. Cal. Pub. Amer. Arch. Eth.*, vol. 31, No. 3), Miss Isabel T. Kelly states that there is little of the old life left. The seed-gathering and hunting, which were formerly the only modes of subsistence, have fallen into disuse. A few baskets are seen and a little skin-dressing done. Little information can be obtained about political institutions, though this may be due to paucity of development; but curiously enough, religion is still more or less flourishing. Shamanistic cures are in vogue and a number of the people frequent the sweat-lodges in order to pray to the sun. It is considered especially fit that one should sweat on Sunday—an interesting secondary association, which is deeply rooted. The sweat-lodge appears to be a recent introduction from the north, although the statement that it originated about forty years ago puts it too low. Other informants declared that they had always sweated. The sweat-house was used principally by men; a few women entered occasionally. Information on shamanism was obtained with difficulty only, as the shaman believes that he will sicken and die if he divulges information. It took the form of curing and, sometimes, of weather control. The antelope shaman officiated at ceremonial hunts. A certain amount of prophecy was also within the power of the shaman. Shamanistic power was acquired through dreams, often beginning in childhood, and to many coming unsought. Anyone who disregarded the 'call' of his dreams fell violently ill. A shaman controls various kinds of animal spirits, which come to him in dreams, the

eagle coming most frequently. The usual correlation of the tambourine with the shaman does not exist here.

Ancestry of the Ferret.—The domesticated ferret was generally regarded as a descendant of the European polecat (*Mustela putorius*) until G. S. Miller suggested in 1912 that certain cranial characters pointed rather to descent from the Asiatic polecat (*M. eversmanni*). The latter view is challenged by R. I. Pocock, who finds that the skulls of ferrets do not resemble those of the Asiatic polecat in the particular likeness claimed by Miller, but differ from them in the position of the post-orbital constriction (*Scottish Naturalist*, p. 97, 1932). The skulls of ferrets, however, are nevertheless distinguishable from skulls of European polecats, but Pocock suggests that the differences are due to artificial conditions of confinement and of food due to domestication. His view is strengthened by the characters of an abnormally large 'polecat-ferret' found wild in Mull, for in it the skull resembles that of the European polecat, a resemblance attributed to reversion in natural conditions to the ancestral form of an individual which was probably a descendant, immediate or remote, of an escaped pregnant female ferret.

Baits for Sheep Blowflies.—Experiments to determine the responses of blowflies to chemical substances have been made by Martin R. Freney, at the instance of a special Blowfly Committee formed to deal with the many aspects of this serious problem in New South Wales. It has been found that wool fibre, consisting largely of the protein keratin, when hydrolysed with sodium sulphide, forms an attractive medium, and this substance was tested as a bait in fly-traps. According to the figures published (*J. Council Sci. Indust. Research*, vol. 5, 1932, p. 28), the small quantity of decomposed keratin (less than 5 gm.) was not so attractive as 50 gm. of fresh sheep's brain, but the results are stated to be without quantitative significance. They show, however, a qualitative selection, for the keratin bait caught a higher proportion of female blowflies, about 98 per cent as against 84 per cent upon carrion, and it proved to be more attractive to primary blowflies, the smooth maggots of which initiate strike, than to the hairy or secondary blowflies. This is an important difference, since the larvæ of the latter are enemies of the smooth maggots; and the raising of the primary maggot death-rate from 45 per cent for brain to 83 per cent for decomposed keratin is an achievement which merits further investigation.

Freshwater Flagellates.—The attention of students of the freshwater fauna is directed to a memoir (*Mem. Mus. Roy. d'Hist. Nat. de Belgique*, No. 47; 1931), by Dr. W. Conrad, on the flagellates recorded from a series of five ponds near Louvain as the result of observations over a period of three years. The Chrysoomonadina are represented by 19 genera, including 52 species (7 new), and the Volvocales by 17 genera, including 44 species. In the genus *Chromulina* the author has given particular attention to the cysts, the characters of which he regards as forming the basis of classification, and he subdivides the genus into three according as the envelope is smooth, or ornamented with ridges more or less spiral, or with spines. Keys are given for aiding in the determination of the species, and six excellent plates in colour reproduce the author's drawings from the living specimens.

Plague in Egypt.—An interesting account of the third pandemic of plague in Egypt, by Dr. A. W. Wakil, has been issued by the Egyptian University (Faculty of Medicine, *Pub. No. 3*: Cairo, 1932). The first and second pandemics of plague in Egypt occurred in the sixth and fourteenth centuries, the third commenced in 1899 and is still continuing. Although cases have occurred every year, the total number has been comparatively small, numbering rather less than 20,000 during the thirty-two years. The bubonic type amounted to 83.9 per cent, the septicæmic to 8.9 per cent, and the pneumonic to 7.2 per cent of the total. Up to the present, the city of Cairo, though well suited in many respects for the occurrence of plague, has been practically immune from plague during the present pandemic with a total of only 16 cases. The cause of this immunity is ascribed to a biological factor, namely, the presence of numerous weasels which keep down the number of rats, the principal agent in spreading bubonic plague. The main species of fleas found upon all types of rats in Egypt is *Xenopsylla cheopis*, the principal vector everywhere of bubonic plague, which numbered about eighty per cent of the total rat-flea population. Graphs are given of the relations between the incidence of plague and of the abundance of rats and rat-fleas, which show the marked relation between these factors.

Economic Botany of Cacao.—A detailed study of "The Economic Botany of Cacao" has recently been published by Prof. E. E. Cheesman (*Supp. Tropical Agriculture*, June 1932). The systematic position of the genus *Theobroma* and the status of the species *Th. cacao* L. is reviewed. Many varieties—both botanical and horticultural—are described. The most important sections deal with requirements of light and other ecological considerations, and with descriptions of the branching systems, leaves, flowers, fertilisation, and fruit production. Much discussion is devoted to the genetics of cacao growing, and to the selection and propagation of good varieties. Physiological and pathological aspects of yield and problems of quality are investigated. The paper is mainly a summary of the literature on the subject and should prove useful to all who are interested in the cacao plant.

Chromosomes and Pollen of *Kniphofia*.—The chromosomes in several species of *Kniphofia* (Liliaceæ) have been studied by Mr. A. A. Moffett (*J. Genetics*, vol. 25, No. 3), who finds the basic haploid number to be six. In *K. Nelsonii*, unlike the other species, diploid, tetraploid, and octoploid tissues were found in the same plant, both in root tips and pollen mother cells. As in certain species of *Crepis*, some roots were partially diploid and partially tetraploid. In one flowering spike most of the cells, if not all, were tetraploid or octoploid, while other spikes were diploid. In species-hybrid, *K. corallina* has a few univalent meiotic chromosomes and fewer chiasmata than the other species, while in the tetraploid pollen mother cells above mentioned two to six quadrivalents, as well as univalents and trivalents, were found. Many giant pollen grains with $2n$ or $4n$ chromosomes were also found in *K. Nelsonii*, their frequency decreasing towards the top of the spike. The majority of such grains have four haploid nuclei, and they appear to be formed directly from pollen mother cells, through a failure of the process of furrowing by which the pollen grain walls are normally formed, but this does not necessarily involve failure of the spindle mechanism.

Geology of the Lupa Goldfield.—An important contribution to the geology of Tanganyika Territory has been made by Dr. D. R. Grantham as a result of

three seasons' work in the Lupa Goldfield and its neighbourhood (*Bull. 3, Geol. Surv. Dept.*, 1932, with coloured geological map, 1 : 100,000). A long sequence of events, including repeated cycles of igneous activity, has been established: granulites associated with banded ironstones—basic flows and intrusions—foliation and *lit-par-lit* injection of the main granitic gneiss, *G1*—shearing—some of the older dolerites—Malwelo rhyolitic and trachytic series with basic lavas now represented by chlorite-schist—Ilunga felsitic series—gneissose microcline-granite, *G2*—older dolerites—Ilunga granite, *G4*—Saza granite with peripheral diorites and 'spessartites', *G5*—younger dolerites, probably Karroo—olivine-dolerites, possibly Cretaceous—peneplanation—rift-valley movements, Tertiary alkali-lavas, and deposition of lake-beds. The 'spessartites' are regarded as a differentiation product of the Saza hornblende-granite overcharged with doleritic inclusions. They have been found to carry gold, and it is suggested that the Saza granite is the parent of at least some of the gold reefs. The lowest of the step-faults producing the Rukwa branch of the western rift valley is well exposed. The actual fault-face is almost continuously visible for a hundred miles as a nearly straight rock-wall two hundred feet or more in height, over which every river makes a waterfall to the old lake-bed below.

Apparatus for Microradiography.—M. A. Dauvillier has described recently (*J. Physique*, June) an apparatus for microradiography which is in a sense a first step to the extension of the magnifying power of a microscope through substitution of X-rays for light. It makes use of the differential penetration of soft X-rays through different elements. The X-rays, generated at about 5 kilovolts in a hot filament tube, fall on a thin section of the tissue to be studied, attached to a photographic plate. Oxygen is decidedly more opaque to these rays than carbon, whilst they are absorbed practically completely by a small quantity of sulphur, so the underlying photographic emulsion takes a record of the elementary composition of the tissue which is practically independent of the exact nature of the compounds in the latter. After exposure, the tissue is removed, the plate intensified, and the image enlarged. By using special finely grained plates, of the type devised by Lippmann for colour photography, magnifications of several hundred diameters are practicable. One is reproduced of a section of elder pith ($\times 600$) with remarkably delicate detail. The range of possible applications of this method appears very wide; the technique is not unduly involved and easily within the resources of most physical laboratories.

Raman Spectrum of Hydrogen.—An account of the scattering of light from compressed hydrogen, much fuller than any previous work of this type, has been published by S. Bhagavantam in the issue of the *Indian Journal of Physics* for May. The aim of the experiments was to extend those of Rasetti and of McLennan, and in particular to compare the observed details of the intensities and polarisation with the quantum theory of the effect due to Manneback. Judging from the spectra and microphotometer traces reproduced, the work has been performed with great care. The main body of results actually affords a quantitative verification of the Manneback theory, but there is a striking disagreement in certain details of the polarisation, which it is again suggested can only be adequately taken account of by attributing an intrinsic spin to the light quantum.

Compounds of Inert Gases.—Whilst it is probable that the inert gases of the argon group are incapable

of forming stable chemical compounds, the long-established existence of a band spectrum which can only be attributed to the molecule He_2 shows that this gas at least can enter into transitory combinations. In the first July number of the *Physical Review*, H. Kuhn and O. Oldenberg discuss the spectrum which appears round the mercury resonance line at 2537 Å. when this is excited by fluorescence in the presence of a large amount of rare gas. This consists of a general broadening of the line in both directions, the broadening showing evidence of structure, and it appears that it must be attributed to the formation of a short-lived compound between the mercury and inert gas. Apparently spatial quantisation of the pair of atoms takes place on their mutual approach. The phenomenon is not confined to mercury, similar spectra being observed with thallium, and some other metallic vapours, in the inert gases. The general correctness of this explanation of the spectra is born out by the occurrence of similar structures with dense alkali vapours, due presumably to the formation of almost unstable diatomic alkali molecules in which the binding forces are in the nature of polarisations.

Treatment of Gastric and Duodenal Ulcer.—Besides the constitutional factor, these ulcers have two causes, the first being the diminished resistive power due to

a circumscribed lesion of the gastric or duodenal wall, and the second the action, continually renewed, of the normal gastric juice. The methods employed for treating such ulcers are discussed by Dr. Bazzano, of the University of Milan, in a communication published in the *Rendiconti* of the Reale Istituto Lombardo di Scienze e Lettere for 1932 (vol. 65, parts 6-10). It is argued that a rational cure involves the excitation of the defensive powers of the gastric wall and the creation of surroundings favourable to cicatrization by modifying the gastric secretion, supported by almost normal conditions of general nutrition and by repose of the patient. These considerations, in conjunction with the results of laboratory experiments showing the marked anti-peptic properties of sodium benzoate, indicated that curative effects might be expected from the administration of this salt. A number of patients were accordingly treated with daily doses of 2 c.c. of a 25 per cent solution of sodium benzoate in sterilised distilled water, applied either hypodermically or intravenously. A few injections (in either way) sufficed to produce appreciable improvement in the symptoms, and complete cures were effected after more or less prolonged treatment. Subsequent examination (after some months) of several of the twenty-four cases treated by this means failed to reveal any disturbance of the digestive apparatus.

Astronomical Topics

Total Solar Eclipse of Aug. 31.—Unfortunately, clouds obscured the eclipse for many of the observers. A telegram to the *Times* from Dr. J. Jackson at Parent reports that the clouds were less thick early in totality, and some useful coronal photographs may result from exposures with the long-focus instrument; but it is feared that the photographs with the slit-spectrographs are failures. Prof. F. J. M. Stratton at Magog has cabled to NATURE: "Cloudy, no success"; and Prof. H. Dingle at Montreal says: "No observations possible at McGill University, Montreal. Sky covered with clouds throughout eclipse."

Similar reports were received from Conway (New Hampshire) and from Derby (Vermont), also from the Mount Wilson expedition; but Dr. J. H. Moore expressed the hope that some results might be obtained from the photographs of the Lick Observatory expedition (*Times*, Sept. 1). There are better reports from Louiseville, 50 miles north of Montreal, where the sky was clear. Eight photographs of the corona were obtained with an 8-inch camera; the shadow bands were well observed, also the effect of the eclipse on the barometer, thermometer, and electrical potential. Prof. Andrew Thomson, of the Canadian Meteorological Service, who has observed several eclipses, noted that the shape of the corona was more pointed and less evenly arranged than in the eclipses of 1918 and 1919. Prof. N. Hiramia states that the expedition from Kyoto obtained a perfect picture of the corona, and colour photographs of every part of its spectrum, which show a new line (*Times*, Sept. 2).

New Minor Planet.—Another minor planet of short period has been found; it is given the designation 1932 PB, as the first observation reported to the Berlin Rechen Institut was made on Aug. 4 by Prof. G. Neujmin at Simeis, the magnitude being 12.7. But R.I. Circular No. 646 reports that Prof. G. van Biesbroeck had already detected it on a plate taken at Yerkes on July 30. Dr. A. Kahrstedt has deduced elliptical elements from four Yerkes observations; these indicate a daily mean motion of $1754''$, and a period of 2.023 years. The only known minor planets with shorter periods are Eros (1.76 years) and the

Reinmuth planet, 1932 HA (about 1.8 years). Hence PB should be followed as long as possible; Dr. Kahrstedt gives the following ephemeris for 0^h:

	R.A.	S. Decl.
Sept. 10	20 ^h 51.7 ^m	18° 38'
18	20 58.6	18 35
26	21 7.8	18 20

The Perseid Meteors.—The August Perseids have been successfully observed this year by the regular workers in England. Mr. King has a useful series of observations extending from July 30 to Aug. 13, and similar work was done by Mr. Aleock (who recorded 479 meteors during this fortnight) and by Mr. Prentice. All three observers had clear skies through the period of maximum (Aug. 10-13): and with the assistance of other observers, notably Mr. Folkard and Mr. Lane Hall, there should be a large number of accordances, yielding heights, etc. Seven meteors were photographed on Aug. 11, one by Mr. Collinson at Orwell Park, three by Mr. Vogel at Hampstead, and three by Mr. Waters at Harrow. Various counts have been made in addition, including one from India by the vice-principal of the Nizam College, Hyderabad. It appears that the return of the stream was rather less than normal strength this year, especially in the early stages: other results remain to be worked out.

Recent Fireballs.—Several bright fireballs have been reported during the past month, an unusual number having occurred during daylight or twilight hours. The first, on Aug. 6 at 10 h. 20 m. G.M.A.T. (noon-to-noon), was widely observed from Cornwall to the Suffolk coast, and a true path will be obtainable. A twilight fireball was recorded from East Anglia in twilight on Aug. 8 at 8 h. 20 m. G.M.A.T., and a preliminary path by Mr. King indicates heights of 43 to 16 miles. Two further twilight fireballs were recorded, on Aug. 10 at 8 h. 25 m. and Aug. 14 at 8 h. 20 m.; and, by Prof. W. J. Jones, of University College, Cardiff, a daylight fireball over the north of Scotland on Aug. 20 at 7 h. 54 m. True paths of the Aug. 10 and 20 objects may be obtainable. A further fireball is reported from Cornwall on Aug. 23.

The New Botanical Building at the University of Toronto

THE University of Toronto owes much to the able and wise administration of the retiring president, Sir Robert Falconer: by the part he played in securing adequate provision for teaching and research

Robert Falconer; his successor, the Rev. Dr. Cody, chairman of the Board of Governors, and others, walked in procession to the new building, which was opened by the Prime Minister.

The Prime Minister paid a tribute to the architects, Messrs. Mathers and Haldenby, both of whom are graduates of the University, and stated that all the material used in construction was Canadian. In handing over the building to the chairman of the Governors, he said that it should be regarded as an expression of the interest of the Government, the legislature, and the people of the province in the cause of higher education.

Dr. Cody, in accepting the building, spoke of botany as one of the first subjects taught in the early days, in 1843, when the University was known as King's College. Botany was then one of several sciences for which the professor of experimental philosophy was responsible. In 1853, when King's College was promoted to university status, the Rev. William Hincks was appointed professor of natural history: one of the applicants for the chair was Thomas Henry Huxley. The present head of the department, Prof. R. B. Thomson, was appointed to that position in 1928.

Dr. Cody gave a brief account of the building, which he described as one of the most attractive in the University group. It was erected at an inclusive cost of 517,000 dollars on a site at the entrance to Queen's Park: there is a well-lighted ground-floor with three floors above arranged round a central court. The inside walls are lined with bare brick: there is about an acre of floorspace. On the ground-floor and the floor above, provision is made for plant pathology and plant physiology under Dr. D. L. Bailey and Dr. G. H. Duff; on the second floor are laboratories for morphology and the anatomy of flowering plants under the personal charge of Prof. Thomson: mycology under Prof. H. S. Jackson, seed laboratories under Dr. H. B. Sifton, and the herbarium are on the third floor. Ample provision is made for

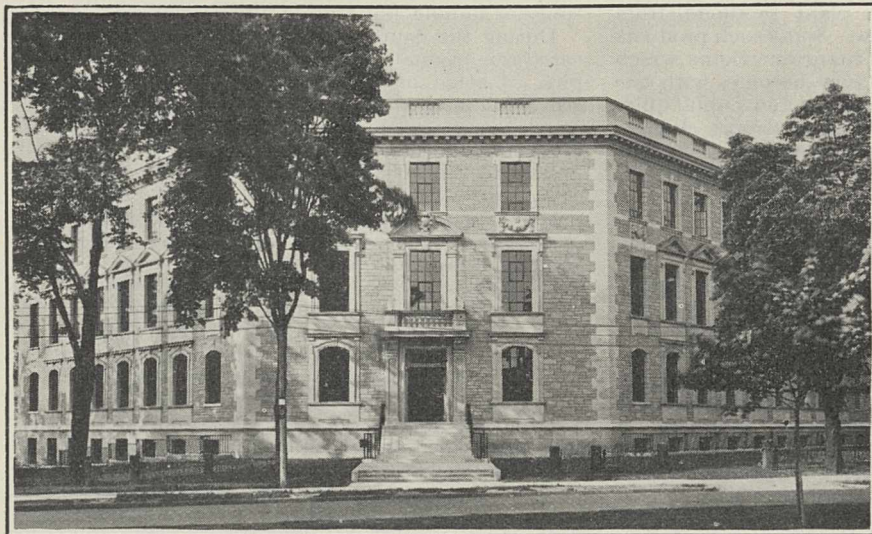
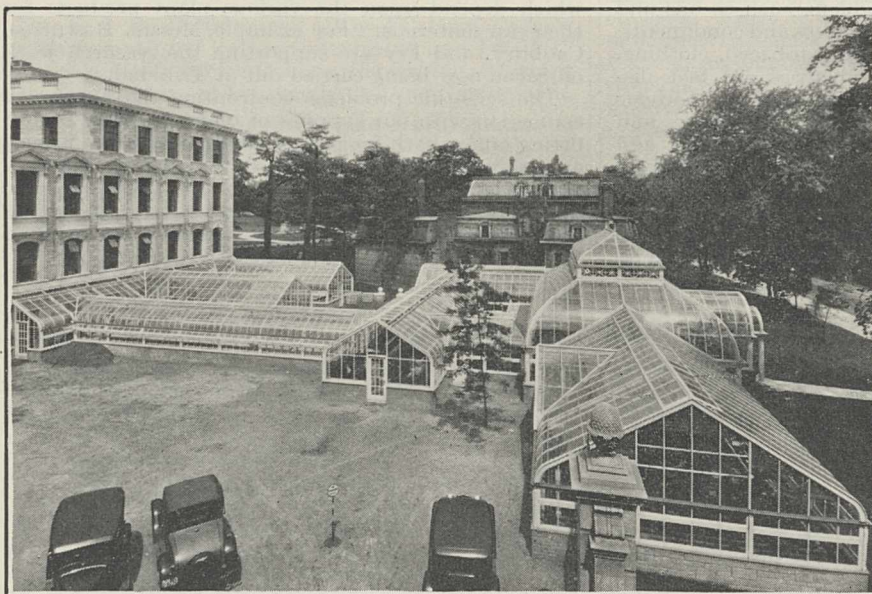


FIG. 1.—Front view, showing the main entrance of the new botanical buildings of the University of Toronto.



Photo] [Peake and Whittingham, Toronto] FIG. 2.—The range of glass-houses behind a wing of the new botanical building, University of Toronto.

in botany he has earned the gratitude of all who are interested in that branch of biology. One of his last acts in Commencement Week of this year was to assist at the formal opening of the new Botanical Department on June 8. After an informal luncheon given to the visiting botanists, the Chancellor of the University, Sir William Mulock; the Prime Minister of Ontario, Mr. G. S. Henry; the President, Sir

Robert Falconer; his successor, the Rev. Dr. Cody, chairman of the Board of Governors, and others, walked in procession to the new building, which was opened by the Prime Minister.

research rooms. Adjoining the building is a range of glass-houses. Dr. Cody added that about a thousand undergraduates would be accommodated in the new laboratories.

Sir Robert Falconer invited five of the botanical delegates to give short addresses: Prof. A. C. Seward

of the University of Cambridge; Prof. K. M. Wiegand of Cornell University; Dr. H. T. Güssow, the Dominion botanist; Prof. Marie-Victorin of the University of Montreal; and Prof. F. E. Lloyd of McGill University. On the following day the honorary degree of Sc.D. was conferred upon Prof. A. C. Seward.

Plant Products of the British Empire

FROM prehistoric times, man has depended to a considerable extent upon plant products, from various economic points of view. Some such products are necessities and others are luxuries. Some which were primarily luxuries have now become, with the great changes in human civilisation and habit, quite essential to human needs. These constant changes and new developments in human needs as regards the vegetable kingdom formed the basis of Sir Arthur Hill's evening discourse delivered at the York meeting of the British Association on Sept. 2, entitled "Plant Products of the Empire in Relation to Human Needs".

The economic botanist seeks to satisfy our human needs, both natural and artificial, and with the tremendous modern developments in human life and habit, his work has become of primary importance. With such a widely scattered Empire, Great Britain is able to supply itself very largely from its own colonies and dominions. Two great 'cravings' of to-day—newspapers and motor cars—are resulting in the destruction of the magnificent forests of Canada and Newfoundland and the extensive plantations of *Hevea brasiliensis*, the latex of which supplies the raw rubber, in various parts of the Empire.

Fortunately for Great Britain, it is possible, to a great extent within the Empire, to meet the growing demand for various plant products, such as oils and fats, cereals, fruit, animal foods, spices and condiments, beverages, gums and resins, drugs, tobacco, clothing, timber, etc. Certain other industries are fast disappearing, owing to changes in present-day methods and fashions. For example, indigo, camphor, and vanilla are giving place to synthetic substitutes, and cotton and flax have a strong competition in artificial silk. Another group of the Empire's plant resources, often lost sight of, because it does not appear on the world's markets, is native products used chiefly by those who cultivate them. The importance of such

Empire products is scarcely ever realised until such times as famine and crop failure.

During the course of his address, Sir Arthur indicated the original homes, throughout the British Empire, of some of the economic plants. Efforts are still being made to find plants of economic value which can be grown within the Empire, with the ultimate aim of making the Empire self-supporting so far as possible. With the large increase in cultivated areas, complications such as plant diseases have been set up, necessitating the creation of an army of specialists—plant pathologists, entomologists, physiologists, etc. Rust on wheat in Canada, for example, is estimated to destroy annually £5,000,000 worth of wheat. Every year, in the British Empire alone, insects destroy enough food to supply forty-five million people.

The band of scientific workers attached to the various departments of plant economic and agricultural research throughout the Dominions and Colonies seems a rather formidable one, yet their numbers and cost of maintenance are negligible compared with the toll levied by the diseases they are attempting to overcome.

Since its inception, the Empire Marketing Board has given invaluable help in the war against plant diseases, in research on plant storage, etc., and it has spent £1,235,000 in grants for research. In many cases, too, research is supported financially by firms which depend upon the various plant products for their raw materials. For example, Messrs. Rowntree, Cadbury, and Fry are supporting the research work on cacao now being carried out at Trinidad.

The scientific problems confronting the Empire in connexion with our supplies of plant products offer a fitting outlet both for private and public munificence, and those who come forward to support the new culture of scientific research and its application to human needs will realise that they are not merely satisfying a noble enthusiasm, but are also fulfilling one of the pressing needs of the Empire.

Electricity Supply in New York

NO city in the world owes more to the advance of engineering than New York, within the boundaries of which are to be found some of the finest bridges, tunnels, subways, high buildings, and power stations ever constructed. The progress of these great undertakings is dealt with from time to time in our own technical journals, and in *Engineering* for May 13, 27, and June 17 is given a well-illustrated account of the present position of the electrical supply schemes in the city.

Fifty years have elapsed since Edison erected the first public electric supply station in Pearl Street, and that was but the beginning of the great interconnected stations by which New York and the suburbs are served to-day. The greater part of New York is now served by the Consolidated Gas Company, which in 1928 obtained control of five separate undertakings serving an area of 550 square miles and a population of 6,017,702. In 1927, the last complete year that the five companies operated as separate concerns, the total output was 4,000,000,000

kwh. and the plant installed had a total capacity of 1,400,000 kw. The capacity of the plant by September 1930 had been increased to 2,009,700 kw., and plans are now in hand for a further increase in plant designed to meet a demand which it is estimated will by 1940 be three times as great as that in 1927.

At present, power is generated in seven stations, of which Hell Gate Station has plant of 605,000 kw. and Hudson Avenue Station plant of 560,000 kw. At Pearl Street Station direct current was generated and distributed, but to-day all current is generated by alternators, the frequency being either 25 cycles or 60 cycles, frequency changers being installed so that current is available from any station for any part of the system. Interconnexion is to be carried still further by the erection of a transmission line to Schenectady, thus enabling power to be brought to New York from Niagara.

A new problem in the economical distribution of electricity arose with the erection in New York of very high buildings, and in *Engineering* for June 17

an account is given of the methods of distribution in the Chrysler Building, 1047 ft. high, and the Empire State Building, 1300 ft. high. Experience with the Irving Trust Company Building had shown that a saving could be effected by installing transformers not only in the basements but also on more than one floor of buildings more than forty stories high. In the Chrysler Buildings the high-tension feeders, therefore, are carried direct to substations with transformers on the thirtieth, sixtieth, and seventy-fourth floors, while in the Empire State Building there are substations on the forty-first and eighty-fourth floors in addition to that in the sub-basement.

The Empire State Building covers an area 420 ft. by 200 ft., and its 86 floors can house some 40,000 persons, or as many as a fair-sized town. Illumination is provided on a liberal scale, and the estimated lighting load is 6000 kw., while for the lifts, fans, pumps, and other plant electric motors of a total of 9600 horse power are installed. The substations are fire-proof brick structures and each contains four or five 600 kw., 13,800/200-volt transformers. The main vertical cables are rated for a pressure of 15 kw. and are about 3 in. in diameter with an approximate weight of 6 lb. a foot, and in the article referred to is an interesting account of the methods adopted for placing them in position and securing them.

University and Educational Intelligence

BIRMINGHAM.—Under the will of the late Mr. James Gittins Chidlaw, of Edgbaston, a member of the Court of Governors, a sum of more than £10,000 will be put at the disposal of the Council of the University for the endowment of scholarships.

MR. E. J. W. BARRINGTON of Oriol College, Oxford, has been appointed lecturer in zoology, and **Dr. F. C. Champion** of St. John's College, Cambridge, assistant lecturer in physics, at University College, Nottingham.

THE Council of the Institution of Naval Architects has awarded the Martel scholarship in naval architecture (1932), valued at £130 per annum for three years at the University of Liverpool, to **Mr. H. G. Herbert**, of Sheerness Dockyard, and the Earl of Durham prize to **Mr. N. H. Young**, of Devonport Dockyard.

A SURVEY of industrial education in the United States of America has been published by the Office of Education, Washington, as *Bulletin* No. 30, 1931. Among recent developments is noted the more general recognition of the importance of maintaining close contact and co-operation between the school officials and industrial firms. Committees composed of representatives of employers and employees have been especially valuable in selecting the courses to be included in the training programme, in securing properly qualified teachers and adequate equipment, and in the organisation of instruction so as best to meet the needs of industry. There is yet lacking, however, a sufficiently high degree of correlation between the courses provided in the schools of a given locality and the needs of the dominant local industries. Increasingly the public schools accept responsibility for vocational guidance with the view of placing their pupils in suitable occupations, and increasing interest is manifest in occupational information courses. Progressive specialisation in industries has led to corresponding specialisation in the schools, and the number of separate courses has been further increased by the inclusion of training for a number of semi-skilled occupations for which a short period of school instruction is now held to be worth while. Evening school

work has received more attention, because money spent on training persons already employed yields a more certain and immediate return than pre-employment training. The increasing use of electricity on the farm and in the home is stimulating the development, even in small schools, of courses in simple electric wiring, the operation and maintenance of electrical appliances, and other instruction in applied electricity. Similarly, a belief that aviation will constitute a principal method of transportation in the future is leading to the provision in secondary schools of courses in model aircraft building, etc.

Calendar of Geographical Exploration

Sept. 13, 1898.—**Capt. M. S. Wellby's Explorations**

Capt. M. S. Wellby left Berbera on the north coast of British Somaliland, penetrated to the Omo River, and thus entered Lake Rudolf. He then turned north-west and explored part of the course of the Sobat River. In 1896, Wellby and Lieut. Malcolm had carried out a journey in Tibet, crossing the country from Leh to Kuku Nor, afterwards following the Hwang-ho and reaching Peking. This journey filled in many previously blank spaces on the map of Tibet.

Sept. 14, 1927.—**The *Norvegia* Expeditions to the Antarctic**

The *Norvegia*, a vessel fitted out by Consul Christensen, left Sandefjord harbour to begin that series of antarctic researches which has added so much to scientific and especially oceanographical knowledge of the region. Various scientific workers and aeronauts have taken part in the *Norvegia's* work, and, under the leadership of H. Ruser-Larsen, Queen Maud Land, Ragnhild Land, and Princess Martha Land were discovered. Early in 1931 the *Norvegia* completed the circumnavigation of the antarctic continent. The Russian explorer, Bellingshausen, in 1819-21, had previously made the circumnavigation of the continent in high latitudes, while Cook and Biscoe had made similar journeys in somewhat less high latitudes.

Sept. 15, 1587.—**Davis Strait**

John Davis arrived at Dartmouth after his third arctic voyage, during which he had pushed through the strait named after him into Baffin's Bay and coasted the west of Greenland to 73° N. On his first voyage, in 1585, Davis had sighted southern Greenland, which he called the Land of Desolation, had crossed Davis Strait, explored part of the Canadian archipelago, and had penetrated some distance into Cumberland Sound. On his second voyage, in 1586, he again reached the north-east coast of America. His voyages pointed the way to the true north-west passage, though it was not given him to reach it. He added much to the knowledge of the coasts of Greenland and north-east America. In 1591 he accompanied Cavendish on his voyage with the object of "searching that north-west discovery upon the back parts of America". After the rest of Cavendish's party had turned back, Davis continued the journey and discovered the Falkland Islands. He was killed by Japanese pirates when off Sumatra in 1605. Davis is also entitled to fame as an inventor; his back staff and double quadrant held the field long after Hadley's reflecting quadrant had been introduced.

Sept. 17, 1776.—**Basin of the Colorado River**

Father Garcés, a Franciscan missionary, reached Bac. He had set out in 1775 from the Yuma country, travelled from the mouth of the Colorado to Mojave,

and opened a new route across to San Gabriel. Thence he made a trip northward to the Tulare valley, returned to Mojave, and proceeded eastward to the Moqui country. Garcés had made many previous journeys of exploration, including a descent of the Rio Gila to the Colorado in 1771. Garcés was murdered by the Yuma Indians in a subsequent attempt to found a mission amongst them.

Sept. 17, 1822.—Weddell in the Antarctic

James Weddell in the *Jane*, accompanied by the *Beaufoy*, left on a voyage which combined whaling with discovery. Weddell had previously, in the *Jane*, visited the South Shetlands, discovered in 1819 by William Smith, and had carried out some surveys there. On this voyage he proved that the Aurora Islands, which were supposed to lie between the Falklands and South Georgia, did not exist. Weddell explored the sea which now bears his name, and reached 74° 15' S. He brought back with him a sea leopard (*Hydrurga leptonyx*); Weddell's seal (*Leptonychotes Weddelli*) is named after its discoverer.

Societies and Academies

PARIS

Academy of Sciences, July 25 (vol. 195, pp. 293-344).—Robert Bourgeois: Obituary notice of Antonio Luiz de Tefé, *correspondant* for the Section of Geography and Navigation.—Émile Guyénot and A. Naville: Reduction of chromosomes in the female *Drosophila* and the theory of crossing over.—M. Syptak: The hypercircumferences and hyperhelices in Euclidian spaces of p dimensions.—Maurice Roy: The definition and laws of the sudden variation of section in gaseous jets.—Edmond Brun and Pierre Vernotte: The measurement of the coefficient of thermal exchange between a solid wall and a current of gas.—Henri Chaumat and Edouard Lefrand: An electric motor utilising the kinetic energy of gaseous ions. A description of the construction and working of an 'ionic turbine'.—René Audubert: The calculation of the average radius of the granules of a dispersed system. If, at high dilutions, the electrokinetic potential be considered as obeying the Debye-Hückel theory, then the average radius of the granules of a dispersed system can be calculated by means of relations deduced from this theory.—Radu Titeica: The vibration spectra of some polyatomic molecules. The results of measurements of the infra-red absorption bands of formaldehyde and of acetone are given.—Ny Tsi-Ze and Chông Shin-Piaw: The absorption of light by ozone between 3050 Å. and 3400 Å. (the region of the Huggins bands).—M. Bourguet: Double conjugated linkages.—Mlle. B. Grédy: The application of Raman spectrography to the study of the rhodinol-citronnellol isomerism. These experiments do not confirm the formula of citronnellol suggested by Verley (α form): rhodinol contains three isomeric alcohols.—D. Skobelzyn: The mechanism of the phenomena of the ultra-penetrating radiation (cosmic rays).—S. Rosenblum: The fine structure of the magnetic spectrum of the α -rays of radium.—H. Muraour and G. Aunis: Study of the velocity of combustion, at a low temperature, of colloidal powders.—Victor Lombard and Charles Eichner: Researches on the conditions of optimum diffusion of hydrogen through palladium.—A. Cochet and J. Houdin: The phosphates of urea and of guanylurea.—Henri Fournier: The results furnished by stamping tests and their relation with extension tests.—Ch. Bedel: The density of ferrosilicons. Thirteen alloys were prepared, ranging from 0 to 100 per cent iron. Indica-

tion of density variations were observed when the composition of the alloys corresponded to Fe_2Si and $FeSi$.—Ed. Chauvenet and Avrad: The determination of barium in iron ores. The iron is removed as ferric chloride by heating to 900°-930° C. in the vapour of carbon tetrachloride.—P. Bugnon and A. Parrot: The morphological value of the cotyledon in monocotyledonous umbellifers.—Mme. Liou (Tchang-Tcheng-Houa): Various peculiarities of the development of the egg of *Bombyx mori* under the influence of bivoltinising agents.—Ch. Dhéré: The fluorescence of phyllærythrin and the structure of its fluorescence spectra.—J.-E. Abelous and R. Argaud: The formation of adrenaline in the suprarenal gland. The results of the experiments described are inconsistent with the view that the medullary substance is exclusively concerned with the production of adrenaline.—Mme. Andrée Roche and Jean Roche: The participation of the hexosephosphoric acid in the glycolysis of the blood.—Aynaud, Peyron, and Falchetti: Cancer of the lung in sheep and its etiological connexion with parasitic and infectious lesions.

CAPE TOWN

Royal Society of South Africa, March 16.—W. A. Jolly: The living organism (Presidential Address). If we are ever to attain to self-knowledge, to explain ourselves, and to determine our place in Nature and our relation to the world around, it is to advance in biology that we must trust. All that we know of the universe is due to physiological changes of some kind. In the living organism, regarded as a whole, we have a phenomenon the unity and fundamental nature of which are as essential as any of the concepts of physics. Psychology, studied by subjective methods, working in collaboration with physiology, has an important part to play in our final achievement of self-knowledge. The address concluded with an account of the methods and difficulties of modern physiological research, with special reference to electro-physiology and the time-relations of the simple reflex.—F. Kirchheimer: On pollen from the Upper Cretaceous dysodil of Banke, Namaqualand. These pollen forms, probably of Upper Cretaceous age, do not in the least agree with the present-day flora of the area. This serves to show, in conjunction with the character of the megascopic plant remains, that the ecological character of the area at the time of formation of the deposits was widely different from that of to-day.—E. Reuning: The composition of the deeper sediments of the pipe at Banke, Namaqualand, and their relation to kimberlite. The various rocks known found in the neighbourhood—granite, dolerite, and Karroo sediments—can have contributed but little to the composition of the dysodil, which is apparently the product of the infilling of the pipe by finest mud obtained from the weathering of ejected kimberlite material lying on the granite in the neighbourhood of the pipe.—S. H. Haughton: On some South African fossil Proboscidea. New proboscidean remains attributed to the genera *Archidiskodon* and *Pilgrimia*. There is evidence of considerable dental variability within the confines of a single living race of African elephant. The geology of the various gravels of the Vaal River area is critically examined; the possibility that the gravels of the so-called 'Middle Terrace' and the 'River-bed Gravels' may be contemporaneous is discussed.

GENEVA

Society of Physics and Natural History, May 19.—R. Cherbuliez and A. Riilliet: On methylcodeine. The methylation of the hydroxyl group of codeine is made difficult by the presence of the basic tertiary function,

the latter being more easily methylated than the hydroxyl group. This difficulty is got over by transforming the codeine into its chlorbenzylate. After methylation of the alcohol group of this quaternary derivative, the original amino group is regenerated by reduction with sodium amalgam.—P. Rossier: (1) The relation between the abscissæ of the extremities of a solar spectrogram (2). The author gives a better approximation, because based on more complete data, of the constants of an astrophysical formula.—(2) On the spectral type of some stars. The *K* line shows an abnormal width on some spectrograms of stars of the type A_0 , obtained at the Geneva Observatory. On the majority of these negatives a spectrophotometric study based on the position of the extremities of the spectrograms appears to indicate a spectral type more advanced than A_0 .—H. Lagotala: The geology of the mining region of Renéville, French Equatorial Africa. The author gives an interpretation of the facts observed in numerous excavations and borings. The general characteristic of the tectonics of this region is given by a series of faults, between which the compartments have had displacements in varying directions. As a result, there are sudden interruptions of the outcrops.—J. Buffle and J. Corbaz: Researches on the chlorination of α -nitronaphthalene. This operation differs substantially from the usual process of chlorination. Although without practical value, it has a theoretical interest, as it leads to a knowledge of the nature of the various intermediate compounds preceding the final products, α -chloronaphthalene and polychloronaphthalene.—L. Reverdin: The fauna of the middle and later neolithic of the station of Auvornier, Neuchâtel. Passing from the middle neolithic to the later neolithic, it is found that the percentage of bones belonging to domestic species increases from 49.2 to 90.4. The percentages of individuals increases from 46.7 to 72.4. For this station, the diminution in the utilisation of wild animals is very clear, but, starting with the middle neolithic only, the mean percentage of individuals belonging to domestic species was about seventy for the lower neolithic.—P. Dive: The risks of extrapolation in the field of geophysics. The author shows by calculation that the contradiction is only apparent, when the rigidity of the globe, such as results from the transmission of seismic movements, is opposed to the viscosity that it is necessary to attribute to the sima on which the continental masses are displaced. This contradiction arises from the fact that the experimental data of the laboratory are applied where the determining factors are magnitudes much too small compared with those factors which act in the mass of the globe. Reduced to the 'human scale' the globe appears as a body 300 times less viscous than water.—R. Wavre: The extension of a formula of H. Bruns. The author extends the formula which Bruns has made known for equilibrium figures to the case of a perfect fluid endowed with any movement.

MELBOURNE

Royal Society of Victoria, July 14.—D. E. Thomas and R. A. Keble: A revision of the subdivision of the Upper Ordovician and Silurian rocks of Victoria. The authors discuss the subdivisions of the two formations and propose a revision based on new and additional graptolite evidence.—Walter J. Parr: Notes on Australian and New Zealand Foraminifera (2). The genus *Pavonina* and its relationships. Two species of *Pavonina*, *P. flabelliformis* d'Orbigny and *P. triformis*, sp. nov., from the Tertiary of Victoria, are described and figured. *P. triformis* differs from previously known species of *Pavonina* in having the earliest chambers triserially arranged, and so resembles the genus *Reussia*. Evidence of the relationship of *P.*

triformis and *P. flabelliformis* is produced by the author, who considers that the genus should consequently be placed in the family Buliminidae, near the genera *Reussia* and *Chrysalidinella*.

ROME

Royal National Academy of the Lincei, March 6.—L. Cambi, L. Szegö, and A. Cagnasso: Magnetic behaviour of complex compounds. (5) Ferric dibutyl-dithiocarbamates. The results obtained with six isomeric compounds are analogous to those furnished by the dipropyl derivatives. Only the *NN*-*n*-butyl-isobutyl salt follows the Weiss-Curie law, the rest obeying a more complex law. This anomalous behaviour appears general in the dialkyl-dithiocarbamates and is shown also by ferric xanthates.—A. Stella: An interesting ferro-titaniferous deposit in the Arabian Desert. This mountainous deposit, known as Abu Galga, was found on ascending for about 20 km. the Madi Ranga valley, which opens out on to the Red Sea. When separated from the gangue the mineral contains about forty per cent of TiO_2 .—G. Andreoli: Reciprocal pairs of V_2 : law of the duality of linear and tangential metrics, of parallelism and metrisim. (2) Formation and properties of the pair of reciprocal varieties.—Patrick Du Val: Observations on the surfaces of one kind which are not bases for a system of quadrics.—M. Kourensky: Integration of the equations to partial derivatives of the second order with two functions of two independent variables.—L. Sona: Orthobaric surfaces of a body.—L. Campedelli: Double planes with curve of branching of the tenth order.—M. Crenna: Deformable Ribaucour congruences (2).—Giulio Supino: Clebsch's problem.—G. Krall: The asymptotic effects of the tides on the motion of celestial bodies. (2) Problem of three bodies.—N. Moisseiev: The law of resistance to the motion of bodies in a pulverulent medium. (2) Special noteworthy cases.—G. Agamennone: Ultra-powerful horizontal pendulum with mechanical registration.—G. B. Bonino and P. Cella: The Raman spectrum of quinoline and manifestations of the carbon-nitrogen linking. Six lines have previously been observed in the Raman spectrum of quinoline, but the authors' investigation reveals nine lines. Those at 3054 (cm^{-1}) and 1571 correspond with the aromatic C-H grouping and with the aromatic double linking respectively. An intense line between 1370 and 1380 must be attributed to the condensed double nucleus of the quinoline molecule; it appears very intensely in the spectrum of naphthalene, but is very weak in that of pyridine. Similar considerations apply to the lines 1142 and 764, which occur with equal intensity in the naphthalene spectrum. The line 1433, which lies within the zone (1200-1800) of the Raman spectrum assigned by Kohlrausch to double bonds, is ascribed to the double linkage between carbon and nitrogen, and is, indeed, shown by all compounds which contain a C:N group but no CH_2 group in the molecule.—G. Natta and M. Baccaredda: Mineral antimonates of calcium (atopite, romeite, calciferous antimony ochre). Descriptions are given of various antimony ochres containing combined calcium which correspond with the formula $2-3CaO, 2Sb_2O_5, 6-8H_2O$. They exhibit cubic lattices, unit cells of side 10.25-10.26 Å., and lattice structures analogous to that of atopite. Romeite gives an X-ray (powder method) appearance similar to that of atopite and, like the latter, has the value 10.26 Å. for the side of the unit cell and belongs to the space group O_4^7 or O_4 .—Z. Jolles: Diazo-resins (2). As would be expected, phenylazoxycarbonamide, which is transformed into the normal diazo-hydrate by the action of alkali, gives a resin identical with that obtained directly from

diazotised aniline. Moreover, nitrosoacetanilide undergoes resinification when left in contact with alkali for some hours, yielding a product which is darker than, but of similar composition to, that derived from aniline. The passage of the nitrosoacetanilide to normal diazo-hydrate possibly takes place by way of an intermediate additive compound.—E. Moltoni: A selection of the birds reported by the Desio mission to the Libyan Desert.—G. Lakhovsky: Cosmic waves and cellular oscillations. The experiments described by Rivera (1930) indicated that the observed excitation of cellular division cannot be ascribed to cosmic waves, which have a slightly depressive influence on germination. The results of these experiments confirm the author's theories, according to which variation in cosmic waves causes oscillatory dis-equilibrium of cells and hence disease and death.

VIENNA

Academy of Sciences, May 12.—G. Gorbach and H. Pick: Ultra-violet inactivation of sucrase in its dependency on the hydrogen ion concentration and ozone. With the purest possible sucrase solutions, the influence of the prevailing hydrogen ion concentration on inactivation by ultra-violet rays is vanishingly small. This inactivation cannot be ascribed to the ozone formed, but results from direct absorption of the short-wave energy either by the sucrase itself or by substances accompanying it.—G. Gorbach and D. Kimovec: After-inactivation of irradiated sucrase solutions, and the influence of added tryptophane and yeast-gum. Sucrase solutions which have been subjected for at least ten minutes to ultra-violet radiation, afterwards become inactivated; this after-inactivation is accelerated somewhat by addition of tryptophane or yeast-gum after the irradiation. If the sucrase solution is exposed to the rays for less than ten minutes, the enzyme retains part of its activity.—G. Gorbach and H. Güntner: Yeast lipase. Lipase from brewery or pure-cultured beer-yeast exerts its optimum activity at pH 6.6-6.8 and at $30^{\circ}C$. In general, pressed yeasts are richer in lipase than beer-yeasts, and pure-cultured yeasts than brewery process yeasts. Artificial fattening of yeasts causes marked increase in their lipase contents.—Richard Weiss and Ernest Knapp: Triphenylmethanes with their benzene nuclei linked together. (7) Methylene-diphenyl-phenyl-methane ketone.—J. Rosenhagen: Observations on the brightness and light-change of the planet Eros. The fact that the phase coefficient, the normal brightness, and the amplitude of the light-change of Eros are subject to wide variations is attributed not so much to physical changes as to a peculiar shape of the planet and to alternation in the position of its axis of rotation with regard to the earth. Other elements, such as precession phenomena, deformation of the body of the planet, etc., also produce secondary effects.—Otto Porsch: An interesting case of convergence of blossom by adaptation.—Emil Heinriche: Further investigations on the descendants of *Primula kewensis*.

May 27.—Ernst Beutel and Arthur Kutzelnigg: Luminescence analysis. (4) Fluorescence of zinc oxide.—Bruno Finzi: Results of a zoological expedition to Morocco in 1930. (5) Ants.—Josef A. Priebsch and Rudolf Steinmaurer: A year's observations of the cosmic ultra-radiation on the Sonnblick peak (3106 metres). Determinations of the ultra-radiation on this peak gave, in a slightly open iron sheath, the value $8.00 I$ (ion-pairs per second per c.c. of air at 760 mm. and $18^{\circ}C$.) and, in the closed sheath, $6.13 I$, reduced to 520.5 mm., which is the mean barometric pressure on the Sonnblick. During the winter months low, and during the summer months

high, values for the radiation intensity were observed, the minimum and maximum appearing to correspond respectively with the lowest and highest position of the sun. In the course followed by the variations, and in the yearly deviations (4 per cent), the results are in agreement with those obtained by Steinke in Königsgberg. The intensity of the radiation is apparently not related to either the degree of cloudiness, amount of precipitation, or direction of the wind.

Forthcoming Events

Congresses

SEPT. 10-18

INTERNATIONAL CONGRESS OF THE HISTORY OF MEDICINE (Ninth Congress). To be held at Bucharest.

SEPT. 12-15

IRON AND STEEL INSTITUTE AND INSTITUTE OF METALS. Joint Autumn Meeting at the Institution of Civil Engineers, Great George Street, S.W.1; and the Institution of Mechanical Engineers, Storey's Gate, S.W.1.

Monday, Sept. 12.

Dr. H. J. Gough: "Corrosion Fatigue in Metals" (Annual Autumn Lecture), at 8 P.M.

SEPT. 12-15

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN (Annual Conference). To be held at Aberdeen. Chairman's Address on Sept. 13, at 10 A.M.

Official Publications Received

BRITISH

- Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 6, July. Pp. 271-322+xxxiv. (London.)
- Bulletin of the Department of Zoology, Panjab University. Vol. 1: Fauna of Lahore. 3: Preliminary Notes on the Life-History of the Firefly *Luciola gorhami* Rits., and Cytology of the Light Organs. By Dev Raj Mehta. Pp. 101-118+plates 9-10. (Lahore.) 1.8 rupees.
- Survey of India. Geodetic Triangulation. By Capt. G. Bomford. Pp. viii+109+37 plates. (Dehra Dun.) 2.8 rupees; 4s. 6d.
- Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1931. Pp. 36+3 plates. (Jamaica: Government Printing Office.)
- Journal of the Chemical Society. July. Pp. iv+1965-2088+ix. (London: Chemical Society.)
- Ceylon. Part 4: Education, Science and Art (F). Administration Report of the Director of the Colombo Museum for 1931. By Dr. Joseph Pearson. Pp. F16+4 plates. (Colombo: Government Record Office.) 30 cents.
- Transactions of the Optical Society. Vol. 33, 1931-32, No. 4. Pp. ii+137-188. (London.) 10s.
- Journal of the Indian Institute of Science. Vol. 15A, Part 5: Bhadravarti Wood-Tar and its Utilization. By Y. K. Raghunatha Rao, B. Sanjiva Rao and H. E. Watson. Pp. 41-58. (Bangalore.) 1 rupee.
- The International Union for the Scientific Investigation of Population Problems: its Foundation, Work, Statutes and Regulations. Pp. 28. (London: c/o Royal Geographical Society.)

FOREIGN

- Memorias del Consejo Oceanográfico Ibero-Americano. Número 8: La corriente del Peru y sus limites nortenos en condiciones normales y anormales. Por Prof. Gerhard Schott. Pp. 57+3 laminas. Número 9: El Instituto Español de Oceanografía y la labor que ha realizado. Por Prof. Rafael de Buen. Pp. 72+10 laminas. Número 10: Nuevas investigaciones gravimétricas sobre los mares. Por Guillermo Sans Huélin. Pp. 14+2 laminas. Número 11: Cooperación española a la Oceanografía. Por Prof. Rafael de Buen. Pp. 32. (Madrid.)
- Egyptian University: Faculty of Science. Publication No. 1: The Food of Protozoa; a Reference Book for use in Studies of the Physiology, Ecology and Behaviour of the Protozoa. By H. Sandon. Pp. iii+187. (Cairo.) 20 piastres.
- Proceedings of the Imperial Academy. Vol. 8, No. 6, June. Pp. xvii-xviii+217-273. (Tokyo.)
- Préhistoire. Tome 1, Fascicule 1. Pp. iv+123+5 planches. (Paris: Ernst Leroux.) 125 francs.
- U.S. Department of Agriculture. Miscellaneous Publication No. 120: A Digest of the Literature of Derris (*Deguelia*) Species used as Insecticides, 1747-1931. By R. C. Roark. Pp. 86. (Washington, D.C.: Government Printing Office.) 15 cents.
- Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia Jaarverslag 1931. Pp. 14. (Batavia.)
- Department of Agriculture: Straits Settlements and Federated Malay States. General Series, No. 9: The Cultivation and Manufacture of Tea in Ceylon and India. By E. A. Curtler. Pp. iii+94+5 plates. 1 dollar. Circular No. 3: The Cultivation of Allotments by Tamil Labourers. By J. N. Milsum. Pp. 12. 10 cents. (Kuala Lumpur.)