SATURDAY, AUGUST 10, 1929.

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Editorial and Publishing Offices :

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

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

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

Darwinism and Social Ethics.

THE Bishop of Exeter, in the July number of the *Hibbert Journal*, lays his finger upon two implications of Darwinism which appeal to many as subversive of social tendencies as they exist to-day, and as they have been encouraged especially by Christianity. The first is the theory of the struggle for existence, which he regards as nothing more than a policy of destruction, forgetting that, as Kropotkin emphasised long ago, destruction is not the whole story, but that mutual aid and combination also play an effective part in the struggle in the lower as well as in the higher orders of Nature. Especially in the higher orders, it is noteworthy that spiritual and intellectual progress has been associated with the development of mutual aid and sociality, and it seems likely that along these lines future progress is most likely to be attained.

The Bishop's own examples of the help given by civilised peoples in the stamping out of disease amongst the lower races, or in the betterment of the lot of the less fortunate amongst their own people, show how clearly spiritual development (which also is evolutionary) has changed the crude notion of destructiveness. The struggle for existence is often a delicate and not very obvious process. Amongst men it has certainly lost much of the crudeness and literalness which it possesses in the world of the lower animals, and the evolution of spiritual development ensures that amongst men there can be no return to the purely physical struggle which is sometimes taken as the whole story in the lower orders.

On the other hand, it is obvious that selection of some sort must take place amongst men, and there is a real danger in the unlimited preservation of the unfittest in mind or body, always, be it noted, at the expense of the more fit. It is difficult to avoid the conclusion that, since man as he has evolved has to a large extent done away with the selection which would have resulted from an exposure to the pressures of Nature, and has replaced that by an effort after general well-being, he must accept the responsibility entailed, and, as Prof. J. Arthur Thomson once expressed it, must "continue in a subtler, more rational, more humane form the automatic singling and sifting which goes on in Nature".

The Bishop of Exeter's second difficulty lies in the specialisation apparent in the structures and functions of animals, which, applied to mankind, suggests to him the need for a political system fundamentally different from the one under which we are at present living; one which will promote classes with specialised functions. "The equality of men is a Christian ideal, but one which should prove subversive to all evolutionary development." But the Bishop's earlier examples of higher races and lower races, of fit and unfit, show that he is no firm believer in equality, and it is evident enough that men are not equal in bodily or mental development, in spiritual development, or capacity for spiritual development.

It must be remembered that specialisation in structure or function is a device to meet a special set of circumstances, and that it implies a lessened ability to meet fresh changes in circumstances, as many extinct groups of animals bear witness. Man is still evolving, and he would be rash who would predict the developments which may be required to meet the changing circumstances of his environment.

The safety of humanity lies not in specialised and therefore fixed castes, but in the mental capacity which enables man to adapt his whole life to the needs of different conditions, as no lower animal can adapt itself. Perhaps the only safe generalisation is that neither bodily evolution alone nor mental evolution alone is likely to be of great survival value, but that sound minds in healthy bodies must combine in a co-operative social evolution wherein the individual will gradually come to mean less and progressive humanity will mean more.

A Source Book of Astronomy.

A Source Book in Astronomy. By Prof. Harlow Shapley and Helen E. Howarth. (Source Books in the History of the Sciences.) Pp. xvi+412. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 20*s*. net.

THIS book is a sheer delight. The multiplication of text-books and popular literature in astronomy, salutary as it is on the whole, has one serious disadvantage: it diverts the attention of inquirers from original sources of knowledge. The reason is obvious. Neither time nor accessibility allows of reference to a separate volume for each piece of information one may require. We need all our store of available knowledge between two covers, and so it comes about that the amateur, nourished on his handbook, and the student, looking only to his text-book, develop into the working astronomer with an almost total ignorance of the original papers of any but contemporary writers. One could probably say with truth that most astronomers who read this volume will read the greater part of its contents for the first time, and yet it contains nothing that can be ignored without loss or that can be assimilated from any paraphrase with quite the same benefit.

In June 1924, Mr. Gregory D. Walcott, of Long Island University, Brooklyn, N.Y., assembled an advisory board of philosophers and men of science with the object of producing a series of "source books" in the history of the sciences which would "present the most significant passages from the works of the most important contributors to the major sciences during the last three or four centuries". Among the members of the board was Prof. Harlow Shapley, of Harvard College Observatory, and he, with the assistance of Miss Helen E. Howarth, has now prepared the first of the projected series, dealing, appropriately, with astronomy. In a brief preface the compilers state some of the difficulties and general characteristics of the work. Several passages which would otherwise have been quoted are excluded on account of their mathematical nature or excessive length; Gauss's description of the 'method of least squares' is, in fact, the only mathematical note in the book. No contribution originating since the year 1900 has been included, nor has the work of any living astronomer been given. Those who wrote in English are represented by their *ipsissima verba* and others by English translations, many of which have been specially made. A short note giving a few relevant facts concerning each of the authors represented (of whom there are more than sixty) is appended, and in some instances portraits or other illustrations appropriate to the work described are reproduced. The chronological order has been followed.

A book of this type, as the authors point out, is not a history; it does not aim at completeness, and there is necessarily no attempt to link up one piece of work with another. Nevertheless, it is clear that the choice has been partly determined by a praiseworthy desire to 'see a thing through'. Thus we may follow the history of our knowledge of Saturn's rings through the contributions of Huygens, Cassini, Maxwell, and Keeler—a consecutive story. It should be said further that the book is in no sense a text-book, on account not merely of inadequacy, but also of radical unfitness. The authors have wisely refused to restrict themselves to accounts of ideas and discoveries which are still accepted at their original value. Some of the matter here reprinted has been definitely superseded, and some has played a negligible part in leading up to modern views: it is not thereby disqualified for a place among the classics of astronomy. The distinctive feature of a 'source-book' is that it contains the actual words, written often in the glow of excitement following a great discovery or idea, of those most worthy to be remembered, and its peculiar value, we would say, lies in the fact that in those words there is an emotional, and sometimes a scientific, significance beyond the power of any second-hand account to reproduce.

It is, of course, impossible in a review to give even an approximate idea of the character of such a book. We can merely cite at random a few of the treasures which it contains. Here, for example, one may read why Copernicus found the geocentric cosmogony unacceptable, and how Kepler advised him "who is so stupid as not to comprehend the science of *Astronomy*, or so weak and scrupulous as to think it an offence of Piety to adhere to *Copernicus*, him I advise, that leaving the study of *Astronomy*, and censuring the opinions of Philosophers at pleasure, he betake himself to his own concerns, and that desisting from further pursuit of these intricate Studies, he keep at home and manure his own Ground". One may renew acquaintance with Salviatus, Sagredus, and Simplicius, and learn from Huygens that the art of constructing telescope lenses "has in reserve more difficulties than it seems to bear on its face", and from Bradley that the agreement between his observations and the hypothesis of the aberration of light "may possibly be thought to be too great by those who have been used to astronomical observations". One may read of Horrox and Goodricke, the marvellous boys who died immortal at the age of twenty-two, and of how Kapteyn estimated his enthusiasm for the Cape Photographic Durchmusterung to be equal to six or seven years of drudgery. The feelings of a "watcher of the skies when a new planet swims into his ken" may be sought in the words of Herschel, but it is doubtful if they will be experienced by any but a kindred spirit. No such limitation characterises Huggins's account of the spectra of gaseous nebulæ.

In the midst of such an illustrious assembly, it is with something of a shock that the reader encounters "an extract from the Will of James Lick". What is it doing in that galley? If the peculiar value of a source book lies in the fact that the words of an original thinker or discoverer may be expected to be 'inspired' in the only legitimate sense of the word, on what grounds can be justified the inclusion of a legal document, of all dusty formulæ the most irredeemably dead? This seems to us to be the one serious defect in an otherwise wholly admirable book.

Perfection in such a publication is impossible of achievement, and, since the standard of judgment is inevitably determined in part by individual taste, is probably without meaning. We should have liked to see a quotation from Newton's "Opticks" as indicating the origin of astrophysics, as an example of the ideal manner of describing experimental researches, and as a timely reminder that Newton was not only a great philosopher but also a great experimenter. This seems the more desirable, as the quotations by which Newton is represented, worthy in many respects though they are, contain an undue proportion of misapprehensions. The laws of motion and gravitation, now superseded, could, of course, not be omitted, but was it necessary to repeat the conclusion that "the least particles of all bodies" are "extended, and hard and impenetrable . . . and this is the foundation of all philosophy"? Or that the possibility that the solar system moves among the stars is "an hypothesis hardly to be admitted"? But doubtless every reader will miss some favourite passage or regret the inclusion of some other. It is wiser and more fitting to enjoy the rich treasure so handsomely compiled and presented than to give the rein to individual prejudices.

'Handsome' is not too strong a word for the outward form of this charming book. It is admirably printed and bound, and the reading is a physical as well as a mental pleasure. In matters of detail only two defects have been noticed. On p. 371 the caption under the illustration refers to "ξ Ursæ Majoris" instead of "ζ Ursæ Majoris", and in the account of Horrox's observation of the transit of Venus, it would have been an advantage if the month of observation had been definitely stated in the footnote.

H. D.

Crystallochemistry.

Crystal Structure and Chemical Constitution: a General Discussion held by the Faraday Society, March 1929. Pp. iv + 253 - 422 + 6 plates. (London: Faraday Society; Gurney and Jackson, 1929.) 8*s*. 6*d*. net.

THE Faraday Society is justly proud of its record of general discussions, the subjects of which have covered a wide field during the quarter-century of its existence. The meeting held last March contained an innovation in that the proceedings started with a formal lecture, and although the subsequent programme was divided into special sections, yet it was Prof. Goldschmidt's opening discourse that sounded the note for all that followed. The report of this conference, which has just appeared, includes all the contributions, many of them by workers distinguished in particular directions in crystallochemistry, and forms a unique collection of opinions and researches upon the nature of the solid state.

Modern theories of crystallography differ from those of even a few years ago chiefly in the method of classifying crystals. Instead of the macroscopic symmetry the atomic environment is now the basic criterion, as expressed by the co-ordination number, *C.N.*; for example, in the well-known rocksalt structure, *C.N.* = 6, meaning that each sodium ion is surrounded symmetrically by six chlorine ions, and vice versa. A combination of X-ray results and optical data has enabled tables of atomic radii to be prepared for the great majority of the elements. This property, however, is not a constant, but depends not only upon the electrical charge but also upon the state of co-ordination. Thus the radius of $S^{6+} = 0{\cdot}34$ A., whereas that for $S^{2-} = 1{\cdot}74$ A. Likewise, the figures for 12-co-ordinated and 4-co-ordinated tin are 1·58 A. and 1·40 A. respectively. These facts show the impossibility of deducing atomic radii correctly, unless crystals are divided into what Goldschmidt calls 'commensurable' groups in which the constituents are in corresponding states of ionisation and environment (or co-ordination).

The quantity *C.N.* is, nevertheless, itself a function of the quotient of the atomic radii of the components, and also of their polarisation or capability of deformation by an electric field. Special types of crystal structure, the molecular lattice and the layer lattice, arise when distortion of the units is very marked. Again, the peculiar nickel arsenide form is found for compounds of the iron family: in these elements the *M*-defect renders the removal of electrons harder than for a metal such as magnesium. Finally, the occurrence of more than one kind of linkage within the crystal is probably responsible for the appearance of the iron pyrites structure, which contains the complex S_2 as a unit.

Prof. Goldschmidt remarks that chemical substitution is the most powerful tool of the investigator in crystallochemistry. Certainly in the hands of the Oslo school it has fashioned a foundation stone upon which to rear a great edifice of systematic inorganic chemistry.

Turning now to the papers contributed to the general discussion proper, those in Part 1 deal with inorganic substances, and here again the part played by atomic arrangement is noticeable. Prof. W. L. Bragg's account of the work undertaken at Manchester on the silicates provides some fascinating reading. Broadly, these structures are like fabrics the stitches of which are groups of oxygen atoms, which groups hold together by common sharing, while the positive ions are widely dispersed throughout the network.

Prof. Lowry and Mr. Vernon present a study of the etch figures of sylvine, which confirms its ionic character, and Dr. A. M. Taylor some interesting reflections upon the AX_4 group, the linkages within which appear to be semi-polar. Other papers include a contribution by Prof. Jaegar on ultramarine, and one on the fine structure of the felspars by Prof. Schiebold.

The introduction to Part 2 (organic compounds) is by Sir William Bragg. Mrs. Lonsdale deals with the history of the benzene ring question, and with her own work on hexamethylbenzene. The ring is definitely plane, and the side chain carbon atoms are placed radially to their respective nuclear atoms, and lie in the plane of the hexagon. Dr. Müller describes his hydrocarbon model, and Dr. Piper produces some examples of the ways in which the long spacings (20 A. to 50 A.) of fatty acids have been made to yield valuable data on composition.

Mr. Bernal, in opening Part 3 (metals), produces perhaps the most suggestive contribution in the report. The physical properties of metals have hitherto been studied almost exclusively on account of their technical importance, and the purely scientific aspect has remained comparatively barren. The term 'metallic state' includes bodies in which the binding forces may be homopolar or ionic: meanwhile, the empirical requirements of the metallic bond (which is different from either) are clearly displayed and their interpretation discussed. The following paper, by Westgren and Phragmén on alloys, is distinctly illuminating in the light of the foregoing.

Experimental and instrumental interests are represented by the two-circle spectrometer due to Dr. Wooster, and the integrating microphotometer for which Mr. Astbury is responsible.

Part 4 consists of a group of papers of a more general character (Kolkmeijer, Mark, Möller, Porter, Reis, Weissenberg), which produced at the meeting a lively exchange of views. Prof. Ewald brings the formal contributions to a close most appropriately with a masterly account of the new Heitler-London theory of chemical combination. That aspect of quantum conceptions most readily approached by the theory of groups finds a natural place alongside the labours of the practical crystallographer.

Just over forty years ago (May 1889) Mendeléeff expressed his ideal in the words : " To hasten the advent of true chemical mechanics." Here is a collection of papers which constitute no mean step towards that goal.

F. Ian G. Rawlins.

The Nature of Epidemicity.

The Genesis of Epidemics and the Natural History of Disease: an Introduction to the Science of Epidemiology based upon the Study of Epidemics of Malaria, Influenza, and Plague. By Lieut.-Col. Clifford Allchin Gill. Pp. xxvi + 550. (London : Baillière, Tindall and Cox, 1928.) 21*s.* net.

THE prevalence of many infective diseases in epidemic form—by which is meant a sharp increase in incidence over a short period of time—is a problem the solution of which has exercised many minds since the times of the medical philosophers of ancient Greece. Many of the hypotheses formerly advanced have been found to be inconsistent with increasing medical knowledge, and there is no unanimity of opinion among epidemiologists concerning those that have survived. Only a careful collection and unbiased analysis of all the factors and data, together with the vision to interpret them, is likely to unravel the tangled skein.

Lieut.-Col. C. A. Gill, Director of Public Health in the Punjab, has now ventured into this ' no man's land ' and has produced an impressive book, the outcome of a painstaking study of epidemics over many years, in particular of malaria. The subject matter is presented in five parts. The first part commences with a statement of definitions, which are particularly good, proceeds to survey ancient and modern hypotheses regarding the cause of epidemics and the methods of epidemiological research, and concludes with a presentation of the author's hypothesis of the nature of epidemicity. In Part 2, the known facts respecting epidemic malaria, and also influenza and plague, are stated at length. Part 3 contains a discussion of the general properties of epidemics and a critical analysis of the author's hypothesis. Part 4, entitled " Bionomics of Disease ", deals with evolutionary factors and influence of climate in health and disease, and Part 5 contains a general review of the subject, with final reflections. The book is illustrated with charts and maps and a diagram of the endemic and epidemic status of communities.

The varying clinical characters and epidemiological features exhibited by the different epidemic diseases, together with the individuality of their specific parasites, almost inevitably suggest that a dissimilar mechanism is operative in the causation of epidemics. The dominant view at present held is probably that the quality of epidemicity is inherent in variability of the properties of the specific parasite, and that epidemics are the outcome of biological modifications of the latter—the mechanism of epidemicity is essentially an attribute of the specific parasite. Col. Gill, however, brings forward some weighty considerations opposed to this view, and maintains that arguments in favour of a unitary nature of the mechanism of epidemicity are no less formidable. His hypothesis, which he designates the ' quantum theory ', suggests that *all* epidemic manifestations consist essentially in a loss of equilibrium between the dose of toxin (or the parasitic factor) and the degree of resistance of the community attacked. The quantum theory postulates

> " that all epidemical phenomena are essentially dependent upon a change in the relationship of the infection quantum and the immunity quantum. It ascribes the precise cause of ' loss of equilibrium ' between ' infection ' and ' immunity ', primarily and predominantly, to an increase of the infection quantum—the essential factor in the causation of epidemics is of a quantitative rather than a qualitative character. . . . An epidemic is thus regarded as mainly the outcome of a quantitative change of the transmission factor and the immunity factor, and the intensity of epidemics is held to be a function of the range of amplitude of these factors, which in turn is attributed to the influence of climatic conditions in determining a great and sudden elevation of the infection quantum and a corresponding depression of the immunity quantum."

The arguments presented in support of this hypothesis are skilfully marshalled and are mainly based upon a consideration of malaria, plague, and influenza. It must be left to the statistician to evaluate the precise significance that can be attributed to some of the figures adduced, but in the case of malaria and plague, the evidence brought forward seems strongly to support the author's hypothesis. As regards influenza, we think he is on more debatable ground and the evidence is perhaps less convincing, though this may be more the fault of the extreme complexity of the influenza problem.

Recent studies on diphtheria, which, though not quite comparable to the diseases discussed, shows periods of epidemic prevalence, tend in one respect to support the author's hypothesis, for it has been shown that the parasitic factor, the diphtheria bacillus, exhibits a remarkable degree of constancy as regards virulence—that is to say, it presents little variation qualitatively. The studies of Sir Leonard Rogers on cholera and other diseases also support the hypothesis of the close relationship between climatic conditions and the occurrence of epidemics.

The author appears to ascribe more importance to an increase in the amount of infection relatively greater than the depression of communal immunity in the genesis of epidemics, but it does not seem clear upon what grounds. In the case of diphtheria, and also of measles, the evidence appears to us to be in favour of depression of immunity being the more important factor. These, however, are side issues, and the author would be the first to admit that he has been able to adduce few certainties. He has undoubtedly produced a work of considerable importance and a hypothesis which deserves the careful consideration of epidemiologists.

R. T. H.

Progress in Psychiatry.

Recent Advances in Psychiatry. By Dr. Henry Devine. (The Recent Advances Series.) Pp. x + 340. (London: J. and A. Churchill, 1929.) 12*s*. 6*d*.

DURING the post-War years, and more particularly since the Royal Commission on Lunacy completed and published its labours, the subject of mental disorder has been one of universal public interest. Dr. Henry Devine, the superintendent of the Holloway Sanatorium, was entrusted with the work of writing the volume in Messrs. Churchill's well-known "Recent Advances" series dealing with this subject.

Dr. Devine has carried out what proved to be a very difficult task with extraordinary thoroughness, and is to be congratulated on a very fine piece of work. Anyone conversant with the extent of the field in mental disorder and its cognate subjects will marvel at the success which has crowned the author's effort to cover as much of the ground as possible. He is careful to emphasise what is perhaps one of the most important attitudes towards mental disorder, namely, that no single etiological factor, in practically all instances, is sufficient to account for the disease. In all cases there are at work closely inter-related mental and physical causes—mental stress, acute or chronic, on one hand, and heredity, focal infection, organic disease and disorder of the internal secretions, on the other.

After a well-balanced discussion of the basis of psychiatry, the author divides the rest of his book into five parts. The first part deals with toxic, infective, and somatic factors in the causation of mental disorders. In this section he discusses the very important subject of the effect of toxic agents on the germ plasm, and concludes that there is a very close relationship between hereditary disease and a psychopathic predisposition. At the same time, he is careful to emphasise the very great importance of focal infections in all parts of the body as causative agents. The important fact is that in the majority of cases these infections are not discovered except by highly skilled biochemical and bacteriological work. This point cannot be emphasised too strongly. Physical examination of a patient by the family doctor is quite insufficient; it is work for highly skilled research workers, of which there are far too few in Great Britain.

In the second part, Dr. Devine discusses the development of what is commonly known as protein shock treatment and other similar forms of treatment, leading up finally to the now almost universal treatment of that most fatal of maladies, general paralysis of the insane, by benign tertian malaria. The author gives a well-balanced account of this most interesting department of therapeutics. In the third part, he discusses the various biochemical and physiological aberrations which are to be found in mental disorders. Perhaps the most important subject in this section is the work of Golla on the physiological investigation of pleasure and pain and of the neuroses. In the fourth part, he discusses what is one of the most recent and most interesting developments of modern psychiatry—the influence of physical and psychological types.

In the fifth and last part, the author deals with the purely mental aspects of mental disorder in a reasonable and impartial manner. Into this section he brings the important work of Pavlov on conditioned reflexes. The chapter entitled "The Morbid Mind" is the best chapter in the whole book, and one from which every morbid and every normal mind would gain great benefit by reading. Dr. Devine wisely points out that psychotherapy is of very limited use in the treatment of the insane, except in the direction of occupational therapy and the attitude of the mental nurse, which are really indirect or environmental forms of psychotherapy.

This book will remain a standard record of progress in a branch of medicine which is all too frequently adversely criticised by the public.

Our Bookshelf.

Methodik der wissenschaftlichen Biologie. Herausgegeben von T. Péterfi. Band 1: *Allgemeine Morphologie.* Pp. xiv + 1425. Band 2: *Allgemeine Physiologie.* Pp. x + 1219. (Berlin: Julius Springer, 1928.) 188 gold marks.

THE aim of the editor and his forty-two expert collaborators has been to produce an account of the most trustworthy methods which have been employed in biological investigation. The first volume opens with an introduction to the mathematical treatment of biological questions including graphic methods, and this is followed by chapters on microscopical optics, including measuring, drawing, polarisation and ultramicroscopy, on vital staining, tissue culture, microdissection and microisolation, and on the methods for making permanent preparations and sections. The next part, on cytology, by Dr. K. Bělař, is noteworthy for the lists of the most suitable animals and plants for the study of cytoplasm, and in the succeeding part on methods for the examination of Protozoa he is equally helpful in indicating the most suitable examples for study. Chapters follow on histological and histochemical methods, on embryological and anatomical material, and on the microtechnique of invertebrates.

In the second volume the opening chapters on zoological and botanical museum technique are followed by others on the collection of living animals of various groups, and the keeping of them in fresh-water or sea-water aquaria, or in vivaria; special attention is devoted to insects (with an appendix on Lymantriidæ and Saturnidæ) and to mammals. The culture of algæ and fungi, and the keeping and rearing of higher plants as objects for the study of heredity or for physiological work, are considered. Excellent accounts are given of methods of illustration for natural history purposes by photography, microphotography, and kinematography. A chapter follows on variation, correlation, proving the agreement between empirical and theoretical figures, the analysis of inheritance factors, etc. The developmental mechanics of plants and of animals, including methods of artificial parthenogenesis, and the more important physiological methods as applied to animals and plants, are the subjects of the concluding chapters. An appendix gives technical names in German, English, French, and Italian.

This is a valuable work of reference for biological laboratories; advanced students and investigators who turn to it will find helpful information and suggestions over a wide range of biology, and the list of published works at the end of each section directs the reader to memoirs with further details. The chapter on the collection of living animals deals only with fresh-water and terrestrial examples; some account of the methods of collection of the more important marine animals would have been welcome.

The work is excellently produced and each volume has a good subject index.

(1) *The Excavations at Ur and the Hebrew Records.* By C. Leonard Woolley. Pp. 61. (London: George Allen and Unwin, Ltd., 1929.) 2*s.* net; paper, 1*s.* net.

(2) *Biblical Anthropology compared with and illustrated by the Folklore of Europe and the Customs of Primitive Peoples.* By the Rev. H. J. D. Astley. Pp. vii + 262. (London: Oxford University Press, 1929.) 12*s.* 6*d.* net.

(1) THOSE who know Mr. Leonard Woolley's "Sumerians" will turn with interest to his Arthur Davis Memorial Lecture on the bearing of his discoveries on Biblical history. Mesopotamia is, of course, a long way from Palestine, and "the periods with which we have to deal are sometimes far removed in time from those which interest most the Bible student", yet the link is there. The two points of contact which concern us most would seem to be the flood narrative and the story of Abraham. Of the first we read that "such archæological data as we possess, and the traditions of the Sumerians themselves, are most easily explained and best reconciled by the assumption that the Flood was the epoch-making historical event which they believed it to be". As for Abraham, the chief point of interest is that "living at Ur, so far from being a primitive Bedouin accustomed only to the wide spaces of the desert, he was the heir to an age-old civilisation sharing the complex life of a great trade centre". Another interesting point is that "it would not be even fanciful to hold that Jacob's dream was based on tales he had been told of the ziggurat of Ur, where on festivals the priests went in procession up and down the long stairways which led from earth to Heaven".

(2) The comparatively new science of anthropology, or the study of man apart from religious and cultural prepossessions, has also shed much light on story and custom in the Bible, as Sir James Frazer's monumental "Folk-lore in the Old Testament" has shown. Canon Astley's book is in part a collection of articles contributed to such periodicals as the *Hibbert Journal* and the *Modern Churchman*, and should prove most interesting material for the Biblical student who is fascinated by anthropological parallels between what he finds there and religious custom in other parts of the world.

J. C. H.

Colloid Chemistry. By Prof. The Svedberg. Second edition, revised and enlarged in collaboration with Arne Tiselius. (American Chemical Society Monograph Series, No. 16.) Pp. 302. (New York: The Chemical Catalog Co., Inc., 1928.) 5.50 dollars.

THE first edition of this book was reviewed in these columns in 1924, and this new edition is a revised version with some fifty pages of additional matter. The original scheme of the book, in so far as relatively greater space is devoted to the author's own investigations, is retained, and in consequence there is a freshness and reality in presentation which a mere compilation so frequently lacks. The amendment of the old text has been thoroughly carried out, and the strange method of printing some of the formulæ has been avoided; crude or inconvenient methods of investigation have given place to better ones wherever the latter have been devised.

The work of the author on sedimentation equilibria with the ultracentrifuge has carried this method of attack on the problem of the size of colloid particles into realms hitherto undreamt of, and those who desire a concise and readable account of this fundamental work will find it here. The extension of the investigation from the inorganic sols, to which it was first applied, to colloids of biological interest, has resulted in the determination of the molecular weights of the latter, which hitherto had been found only in a few cases by more tedious methods. New work in ultramicroscopy, in the technique of measurement of diffusion and cataphoresis, and in the application of X-ray analysis to the study of sols and gels, has been carefully incorporated. No chemists or physicists interested in colloids should miss reading this book, even if they have already enjoyed the first edition.

P. C. L. T.

Comparative Vocabularies of Bushman Languages. By D. F. Bleek. (University of Cape Town: Publications of the School of African Life and Language.) Pp. vi+94. (Cambridge: At the University Press, 1929.) 7*s.* 6*d.* net.

In this volume, Miss Bleek has worked on eleven vocabularies, the materials for which for the most part have been collected by herself at one time or another. In her previously published study of the Naron she gave a preliminary account of the classification of Bushman languages which is here elaborated. The languages are divided into three groups, of which six belong to the southern group, three to the northern, and two to the central. The groups differ in the characteristic clicks and in change in root and grammar, especially the last. In the introductory section which deals with the peculiar features and characteristics of the groups, Miss Bleek has analysed Bushman physique and culture with the view of a possible coincidence in distribution of language and race. The smallest average in height is found in the southern group. As regards culture, all Bushmen live in bush huts, and are hunters and collectors of food. The Hottentots, who have taken to a pastoral life, used huts in the old days, but they differed from those of the Bushmen in being made of reed mats and not bush. The clothes of all Bushmen are similar, a leather loincloth and small kaross. The ancestors of the southern group painted and engraved in stone down to a recent date, but have now lost the art. The general conclusion at which the author arrives is that, while a number of features are common to all, a good many differences in custom coincide with differences in speech.

Chemistry in Daily Life. By Dr. Samuel Glasstone. Pp. vi+250. (London: Methuen and Co., Ltd., 1929.) 6*s.* net.

Dr. Glasstone's book is of a type which should be very welcome. It deals with a number of aspects of chemistry which are of interest in daily life, and each chapter concludes with a few questions, some subjects for essays and discussion, suggestions for further study, books to read, and suggestions for experiments. The contents are based on a course of extension lectures and some B.B.C. broadcast talks, and the style and choice of material are both excellent.

The author expresses the hope that the book will be found of interest to the general reader, useful as a basis of extension and similar lectures for adults, and suitable for use in schools, whether chemistry is taught or not. There can be no doubt that it will fulfil all these requirements satisfactorily. The information is generally accurate, and the treatment is more detailed than usual in books of this type, so that even advanced students will find much that is new to them. Symbols and formulæ are used. The least satisfactory parts are some of those dealing with the early history of chemistry. On p. 5 the really valuable contributions to experimental chemistry made by the Alexandrian chemists are not given proper credit, and on p. 82 it is stated that there are representations of glass-blowers on Egyptian inscriptions so far back as 3000 B.C. These are minor faults and the book may be strongly recommended.

Lumineszenz-analyse im filtrierten ultravioletten Licht: ein Hilfsbuch beim Arbeiten mit den Analysen-Lampen. Von Prof. Dr. P. W. Danckwortt. Pp. vi + 106 + 16 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 6·50 gold marks.

The main subject matter of this little book has become familiar to most workers in practical science, even if only by witnessing a few fascinating demonstrations at some conversaziones. Most of these can be repeated with some form of the well-known tent or camera, open and curtained in the front, in the roof of which is concealed a quartz mercury burner; the light is filtered through a 'sky-light' of Wood's glass, which allows only the ultra-violet rays to fall on the object placed on the floor of the tent. While such phenomena appeal to the layman, they open up a far wider field to the imagination of the scientific worker and the technologist, and the object of this handbook is to broaden the horizon and lure the reader to explore much further by pursuing observations in his own laboratory.

The invitation is irresistible to the chemist, the mineralogist, the pharmacist, the toxicologist, the biologist, and the industrialist, who may differentiate between substances so closely allied that they are in ordinary practice indistinguishable either chemically or physically, for example, olive oil of different grades; or between substances essentially different although similar in appearance, such as a normal paper and the same after acetylation.

Of the forty illustrations one may be selected—the fluorescent structures in the sporangia of a fern are revealed in striking contrast, whereas all appear similar in daylight. The book is well written and well produced; while its value is enhanced by a comprehensive, classified bibliography.

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.]*

Natural Selection.

IN NATURE of June 8 there appears a letter from my friend Prof. Poulton in which he replies to my statement that 'natural selection' affords no explanation of evolution. He quotes *in extenso* a letter from Darwin to the distinguished American botanist Asa Gray, in which Darwin endeavours to deal with the objection that natural selection is a truism and that variations are produced by definite causes and are not due to 'chance'. Darwin compares the action of natural selection to that of a man building a house from stones of all shapes found at the foot of a precipice on a mountain-side. The shapes of these stones, he says, would be due to definite causes, but the uses to which the stones were put in building the house would not be explicable by these causes.

Of course, when I wrote the statement which Prof. Poulton criticises, I was well acquainted with this letter of Darwin. Prof. Poulton quotes it with the same reverence as our fathers used to quote a passage from Holy Writ; but a false analogy and piece of thoroughly bad reasoning seem to me to be as worthy of censure when the author is Darwin as they would be if the author were one of his religious opponents.

A little reflection will show the fallacy in Darwin's argument. That the shapes of stones on the mountain-side are due to definite causes is obvious to anyone who has ever compared a scree on a hill-side of Harlech grits with one on a hill-side of Llanberis slates —to go no farther away than Wales for an example. But when a man begins to build a house, we have the intervention of a *definite purpose* directed towards a *fixed end* and governed by a *clearly-conceived ideal*— and it is doubtless true to say that these psychic factors have no conceivable relation to the causes which produced the stones.

'Natural selection' means, as I said before, merely that a creature survives in a given environment; as to why it survives, or whether its survival be due to one character more than another, and as to how it acquired that character, the theory gives us no information whatever. The supporter of the 'mimicry' theory, when he finds one insect superficially resembling another belonging to a different family or order, *assumes* that it is because of this resemblance that one of the insects survives. It may be so, but there is no proof that it is so; it ignores the fact that the most marvellous resemblances often occur between insects belonging to different orders *inhabiting different countries.*

The supporter of evolution by 'natural selection' further assumes that the insect which survives is one of a large number of differing types produced by 'variation', that is, 'chance', which happened to fit the environment, and that all the others perished. This, again, is an unsupported assumption; in fact, one may go further and say that it is definitely not true. When in the wild we meet, as we occasionally do, with ill-adapted types such as albinos, melanics, etc., they belong, as Uexküll has well said, not to the *natural*, but to the *pathological*. Darwin, through constant usage, had grown to personify natural selection, and sub-consciously to regard it as a purposeful agency. It became a habit, and was shared by his family. I have even heard one of them talking of the 'mistakes' made by 'natural selection'. The whole mental attitude is a first-class example of the error due to what McDougall calls the "reification of words".

That when a species of animals is examined a general type can be discriminated and that individuals deviate slightly from this type, no one would deny. But to what are these deviations due? Even Morgan admits that they are due to the environment, "for there is no other source for them". Did Darwin, then, mean to say that the changes produced in a creature by the environment have no relation to its survival in that environment? If he did so, is it not obvious nonsense? No! There is no escape from the dilemma so ably posed by the late Dr. Bateson: "Either variation is due to chance or to the reaction of the animal to the environment".

That natural selection is a reality no one, who like myself has for the last seventeen years raised annually thousands of larvæ of the same species, would doubt for a moment. But what is 'selected' is not the 'random' variation but, as Kammerer has well put it, "the most plastic individual", that is, the one which reacts best to the environment; in other words, *the most vigorous.* As to why individuals of the same brood differ from each other in vigour we do not fully know, but we are beginning to get glimmerings of the reasons. If, for example, we obtain eggs from a sea-urchin at the end of the season, these eggs, though to all appearance ripe and normal, are able to give rise only to feeble larvæ which live only a day or two and only complete the early stages of development. Again, it has recently been shown that the position in the ovary of the immature egg has much to do with the vigour of its constitution when ripe and fertilised.

As to attacks of birds on insects, Prof. Poulton has failed to note that I said "serious attack". That birds occasionally attack insects I am well aware. I have myself seen the sparrow, normally a grain-eating bird, chase one of our common cabbage white butterflies, and I have seen some of the jealously guarded treasure of damaged butterfly wings which Prof. Poulton has collected after a search of many years. But that butterflies are subject to such decimating attack that the occurrence or absence of a patch of colour means life or death there is no evidence whatever.

I have written at some length on the subject, because, although I recognise that the facile truism of 'natural selection', so easily grasped by the uncritical mind, did succeed in making mankind believe in evolution, yet now I am convinced that the view that 'natural selection' explains evolution is one of the greatest hindrances to biological science. It leads to unsupported hypotheses, and to facile teleological explanations which dispense with and discourage research into the functional significance of the organs of animals. Why has an animal got a particular pattern or shape? Because it has been developed by 'natural selection' in order to enable it to escape its enemies! With this explanation too many biologists are content. "Verily all things are possible to him that believeth."

E. W. MACBRIDE.

Imperial College of Science, S.W.7,
June 29.

Super-cooled Water.

IN a recent letter to NATURE (Feb. 16, p. 244) I directed attention to Beilby's observation that water drops become hard when chilled to − 12° C., and to the fact that water is quite fluid at − 9·3° (White and Twining, *Jour. Am. Chem. Soc.*, **50**, pp. 380-389; 1913). That an important change in properties takes place between these temperatures is indicated by the difficulty all experimenters have had in cooling water below - 10°. It may be that here the steady expansion which water undergoes below 4° ceases, and that with further lowering of temperature the contraction obtains which was predicted by Bridgman (*Proc. Am. Acad.*, **47**, p. 543; 1911–12). Water has been cooled in capillary tubes to - 18·5° (T. Borovik-Romanova, rev. in *Chem. Abs. Am. Chem. Soc.*, **19**, p. 3186; 1925), and as fine drops suspended in oil to - 20° (M. L. Dufour, *Arch. Sci. Geneva*, **10**, p. 350; 1861), but no information is given as to the physical state at these temperatures.

Two observations may be cited which are difficult to fit in with the result obtained by Beilby. Crystallisation of super-cooled water may be prevented either by keeping it perfectly still or by rapid movement, and R. Pictet cooled water to - 19° by subjecting it to constant agitation (*Arch. Sci. Geneva*, **1**, p. 498; 1878). Mousson found that a copper rod passed through a column of ice when it was under the melting pressure at - 18° (*Pogg. Ann.*, **105**, pp. 161-174; 1858). Thus, if water becomes glassy at - 12°, we have the surprising result that vitrification can be prevented by movement of the liquid, and that under great pressure the glass is liquefied.

By the kindness of the Union Cold Storage Company, observations were made at their Cannon Street stores in a chamber the temperature of which was on one occasion - 17° and on another - 22°. Drops of water at + 15° were chilled by contact with a glass slide. The larger drops crystallised to form negative spherulites, but smaller ones averaging 1 mm. to 2 mm. in diameter remained isotropic. When a steel point was brought sharply down on to the drops, they crystallised with an audible click: the point did not penetrate the drops and the inference is that they were hard. The possibility must be considered, however, that the velocity of crystallisation is so great that it is ice which is being tested and not water. Walton and Judd have found that the linear velocity of crystallisation increases with super-cooling and is 11·4 cm. per sec. at - 9°. They were unable to determine the temperature and value of the maximum velocity owing to the spontaneous crystallisation which occurred below - 9° (*Jour. Phys. Chem.*, **18**, p. 722-728; 1914).

Apart from its intrinsic interest, definite knowledge of the physical state of water would be valuable in the application to ice of those theories of solid structure and flow which are based on the conception of a liquid cement binding the grains of the aggregate together, and on the production of liquid at the surfaces of slip. The subject is also of interest in view of the fact long known and recently so conclusively demonstrated by Köhler ("Untersuchungen über die Elemente des Nebels und der Wolken", *Akad. Abhandl.*, Stockholm, 1925) that clouds at temperatures down to - 28° (at least) are composed of water drops. It may be noted here that the deposit on the cooling pipes at the Cannon Street stores was found to be a mixture of water drops and ice—this at - 22°. Direct passage from the vapour to the vitreous state has been obtained in other substances than water, and sudden vitrification with falling temperature would be in accordance with the general behaviour of super-cooled liquids. E. Berger has directed attention to the similarity between the glasses and water, in that with super-cooling a relatively rapid increase of viscosity takes place (*Glastechn. Ber.*, **5**, pp. 399-400; 1927).

That vitrification should be prevented by movement or pressure, however, is so anomalous as to call for further examination. I have no opportunity to pursue this work, but it is to be hoped that a careful study of the properties of water below - 10° will be undertaken; the investigation could be most conveniently carried out where low winter atmospheric temperatures are experienced.

LEONARD HAWKES.
Bedford College,
Regent's Park, N.W.1,
July 6.

Occurrence of Sea Urchins on the Foreshore in Britain.

IN the latest number of the *Journal of the Marine Biological Association* (vol. 16, 1, p. 289), Dr. J. H. Orton discusses the occurrence of the common sea urchin, *Echinus esculentus*, on the foreshore. In view of the fact that, in comparison with Plymouth, these animals can frequently be picked up at low tide at Millport and the Island of Skye, it may be of interest to put on record some observations made by me in August 1923 at Fetlar, in the Shetland Islands, especially as this island, lying in lat. 60° 35′ N., is some 3° farther north than Skye, from which records by Dr. Lebour are quoted by Dr. Orton.

The shore at Fetlar is for the most part very rocky and often precipitous, sometimes with pinnacles jutting out of the water. I can remember picking up *E. esculentus* between tidemarks on several occasions in the big sheltered bay, called Tresta Wick, on the south side of the island. Others were obtained from the sides of the rocky pinnacles just below the water level, while one was found on the side of the stone steps of the private landing stage. All were apparently normal and active, and of a large size. So far as my recollection goes, I do not think they were discovered at any period of exceptionally low spring tides.

The temperature of the water was decidedly low, and though I have no exact figures (which could probably be obtained from the Meteorological Station at Lerwick), I can vouch for the fact that the water was sufficiently cold to make shore collecting with bare feet a distinctly painful process. During the last few days of my stay, the Shetlands were swept by a terrific gale accompanied by very high seas, as the result of which no more sea urchins could be found. Presumably they had either been dislodged by the waves or had migrated to deeper water for safety.

The fact that the occurrence of *E. esculentus* on the foreshore appears to be more common in the northerly parts of the British Isles than in the south would seem to emphasise, as Dr. Orton points out, a direct correlation between the temperature of the water and the life of the animal.

C. C. HENTSCHEL.
Biology Department,
St. Bartholomew's Hospital and College,
London, E.C.1, June 8.

IN the *Jour. Marine Biol. Assoc.*, vol. 16, No. 1, May 1929, Dr. J. H. Orton asks for information regarding the occurrence of *Echinus esculentus* above low water mark on the British coasts. On the north coast of Scotland I have observed this species at different times of the year. Between April 8 and 16 of this year, *E. esculentus* was quite plentiful above low water mark on the rocky shores of the west side of Loch Eireboll, more especially in the numerous bays and inlets around Rispond, the organisms having frequently become stranded in the rock crevices as the tide fell. During August and September, on the other hand, this species is not quite so abundant, although on many occasions I have captured specimens with a landing-net as they retreated down the rocks with the ebbing tide.

I cannot find any reference in my notes to the occurrence of *E. esculentus* on the limestone headland of Heilim on the east side of the loch. This is peculiar because, since the headland is of much eroded limestone affording a fine habitat for a multitude of organisms, I have examined it frequently during low water spring tides.

This would suggest that the nature of the rock—its physical nature or its chemical composition—might be a possible factor affecting the occurrence of *E. esculentus*. This point is being further investigated.

DOUGLAS M. REID.

Science Schools, Harrow-on-the-Hill,
Middlesex, June 25.

Dinosaurian and Mammalian Remains in South India.

MY attention has been directed to an article on "Geological Exploration in India—Dinosaur Remains Unearthed" contributed by Dr. Matley to the *Records* of the Indian Geological Survey, 1929, in which he refers to a preliminary note on the fossil finds from Ariyalur—Trichinopoly Cretaceous area—published by Mr. B. R. Seshachar and myself in the *Mysore University Journal* (vol. 1, No. 2, July 1927). He writes that this party (zoology students) has been "fortunate in finding a number of dinosaurian bones including a vertebra, ilium, scapula, coracoid, head of a humerus, a tooth with a portion of the dentary, and limb bones,

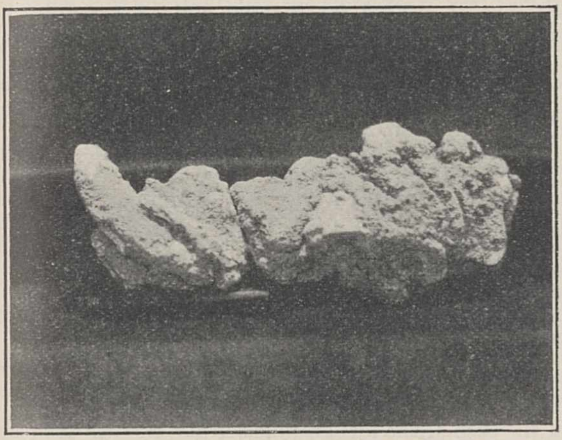

FIG. 1.—Fossil mandible of a carnivore taken in the Ariyalur area.

mostly in a broken condition. This discovery is of importance, as it is the first time that Southern India has yielded identifiable remains of dinosaurs." In the article referred to by Dr. Matley, there is a brief description of the humerus and carpal nodules and a broken amphicœlous vertebra of an ichthyosaurian, besides the ungulate remains of molar teeth of both perisso- and artiodactyles.

A detailed treatment of this interesting collection was deferred with the view of exploring the region more thoroughly, so as to obtain more evidence of the occurrence of the reptilian and mammalian fossils in the Trichinopoly area. In an expedition conducted to this place in December last, we have, in spite of the unfavourable weather conditions prevailing at the time, been fortunate in obtaining some more fossils. Among them we found a portion of a carnivore mandible with the teeth beautifully preserved, a large number of molar teeth of artiodactyles, together with tarsal, metatarsal, and phalangeal bones, humerus and femur, tibia, radius and ulna, scapula and broken specimens of vertebra of both carnivores and ungulates. Our collection is by no means exhaustive, but is sufficient to establish the occurrence of both reptilian and mammalian fossils in the area. I do not propose to deal with the material in this communication, which is merely intended to notify the discovery of an extremely interesting series of fossils in South India, nor do I propose to discuss here the probable theories which have been put forward to account for such occurrence. The photograph of the mandible reproduced as Fig. 1 will give an idea of the condition in which the fossils occur in the Cretaceous area of South India. A detailed description of the material will appear soon elsewhere.

C. R. NARAYAN RAO.

Central College, University of Mysore,
Bangalore, June 12.

Natural Ionising Radiation and Rate of Mutation.

ABOUT a year ago there appeared in these columns a communication by A. R. Olson and G. N. Lewis on natural radioactivity and the origin of species (NATURE, April 28, 1928, p. 673), in which it was suggested that the natural ionising radiation of the earth plays an important part in evolution. It was pointed out that the relative effects of rays of different frequency upon the production of variants have not been experimentally ascertained, but that since the rays can only be effective when absorbed, and thus produce ionisation, it seems safe to assume that the various rays will produce biological effects in proportion to the ionisation they cause.

It was our good fortune to discover a location in a street car tunnel in San Francisco, only 15 miles from Berkeley, where the natural ionising radiation is fully twice as great as the radiation in our laboratory in Berkeley. Accordingly, an experiment was planned for the purpose of comparing the rates of occurrence of sex-linked lethal mutations in *Drosophila melanogaster*, following a method already devised by Muller (*Genetics*, **13**, 279-357; 1928) and using a balanced lethal strain synthesised by him.

Up to the present, 5981 individual males have been tested in the first phase of the experiment. Of this number, 3481 tests were made in Berkeley, and 9, or 0·26 per cent, produced no male flies and so revealed the occurrence of new lethals, while 2500 tests were made in the tunnel, and of these 13, or 0·52 per cent, contained no male flies. The difference in rate, $0{\cdot}26 \pm 0{\cdot}11$, while only 2·5 times the probable error, may be fairly significant. When the difference in rate of mutation is computed by a method which analyses the actual experimental variation in rate in the several subgroups in each of the two series (Berkeley and San Francisco), the variation within the series is found to be less than that to be expected in random sampling, so that the significance of the difference between the average rates for the two locations is increased. This difference is $0{\cdot}275 \pm 0{\cdot}086$.

It seems fairly safe to assume, therefore, that the same difference in rate of mutation will continue throughout the remainder of the experiment, in the second phase of which an X-chromosome from a normal wild type strain is being tested in alternate generations. This not only doubles the scope of the experiment but also makes it possible to test such lethals as occur in this new chromosome, which it is impossible to accomplish when working with the balanced lethal strain alone.

Even now, however, it seems fairly safe to conclude that the natural ionising radiation of the earth is a very important factor controlling the rate at which new inherited characters originate in animals and plants. While it may not be inferred from existing evidence that such radiation is the direct cause of mutation, yet a way is now open by which this question can be attacked experimentally. It is our intention to conduct a second experiment which will approximate fairly closely to the requirements of a crucial test of this important question.

E. B. BABCOCK.
J. L. COLLINS.

College of Agriculture,
University of California,
Berkeley, California.

Mammalian Life in High Latitudes.

How far seals and whales migrate north in the summer months is a moot question, but the following facts suggest that the latitude reached in the case of the floe-seal, the narwhal, and the Greenland whale is a high one.

The occurrence is recorded, in log-books of whaling vessels in my possession, that in the Greenland Sea, in lat. 80°—a situation in which, owing to the direction of the prevailing winds, the ice is usually drifting south—in May of numbers of floe-seals—seals which, as Stefansson explains in his "Friendly Arctic", are tied to sheets of ice, of moderate thickness, the product of a single winter's frost, which therefore must have drifted south from a higher latitude during the winter and early spring. For example, on May 27, 1887, lat. 79° 58′ N., long. 3° E., "got into a Floe-water; some Narwhals and many floe-seals".

The occurrence is also recorded in my father's log-books, that in the Greenland Sea, in lat. 80°, in May, large numbers of narwhals were often seen going north-east and in the direction of the high latitude in which the observers in the *Fram* saw them. Example, May 28, 1887, lat. 80° N., long. 2° E., "Numbers of Narwhales passed us during the night; all going north-east".

The Greenland whales, with the exception of a few old ones, mostly males, which in some seasons were seen off the Greenland coast in the summer months, deserted the waters between Greenland and Spitsbergen in June (in late seasons, not until July) and were not seen again by the whalers until the following spring. As Scoresby says: "It has often happened that not a single whale has been seen by any individual belonging to the whole Greenland fleet after perhaps the middle of June". They disappeared going north-west, but how far they went in that direction the whalers, being unable to follow them, never knew. Example, July 7, 1876, lat. 78° 40′ N., long. 2° W., "Saw a whale . . .; whale (the last one seen that season) making much headway to north-west".

The Greenland whale appears also to make the Arctic Ocean its usual breeding place; the fully grown whales that Scoresby speaks of seeing in latitude 80°, in the spring, which disappeared by the end of April, might quite well have been pregnant females on their way to produce their young in the Arctic Ocean. As mentioned in my letter on the "Breeding Habits of the Greenland Whale" (NATURE, April 13, 1929), Greenland whales were seldom seen in the Greenland Sea with calves with them, and then usually in the spring, in lat. 79° or 80°, on the confines of the Arctic Ocean. That they did have calves was proved beyond a doubt, as my father says, by the numbers of young whales that were frequently seen.

It seems also worth while pointing out that each of the Greenland whale's haunts communicates with the Arctic Ocean and that they migrate towards it in the spring: the whales of the Bering Sea going north through the strait of the same name, those of the Greenland Sea north through the strait between Greenland and Spitsbergen, and those of Davis Strait and Baffin Bay west through Lancaster Sound, etc. Lastly, in the Antarctic, where there is no polar ocean to which it can retreat in the summer months, it is absent.

ROBERT W. GRAY.

8 Hartley Road,
Exmouth.

The Origin of Alphabets.

THE mouth gesture theory of human speech—of which a summary appeared in NATURE of Feb. 23, p. 281—has just received a further extension which may be of anthropological and psychological interest.

The basis of the main theory was:

(1) That man naturally and unconsciously tends to express his ideas in pantomime.

(2) That there is a natural and unconscious sympathy between bodily gesture—more particularly hand gestures—and movements of the mouth and tongue.

In this way, it was suggested, the primitive pantomimic code of human expression became associated with a related code of unconscious mouth gestures which resulted in the production of the various speech sounds, and their use in the form of language.

Let us consider what might be expected to happen when—after a million years or so of speech development—man began to feel the need of a method of recording his speech. It is obvious he could not attempt to record its sounds, and *ex hypothesi* he could not directly record its gestures, for he was unconscious of them. Under these conditions it seems likely that the original sympathy between hand and mouth became once more operative, but in the reverse direction.

Man's mouth, by this time, had established a well-defined code of gestures by which his ideas could be expressed. His hand was now searching for a new form of symbolism by which to record his speech. This symbolism was one of hand gestures, which were made to leave their track on the surface of stone or bark or plastic clay; these were (still unconsciously) inspired by the mouth gestures for which they stood.

Human writing admittedly derives originally from pictographs, that is, hand gestures which outline the form of the object or motion described, but except in the case of the ideographic scripts, such as Chinese, the development of writing has tended to be largely phonetic—either syllabic or alphabetic. In other words, the system has tended to be one of hand gestures which symbolise mouth gestures.

Granting that the words for natural objects would most simply be recorded by outlining the objects themselves, as in pictography, there must have been an early need for a method of recording speech sounds *per se*. I have recently found definite evidence that in Sumerian, and still more in Greco-Roman writing, the symbolism depended largely on the principle of unconscious imitation of mouth gestures.

Thus, in the case of the Greek alphabet:

B represents an outline of the two lips of a head facing to the right; Θ is a front view of a mouth showing the tongue between the teeth; Δ is a view of the tongue raised to the palate, as in articulating the consonant D; Λ is a similar gesture, but made more lightly.

Mr. H. B. Walters, of the British Museum, whom I have consulted on the matter, agrees that nearly all the letters of the Greek alphabet show influence of mouth gestures. I may add that more than twenty of the letters of our own alphabet still show the same influence.

The evidence on which the theory rests will be published elsewhere. R. A. S. Paget.

1 Devonshire Terrace,
Lancaster Gate, W.2,
July 16.

Natural History and Folk-Lore.

Dr. W. Maldwyn Davies's reference (Nature, July 13, p. 55) to 'gwas-y-neidr'—the Cymric equivalent of 'ether's mon'—as the name for a dragonfly reminds me that 'gwas-y-neidr' is a not unusual folk-name for the yellow-hammer, although perhaps the bird is more often called 'pen-felen' (= yellow-head). In 1914 I was at Nevin, Carnarvonshire, where a man, about forty-five years of age, asked me if I thought that the 'gwas-y-neidr' was really poisonous. He went on to explain that as boys his companions and he always smashed the eggs of the yellow-hammer if they found a nest, and that when in winter they caught small birds in his father's farm-yard, the yellow-hammers were always killed with a stick, as it was considered dangerous to touch them with a naked hand. The birds had been hatched from eggs laid by adders and the serpentine markings on the eggs in the yellow-hammers' nests were evidence of their reptilian origin; markings which elsewhere have earned for the yellow-hammer the less sinister names of 'writing master' and 'scribbling lark'.

What was substantially the same story was told by peasants and fishermen in other places in Lleyn, and since then I have met with 'gwas-y-neidr' in other parts of Wales, the bird always being associated, to its detriment, with the adder. At St. David's and at Fishguard, Pembrokeshire, the adder is by some reputed to go into the nest of the 'gwas-y-neidr'; others say that the bird carries food to the adder; and one man told me that he always destroyed the eggs in order to save them from the adder. At Newcastle Emlyn, Carmarthenshire, the 'gwas-y-neidr' is said to warn the adder by its notes of the approach of an enemy.

Dr. Davies cites 'gwas-y-gog' as a Welsh name for the hedge-sparrow. Personally, I have never heard it applied to that bird, but it is a common folk-name for the meadow-pipit, the most frequent fosterer of the cuckoo (gog) on the Welsh moorlands, where the feeding of a young cuckoo by meadow-pipits is a familiar sight in July and August. The name is a singularly apt one, by reason of the unwearying ministrations of the duped pipits which are evoked by the peremptory and incessant hunger-cries of the cuckoo.

Chas. Oldham.

The Bollin, Shrublands Road,
Berkhamsted, July 23.

In reference to Dr. R. J. Tillyard's letter in Nature of June 1 and succeeding letters in the issues of June 15 and July 13, concerning the dragonfly's being called the 'ether's mon' or 'adder's servant', I may add that in the coal-field districts of South Wales, when I was a boy, we used to call the dragonfly the 'gwas-y-neidr', or 'servant of the snake', and the tradition was that where the dragonfly was seen above the grass, the snake would be found below.

Obviously this would be a likely event if the 'nader' (snake) were the common grass snake, which like the dragonfly frequents marshy meadows and the water-side, but if 'nader' is translated 'adder' or 'viper' in the modern scientific sense, the association of fly and snake would be accidental at best.

The fact that the tradition exists in the rather isolated valleys of the Welsh mountains and in the Welsh language in precisely the form given by Dr. Tillyard in English, suggests that the legend may be of very ancient origin. L. Rowland.

Second Spark Spectrum of Selenium (Se^{++}).

The spectrum of selenium obtained by the condensed discharge is much more complicated than that of sulphur under the same condition of excitation. Of the existing data on the subject, Misserschmitt's list of lines given in vol. 6 of "Handbuch der Spectroscopie" by Kayser and Runge appears to be fairly complete, but the abundance of lines in his list and inaccurate values of their intensities were rather perplexing. Bloch's recent record of a few Se^{++} and Se^{+++} lines (*Comptes rendus*, T. 183, p. 762), and the photographs obtained in this laboratory with a prism spectrograph and a ten-foot concave grating under varying conditions of excitation, have been found to be promising in sorting out lines of Se^{+}.

Taking the structure diagram of Se^{++}, the possible transitions are

$$2N_2 \begin{array}{l} \swarrow N_2N_3 \\ \nwarrow N_2O_1 \end{array} \quad \longleftarrow N_2O_2 \begin{array}{l} \swarrow N_2O_3 \\ \nwarrow N_2P_1 \end{array}$$

By the application of the extension of the irregular doublet law given by Saha and Kichlu combined with the method of horizontal comparison described by Saha and Majumdar, *PD*, *PP*, and *PS* groups of $N_2O_1 \longleftarrow N_2O_2$ were located graphically at 24000, 28000, and 28400 respectively.

Leading lines of these multiplets in the same transition are:

$$^3P_2 - {}^3D_3 = 23979 \quad (\lambda = 4169{\cdot}16)$$
$$^3P_2 - {}^3P_2 = 27482{\cdot}6 \quad (\lambda = 3639{\cdot}6)$$
$$^3P_2 - {}^3S_1 = 28210{\cdot}0 \quad (\lambda = 3643{\cdot}8),$$

the term differences being

$$\Delta P_{01} = 450, \ \Delta P_{12} = 949, \ \Delta D_{12} = 187, \ \Delta D_{23} = 446.$$

A full description of this analysis will appear along with that of Se^{+}. D. K. Bhattacharjya.

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June 19.

Spectrum of Doubly Ionised Arsenic.

The deepest term of the separation of doubly ionised arsenic (As III) is $4p\ {}^2P_1$. The values of these doublet terms relative to ^2G were reported in a recent paper (*Ind. J. Phy.*, 5, 3, p. 3) to be 220, 221 cm.$^{-1}$. It was found in the course of this work that a number of lines that could be attributed to doubly ionised arsenic remained unclassified. The spectrum has been further investigated. About forty-five of these unclassified lines have entered into quartet systems, the terms identified being:

$5s'\ {}^4P$; $5p'$ (^4P, ^4S, and ^4D) and $5d'$ (^4D and ^4F).

It is found that

$5s'$, ^4P	separations are	2133 and	1062
$5p'$, ^4P	,, ,,	1324 and	737
^4D	,, ,,	1429 and	793 and 432
and $5d'$, ^4D	,, ,,	1283	749 and 367
and ^4F	,, ,,	850	367 and 124.

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Decay Problems in Mathematical Physics.

CONSIDER a quantity u, satisfying the equation :

$$L(u) = \rho\frac{\partial^2 u}{\partial t^2} + w\frac{\partial u}{\partial t}, \quad . \quad . \quad . \quad . \quad (1)$$

in a closed finite space, with any homogeneous boundary condition at the boundary of the aforesaid space.

Here L is a linear differential operator of the second order, extending to any number of dimensions ; for example, for three dimensions :

$$L(u) \equiv \frac{\partial}{\partial x}\left(p\frac{u}{\partial x}\right) + \frac{\partial}{\partial y}\left(p\frac{\partial u}{\partial y}\right) + \frac{\partial}{\partial t}\left(p\frac{\partial u}{\partial t}\right) - qu,$$

whereas ρ and w are finite and positive functions of the independent variables entering in L.

Then the following theorem has been proved : If a system at rest, the free motion of which is described by (1), is acted on by an oscillatory force of frequency large with respect to the lowest natural frequency of the system, until the stationary state is reached, the time of increase is directly proportional to the whole absorption and indirectly proportional to the volume, but independent of the shape of the system and of the places of the experimenter and the force. If the force, after the stationary state is reached, stops abruptly, the time of decay obeys the same law. Moreover, the increase is complementary to the decay, the sum of the amplitudes at a time t, measured from the moment the force starts in one case and from the moment the force stops in the other, being constant and independent of t.

This theorem may immediately be applied to the theory of electromagnetic radiation in closed spaces and to the acoustics of large rooms. In both cases it gives the time required by the system to reach the stationary state after a change of the radiating forces.

It has been verified experimentally by W. Sabine in the acoustics of large rooms ("Collected Papers on Acoustics", p. 39), whilst experiments by Dr. Zwikker in this laboratory have shown that the complementary nature of increase and decay really exists.

An extension, comprising absorption w, which depends on the frequency, but in a bounded and for high frequencies slowly variable way, may easily be proved.

For details reference is made to a paper, entitled : "Über das Dämpfungsproblem der mathematischen Physik", which will be published in the *Mathematische Annalen* and to a paper entitled "On the Acoustics of Large Rooms", which will appear shortly in the *Phil. Mag.*

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Raman Effect in Gases and Liquids.

IN a note recently communicated to NATURE it was pointed out that the Raman effect in triatomic molecules having a linear model could be explained on the assumption of a fundamental mode of vibration along the line joining the three nuclei of the molecules. Such vibrations take place along the direction of propagation of the radiation and behave as optically inactive ones and are not manifested in the near infra-red bands. The case of carbon dioxide was discussed on this basis.

The Raman effect of liquid carbon disulphide has recently been studied in Sir C. V. Raman's laboratory, and it shows two prominent modified lines due to absorption of energy corresponding to infra-red wave lengths 12·5 μ and 15·27 μ (private communication), which have so far not been observed as absorption bands. This can now be explained on the supposition of an optically inactive frequency $\nu = 728$ cm.$^{-1}$ of $\lambda = 13{\cdot}73$ μ. The two lines being due to transitions $\Delta i = \pm 1$ of the molecule (*Nat. Research Council Bull.*, **57,** p. 62) from this fundamental vibrational state.

The observations of McLennan and McLeod (NATURE, Feb. 2, 1929) regarding the Raman effect in liquid oxygen, nitrogen, and hydrogen, showing the absorption of energy corresponding to values of $\nu = 1554$ cm.$^{-1}$, $\nu = 2335$ cm.$^{-1}$, and $\nu = 4149$ cm.$^{-1}$, also suggest that the nuclei of these homopolar molecules even in the liquid state execute vibrations under impressed radiation, though no bands in these regions have so far been observed. One may thus be led to imagine that nuclear vibrations occur along the direction of propagation of the radiation and are thus optically inactive so far as absorption is concerned. Dennison (*Astro. Jour.*, **62,** 1925) calculated the fundamental frequencies of the methane molecule from dynamic considerations, and out of the four fundamental frequencies, three have been identified in the absorption bands and it has been suggested that the fourth one at $\lambda = 6{\cdot}58$ μ is optically inactive. The presence of such an optically inactive vibration is also suggested from the work of Bennet and Meyer on the spectra of methyl halides (*Phys. Rev.*, **33,** 895 ; 1929). It will be worth while to study the Raman effect of this gas to ascertain from the modified lines the presence of this fundamental frequency suggested from dynamical considerations.

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The Raman Effect for X-rays.

IN a letter in NATURE of April 27, p. 642, we reported some experiments on the fine structure of the normal scattered molybdenum $K\alpha$-radiation. From our photometer curves it is clearly shown that the normal scattered molybdenum radiation from graphite has exactly the same structure as the direct radiation from a molybdenum target or, in other words, that no Raman effect exists. An analogous result was obtained by W. Ehrenberg (*Zeit. f. Physik*, **53,** 234 ; 1929) ; whereas B. Davis and D. P. Mitchell (*Phys. Rev.*, **32,** 331 ; 1928) obtained on the contrary a much more complicated structure in the case of the normal scattered radiation.

In the meantime the experiments were continued by D. P. Mitchell (*Phys. Rev.*, **33,** 871; 1929), and analogous results to those obtained with graphite are reported when beryllium and aluminium were used as scattering substances. Though for the moment we cannot explain the difference between Mitchell's results and our own, we should like to direct attention to the following fact : In the case of beryllium Mitchell finds an 'anti-Stokes line' which should be scattered by an atom in the excited L-state. Now a simple calculation shows that even when working with an energy so large as 3 kw., and such short distances as was done by Mitchell, much less than one beryllium atom in 10^{15} can be in the excited L-state. Hence it follows that it is quite impossible to account for the order of magnitude of the intensity of the anti-Stokes line quoted by Mitchell.

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Adaptation.[1]

By Prof. D. M. S. Watson, F.R.S.

The only great generalisation which has so far come from zoological studies is that of evolution—the conception that the whole variety of animal life, and the system of inter-relationships which exists between animals and their environment, both living and non-living, have arisen by gradual change from simpler or, at any rate, different conditions.

Evolution itself is accepted by zoologists not because it has been observed to occur or is supported by logically coherent arguments, but because it does fit all the facts of taxonomy, of palæontology, and of geographical distribution, and because no alternative explanation is credible.

Whilst the fact of evolution is accepted by every biologist, the mode in which it has occurred and the mechanism by which it has been brought about are still disputable. The only two ' theories of evolution ' which have gained any general currency, those of Lamarck and of Darwin, rest on a most insecure basis ; the validity of the assumptions on which they rest has seldom been seriously examined, and they do not interest most of the younger zoologists. It is because I feel that recent advances in zoology have made possible a real investigation of these postulates that I am devoting my address to them.

Both Lamarck and Darwin based their theories on the assumption that every structure in an animal had a definite use in the animal's daily life or at some stage of its life history. They understood by adaptation a change in the structure, and by implication also in the habits of an animal, which rendered it better fitted to its " organic or inorganic conditions of life ". Thus, for Darwin at any rate, a general increase in the efficiency of an animal was an adaptation. But amongst his followers the term came to imply a definite structural change of a part or parts by which an animal became better suited to some special and characteristic mode of life. The adaptation of flowers to ensure fertilisation by definite species of insects is a characteristic case. Such definite adaptations can only be shown to exist by very long continued observation of the animal under its natural conditions of life. In the post-Darwinian literature the suggestion that such and such a structure could be used for some definite function is too often regarded as evidence that in fact it is actually so used. My colleagues amongst the palæontologists are, I am afraid, offenders in this way.

Even if it can be shown that the structure of an animal is such that it is specially fitted for the life which it in fact pursues, it does not necessarily follow that this structure has arisen as a definite adaptation to such habits. It is always conceivable, and often probable, that after the structure had arisen casually, the animal possessing it was driven to the appropriate mode of life.

The only cases in which we can be certain that adaptation in this true sense has occurred are those, unfortunately rare, in which we can trace in fossil material the history of a phylogenetic series, and at the same time establish that throughout the period of development of the adaptation its members lived under similar conditions.

It is not unusual for a student of fossils to discuss the habits of an extinct animal on the basis of a structural resemblance of its ' adaptive features ' to those of a living animal and then to pass on to make use of his conclusions as if they were facts in the discussion of an evolutionary history or of the mode of origin of a series of sediments.

In extreme cases such evidence may be absolutely reliable : no man faced with an ichthyosaur so perfectly preserved that the outlines of its fins are visible can possibly doubt that it is an aquatic animal, and such a conclusion based on structure is supported by the entire absence of ichthyosaurs in continental deposits of appropriate ages and their abundance in marine beds. But if extremes give good evidence, ordinary cases are always disputable. For example, there is, so far as I know, not the least evidence in the post-cranial skeleton that the hippopotamus is aquatic : its limbs show no swimming modification whatsoever, and the dorsal position of the eyes would be a small point on which to base assumptions.

Most palæontologists believe that the dentition of a mammal, and by inference also that of a reptile or fish, is highly adaptive, that its character will be closely correlated with the animal's food, and that from it the habits of an extinct animal can be inferred with safety.

Here again the extreme cases are justified ; the flesh-eating teeth of a cat and the grinding battery of the horse are clearly related to diet. Crushing dentitions, with the modification of skull and jaw shape and of musculature which go with them, seem equally characteristic. I had always believed that the horny plates and the jaws of the platypus were adapted to hard food, and that that animal possessed them, whilst the closely allied *Echidna* was toothless, because it was aquatic and lived in rivers which might be expected to have a rich molluscan fauna that could serve as food. But the half-dozen specimens the stomachs of which I have opened contained no molluscs whatsoever, and seem to have fed on insect larvæ, the ordinary soft bottom fauna of a stream. I do not know whether this is an accidental occurrence, dependent on a special abundance of insects in the Fish River in late spring, or whether it really represents the normal food. Nothing but continued observations made throughout the year can justify any statements about this case.

In the face of this uncertainty, can we make use of the character of the dentition of fossil vertebrates for the determination of the nature of their food, and thus by building up phylogenetic series investigate the gradual development both of habit and their adaptation ? One without the other is valueless. The classical case of the horse is, of course,

[1] From the presidential address to Section D (Zoology) of the British Association, delivered at Johannesburg on Aug. 2.

familiar to everyone. From the time of Huxley the story of the gradual increase in depth of crown of the molar teeth and in the complexity of the pattern formed by the worn edge of the enamel which coats the cusps of the molars has been held to show a steady improvement in mechanism which enabled the Equidæ to take advantage of a wide extension of grass land which was assumed to have occurred in Miocene times.

This assumption in its ordinary form, however, rests on the basis of an inadequate analysis of all the factors involved. The modern horses are bigger than those of the Eocene: an ordinary hackney weighs about fifty times as much as *Eohippus venticolus*. Thus, the modern horse will wear away in a day fifty times as much tooth as its ancestor; but the surface area of its cheek teeth is only about fifteen times as great, so that without a deepening of the tooth crown by three and a third times it would have a shorter life. Actually the crown is deepened about thirteen times, so that its potential longevity is increased to about four times that of *Eohippus* on the assumption that the abrasive qualities of the food of the two animals have not changed: Dr. Matthew has produced evidence to show that in *Merychippus*, the Miocene genus of horse, tooth change took place at a younger age than it does in modern horses; the implication being that the potential longevity was less than it now is.

Thus the fact that *Equus* has proportionately some four times as much tooth as *Eohippus* may mean no more than that it lives longer, and its marvellous dentition may not be adaptive in the sense that it is specially modified for the trituration of a new type of food. It may represent no more than a reaction to the requirements of a large animal. I believe that most adaptations the history of which can be traced in fossil material are of a similar kind.

Whether a change which enables a mammal to become larger and to have a greater potential longevity is an adaptation may be disputed. Certainly it is very different from the usual conception of a structural change fitting an animal for a definite type of life in particular circumstances.

There are, however, a few cases where we are, I think, on firmer ground. The slow and steady improvements in limb structure which go on in the mammal-like reptiles from Lower Permian to Lower Triassic times take place in animals which do not exhibit a steady increase in size, which indeed cover nearly the same range of sizes at the beginning and end of the story.

In the earliest of these animals the upper arm projected at right angles to the body, and the forearm lay at right angles to it, nearly parallel to the ground. The track was very wide, the stride absurdly short, and only one foot could be moved at a time, whilst some of the muscles were devoted entirely to the support of the weight of the body, leaving the whole propulsive force to be supplied by the remainder, or rather by such of them as were not concerned with returning the limb to the position it occupied at the beginning of the stride. From these slow and clumsy ancestors we may trace the gradual acquirement of the structure found in *Cynognathus* or in a mammal; where the arm moves nearly parallel to the principal plane of the animal, the stride is greatly lengthened and every muscle contributes both to the support of the body and to its propulsion. Here we have a case where we can observe an improvement of an animal mechanism which definitely enabled an animal to move faster than its ancestor.

Such general improvements in the mechanism of an animal's body, which are the only adaptations which can be proved to have occurred, differ so greatly in scale and in their general nature from that detailed fitting of an animal to some particular niche in its environment which Darwin believed to occur, that it is important to investigate whether there is any general occurrence of such special relationship of structure and habit, and whether if it occurs it is rightly to be regarded as of adaptive origin. It is, I believe, in the first part of such investigation that a good deal of the future value of physiological work in zoology lies.

The physiological work which is at present being conducted by zoologists falls under two main heads. It may be concerned with the explanation in physico-chemical terms of definite life processes, such as fertilisation or cleavage, the activities of cilia or the nature of muscular activity. Such work is of value to zoology because it increases our knowledge of the cell and all its parts and of the things which may control its activities. It will become essential for an understanding of the factors which underlie morphogenesis, that is, of those factors some of which are carried as material bodies in the chromosomes.

The other type of physiological work is that which, like the classical 'experimental physiology' of the medical school, is devoted to an attempt to understand the functioning of the different systems of organs and ultimately of the whole body of an animal. I believe that such studies hold out the greatest promise of results of any in zoology. We do not know even as a first approximate the mode of working of the body of any one member of the majority of the phyla of the animal kingdom. Until such is known, in at least a few individual species of each phylum, we shall not be in a position to understand the possibilities of adaptation which each fundamental type of morphology holds out and the real significance of the fitting of an animal to its environment.

The ecological relationships of animals to their environments present many aspects which are now capable of investigation by simple physiological experiment, and South Africa seems to me the country of all others which could provide the subjects for such an investigation.

Physiological work of the kind which I suggest, although it will show to what extent there are variations between races and species of animals which fit them specially for life under definite physical environments, will not in general elucidate those morphological differences which alone are recognisable in a museum, and have commonly been assumed to be of an adaptive nature. That these structural differences are adaptive even in the sense that, no matter in what circumstances they arose, they do now in fact fit each form especially to its circumstances, is for the most part pure assumption. I do not know a single case in which it has been shown that the differences which separate two races of a mammalian species from one another have the slightest adaptive significance.

There is no branch of zoology in which assumption has played a greater, or evidence a less, part than in the study of such presumed adaptations. The implication which lies behind any statement that such and such a structure is an adaptation is that under the existing environmental conditions an individual possessing it has a greater chance of survival than one which has not.

The extraordinary lack of evidence to show that the incidence of death under natural conditions is controlled by small differences of the kind which separate species from one another or, what is the same thing from an observational point of view, by physiological differences correlated with such structural features, renders it difficult to appeal to natural selection as the main or indeed an important factor in bringing about the evolutionary changes which we know to have occurred. It may be important, it may indeed be the principle which overrides all others ; but at present its real existence as a phenomenon rests on an extremely slender basis.

The extreme difficulty of obtaining the necessary data for any quantitative estimation of the efficiency of natural selection makes it seem probable that this theory will be re-established, if it be so, by the collapse of alternative explanations which are more easily attacked by observation and experiment. If so, it will present a parallel to the theory of evolution itself, a theory universally accepted not because it can be proved by logically coherent evidence to be true but because the only alternative, special creation, is clearly incredible.

The alternative explanations which are put forward of the existence of the differences which separate species from species or one geographical race from another are in essence three : either the difference is regarded as adaptive and its initiation and perfectioning are attributed to a reaction of the animal which alters its structure in a favourable manner followed by an inheritance of the character so acquired ; or, secondly, it is regarded as non-adaptive, or only accidentally of value, and held to have arisen by a change induced in the course of an individual development by the direct effect of some one or more environmental features, such change not necessarily being heritable in all cases. The third explanation is that the difference between one form and the other has arisen casually, isolation having enforced an inbreeding which led to the distribution of genes in different proportions in the two stocks.

The first alternative explanation suffers from the defect that the characters in question have not in general been shown to be adaptive, and that an inheritance of an acquired character of the kind required has not been shown to occur.

The second explanation, the direct influence of the environment, has the immense advantage that it is open to investigation by experimental methods, and suggests many attractive lines of work. Here again experiments have been few. The most successful is that on the induction of melanism in moths by Heslop Harrison and Garrett. By feeding caterpillars on food impregnated by salts of manganese or lead, these authors, in three independent series of experiments, obtained melanic individuals of a character which did not occur in the much larger numbers of controls fed on untreated food, nor under natural conditions in the district of origin of the parent individuals.

Harrison and Garrett attribute the melanism which appeared under these conditions to the direct effect of the metallic salts, either on the soma or, as is perhaps more probable, on the germ cells. They showed by a very adequate series of breeding experiments that the melanism which arose in this way is inherited as a simple Mendelian recessive.

It is obvious that such a direct environment effect, when taken in association with the completely established fact of the common occurrence of parallel or identical mutations in allied animals, provides a complete formal explanation of such facts as that the coat-colour of a race of a species of rodent from an arid region will in general be lighter in colour than that of a race from a more humid and therefore more thickly vegetated area. It is clear that such an explanation does not require that the coat-colour has any adaptive significance whatsoever : it is in complete contrast with the equally formally complete explanation by natural selection. But it has the advantage that it can be submitted to experimental confirmation.

The neo-Darwinian would explain this occurrence by assuming that the dark-coloured forms were less visible against the moist and therefore darker soil of the humid locality than lighter animals would be, and would thus escape the attacks of carnivores for a longer period. The light forms would escape notice under the bright illumination and glitter of an arid and especially a desert country. Such a view assumes without question that the colour of the two groups is heritable, though it makes no demands for any particular type of heredity.

The only experiments which have been made with geographical races of mammals are those which Sumner has carried on over many years. Sumner began his work by collecting considerable numbers of individuals of a certain species of the deer-footed mouse *Peromyscus* from localities in California which present extreme variations in rainfall and temperature. He showed that the mice from each locality varied, and that the distribution of the variates for each character formed a unimodal curve. He investigated by statistical methods the correlation between pairs of the characters with which he worked, showing that for many of them the correlation was small. He showed that the curves for different subspecies might overlap, so that no one individual could fairly represent its race.

Sumner also attempted to investigate the possibility of such environmental influences by direct experiment. He transplanted a small colony of mice into a very different environment, enclosing them in a small netted area and leaving them to breed. The offspring which appeared during the course of the experiment showed no tendency to approach the local races in their characters.

It may be accepted as a working hypothesis that the variable characters which separate one geographical race from another are produced under the influence of a number of genes, all independent, and all producing similar effects. As Prof. Karl Pearson pointed out in 1904, the effect of such multiple factors will be to produce an apparent blending inheritance ; a view now very generally accepted. It follows that, in certain cases at any rate, if a small group of individuals phenotypically similar, though genotypically different, differing from the norm of a population, be isolated and left to breed freely, they will, when considered as a population, tend to vary still more from the original mode in the population from which they sprang and that they will do so in the direction in which the original isolated group differed. Prof. Pearson has reached the same conclusion from his own very different point of view and has evidence that the expected result does actually occur.

If, then, we can conceive of circumstances which will bring about such isolation in such a way that the individuals so separated are determined by an environmental condition, we shall have an explanation of the divergence of local races which will account for the appearance in them of individuals which lie outside the range of variation actually observed in the small samples of the parent races which have been investigated.

There remains one type of adaptation which is perhaps of greater importance than those which we have been considering. Perhaps the most striking of all the phenomena of life is the power which all animals and plants possess of so regulating their functioning, and when necessary their morphology, that their life is continued in equilibrium with the conditions under which they find themselves.

How far such physiological adaptations are of the same nature as those internal morphological adaptations which alter the relative sizes of parts in ways determined by geometrical considerations of squares and cubes, and produce analogous modifications in other structural features, there is no evidence. What is certain, however, is that these, which are the fundamental things in evolution, lie open to experiment.

Thus the present position of zoology is unsatisfactory. We know as surely as we ever shall that evolution has occurred ; but we do not know how this evolution has been brought about. The data which we have accumulated are inadequate, not in quantity but in their character, to allow us to determine which, if any, of the proposed explanations is a *vera causa*. But it appears that the experimental method rightly used will in the end give us, if not the solution of our problem, at least the power of analysing it and isolating the various factors which enter into it.

The Relation of Organic Chemistry to Biology.[1]

By Prof. GEORGE BARGER, F.R.S.

SINCE, in the last resort, we are dependent on naturally occurring materials, which scarcely ever occur in a state of purity, it follows that the early chemists were even more concerned with separating one substance from another than many of us are to-day. Progress was at first limited to mineral substances capable of withstanding powerful reagents and a high temperature ; much of the old chemistry is concerned with the heavy metals. The substances formed in such large numbers by living beings are much less stable, and their isolation demands a special technique. It is significant that, in spite of their knowledge of the smelting of ores, of the manufacture of glass, and of many other arts, the ancients failed to distil alcohol. Later, the chemical investigation of organic material was apt to consist in destructive distillation, naturally adding little to knowledge. Only the more volatile and stable substances could be isolated in this fashion.

An important systematic advance was made by K. W. Scheele (1742–1786), whose contributions to organic chemistry are almost as important as his discovery of oxygen. Scheele was a pharmacist, and most of the early chemists were trained as such, or as physicians, from the iatro-chemical period onwards. This old connexion between chemistry and medicine was, however, scarcely a biological one. Joseph Black's work on fixed air and the mild alkalis indeed originated in medicine, from his M.D. dissertation, " De humore acido a cibis orto et magnesia alba", but the subsequent developments of Black's work were not biological in character. Again, although Berzelius was trained as a physician, his work had little connexion with biology.

The use of vegetable drugs, however, led pharmacists to examine the constituents of plants, and thus the foundations of descriptive biochemistry were laid. Scheele investigated a number of organic acids in the wet way. He obtained tartaric acid in 1769, and later benzoic acid by boiling gum benzoin with lime. He first prepared lactic acid (1780) from sour milk, and mucic acid by oxidation of milk sugar. When, soon afterwards, mucic acid was also obtained from gum tragacanth, it became evident that one and the same substance may be derived from both animal and vegetable sources. Oxalic acid was obtained from the acid potassium salt in *Oxalis acetosella*, and shown to be identical with an oxidation product of cane sugar. Scheele also obtained citric, malic, and even gallic acid by crystallisation from solution. Of more general biological interest is his discovery of uric acid, of glycerol, and of hydrocyanic acid ; the last (acidum berolinense) by heating potassium ferrocyanide with dilute sulphuric acid.

[1] From the presidential address to Section B (Chemistry) of the British Association, delivered at Cape Town on July 23.

Scheele's discovery that esterification is greatly furthered by the presence of mineral acids later became important in connexion with catalysis, but theoretical speculations were foreign to his nature, and he was not greatly concerned with the essential character of acids. Such questions appealed more strongly to Lavoisier, who improved the nomenclature of organic acids and also investigated alcoholic fermentation, a biochemical process which early engaged the attention of chemists.

A knowledge of structure gave a great impetus to organic synthesis, not only in the laboratory for theoretical purposes, but also in the factory for practical uses; the manufacture of dyes, of synthetic drugs, of explosives became an important industry. The number of known carbon compounds grew at an enormous rate. Instead of being the chemistry of organised beings, organic chemistry became the chemistry of carbon compounds. Until the present century the proportion of chemists who, like Scheele, were interested in natural products steadily declined, and biology became of little interest to chemists as a whole, but physiologists have more and more realised the importance of chemistry for their subject and the intermediate subject of biochemistry has rapidly developed.

The systematic study of natural products, inaugurated by Scheele, was at first continued most successfully in France by Fourcroy, Vauquelin, and their pupils. Braconnet examined plants and discovered substances such as salicin and ellagic acid, of no particular importance to physiology, but also obtained glucose from cellulose (linen) and 'sucre de gélatine' or glycine from glue, thus making two fundamental observations in biochemistry. Kirchhoff, a German pharmacist, working at St. Petersburg, had already shown in 1811 that glucose is formed from starch, and investigated the process of malting. In 1833, Payen and Persoz discovered the first enzyme, diastase, and in 1827 a medical practitioner of London, W. Prout, better known to chemists in another connexion, could say in a paper "On the ultimate composition of simple alimentary substances" that they might be arranged in three classes, "the saccharine, the oily, and the albuminous".

By analysis Gay-Lussac was able to establish the fundamental equation for the fermentation of glucose into alcohol and carbon dioxide, and the first systematic advance in biochemistry, also due to analysis, was Chevreul's great work on the fats. In 1824, Wöhler obtained oxalic acid from cyanogen, the first synthesis of a vital product, if we except Scheele's production of cyanides from carbon, potassium carbonate, and ammonium chloride. Four years later, in 1828, Wöhler's synthesis of urea attracted universal attention, and since then much labour has been expended on the synthesis of vital products as an ultimate proof of their structure.

Wöhler had apparently no connexion with medicine or pharmacy, but Liebig was a pharmaceutical apprentice for one year, Frankland a druggist's assistant, Dumas, Schorlemmer, and even Wilhelmy, who investigated the kinetics of sugar hydrolysis, were pharmacists. Gmelin, Mitscherlich, Wurtz, and Cannizzaro studied medicine; even in the present century medically qualified professors of general chemistry survived (Crum Brown, Emerson Reynolds). The pharmacists soon found a special field of research in alkaloids, essential oils, and other products of the materia medica. Within a few years of the recognition of the first organic base, morphine, by the German pharmacist Sertürner, a dozen alkaloids had been discovered, mostly in France, by Pelletier and Caventou, professors at the École de Pharmacie. It is presumably due to this institution, and to the high standard of pharmaceutical education in France, that the scientific output of French pharmacists has been so long maintained. For recent times we may refer to Bourquelot, professor at the École de Pharmacie, and to Charles and Georges Tanret, father and son, both practical pharmacists, who not only made important contributions to our knowledge of drugs but also to that of sugars. In Germany contributions of pharmacists to organic chemistry were of less importance, compared with the great developments in university research inaugurated by Liebig and fostered by the German States.

In Britain the State did very little for the universities and nothing for pharmaceutical teaching; although British pharmacists have the exclusive legal right to call themselves 'chemists', the State has not helped them to justify the title. At first the British themselves contributed little to organic chemistry; of the pioneers Faraday, Frankland, Perkin, and Williamson, only two were teachers. The sojourn of Hofmann in London, from 1845 to 1865, from the age of twenty-seven to that of forty-seven, was of the greatest influence on the development of organic chemistry in England, but it did not lead to biological applications. Particularly through the inauguration of the dye industry, by Hofmann's pupil, Perkin, and Mansfield, attention was directed to practical problems.

As a result of Emil Fischer's work, the new science of biochemistry was firmly established in the beginning of the present century. It should not be supposed that organic chemical theory is wholly unconnected with biology. Two examples out of many will show the contrary. When a protein is 'racemised' so far as possible, by Kossel's method, by leaving it for some weeks at 37° in half-normal alkali, it is found that certain amino-acids retain their optical activity, and these Dakin has assumed to be the ones with free carboxyl groups, situated at the ends of chains. The others undergo racemisation probably because in their case tautomerism is possible:

$$\text{—CO . NH . CR'H . CO . NH . CR''H . COOH}$$
$$\uparrow\downarrow$$
$$\text{—CO . NH . CR' : COH . NH . CR''H . COOH.}$$

On subsequent acid hydrolysis the amino-acid $NH_2 . CR'H . COOH$ would be racemic, but $NH_2 . CR''H . COOH$ optically active. Dakin's views were first applied by Dudley and Woodman to show a structural difference between the caseinogens from cow's milk and sheep's milk, which had been considered by some to be identical.

Elementary analysis shows no difference, and individual amino-acids are obtained in the same amounts after hydrolysis. After racemisation, however, Dudley and Woodman found the tyrosine from cow's caseinogen to be wholly inactive, that from the sheep fully active. In the former animal the tyrosine is probably inside the molecule, in the latter it is on the periphery. We are thus able to discover differences in the intimate pattern of the molecule. Dakin and Dale connected these differences with antigenic specificity.

Crystallised albumins from the whites of hens' and ducks' eggs are very similar and seem to be composed of the same units in equal amounts, but Dakin found that three amino-acids, leucine, aspartic acid, and histidine, behave differently to alkali in the two molecules, and appear to occupy different places. Hen's albumin has some aspartic acid but no leucine or histidine on the periphery; duck's albumin, on the other hand, has no aspartic acid, but some leucine and histidine on the outside of the molecule. By the very sensitive anaphylactic reaction of the isolated guinea-pig's uterus, Dale showed that the two proteins are specifically different as antigens. Differences in arrangement, even of the same amino-acids, help to differentiate the proteins of various species. It is on the diversity of the proteins that the difference of species is based.

Another recent example of the application of organic chemical theory to biology is due to Stedman. Having traced the miotic action of physostigmine to a urethane grouping, he synthesised a number of urethanes of simple dimethylamino-phenols, for example, $R.NH.CO.O.C_6H_4.N(CH_3)_2$. The physiological activities of the tertiary bases is generally in the order ortho and para > meta, but on conversion into quarternary salts the ortho and para become less active, the meta more so, and the order is meta > ortho or para. This recalls the reactivities of disubstituted benzene derivatives, which have of late been studied in connexion with the polarity theory.

Whilst organic chemists are often eager to investigate the constitution of animal and vegetable substances, they are less ready to undertake the preliminaries of purification and isolation, and are therefore less apt to discover new ones. By esterification and by the use of a high vacuum, Emil Fischer made the monoamino-acids amenable to fractional distillation, a standard operation of organic chemistry. He discovered several new members of the group. But most substances of physiological interest require a special technique, on the development of which the biochemist may spend much labour. Thus Kossel showed how to separate the purine and pyrimidine bases of the cell nucleus, and the important diamino-acids histidine, arginine, and lysine. Hopkins, by his special reagent, was able to isolate tryptophane, the parent substance of indigo, long after indigo itself was being manufactured synthetically. Dakin found that monoamino-acids can be extracted from aqueous solution by butyl alcohol, and using this new technique and Foreman's method of separating aspartic and glutamic acids by their calcium salts, Dakin discovered hydroxyglutamic acid, an entirely unsuspected unit of protein.

A knowledge of the structure of amino-acids may throw light on how other nitrogenous constituents arise, particularly in plants. As an example the most recently discovered amino-acid may be quoted. The American bacteriologist Mueller found in casein and other proteins a new constituent containing sulphur, quite different from the well-known cystine. Dr. Coyne and I have recently established its constitution by synthesis. It turns out to be γ-methylthiol-α-amino-*n*-butyric acid, $CH_3 . S . CH_2 . CH(NH_2)COOH$, and we named it methionine. The methylthiol grouping at once indicates that it is the source of methylmercaptan, the occurrence of which in putrefaction was known, although not hitherto intelligible. Methionine is evidently also the parent substance of cheirolin occurring in the seeds of the wallflower and of other Cruciferæ. Schneider had long ago established for this substance the remarkable constitution $CH_3 . SO_2 . CH_2 . CH_2 . CH_2 . N . CS$. We now see at once that cheirolin is the thiocarbimide of oxidised and decarboxylated methionine. Similarly Perkin and Robinson connected the chemistry of harmine and harmaline with tryptophane when they showed that the mysterious base $C_{12}H_{10}N_2$, which Hopkins and Cole obtained by oxidising tryptophane, $C_{11}H_{12}O_2N_2$, with ferric chloride, is identical with harman. This observation not only settled the constitution of the alkaloids in question, but also explained the fitful yield of the oxidation product of tryptophane, which, after decarboxylation, had condensed with acetaldehyde.

Soon afterwards, Späth showed that harman itself occurs in Nature, as the alkaloid aribine, which had been given the erroneous formula $C_{23}H_{20}N_4$. It is becoming increasingly evident that many alkaloids arise by condensation of amino-acid residues. Mezcaline and other alkaloids of Cactaceæ are closely connected with phenylalanine and tyrosine, as Späth has shown, and the mode of origin of *iso*quinoline alkaloids from aromatic amino-acids has also become clear. Harmine, harmaline, physostigmine, and rutæcarpine are all derived from tryptophane, and it looks as if the same is true of other alkaloids the constitution of which, like that of strychnine and of brucine, remains obscure.

The isolation of some natural substances, of great physiological interest, is beset with difficulties because they are present in minute amount and have not the convenient solubility relations which facilitate the separation of the alkaloids. This applies to the hormones present in animal tissues. Here the American slaughter-houses provide valuable facilities, and it is significant that adrenaline, thyroxine, and insulin were first crystallised in America, although the constitution of the two former hormones was later established in Europe, where also their synthesis was effected, that of thyroxine only a few years ago, through the brilliant work of Harington.

The difficulty of isolating vitamins is still more formidable; in the case of the antineuritic vitamin B, which is almost certainly a fairly simple substance, susceptible to attack by the methods of organic chemistry, much progress towards isolation has been achieved by selective adsorption and elution, the methods employed by Willstätter for enzymes. The discovery by Rosenheim and Windaus that vitamin D is formed by the irradiation of ergosterol has suddenly brought into prominence a substance which before was but a curiosity, chiefly known through the work of the French pharmacist, Tanret. At the same time the interest of biochemists in photochemistry has been stimulated, as well as in the extensive work of Windaus on the structure of cholesterol, which the latter had already shown to be connected with the bile acids, largely investigated by Wieland.

The sudden emergence of ergosterol into prominence does not stand alone; another of Tanret's ergot substances, ergothioneine, at first also an isolated curiosity, has acquired more general significance because it has been found in mammalian red corpuscles; it is likely that this will lead ultimately to the discovery in proteins of yet another sulphur-containing amino-acid, possibly a thiolhistidine. Altogether, ergot has yielded more substances of general biological interest than any other single plant.

The above examples of the relation between biological and organic chemical work relate to that division of biochemistry which may be termed descriptive. A knowledge of structure is also necessary in dynamic biochemistry, the study of the transformations which substances undergo in the living organism. The recognition of the fats as esters, and their behaviour to fat-splitting enzymes, the transformation of starch into sugar under the influence of diastase, the end-products of alcoholic fermentation; all these were early discoveries in dynamic biochemistry.

Just as the organic chemist may wish to know the mechanism of a reaction, for example of the Skraup synthesis of quinoline, so the biochemist wishes to know the intermediate steps in the transformation of, say, glucose into alcohol. The detection of these stages of metabolism is a matter of considerable difficulty, since under normal conditions the intermediate substances generally disappear as rapidly as they are formed. They have to be trapped by suitable means, as did Neuberg with acetaldehyde in alcoholic fermentation, or the metabolic process may sometimes be cut short, by using an isolated organ, such as the surviving liver, or the precursor of the intermediate substance may be administered in large excess.

Very little has been learned in this respect from the higher plants. The very process of photosynthesis is still beset with obscurity in spite of a plausible hypothesis; we know next to nothing about transformation of carbohydrate into fats, and vice versa, and in particular we are ignorant of the stages by which amino-acids are formed in plants from nitrates and carbohydrates; we simply do not know how the proteins of living beings originate. Nor have the higher plants given us much information of the way in which their fats, carbohydrates, and proteins are ultimately broken down.

Our knowledge of catabolism is principally derived from the animal world. It is found that the breakdown does not always occur in the manner in which the organic chemist would expect. Thus an organic chemist presented with the problem of transforming stearic acid into palmitic might brominate in the alpha position, and break down the corresponding α-hydroxy acid; or he might do a Hofmann degradation on the amide. In either case he would get an acid with 17 carbon atoms, and have to repeat the degradation in order to obtain palmitic acid. Knoop has shown, however, that in the animal organism the β-carbon atom is attacked so that the chain is shortened by two carbon atoms at a time, an acid with 18 carbon atoms being converted successively into one with 16, 14, 12, etc. In accordance with this scheme the principal fatty acids in Nature are those with an even number of carbon atoms. Knoop established this by feeding ω-phenyl fatty acids; those with an even number of methylene groups in the side chain were converted into benzoic acid and appeared in the urine as hippuric, those with an odd number of methylene groups yielded phenylacetic acid and were excreted as phenaceturic acid. Instead of using a resistant phenyl group and the whole animal, fatty acids themselves and the isolated liver may be used to establish the same result.

The degradation of amino-acids in the body also proceeds contrary to the expectations of the organic chemist. If he were asked to bring about the degradation by gentle stages he would doubtless first convert the α-amino into the α-hydroxy acid. The organism forms the α-keto acid, however, as shown by Neubauer and by Knoop. This biochemical result suggested to Knoop an interesting and unlooked-for synthesis of amino-acids *in vitro*, by reversing the normal breakdown. He shook solutions of α-keto acids, containing also ammonia and platinum black, in a hydrogen atmosphere, when the corresponding amino-acid resulted by the reduction of the hypothetical imino-compound. The transformation of tryptophane into kynurenic acid may be quoted as a particular problem of metabolism to which a good deal of organic chemistry has been applied.

The first stage in the degradation of fatty acids and of amino-acids seems pretty well established, and analogies *in vitro* have been found. Other problems are more obscure. Why is the benzene nucleus in phenylalanine oxidised, but not that in benzoic acid? What is the mechanism in the former case? Why is *p*-hydroxyphenylpyruvic acid easily oxidised and the corresponding lactic acid not? Why is *d*-phenylglycine easily oxidised and *l*-phenylglycine excreted almost unchanged? Altogether, the processes by which organic substances are burnt to carbon dioxide and water, by atmospheric molecular oxygen, at a low temperature, are still very puzzling, although Dakin, Hopkins, Knoop, Warburg, Wieland, and others have done much towards their elucidation. In the study of the chemical processes, as in that of the chemical constituents of living organisms, there is much scope for the application of organic chemistry, and in addition, physical chemistry requires to be utilised.

Probably the most extensive attempt to use chemical constituents for botanical classification has been made by R. T. Baker and H. G. Smith, in the case of the Australian genus *Eucalyptus* with about two hundred species: the essential oils from well over half of these have been examined. Baker and Smith trace a relation between the venation of the mature leaves and the composition of their essential oil. The genus is thus divided into fairly well-marked groups, and it is possible to suggest the probable constituents of the oil of a given species by examining the venation of the leaves, and, conversely, by chemical investigation of the oil to gain a clue to the species. Maiden, the botanical expert on *Eucalyptus*, did not always agree with the classification of the chemists, but upon occasion he discovered morphological differences after a delimitation of species had been proposed on chemical grounds.

The main biological interest of alkaloids is not botanical in their distribution, but pharmacological in their action. This leads to a mention of the great developments in synthetic drugs, due to organic chemistry. In particular there is great scope for the organic chemist in chemotherapy, the combating of general infections of the host by synthetic drugs. The production of salvarsan, which has made such a great change to the treatment of syphilis and other protozoal diseases, and the subsequent introduction of germanin (or Bayer 205) in the treatment of sleeping sickness, indicate great possibilities of applying organic chemistry to this particular department of medicine, and constitute a link between workers in very different fields.

I have directed attention to the many points of contact between organic chemistry and biology in the past and present, and if finally I am permitted to draw a conclusion it would be an educational one. I hold it to be desirable that biologists should have at least an elementary knowledge of organic chemistry, in spite of the difficulties imposed by ever-increasing specialisation in science. These difficulties are particularly felt in apportioning the time available for medical education among the many subjects of a crowded curriculum, and may to some extent be met by a careful consideration of what is really useful.

The chemical training of the physician (and of the biologist) should not be identical with the preliminary training of the professional chemist, although it still is so in many universities. In order to save time, much elementary chemistry, particularly inorganic, must be abandoned, thus making room for those aspects of the subject which have biological applications. This differentiation between the chemical needs of various groups of students requires special courses, and teachers who have a sympathetic understanding of the peculiar needs of their students, medical and biological.

Obituary.

Prof. Charles Moureu.

Not only the French but also chemists generally suffer a specially severe loss by the death of Charles Moureu, professor of organic chemistry in the Collége de France, the second to succeed Berthelot. In France, the leader in his subject, he was not merely a chemist of great achievement and high repute but also a man of outstanding personal character and social distinction. During the War he rendered inestimable service to his country by organising and directing the work—defensive and offensive—of the French chemists; in this connexion he was brought into close contact with our English workers. Since then he has been a familiar figure in England.

At the close of the War, Moureu entered upon a vigorous campaign in which he made clear to politicians and the public the importance of chemistry in the modern State and the great need of improving the status and financial position of the French scientific schools. His efforts to this end were in large measure successful. His success was in no slight degree due to the eloquence with which he stated his case in his book "La Chimie et la Guerre". Known throughout the world of chemistry, a shrewd man of affairs, a polished diplomat, in fact, Moureu was particularly endeared to the chemists of other nationalities, who met him during recent years at various international conferences, by his engaging manner and the obvious sincerity and breadth of his outlook. The thesis developed in his book is that stated by his countryman Duclaux, which he quotes: "La chimie est au fond de tout et rien ne lui échappe". He expressed what to him was a profound truth when he said: "Le Français le plus illettré a le sentiment, net ou confus, que sa patrie est grande et belle entre toutes. Fier, sans arrogance, d'être Français, il est profondement patriote." Patriotic to the core, at the same time he was so scientifically minded, so sane in his judgments, that he was not only willing but also able to deal with international problems broadly and dispassionately. He was the first president of the International Union of Pure and Applied Chemistry and contributed greatly to the foundation of the Union. At the conference at the Hague last summer, he rendered most important service in the very difficult discussion on the constitution of the Union which occupied the meeting.

Moureu was a son of the mountains, a native of the Basque region. He was born on April 19, 1863, at Moureux, a village in the Bearnese country, in which his family had lived during centuries; he died at Biarritz on June 13. An eloquent funeral discourse was delivered there, by his colleague and friend, Prof. Camille Matignon, on June 17; he was buried the following day at Oberon, in the Basses Pyrénées. The youngest of a large family, his father having died while he was an infant, he was cared for by an elder brother, Félix Moureu, who lavished upon him the affection of a father, an affection which, throughout his life, he fully reciprocated. Félix Moureu died only last year, at the age of seventy-eight. He was a pharmacist of distinction in Biarritz, ten years Mayor of the town; he did much to develop its attractions. Charles Moureu's early training was in his brother's pharmacy at Biarritz. In Paris, he quickly passed through the courses in pharmacy and those at the Sorbonne. He qualified as pharmacist, in the first class, in 1891. After serving, during several years, as chief assistant, he was admitted to the Faculty of Pharmacy in 1899 and became professor of pharmaceutical chemistry in 1907. Ten years later he succeeded Jüngfleisch, Berthelot's successor in the chair of chemistry at the Collége de France. He also became Director of the Verdun Agricultural Research Station, founded by Berthelot. He was elected into the Academy of Medicine in 1907 and into the Academy of Sciences in 1911. During more than thirty years he has been a prolific worker.

Moureu began by studying various vegetable essences, eugenol, etc. He also worked on alkaloids, determining the constitution of sparteine. Following the Berthelot tradition, he devoted himself to synthetic studies in the acetylene series. His most noteworthy discovery is that of the *red hydrocarbon*, rubrene, which is remarkable on account of the way in which it simulates the behaviour of hæmoglobin towards oxygen, absorbing the gas with avidity, *when irradiated*, forming a colourless peroxide from which the oxygen may be removed by exposure in a vacuum. If heated, at temperatures below 140°, this gives off oxygen alone, to within 80 per cent of the theoretical amount. Even at ordinary temperatures, if exposed to light but not in the dark, the peroxide dissociates reversibly, the dissociation pressure at 16° being of the order of 0·5 cm. of mercury. Light is emitted during the deoxidation. If the hydrocarbon be subjected to oxygen in admixture with either benzaldehyde or propionic aldehyde only the rubrene absorbs the gas; its oxidation is retarded by quinol and other anti-oxidants; it is not oxidised at all in the presence of carbonic oxide. Moureu has suggested, in view of the behaviour of rubrene towards oxygen, that in oxyhæmoglobin the oxygen may well be in organic connexion with the molecule, not through the iron.

From 1906 onwards, Moureu devoted himself to the study of the rare gases present in French mineral waters, oil springs, etc., even extending his researches in this field to Madagascar, where he made a careful survey of the chemical resources of the island. For this last service he was promoted to the rank of Grand Officer of the Legion of Honour. A summary of his work on the rare gases was presented to our Chemical Society, of which he was an honorary member, in a lecture which he delivered on June 14, 1923. Fifty-seven springs in all were studied. The results are very remarkable. The amount of helium present varied greatly, reaching 5·92 per cent in the gas collected at Maizieres, Côte d'Or. The other gases, krypton, argon, neon and xenon, however, were present in practically the same proportion, whatever the source. In 1913 he initiated an Institute of Hydrology and Climatology for the study of mineral waters and problems of climate in France and its colonies.

Being familiar with acrolein from his early studies, during the War Moureu sought to utilise this aldehyde as a tear excitant. The difficulty was to preserve it unchanged, as it soon set to a solid. Having traced the polymerisation to the action of acid formed by atmospheric oxidation, he set to work to discover means of preventing the change. He soon found that a great variety of substances could be used as anti-oxidants: phenols, aldehydes, amines, even potassium iodide. From 1919 onwards, Dufraisse and he, assisted by various young workers, systematically explored the field thus opened up, with the result that we are now in possession of a mass of exact data of extreme value. The full importance of the work, in its bearing upon vital phenomena, is yet to be realised. It is already clear that, more often than not, when two oxidisable substances are together subjected to attack by oxygen gas, oxidation is apparently inhibited because both are simultaneously oxidised to oxides which interact reversibly. Obviously, if the living organism were not in some way protected against excessive oxidation, through the heat developed, the action would necessarily tend to take place at an increasing rate: there is little doubt that, through what may be termed the Moureu effect, a control is exercised preventing excessive action. Maybe the office of some advitants is of this order.

Moureu's work in general is characterised by a breadth and philosophical exactitude which renders it of special importance and value. In him we lose a true chemist of the old school—a man who worshipped at the shrine of severe laboratory practice, a cult to-day by no means overpopular even in France. Fortunately, the name survives in his son, already a young chemist of distinction.

Henry E. Armstrong.

Mr. H. C. Robinson.

Mr. Herbert Christopher Robinson, who was born in Liverpool on Nov. 4, 1874, died on May 30 last, after an illness which had lasted for nearly a year. Mr. Robinson belonged to one of the leading Liverpool families, whilst one of his uncles, Mr. William Fothergill Robinson, had been Vice-Chancellor of the Duchy of Lancaster.

Robinson was educated at Marlborough College, and on leaving school went to the Royal School of Mines, for which he had obtained a scholarship. In 1894, constant ill-health compelled him to give up his studies, and he then commenced his career as a zoologist at Davos, where he resided for a couple of years. Here his health considerably improved, and in 1896 he went to Queensland, where he made a large collection of birds in Cooktown and its vicinity, but was obliged to return home owing to chronic dysentery. On his return to England he was appointed an assistant in the Liverpool Museum, where between 1897 and 1900 he assisted Dr. H. O. Forbes to publish catalogues of the bird collections in that Museum. In 1901 he accompanied Dr. N. Annandale, who was then Director of the Indian Zoological Survey, to the Malay Peninsula, on an expedition attached to the Skeat Expedition which had been organised by the Royal Society of Edinburgh and by the University of Liverpool. The results of this expedition appeared in several volumes between 1903 and 1907, that on birds being written by Mr. Ogilvy Grant in 1905—but the work, which was entitled "Fasciculi Malayenses", was unfortunately never completed.

In 1903 Mr. Robinson was appointed curator of the Federated Malay States Museums, and shortly afterwards, on the resignation of the Director, Mr. Wray, he was promoted to that appointment, which he held until his resignation in 1926. From this time forward Mr. Robinson—latterly often in conjunction with Mr. Boden Kloss—wrote from time to time many articles on the various branches of zoology, though principally on the Vertebrata. In addition to this, Mr. Robinson organised and directed both the Federated Malay States Bureau of Fisheries and also the Meteorological Service. For the last two years of his service Mr. Robinson was in charge of a section of the Malayan Pavilion at the Wembley Exhibition. Throughout his directorship of the Federated Malay States Museums, Mr. Robinson wrote principally in the *Journal* of those Museums, the *Journal* of the Asiatic Society, and, to a less extent, in the *Ibis*.

Mr. Robinson was not only a scientific ornithologist with a wide knowledge of the literature of birds, but was also himself a keen and indefatigable field naturalist with an intimate knowledge of the birds in a state of Nature, a fact which made his writings of interest as well as of value. Among the more important of his articles may be mentioned the various catalogues of the birds of Siam, different States of the Malay Peninsula and the larger islands, which appeared from time to time in the journals already mentioned, as well as in the *Journal* of the Natural History Society of Siam. His most important work, however, was the one on which he was engaged at the time of his death, which he was producing for the Government of the Malay States. It was intended that this work on the birds of that country should be divided into five parts: (1) Commoner Birds; (2) Birds of the Higher Hill Stations; (3) Sporting and Shore Birds; (4) Birds of the Low Country; and (5) Remaining Birds. Of these parts, only the first two have appeared, though we understand that part 3 was also practically finished before Mr. Robinson's death. The two volumes in print prove the great loss that ornithology has sustained in the death of Mr. Robinson.

It can scarcely be said of Mr. Robinson that he was widely popular, for he was very reserved; at the same time, the better he was known the more he was liked. In manner most unassuming, he was yet always ready to assist his brother ornithologists to the utmost of his capacity, and to these his death means the loss of a great personal friend and a clever scientific worker.

WE regret to announce the following deaths:

Dr. Etienne Bieler, deputy-director of the Imperial Geophysical Experimental Survey, at Geraldton, West Australia, on July 25, aged thirty-four years.

Dr. W. G. Duffield, Director of the Australian Commonwealth Solar Observatory at Mount Stromlo, and formerly professor of physics at University College, Reading.

Dr. T. Blackwood Murray, formerly chairman and managing director of the Albion Motor Car Co., Ltd., and a past president of the Institution of Engineers and Shipbuilders in Scotland, on June 11, aged fifty-eight years.

The Very Rev. Dr. David Paul, a past president of the Botanical Society of Edinburgh and of the British Mycological Society, on July 12, aged eighty-three years.

Dr. R. B. Riggs, Scoville professor emeritus of chemistry at Trinity College, Conn., and a member of the college faculty for thirty-three years, on May 11, aged seventy-three years.

Prof. E. M. Terry, associate professor of physics in the University of Wisconsin, known for his work on the effect of temperature on the magnetic properties of iron, cobalt, and nickel, and also on radio telephony, on May 1, aged fifty years.

News and Views.

THE formation of a committee for the excavation of Caistor-by-Norwich, which has followed on the publication of an air photograph revealing the street plan of the Roman town, affords Dr. R. E. Mortimer Wheeler an opportunity for some pertinent comments in the June number of *Antiquity* on the question of the exploration of Roman Britain. In the last few years the excavation of Roman sites in Britain has been extended remarkably. It has attracted a great deal of public attention and the discovery of Romano-British antiquities has become 'news' in the public press. As a consequence, appeals for funds are made more widely known and meet with a more liberal response. Caistor is only one of a number of recent cases in point. At present it is true this applies in some degree to all archæological investigation; but in Romano-British archæology, as Dr. Wheeler points out, much of this effort is wasted and misdirected. He suggests that Romano-British research should be more systematically organised. It is expected that the complete excavation of Caistor will cost at least £15,000, and this exclusive of publication, without which research is of little value for the general advancement of knowledge.

INTERESTING as it may be expected that the results of the exploration of Caistor will prove, there are other sites, especially those in urban or developing areas, which may be regarded as more urgently in need of excavation—such sites, for example, as Caerleon, Colchester, and St. Albans, where changing conditions may in a short time preclude all digging.

This argument is sound; nor should too much weight be allowed to the opportunism which Dr. Wheeler recognises as a factor in determining the exploration of any given site. At present the scene of the archæologist's activities must be fixed largely by its capacity to arouse practical interest in the form of funds to meet expenses. This depends in part only on its scientific importance and more often than not local support is a paramount necessity. But this element of opportunism might be eliminated to a large extent. In the past, Roman Britain has been a highly technical study, and even now its problems of a more general character are only vaguely appreciated by the public. If the questions which await solution and can only be answered by the spade were more frequently stated on broad lines in surveys of the position at a given moment—surveys, for example, such as that recently published by Dr. Wheeler himself in *Discovery* —public interest would inevitably take a practical form which would make systematic investigation a possibility free from the fortuitous attraction dependent upon locality.

It is with much interest we learn that the Foucault pendulum for demonstrating the rotation of the earth is to be re-suspended in the Science Museum. For many years Foucault's notable experiment was to be seen in the old galleries now occupied by the Imperial War Museum, and it always created great interest. In its new position it will be seen by many who have never previously heard of it. Foucault, who was born in 1819 and died in 1868, described his pendulum to the Paris Academy of Sciences in February 1851, but he had already erected one in the Paris Observatory. It was some years afterwards to be seen on the Champ de Mars. According to the "Life" of Frank Buckland, the naturalist, the experiment was first shown in England at the old Polytechnic in 1851, the year of the Great Exhibition, and Buckland himself that year, with the aid of two sons of Chief Baron Pollock, suspended a Foucault pendulum from the roof of the nave of Westminster Abbey, of which his father, William Buckland, the distinguished geologist, was then Dean. Foucault's second method of demonstrating the rotation of the earth, by means of the gyroscope, was described in 1852. It is from that our modern gyroscopic compasses and other similar instruments come.

It seems possible that in a year or two we shall not only be able to speak to people in all parts of the world by telephone, but also to see a clear image of them showing the tint of their complexions and the colour of their clothes. Colour television was first achieved by Baird in England. According to a recent *Daily Science News Bulletin*, issued by Science Service, Washington, D.C., it has now been demonstrated more elaborately at the Bell Telephone Laboratories by Dr. Ives, whose father, Dr. F. Ives, of Philadelphia, invented one of the first and best methods of colour photography. In this method three photographs are made of the same scene. One is taken through a red glass filter and records all the objects coloured red, another records all the blues, and the third records all the greens. These are made into lantern slides, and in a triple lantern all three are projected on the same screen. Over the slide showing the reds is placed a red glass, over the one showing the blues a blue glass, and over the one showing the greens a green glass. The combined picture on the screen gives a natural colour reproduction. In ordinary television a group of photoelectric cells picks up varying light as the spots of the scanning disc show bright or dark areas on the object. The cell converts the moments of brightness into electric impulses which are transmitted by radio or by wire. In order to obtain colour television, we must use three groups of cells, one covered with a red filter, the second with a blue, and the third with a green. Red rays reflected from the object pass through a scanning disc and then through the red filter, and are stopped by the other filters. The electric impulse from the cells passes through vacuum tube amplifiers and over wires to the receivers, where it operates a glow lamp in front of which is a red screen, finally passing through another scanning disc. Similarly for the other colours, and we thus can get a combined image showing the natural colours. This development has been made possible by recent improvements in the manufacture of photoelectric cells.

The two new short wave radio stations in New Jersey, U.S.A., for receiving and transmitting transoceanic telephonic communications have now been opened. Four channels from these stations are now in operation, two to Europe, one to South America, and one for experimental purposes. We learn from the *Bell Laboratories Record* for July that three frequencies are used, namely, 19,000, 14,000, and 9000 kilocycles respectively, corresponding to 16, 22, and 33 metres. Power for the transmitter is purchased from a supply company and is finally delivered into the line at 10,000 volts from a large rectifier. The antennæ consist of curtains of vertical and horizontal wires strung between towers 180 feet high and 250 feet apart. Each antenna is 500 feet wide and there are nine antennæ looped up end to end, giving a total length of 4500 feet. The receiving sets have two stages of radio frequency amplification, six stages of intermediate amplification, and one stage of audio amplification. The antennæ used at the receiving stations are also directive. The signals coming from the required direction are thus greatly strengthened, and those coming from other directions are weakened and thus cause little interference. In selecting sites for the receiving stations, great care was taken to avoid the proximity of motor-car and aeroplane routes, their unshielded ignition systems having been found to cause serious interference. As radio communication between aeroplanes and earth is now compulsory, their ignition systems will have to be shielded, and hence this cause of trouble is eliminated. Motor-car ignition systems are only shielded when a radio receiving set is carried on the car. Limits have therefore been assigned to the distance at which motor-cars can approach the stations. Horses are generally used for transport in their immediate vicinity.

IT is to be hoped that the development in Great Britain of the ' grid ' system of high-tension mains by the Central Electricity Board will, amongst other things, materially help the farmer, but as R. E. Turnbull points out in an article in the *Nineteenth Century* for June last, the question is almost entirely an economic one, for unless the current can be supplied at a sufficiently low rate it will not pay the farmer to change over from the other sources of power which he has already installed. Further, electricity will naturally tend to be dearer in rural than in urban districts, as there are fewer consumers per square mile to share the costs of distribution. However, rural electrification has been carried out with great success in other countries such as Germany and Sweden, and it is stated on good authority that there is no fundamental reason why it should not be made a paying concern in England. In Canada also, the use of electricity is revolutionising both domestic and farm labour. It is particularly with regard to capital costs of transmission and distribution that England is at a disadvantage compared with other countries. Overhead lines, which on the Continent cost £150 to £200 per mile, cost as much as £600 to £800 per mile in England owing to Government restrictions. Competition with the gas industry and a local rather than a national method of dealing with the supply are other reasons why we are backward in our use of electricity. The lack of natural water power is not such a disadvantage as is often thought, for costly engineering works may be required before that natural power can be utilised.

A SCHEME has now been started in the Bedford area to test how far it is economically possible to extend the use of electricity in the rural districts of England. Active propaganda is to be carried out with the view of increasing the demand and awakening interest, demonstrations and hire or hire-purchase of electrical apparatus being included in the programme. Restrictions are being removed so that the cost of overhead lines will be less than £200 per mile, and it is thought that loss will be incurred for the first three years only. Similar developments will be made in other parts of the country if the Bedfordshire scheme proves successful. The wisdom of giving the farmer a subsidy on his crops has always been a debatable question, and it is suggested that a useful compromise would be found if a subsidy were granted to all authorities undertaking to supply electricity within their own rural area. The farmer would undoubtedly benefit, many other industries would obtain similar help, and new industries would tend to arise in the country districts, thus relieving the congestion in the towns. The farmer must in some way increase his output if he is to compete successfully with other countries. The use of electricity has been shown to achieve this, but in order to be an economic advantage the supply must be reasonably cheap.

THE jubilee of the Royal Zoological Society of New South Wales was celebrated on Mar. 24. Much water has flowed under the bridge since that date in 1879, when the New South Wales Zoological Society was formed " for the introduction and acclimatisation of song birds and game, and for other objects set forth in the prospectus ". From the beginning the scheme had the support of the Government, and its donation of £500, together with private donations, allowed of the erection of aviaries and a keeper's house on 'Billygoat Swamp'. Gradually the gardens here expanded until, 11 acres in extent, they were found to be too cramped and unsuitable for their purpose. In 1911 the Government offered a choice of several new sites near Sydney, and Bradley's Head having been unanimously agreed upon, by 1913 £6000 had been expended and the new site had been cleared, fenced, and planted with some 2000 trees, shrubs, palms, and ferns. In 1916, when the enclosures were almost ready for the reception of the animals, the whole collection was transferred from the old Council to Trustees, and in 1917 the prefix ' Royal ' was granted. The transference of the collections meant much more than a mere ' flitting ', for since that time the Society has intensified its efforts to promote and advance the science of zoology. To this end it has worked with great success, as five volumes of the *Australian Zoologist*, as well as monographs on the fishes of New South Wales and the Australian Loricates, bear witness. The intensive study of the various branches of the science has been furthered by the establishment of specialised sections, and the monthly meetings of these are well attended and have stimulated research work both in the field and in the cabinet. We extend our congratulations to the Society on the good work it has accomplished and is carrying on for the behoof of popular and technical zoology.

A SURVEY of the utilisation of land in the county of Northampton has been published in three one-inch sheets by the Northamptonshire Education Committee. The survey was carried out by the pupils of the elementary schools of the county, under the guidance of their teachers and the general supervision of Mr. E. E. Field. The work was originally recorded on six-inch maps, and is now reduced to one-inch and printed by the Ordnance Survey. Three colours are used: light green for grassland, dark green for woods, and brown for cultivated land including rotation grasses and fallows. Building areas and mineral workings are uncoloured. The map is the first of its kind for a whole county, and is the sort of survey which is much needed in relation to various geographical and economic problems. Its construction must have been of great educational value to the children who took part, for it entailed an exploration of the region about the school and home and gave practical experience in the use of large-scale maps.

IN the June issue of *Sunlight* (Vol. 1, No. 8, p. 21), Dr. Vevers, the superintendent of the Zoological Society's Gardens at Regent's Park, London, describes the beneficial effect of fresh air and sunlight upon the animals. In the new monkey house, all the animals have access to the open air, the windows are of ' vitaglass ', and in winter the cages are warmed by steam-heated panels and artificial sunlight is provided in the form of quartz gas-filled incandescent lamps.

By this means some of the most delicate monkeys and marmosets have been kept in perfect health through a severe winter. The effect upon the *moral* of the animals is also very noticeable. In the reptile house, similar good results have been obtained. The giraffes are among the latest zoo inmates to receive the benefit of artificial sunlight and radiant heat, and the success of the installation has been conspicuous.

The disaster to the *Italia* airship off the north of Spitsbergen last year found Norway unequipped with any vessel of sufficient power and strength for navigation among heavy pack-ice. Appeal had to be made to the Soviet Government for the loan of an ice-breaker. The Norwegian government has now begun the construction of a vessel specially designed for ice navigation in view of Norway's interest in Spitsbergen. *La Geographie* for March–April gives some details. The vessel is to be some 230 feet long, with a beam measurement of 33 feet and a tonnage of 1275. It will be steam driven and both coal and oil burning. The engines will have 2000 h.p. and a speed of 15 knots is expected. The ship will have a cruising radius of about 7000 miles. There will be space for an aeroplane on deck. The ship is not to be primarily an ice-breaker, but it will be specially strengthened for ice navigation.

The National Radium Trust has appointed Mr. P. Barter, of the Ministry of Health, Whitehall, to be secretary of the Trust, and Mr. Niven F. McNicoll, of the Department of Health for Scotland, to be assistant secretary.

More than six months before the opening of the next British Industries Fair, only five per cent of the total space in the new and enlarged Olympia, where the London section of the Fair is to be held on Feb. 17–28, remains unlet. In some trade sections of the London Fair there is no room left at all. The applications for space in the heavy section of the Fair, which is held simultaneously in Birmingham, are such that the question of further extensions is again becoming urgent. According to the scheme agreed upon by the advisory committee of the exhibitors in the London section of the Fair, the scientific section will be on the ground floor of the main hall, Olympia.

At the tenth annual meeting of the American Geophysical Union on April 25 and 26, the following officers were elected—*Chairman:* Dr. Wm. Bowie; *Vice-Chairman:* Mr. L. H. Adams; *General Secretary:* Dr. J. A. Fleming. Sectional officers were elected as follows, the chairman, vice-chairman, and secretary being given in that order: *Section of Geodesy*—Mr. W. D. Lambert, Dr. L. J. Briggs, Mr. H. G. Avers. *Section of Seismology*—Mr. N. H. Heck, Dr. F. Wenner, Mr. F. Neumann. *Section of Meteorology*—Mr. G. W. Littlehales, Dr. W. R. Gregg, Mr. O. H. Gish. *Section of Terrestrial Magnetism and Electricity*—Mr. D. L. Hazard, Prof. L. W. Austin, Prof. H. W. Fisk. *Section of Oceanography*—Mr. A. H. Clark, Dr. H. B. Bigelow, Mr. H. A. Marmer. *Section of Volcanology*—Dr. A. L. Day, Mr. R. L. Daly, Dr. C. N. Fenner.

The Secretary of State for the Colonies, with the approval of the Treasury, has appointed the following committee in accordance with section 1 of the Colonial Development Act, 1929: Sir Basil Blackett (chairman), Mr. Ernest Bevin, Sir John Eaglesome, Mr. R. H. Jackson, Sir Felix Pole, and Mr. Alan Rae Smith. According to the terms of reference the committee will "consider and report on, in the manner to be prescribed in the regulations to be made by the Secretary of State under section 1 (9) of the Act, applications for assistance from the Colonial Development Fund, in furtherance of schemes likely to aid and develop agriculture and industry in the Colonies, Protectorates, and Mandated Territories, and thereby promote commerce with, or industry in, the United Kingdom by any of the means specified in section 1 (1) of the Act". Mr. E. B. Boyd and Mr. C. G. Eastwood, of the Colonial Office, have been appointed respectively secretary and assistant secretary to the committee.

Applications are invited for the following appointments, on or before the dates mentioned:—A teacher of electrical engineering in the Jarrow Secondary School—The Director of Education, Shire Hall, Durham (Aug. 16). A civil engineering draughtsman under the West Midlands Joint Electricity Authority—The Chief Engineer and Manager to the Authority, Central Administrative Offices, Phœnix Buildings, Dudley Road, Wolverhampton (Aug. 17). A keeper of the Art and Industrial Division of the National Museum, Dublin—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin, C.8 (Aug. 22). A lady guide-lecturer in the Leicester City Museum and Libraries—The Director, Museum and Libraries, The New Walk, Leicester (Aug. 24). A teacher of theory and design of structures at Goldsmiths' College, New Cross—The Warden, Goldsmiths' College, New Cross, S.E.14 (Aug. 26). An assistant in the Herbarium of the Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Aug. 26). A visiting teacher of chemistry and physics in its relation to photo-engraving at the L.C.C. School of Photo-engraving and Lithography—The Education Officer (T. 1a), County Hall, Westminster Bridge, S.E.1 (Aug. 27). An assistant curator at the Leeds City Museum—The Committee Department, Town Clerk's Office, 26 Great George Street, Leeds (Aug. 27). A chief inspector of weights and measures under the County Council of the West Riding of Yorkshire—The Clerk of the County Council, County Hall, Wakefield (Aug. 31). Junior assistants in the Metallurgy Department of the National Physical Laboratory—The Director, National Physical Laboratory, Teddington (Aug. 31). A junior lecturer in electrical engineering at the East London College—The Registrar, East London College, Mile End Road, E.1 (Sept. 1). A demonstrator in the Department of Physiology of the Middlesex Hospital Medical School—The School Secretary, Middlesex Hospital Medical School, W.1 (Sept. 1). An assistant lecturer in agriculture under the Cornwall County Council Education Committee—The Secretary for Education, Education Department, County Hall, Truro (Sept. 6). An assistant lecturer and demonstrator in metallurgy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Sept. 14). A director of the Ceylon Coconut Research Scheme—The Assistant Agricultural Adviser to the Secretary of State for the Colonies, 2 Richmond Terrace, Whitehall, S.W.1 (Sept. 14). A librarian of the National Library of Wales—Dr. D. Davies, Plas Dinam, Llandinam, Montgomeryshire (Sept. 28). Professors of surgery, medicine, and bacteriology in the University of Sydney—The Agent-General for New South Wales, Australia House, Strand, W.C.2 (Oct. 19). A laboratory assistant at the King Edward VII. School, Sheffield—The Head Master, King Edward VII. School, Sheffield. A full-time lecturer in mechanical engineering at the St. Helens Municipal Technical School—The Secretary for Education, Education Office, St. Helens. A technical office assistant in the Mechanical Department of the Egyptian State Railways, Telegraphs and Telephones Administration—The Chief Inspecting Engineer, Egyptian Government, 41 Tothill Street, S.W.1. A Grade "C" experimental officer at the Army Signals Experimental Establishment—The Superintendent, Signals Experimental Establishment, Woolwich, S.E.18.

Our Astronomical Column.

Brilliant Detonating Fireball on July 28.—This object made its appearance at 2 A.M. (summer time) on July 28 and was noticed by a number of observers who happened to be out of doors or looking from windows at the time. The object passed from over the sea north-north-west of Cornwall in a direction to south-south-east, and appears to have descended into the sea near Falmouth. Several observers describe the fireball as leaving a long, glittering train of sparks in its wake and as giving a loud detonation, which reached them soon after the light vanished. Some observers who did not see the actual flight of the object across the heavens thought the sudden illumination and thunder-like noise were due to an electrical storm; others thought an earthquake had occurred, for buildings in Falmouth were shaken and many people were awakened. The body of the fireball was of sensible size and seemed to one observer to have a diameter about twice as large as that of the sun. The whole countryside was lit up for two or three seconds and the full moon was paled into insignificance. The object must have penetrated to within a few miles of the earth's surface, for a few of the observers saw it apparently fall into the sea. Quite possibly it descended a little to the south-east of Falmouth, but further observations are required before the exact path can be ascertained.

The Observatories of Paris and Meudon.—*La Science Moderne* for July has an interesting article on the history of these observatories, with reproductions of old prints, one of which portrays Louis XIV. visiting the Paris Observatory shortly before its completion. It contained a museum, in which many early astronomical instruments were exhibited. It was Auzout who persuaded Louis that such an observatory was needed in France; the building was commenced in 1667 and completed in 1672, Perrault being the architect. Among the early observers we find the famous names of Cassini, Maraldi, Picard, Roemer, Huygens. Cassini here discovered the division in Saturn's ring, and four of its satellites, and Roemer made the first determination of the velocity of light. The reproduction of a woodcut made early in the eighteenth century helps us to realise the manner of observing with the enormously long refracting telescopes that were then in use; one was pivoted on the roof of the observatory, another on a high tower in the grounds. The article also describes the recent work at the two observatories, and gives a reproduction of one of Janssen's large-scale photographs of the solar 'rice-grains' on the scale of 1·20 metre to the sun's diameter.

The Nebula in Andromeda.—In the *Astrophysical Journal*, vol. 69, p. 103, Dr. E. Hubble continues his researches on nebulæ with a detailed study of the great spiral *M* 31, based on 350 photographs taken with the 60-inch and 100-inch reflectors at Mount Wilson. Owing to the size of the image, attention was concentrated on four regions giving a total area of about 40 per cent of the whole nebula. No indications were discovered of resolution into stars in the nuclear regions, though the outer and intermediate regions were partially resolved. Fifty variables were found, of which forty are definitely Cepheids with periods between 10 and 48 days. The latter show the period-luminosity relation conspicuously and give the distance of *M* 31 as 275,000 parsecs. The number of photographically observed novæ (previously 22) has been raised to a total of 87, and these form the basis of an interesting statistical discussion. A tentative comparison with the galactic system suggests that the latter is much larger than *M* 31, but that the ratio is not greater than that between *M* 31 and other extra-galactic systems.

Report of the Cape Observatory for 1928.—The report of His Majesty's Astronomer at the Cape has lately been issued. Upwards of 13,000 observations of right ascension and declination were made with the reversible transit circle. The stars under observation were: (1) zodiacal stars; (2) those south of declination $-30°$ and not fainter than mag. 7·5; (3) Eros comparison stars for the near approach of that planet to the earth in 1930–1931. Heliometer measurements of the major planets were made near opposition, in continuation of the series commenced by Sir David Gill. A wide-angle lens, covering a field of 25 square degrees, with aperture 6 inches and focal length 80 inches, is under construction by Messrs. Taylor and Hobson of Leicester. This will be used for the construction of zone catalogues of stars from $-30°$ to the south pole, on the plan inaugurated by Prof. Schlesinger. The Victoria telescope is being used for photographic determination of stellar parallaxes. 101 parallaxes are ready for publication, and material is available for determining about 100 more. Five parallaxes of more than a tenth of a second are noted, three of these being new. With the astrographic telescope, besides the ordinary programme, 14 plates were taken of Nova Pictoris, 9 of the bright comet 1927*k* Skjellerup, and 6 of Forbes's Comet. The repetition of the photography of the Cape astrographic zones has now been completed, and the determination of proper motions is in progress. It is stated that a series of photographs of Nova Pictoris, taken with the Victoria telescope using colour filters, show that the rings round the star are an optical phenomenon due to the peculiar distribution of light in the spectrum, and the colour-curve of the objective. The spectrum of the Nova in July 1928 was photographed with this telescope, using an objective prism in front of the object glass. It was a bright-line spectrum approximating to the Wolf-Rayet type. The continuous spectrum was weak; the line at $\lambda 4363$ was strong.

Research Items.

Sinanthropus Pekinensis : Further Discoveries. — Further investigations by the Geological Survey of China at Chou Kou Tien during the season of 1928 have brought to light more *Sinanthropus* material from the site on which the type form molar tooth was previously discovered. The new material is described in general terms by Dr. Davidson Black in *Science* for June 28. It consists of the greater part of the right horizontal ramus of an adult lower jaw with the molar teeth *in situ* and having the premolar canine and distal half of the lateral incisor sockets preserved. Further, there are a worn right upper molar with evidence of injury during life, the labial side of the crown and portion of the root of a permanent median incisor, an immature lower median incisor and the root of a worn lower permanent median incisor posthumously crushed and deformed. All the specimens are deeply pigmented and mineralised. Though not found in the same deposit as the earlier material, there can be no doubt as to their contemporaneity and their geological age—Lower Quaternary (Polycene). The greater part of this material has still to be prepared and studied in the laboratory, but enough is now available to make it possible to draw certain conclusions. It is evident that *Sinanthropus*, like *Eoanthropus*, was a large brained form though the calvaria is not unduly thick. The morphology of the jaw of the two specimens presents features of unusual interest. The general architecture of the symphysis region makes it evident that the very generalised hominid dentition is supported with a framework of a type hitherto encountered only among forms having relatively formidable canines. The architecture of the jaw is much less hominid than that of the teeth ; it supports and represents a type which, until the discovery of *Eoanthropus*, had been supposed to be associated only with an anthropoid type of dentition. It is clear, therefore, that distinctive hominid teeth were evolved before the supporting jaw lost its anthropoid form.

Is Evolution Continuous or Discontinuous ?—Very considerable modifications have taken place in the views regarding the nature of Darwinian variations and mutations since these processes came into opposition as the alternative bases of the origin of species. Dr. Francis B. Sumner, in a short article in the July *Scientific Monthly*, summarises the present day point of view. He indicates that although the mutationists still ' stick to their guns ', deductions from the results of genetic experiments, while allowing discreteness to the gene, have added to it a content of quantitative potentialities or values. So that mutation in the new view is no greater a ' saltation ' than variation was in the old. It comes to this, apparently, that mutation is hereditary variation, regardless of magnitude, that is to say, it is a hereditary (transmissible) modification of the germinal substance, while the alternative variation is a non-hereditary change, due, as is commonly assumed, to the action of environment, broadly speaking, upon the individual. If mutation be regarded as of this minimal type, then evolution is due to a process which, while discontinuous in essence, produces a sensible continuity, for in the author's opinion the transition from one species to another has commonly involved no greater breaks in continuity than may now be observed between one individual and another in the same species.

Alcoholism.—The June issue of the *Bulletin of Hygiene* contains a review of recent literature on alcoholism, by Dr. J. D. Rolleston, whose previous contributions to this subject were noted by us last year (NATURE, Aug. 25, 1928, p. 285). The review deals with the historical aspects of alcoholism, its prevalence in Great Britain, France, Germany, Denmark, Russia, and the United States ; its association with other morbid conditions, especially cancer, pellagra, and mental disease, experimental work, tests of drunkenness, mortality, legislation, and modes of prevention. A bibliography of 40 references to the literature of nine different countries is appended.

Changes in the Earthworm Fauna of Illinois.—Frank Smith records changes in the earthworm fauna of Illinois (*Bull.*, Div. Nat. Hist. Survey, State of Illinois, vol. 18, art. 10, 1928). The tendency is towards an increasing domination of European species and a corresponding decrease in the abundance of some indigenous forms. The author compares collections which he and others made thirty years ago with recent collections, and records that about 1896 only a few specimens of *Lumbricus terrestris* were seen in a restricted locality near Champaign crawling about during a rain storm. For several years afterwards specimens of this earthworm needed for class-work had to be obtained from dealers elsewhere, but about 1905 specimens were fairly abundant in the Arboretum in the University campus. Later the neighbouring area became abundantly stocked with them, while specimens of *Diplocardia communis*, which was formerly common, became infrequent. The area in Champaign into which *L. terrestris* has extended its distribution has also greatly increased in recent years.

Gas Vacuoles of *Arcella*.—The April issue of the *Quarterly Journal of Microscopical Science* (vol. 72, pt. iv.) is devoted to a memoir by the late Dr. Edward J. Bles on *Arcella*, and is a study in cell physiology. The experiments were devised by Dr. Bles and carried out with his well-known skill and care. He describes the morphology of *Arcella discoides*—the species selected for observation because of its transparent test, which is paler in colour, and flatter than that of *A. vulgaris*—and how he obtained a constant supply of young examples for study. The original object of the investigation was to determine the nature of the contents of the gas vacuoles in *Arcella*, and the author states that the gas is pure oxygen—if any other gas is present it is only in exceedingly minute traces. The oxygen is produced by oxidase action. The generally accepted view that the gas in the vacuoles is carbon dioxide is founded on a single experiment by Bütschli, and the author shows that this conclusion is untenable. The movements of pseudopodia from their protrusion to their disappearance are connected directly with the activity of an oxidase (the granules of which stain blue with benzidine), and on applying the benzidine test to several flagellates and ciliates it was found that a similar oxidase was present in them, and the author adduces evidence in support of his view that there is in these cases as in *Arcella* a similar method of converting the chemical energy of the oxidase action into the energy used in movement. The paper is illustrated by eleven plates of excellent drawings by Mr. A. K. Maxwell.

Evolutionary Sequence among Protophyta.—At the present time, eleven classes of simple, holophytic organisms are recognised, in no two of which do chromatophore pigments, reserve substances, and cell membranes show complete correspondence. In Fritsch's review of these classes under the title of " Evolutionary Sequence and Affinities among Protophyta " (*Biol. Reviews*, vol. 4, April 1924), it is brought out very clearly that these classes may be regarded as parallel evolutionary series, most of which are represented by forms ranging from motile flagellate organisms to typical algæ types such as the chlorococcoid, filamentous, siphonaceous, etc. In fact, it is in only two of the eleven classes, the Euglenineæ and Chloromonadales, that typical algal forms are still unknown. In view of these facts, it is only reasonable to agree with Fritsch that the purely artificial distinction into Flagellata and Algæ should be abandoned. Recent work has also brought about a readjustment of the groups formerly included under the Chlorophyceæ. Borzi's original suggestion that yellow-green, oil-forming organisms should be placed in a class distinct from that containing the green, starch-forming organisms, has received ample justification and such forms are now classified as Heterokontæ —a group of equal rank with Chrysophyceæ, Bacillariales, etc. On the other hand, Bohlin's group Stephanokontæ, and Blackman and Tansley's Akontæ, do not receive equal support, and the tendency at the present time is to reduce these to the rank of sub-groups co-equal with Ulotrichales, Siphonales, etc., of the large class Isokontæ, with the other sub-groups of which their metabolism is in agreement. The classification of the Isokontæ now appears to be satisfactorily established, but much work still remains to bring the other groups into an equally satisfactory condition.

Theories of Coral Reefs.—Wharton's view that foundations for coral reefs have been furnished by the marine abrasion of volcanic islands is shown by Prof. W. M. Davis to be untenable as a general explanation (*Science Progress*, July 1929). Darwin's theory involves slowly subsiding volcanic islands, and therefore uncliffed and bayed shore-lines would be expected, and such evidence as is available of the original foundations should reveal the slopes of a dissected cone. In contrast, Wharton's theory demands cliffed and non-embayed shore-lines, and uplifted reefs ought to be based upon flat platforms. It is shown that both Darwin and Wharton overlooked these and other inevitable consequences, but that, whereas Wharton's theory is found to be contradicted when it is confronted by the facts of exploration, that of Darwin is convincingly confirmed. The article is stimulated by a review of "The Coral Reef Problem", in which Prof. J. Stanley Gardiner suggests that Wharton's theory has not been proved untenable by definite evidence. Prof. Davis has now specifically answered this criticism in a paper which is not only a valuable summary of coral-reef evidence but also an admirable lesson in scientific method.

Continental Drift.—The attention of geologists is directed to a review of the continental drift hypothesis by Prof. Arthur Holmes (*Mining Magazine*, April, May, and June 1929). Evidence is summarised suggesting that the movements involved in the changes that have affected the face of the earth since the close of the Palæozoic include (*a*) a breaking up of Laurasia and Gondwanaland with a radially outward drift of the individual parts of each area towards the Pacific and the Tethys ; and (*b*) a general drift, probably involving the whole of the crust, with a northerly component on the African side sufficient to remove Natal from the neighbourhood of the late-Carboniferous south pole and Britain from the late-Carboniferous tropics. It is shown that the motive force cannot be of external origin but must arise within the earth itself. What is required for (*a*) is a mechanism operating beneath the continents capable of stretching or splitting them and of dragging the parts away from each other. The radially outward movements suggest a system of convection currents generated by differential radioactive heating beneath each of the two great land-masses. The importance of recognising thermal and electromagnetic processes as well as those due to gravitation is emphasised.

Effect of Nuclear Spin on Spectra.—The line spectra of bismuth and cæsium have a hyperfine structure, the description of which falls outside the usual quantum theory of electronic motions. Stated formally, it requires the introduction of a new quantum number, and the corresponding physical accompaniment of this in the atomic model has been traced to the quantised rotation of the positive nucleus. The development of this idea on the quantum mechanics has been carried out by J. Hargreaves in a paper appearing in the July issue of the *Proceedings of the Royal Society*, for the relatively simple case of a nucleus with a half-quantum spin in an atom with a central field. After some empirical adjustment, the results of theory and experiment can be made to agree, and there emerges, *inter alia*, a rule for the most probable type of transition, namely, one in which there is reversal neither of the spin axis of the nucleus, nor of that of the electron which is responsible—loosely speaking—for the emission of radiation. Mr. Hargreaves suggests that some of the effects observed indicate that the charge of the nucleus is localised chiefly in its outer parts.

Raman Effect for X-Rays.—When homogeneous X-rays are scattered, some of the deviated quanta form a group which has hitherto been supposed to be of the same frequency as the incident beam. A careful analysis of this so-called unmodified radiation by D. P. Mitchell with a spectrometer of very high resolving power (*Physical Review*, vol. 33, p. 871) has now shown, however, that it is actually not homogeneous, but possesses a fine structure. The detail of the latter depends upon the nature of the scattering material, but is independent of the angle of scattering, and it is found that the changes in frequency correspond fairly well with characteristic frequencies of the atoms responsible for the scattering. The effect thus appears to be analogous to that discovered in the region of optical frequencies by Raman and Krishnan, except that the transitions involved are electronic in the case of X-rays, and molecular for the Raman spectra. It is perhaps somewhat difficult to picture how, as has been observed in one instance, the frequency of an X-ray can be increased by electronic scattering, and it also seems necessary to assume that when an X-ray has its frequency diminished, the electron concerned is only taken to the periphery of the atom, and then left there at rest.

A Simple Audio-Frequency Oscillator.—Most laboratory courses in physics and chemistry include electrical bridge measurements for which an alternating current supply is needed, and it is a common experience of instructors that these often prove extremely troublesome to operate. Mr. C. W. Oatley has described a low-power audio-frequency oscillator in the July number of the *Journal of Scientific Instruments*, which appears to be a considerable advance on previous pieces of apparatus used for this purpose. It consists essentially of a valve-maintained tuning-fork, of the type introduced by Dr. Eccles. The alternating voltage from this is taken to benches round the laboratory, and is amplified by a single-valve circuit on each, the bridge terminals being finally connected to tapped transformers on the anode circuits of the latter. A special feature of the circuits described is that the only source of power required, both on the high-tension side and the low-tension side of all the valves, is the 110 volt D.C. main. In the actual circuit for which the details are given in this paper, the fork has a frequency of 180 cycles per second, and yields immediately 10 volts r.m.s. The maximum voltage which can be used on the bridge is 30 volts r.m.s., but Mr. Oatley's arrangements would appear to be susceptible of considerable modification, and apparatus similar in principle could be readily set up in most laboratories.

Crystallisation.—We have received from Dr. F. H. Maberley a note on a simple experiment in which half a stick of 'meta-fuel' is set on edge on a penny resting on a cork, is ignited and three-quarters allowed to burn. It is then blown out, and the sublimate collecting is examined with a lens. It consists of delicate crystalline needles, some with branching ends.

Oxidation-Reduction.—The twelfth (1927), thirteenth, and fourteenth (1928) of the series on this subject being issued by the U.S. Public Health Service, which were referred to in NATURE of Aug. 3, p. 213, have recently come to hand. A reply is made to Kodama's criticisms of the author's work on the Schardinger reaction, the previous results being confirmed. The thirteenth paper describes the preparation of 34 indophenols, many of which are new; all can be used as oxidation-reduction indicators, but nine are listed as being specially useful. The fourteenth presents data on the equilibrium potentials of four of the new indophenols, which are all rather easily prepared and have useful properties as indicators of oxidation-reduction. The potentials of three of the compounds lie at the electropositive end of the series, two of them extending the range beyond the limit previously reached with satisfactory reversible indicators. A revised list of useful oxidation-reduction indicators is also presented with their equilibrium potentials between pH 5·0 and 9·0 at intervals of 0·2 pH.

Solubilities of Calcium and Magnesium Carbonates in Water containing Carbon Dioxide.—The solubilities of calcium and magnesium carbonates in water containing dissolved carbon dioxide under varying pressures have been measured by Frear and Johnston and by Kline, respectively, and their results are stated in the July number of the *Journal of the American Chemical Society*. These authors give a critical summary of the work on the solubilities of the two substances in pure water at various temperatures and then describe experiments with water containing carbon dioxide. It is found that the concentration of calcium carbonate in solution is very nearly proportional to the cube root of the partial pressure of the carbon dioxide. The effect of the simultaneous presence of calcium sulphate was also investigated. In the case of magnesium carbonate, this was found to be stable down to a partial pressure of carbon dioxide of 0·004 atm., below which the hydroxide was stable. No indication of definite basic carbonates was obtained. The results are of importance in connexion with the use of hard waters in steam boilers and also in the theory of the formation of mineral deposits.

Heating Systems.—*Bulletin* No. 189 of the University of Illinois is the sixth dealing with an investigation of warm air furnaces and heating systems which is being conducted by the Engineering Experimental Station of the University in co-operation with the National Warm-Air Heating Association. A 3-story house has been built and equipped for testing at a cost of £5000, and the present bulletin deals with work carried out in this house by Profs. Willard, Kratz, and Day. It covers tests of efficiency, capacity, rating, and heat losses of commercial furnaces, heat insulators, sizes, positions, and resistances of air ducts, and the effects of conditions outside the house on their action. Six varieties of solid fuel have been compared, two types of chimney stacks and stove pipes, and the effect of providing thermal insulation in the ceiling has been determined. The loss of heat from the outside surfaces of the walls and windows and the influence of sunshine on it are to form the subject of a future bulletin.

Martinsel Steel.—Any improvement in the quality of steel for ships enabling scantlings to be reduced is welcomed by shipowners and shipbuilders. Among the new steels available is martinsel steel, which is referred to in a short article in the *Engineer* for July 19, by Mr. P. G. Rouse. The development of this steel was described in a paper read on Mar. 22 to the West of Scotland Iron and Steel Institute by Mr. F. G. Martin, who some seven years ago advocated the heat treatment of ship steel and the careful measurement of its elastic limit. It has been found that the elastic limit of steel depends on the arrangement of its microstructure, and this in ordinary ship steels is affected by the rolling. Martinsel steel is a special quality steel subjected after rolling to a special heat treatment ensuring the formation of a microstructure most favourable to the greatest elastic strength of the steel, and Mr. Rouse gives microphotographs of ordinary mild steel and the martinsel steel. Martinsel steel has been adopted by Messrs. Alfred Holt and Co. for their ships, and it is being used for the topsides and deck structure of the liner *Empress of Britain* now being constructed for the Canadian Pacific Steamships, Ltd. It allows a reduction of up to 12½ per cent in the thickness of certain parts. High elastic limit steel is also being considered for large bridges in which the saving of dead weight has a cumulative effect.

The Coefficients of Relativity.—In a short paper read before the meeting on June 21–22 of the Physical Society of America, Prof. S. R. Cook, of the College of the Pacific, Stockton, California, proposes to replace the well-known equations of the special theory of relativity, namely,

$$\left.\begin{aligned} x'&=\beta(x-vt),\ y'=y,\ z'=z, \\ t'&=\beta\left(t-\frac{vx}{c^2}\right); \end{aligned}\right\}$$

by the following set

$$\left.\begin{aligned} x'&=\beta^2(x-vt),\ y'=\beta y,\ z'=\beta z, \\ t'_x&=\beta^2\left(t-\frac{vx}{c^2}\right),\ t'_y=\beta t,\ t'_z=\beta t; \end{aligned}\right\}$$

where in both sets β denotes $(1-v^2/c^2)^{-\frac{1}{2}}$. The second set of equations introduces a transverse time as well as a longitudinal time, and is said to imply that clocks moving transversely to the direction of motion run more slowly than when at rest, but not so slowly as when moving in the direction of motion. The chief object of the communication, it is stated, is to inquire into the specific reasons for the universal adoption of the Einstein-Lorentz equations rather than those suggested by Prof. Cook. But in view of the facts that the Einstein-Lorentz equations are simpler, that they involve the two systems corresponding to the dashed and undashed letters in a perfectly reciprocal manner, and that their consequences have been very fully investigated, one cannot help feeling that before they can be given up a great deal more evidence must be furnished than is available in Prof. Cook's paper, which is described as a preliminary note.

Geology in Great Britain.

THE *Summary of Progress* for the year 1927 of the Geological Survey of Great Britain appears in two parts. Part I.[1] contains the Annual Report of the Geological Survey Board and of the Director. Eighty maps were published during the year, together with a number of memoirs, most of which have been already noticed in our columns (Nature, Feb. 11, 1928). Among the new developments are the inception of a programme of geophysical work with the Eötvös balance; the authorisation of the sale of photographic copies of six-inch manuscript maps; and the opening out of a new district, the Orkney Islands. The volume also includes the field reports of the district geologists; an account of the petrology of the Cheviot rocks by Dr. H. H. Thomas; and details of nineteen new chemical analyses of rocks.

Part II.[2] contains thirteen original papers on British geology, thus extending in a welcome form last year's important innovation. Dr. W. E. P. M'Lintock and J. Phemister give an account of their gravitational survey along the line of the Swynnerton Dyke in Staffordshire; their investigation shows that in the proper hands this method is capable of affording valuable evidence regarding the situation and form of deep-seated rock-bodies. There is an interesting discussion relating to the origin of Cumberland iron-ores. E. E. L. Dixon attributes the hæmatite to a magmatic source, a hypothesis that is opposed by Bernard Smith. A new discovery of Lower Carboniferous basalts in the Lockermouth area, Cumberland, is described by T. Eastwood. The remarkable structures known as 'Ptygmatic Folding' have been found in great variety by H. H. Read in Sutherland, and he gives a valuable survey of various hypotheses that have been advanced to 'explain' them. There are also papers on the Yorkshire and Kent coalfields; on the geology of Manchester as exhibited in a tunnel; on new fossils from the Coal Measures; and on deep borings in the south-east of England and in Yorkshire. Altogether, this is a most valuable and stimulating publication which should be in the hands of every British geologist, whether he be an amateur, an honours student, or a teacher. The Survey is to be congratulated on having introduced such a medium for personal contributions and on having issued it at an attractive price.

To petrologists the most noteworthy publication of last year was Dr. Tyrrell's memoir on Arran,[3] a classic area which in Tertiary times was one of the great centres of igneous activity in the west of Scotland. This is the first complete account of the geology of the island. Though based on the descriptions of the northern two-thirds, which were included in Sheet 21 of the one-inch map of Scotland (1903), the treatment is unified and embodies the results achieved by many competent workers, including Mr. E. B. Bailey and Dr. Tyrrell himself, since that date. The earlier chapters deal with the crystalline schists of the north; with the black shales and spilites of Glen Sannox, which are reasonably assigned to the Lower Ordovician; and with the Carboniferous and New and Old Red Sandstone formations. The succeeding and greater part of the memoir is devoted to a detailed account of the Great Central Ring Complex and of the varied major and minor intrusions. Here there is much that is new, structural, petrological, and chemical, all replete with interest and scientific importance.

[1] Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year 1927. Part I. Pp. viii+82. 1*s*. 6*d*.

[2] Summary of Progress of the Geological Survey and Museum of Practical Geology for 1927. Part II. Pp. viii+110+4 plates. 2*s*. 6*d*.

[3] The Geology of Arran (Memoirs of the Geological Survey, Scotland). By G. W. Tyrrell. Pp. viii+292+6 plates. 6*s*. 6*d*. net.

Statistics of 525 dykes are presented, showing that the total extension of the crust in the east-north-east—west-south-west direction amounts to 5410 feet in 14·8 miles. In Mull the corresponding figures are 2504 feet in 12·5 miles.

The district described in the Northumberland memoir[4] includes Holy Island, the Farne Islands, and the delightful stretch of coast north and south of Bamburgh Castle, and extends inland to the edge of the Cheviots. The stratigraphy of the Lower Carboniferous and the tectonics are dealt with in greater detail than was formerly practicable, but it has been found that much of the earlier work by Gunn has required little or no revision. Important additions have been made to the chapter dealing with the Whin Sill and associated dykes, and the glacial deposits also receive more extensive treatment. There is a useful glossary of the local and mining terms of North Northumberland.

Part II. of the Wrexham memoir[5] continues the description of an area that includes the densely populated belt of the Denbighshire coalfield. The older formations were dealt with in Part I.; here the Coal Measures are described in detail with fossil lists, particulars of important shaft and boring sections, and a valuable account of tectonics. After a short chapter on the Triassic deposits, there follows a fascinating account of the mantle of glacial drifts left over half the area by the Irish Sea and Welsh ice-sheets. Mineral deposits and water supply are also adequately described.

The area covered by Sheet 153[6] is situated on the border between Staffordshire and Shropshire, and within it lie Wolverhampton and Lilleshall and an interesting stretch of the Severn Valley below Ironbridge and Broseley. The memoir is notable as being the first survey publication to describe the geology of the Coalbrookdale Coalfield. The solid-rock sequence described ranges from the Uriconian to the Triassic. Here again considerable attention is devoted to tectonics. The glacial and later deposits are significant of marked geographical changes, culminating in the development of the Severn gorge at Ironbridge.

The next memoir[7] to be noticed includes the towns of Ramsgate, Margate, Sandwich, Deal, and Dover, and covers a district that is well known for its coastal scenery and its excellent exposures of the Chalk. The work of the late Dr. A. W. Rowe on the succession of characteristic fossils has made this coast one of the younger classics of British geology. There is a short account of the concealed geology, but the memoir—and the new colour-printed maps—will be chiefly appreciated as an indispensable guide to the geology of a popular coastal district.

Prof. Boswell's memoir[8] describes the geology of a region that has long been an attractive field for geologists and students of the prehistoric periods of mankind. The neighbourhood of Woodbridge and Felixstowe is well known for its fine exposures of Crag de-

[4] Explanation of New Series Sheet 4: The Geology of Belford, Holy Island, and the Farne Islands. By W. Gunn. Second Edition by R. G. Carruthers, C. H. Dinham, G. A. Burnett, and J. Maden. Pp. vi+195+3 plates. 4*s*. net.

[5] Explanation of Sheet 121: The Geology of the Country around Wrexham. Part 2: Coal Measures and Newer Formations. By C. B. Wedd, B. Smith, and L. J. Wills; with a Contribution by G. W. Lamplugh. Pp. xvii+237+5 plates. 5*s*. net.

[6] Explanation of Sheet 153: The Country between Wolverhampton and Oakengates. By T. H. Whitehead, T. Robertson, R. W. Pocock, and E. E. L. Dixon; with Contributions by T. C. Cantrell, H. Dewey, R. L. Sherlock, J. Pringle, and R. Crookall. Pp. xvi+344+8 plates. 5*s*. 6*d*. net.

[7] Explanation of Sheets 274 and 290: The Geology of the Country near Ramsgate and Dover. By H. J. Osborne White. Pp. vi+98+5 plates. 2*s*. 9*d*. net.

[8] Explanation of Sheets 208 and 225: The Geology of the Country around Woodbridge, Felixstowe, and Orford. By P. G. H. Boswell. Pp. v+80+2 plates. 2*s*. 6*d*. net.

posits, and the labours of Mr. J. Reid Moir have disclosed numerous examples of what may be primitive implements. The area, which extends from Aldeburgh to Harwich Harbour, is now represented by two of the new series of colour-printed maps.

The next three memoirs belong to a county series in which the sources of underground waters are described in considerable detail. The Warwickshire volume [9] gives a general account of the geology of the county, and of the water-bearing strata and springs. Leamington Spa and the water supplies of Birmingham and Coventry receive special attention. An excellent coloured geological map accompanies the Somerset memoir,[10] which gives particulars, like the others, of all the principal deep wells and borings, with the geological classification of the strata passed through. There is a full bibliography of the mineral waters of Bath. There have been two previous volumes issued on the water supply of Sussex, but the new memoir [11] now published brings the account of the water resources and borings up-to-date by the addition of much new information. All three memoirs contain analyses of the waters, and will prove invaluable to engineers and others in search of underground supplies.

There remains to be mentioned a useful list of geological photographs,[12] arranged under subjects, which has been compiled from the complete set of more than 7000 subjects accumulated by the Survey during the last thirty years. The list has been prepared to help teachers and the public in general towards a proper and rapid selection of the more instructive and striking photographs. Copies, either as prints, enlargements, or lantern slides, can be purchased on application to the Director of the Survey.

[9] Wells and Springs of Warwickshire. By L. Richardson. Pp. vi+204. 5s. net.

[10] Wells and Springs of Somerset. By L. Richardson; with a Bibliography of the Bath Thermal Waters, by W. Whitaker. Pp. v+279+1 plate. 7s. 6d. net.

[11] Wells and Springs of Sussex. By F. H. Edmunds. Pp. v+263+1 plate. 5s. net.

[12] Classified Geological Photographs from the Collection of the Geological Survey of Great Britain. Pp. iii+76. 1s. net.

(London: H.M. Stationery Office, 1927–1928.)

The Forests of the Andaman Islands.

THE forests of the Andaman Islands were first reported on in 1866 by Mr. S. Kurz, Curator of the Herbarium of the Royal Botanic Gardens, Calcutta. At the instance of the Government of India, Mr. Kurz was deputed to explore these forests by Dr. Anderson, at the time superintendent of the gardens. Whilst recommending, in his interesting report, a certain amount of forest clearing for the extension of agriculture, and in order to render the settlement healthier, Kurz stated that, in his opinion, it was of the highest importance that the forests should be preserved, as they should have a considerable future value. Since the publication of this report the management of the forests of the islands has had a somewhat chequered career, but throughout a recognition of their value has persisted. The report on a recent "Tour of Inspection of the Forests of the Andamans" by Mr. A. Rodger, Inspector-General of Forests to the Government of India, should prove interesting reading to all having a knowledge of these interesting islands and their arborescent flora, so far as it is known (Calcutta: Govenment of India Central Publication Branch, 1928). The difficulties of working dense tropical forests by means of convict labour, and peopled in parts by an indigenous race of hostile people, need scarcely be emphasised; whilst the marketing of the products, even of so fine a timber as the padauk (*Pterocarpus dalbergioides*) has been fraught with unforeseen troubles. Mr. Rodger's report, however, goes to show that a turning point has been reached; and given the hearty and maintained support of the Government of India, which nowadays includes the Legislative Assembly and the Standing Finance Committee, these forests should become the source of an important export trade.

For many years, when the Andaman forests were alluded to, the average person thought only in terms of padauk, the sole timber then exploited. Other species, for trade purposes, were negligible. No less than fourteen different timbers are mentioned in the report, of which *Sterculia campanulata* is exported to Calcutta and Rangoon for match-making; Gurjan (*Dipterocarpus turbinatus*, *Griffithii*, *incanus* and *costatus*) to England, Madras, and Calcutta; the white chugalam (*Terminalia bialata*), which is in much demand as the source of silver grey wood; whilst the use of padauk is almost world-wide. A systematic survey of the forest crops for stock mapping purposes is now in progress, whilst a logging engineer has reported on the possibilities of introducing mechanical extraction to supplement the elephants and buffaloes at present employed. The engineer estimated that there are some 1870 square miles of forests which carry enough tonnage of timber per acre to make mechanical extraction possible. Even at the low figure of 20 tons per acre, this would give more than 20 million tons; and with a hundred year rotation an annual extraction of about 240,000 tons would be possible, or about nine times the present output.

The Inspector-General of Forests states that a rotation of a hundred years would be too short to produce the requisite sizes of the valuable species such as padauk, gurjan, and white chugalam; but, he adds, it must be remembered that the forests are full of over-mature timber which is certainly deteriorating, and should consequently be extracted as soon as possible. There would seem to be, therefore, every inducement for the Government to sanction the sums necessary for the introduction of the new methods of extraction recommended; the more so since the persistent efforts of the Forest Department have succeeded in placing on the market other species besides padauk, and that an increasing demand appears fairly certain.

On this head Mr. Rodger writes: "I have little doubt that the markets for Andamans hardwoods in India and England, and possibly also in South Africa, Mesopotamia, and elsewhere, can be gradually developed until we have an assured and profitable trade. . . . I look forward to the time when the very extensive mangrove forests of the Islands will be of value. Containing as they do as much as 160 tons of timber per acre, being most accessible and easily worked, it seems reasonable to imagine a time, not very distant, when the fuel market of Calcutta, now hard put to it to find enough fuel in the Sundarbans, will obtain its supplies from the Andamans. I understand that modern plant has been erected in the Philippines for the manufacture of tannin, wood alcohol, and charcoal from mangroves, and I see no reason why this should not be done in the Andamans."

The explorations now being carried out in these forests should produce fascinating results both botanical and zoological; some of the sylvicultural work already undertaken, in plantations and so forth, offers possibilities of considerable success. Mr. Rodger is to be congratulated on his most interesting report: for restrained, as is the case with official reports, though its phraseology may be, it proves that opportunities for carrying out work and investigations of considerable value and interest lie to the hand of the Andamans Forest Officer.

University and Educational Intelligence.

Glasgow.—Sir Donald MacAlister, who has been Principal and Vice-Chancellor of the University since 1907, is retiring from the principalship in October next.

The American Association of Museums is carrying out a scheme, for which it has this year obtained a grant of 118,000 dollars, for the construction of museums in Yellowstone National Park. Since 1924, when it obtained a grant of 70,500 dollars from the Laura Spelman Rockefeller Memorial for the establishment of a museum in the Yosemite Valley, this association has been very active in prompting the exploitation of the educational and scientific opportunities offered by the American national parks. In co-operation with the Carnegie Institution of Washington and the National Academy of Sciences, it established an observation station and museum at Yavapai Point in the Grand Canyon National Park, of which Dr. John C. Merriam, president of the Carnegie Institution, declared that it presented "one of the greatest educational and scientific possibilities of America or of the world". Some of the universities, notably Princeton and Northwestern, regularly hold courses in these reservations, and the Federal National Park Service and California Fish and Game Commission have for some years jointly conducted a field school of natural history in the Yosemite district which supplements the lower division of the university courses in botany and zoology and, incidentally, utilises the services of students as public guides. Last year the Secretary of the Interior appointed a committee of eminent men to make a survey of the educational possibilities of the parks. An account of these developments is given in the February number of *School Life*.

The Commonwealth Government has appointed a Committee to consider the question of establishing a National University at Canberra. While not desirous at the present time of establishing an undergraduate university, the Government is of the opinion that a post-graduate University for the encouragement of original research work would be of very great service to the country and might well be initiated in the immediate future. The Committee is desired to examine the whole position and to report to the Council for Scientific and Industrial Research concerning: (*a*) The constitution and government of the said university; (*b*) its relations to the Council for Scientific and Industrial Research and to such other appropriate Commonwealth institutions as have been or may be established at Canberra; (*c*) its relations to the existing universities in the States, having regard to the consideration that it should be designed to supplement their work and not to compete in the training of undergraduates; (*d*) the departments of learning suitable for cultivation in the proposed university and the order in which they should be undertaken, whether at the outset or in the future; (*e*) the provision of a research teaching staff and of all necessary means of teaching and research, including buildings, laboratories, libraries, etc.; (*f*) the power to grant research degrees and the conditions under which such degrees should be granted; (*g*) the problem of endowments and financial administration; (*h*) any further matters which may seem to the Committee to require consideration in connexion with the proposed undertaking. Sir David Orme Masson is chairman of the Committee and the members are Sir Thomas Lyle, Sir Henry Braddon, Sir Robert Garran, Mr. A. J. Gibson, and, *ex officio*, the Executive Committee of the Council for Scientific and Industrial Research (Sir George Julius, Dr. A. C. D. Rivett, and Prof. A. E. V. Richardson).

Calendar of Patent Records.

August 11, 1598.—Edward Darcy's playing card patent, dated Aug. 11, 1598, which was an extension for twenty-one years of an earlier grant made to Ralph Bowes in 1588, for the sole making, importation, and selling of playing cards, was the cause of the famous law-suit known as "The Case of Monopolies", in which the common-law distinction between a patent for an invention and a monopoly in restraint of trade was clearly laid down. "Where any man by his own charge and industry or by his own wit or invention doth bring any new trade into the realm, or any engine tending to the furtherance of a trade that never was used before and that for the good of the realm, that in such case the king may grant to him a monopoly patent for some reasonable time, until the subjects may learn the same, in consideration of the good that he doth bring by his invention to the commonwealth, otherwise not." The grant, the avowed motive of which was to prevent able-bodied persons who might go to the plough employing themselves in the art of making cards, was declared contrary to the law, and the patent void.

August 11, 1868.—One of the earliest practicable typewriters was the invention of John Pratt and was patented in the United States on Aug. 11, 1868. The machine, which had a vertically disposed type-plate, movable in two directions to bring the required character to the printing point by means of connexions from the key levers, never came into practical use, but it was exhibited and worked at a meeting of the Society of Arts in 1866, the year in which the British patent was sealed; and it is said that an account of this meeting, which appeared in the *Scientific American* the following year, was the direct incentive that led Latham Sholes to the invention of the first Remington machine.

August 12, 1794.—The first patent for a ball-bearing was the English one granted on Aug. 12, 1794, to Philip Vaughan, ironfounder of Carmarthen, for the bearings of wagon axles. The axle box, having a ball race corresponding to a groove in the axle, was provided with a detachable section, secured in position by a wedge, to allow the balls to be inserted and removed.

August 12, 1851.—The sewing machine patent of Isaac M. Singer was granted in the United States on Aug. 12, 1851. Though this was not the first commercially successful sewing machine—the credit for the invention of which must be given to Elias Howe, whose American patent is dated five years earlier—it was on Singer's patent that the world-wide industry of to-day was founded (cf. Calendar of Patent Records, April 26 and July 17).

August 12, 1861.—The Langen 'bell and hopper' for the charging of blast furnaces, in which a central member in the form of a plug seats downwards in the bottom of the hopper to close it instead of being pulled up from beneath as in the usual type, was patented in Prussia by Eugene Langen on Aug. 12, 1861. The invention produced excellent results, but has not had very extensive application outside Germany.

August 14, 1839.—The first photography patent was the English one sealed in the name of Miles Berry, the patent agent, on Aug. 14, 1839, for "A new method of obtaining the spontaneous reproduction of all the images received in the focus of the camera obscura", as communicated to him by J. M. Daguerre. Daguerre was refused a French patent in order that the invention might at once be given to the public, but he was granted a government annuity of 6000 francs for "la gloire de doter le monde savant et artiste d'une des plus merveilleuses découvertes dont s'honore notre pays".

Societies and Academies.

Dublin.

Royal Irish Academy, June 24.—**Brian Coffey** and **Hugh Ryan**: The action of alcoholic hydrochloric acid on certain unsaturated ketones. Alcoholic hydrochloric acid with α-benzylidene-methylethyl-ketone gave a crystalline substance, m.p. 195°-196° C. with formula $C_{22}H_{24}O_2$, from which a tribromide $C_{22}H_{21}O_2Br_3$, m.p. 171°-172° C. was obtained. Unlike α-benzylidene-methylethyl-ketone, it did not condense with either piperonal or methylethyl-ketone and was stable towards mild reducing or oxidising agents. It proved to be the dimer

$$\begin{array}{l} C_6H_5.CH.CH.CO.CH_2.CH_3 \\ \quad\quad\ \ | \quad\ \ | \\ C_6H_5.CH.CH.CO.CH_2.CH_3. \end{array}$$

The same substance was formed by the action of stannic chloride on an alcoholic solution of the mono-ketone. In a similar manner α-anisylidene-, and α-piperonylidene-methylethylketones were converted into crystalline dimers melting at 199° and 202·6° respectively.—**Hugh Ryan, W. B. Cornelia**, and **Pierse Hurley**: The condensation of aldehydes with benzyl-acetoacetic ester. Mono-substituted acetoacetic esters react with aldehydes in the presence of alkali to yield alkylidene-alkyl-acetoacetic acids and alkylidene-alkyl-ketones.—**Hugh Ryan, Peter McGeown**, and **John Keane**: Some derivatives of γ-anisylidene-methyl-ethylketone. By the action of anisaldehyde on γ-anisylidene-methylethylketone in the presence of alkali, a crystalline di-condensation compound which melted at 88°-90° C. was formed. This substance appeared to be 1-methyl-4·5-dianisyl-cyclopenten (3)-one (2). From the latter compound, by the further action of anisaldehyde in the presence of hydrochloric acid, a tri-condensation derivative melting at 158°-160° C. was formed, which was probably 3-anisylidene-1-methyl-4·5-dianisyl-cyclopenten (4)-one (2). The same compound was obtained by the action of anisaldehyde on α-anisylidene-methylethylketone in the presence of hydrochloric acid. By the interaction of γ-anisylidene-methylethylketone with benzaldehyde and piperonal respectively, similar di- and tri-condensation derivatives were prepared.—**Hugh Ryan** and **George Cruess-Callaghan**: Preparation and oxidation of flavindogenides. By the action of aldehydes on flavanone in the presence of acid, flavindogenides were obtained. Oxidation of 3-benzylidene-flavanone with potassium permanganate gave a colourless crystalline compound which melted at 163°-164° C. and has not yet been identified.—**A. J. McConnell**: The brachistochronic motion of a dynamical system. In this paper the equations of the brachistochronic motion of any dynamical system, that is, the motion from one configuration to another requiring the shortest time, are obtained in various forms and the geometrical properties of the brachistochronic curves are discussed in the manifold of configurations.—**S. B. Wigoder** and **R. E. Patten**: Some effects of Röntgen rays on seedlings. X-rays inhibit the growth of germinated seedlings. In broad beans both roots and shoots are stunted, while in barley the shoots are most affected. The degree of stunting varies with the age of the bean and the part irradiated. Microscopically, the number of cell divisions diminishes three hours after irradiation, but usually recommences, although sometimes abnormally, after six days.

Edinburgh.

Royal Society, July 1.—**R. A. Sampson** and **A. E. Conrady**: Description of three Huygens lenses in the possession of the Royal Society of London. These three celebrated lenses, of 122 feet, 170 feet, and 210 feet focal length, which have never been examined by modern standards, were borrowed from the Royal Society for that purpose. They were examined with a plane test plate, and the interferometer; the Hartmann test was also used, and the effect of interposing the lens in front of a six-inch telescope of ascertained perfection. As a result the mechanical methods of figuring and centering the surfaces prove astonishingly efficient. The quality of the glass, however, is hopelessly bad. A photograph, taken according to one of Huygens' own tests, namely, the so-called 'Foucault' test of an artificial star or point source, filling the whole lens with light, shows little but a tangle of veins. Investigation of the history of these lenses confirms the conclusion of P. J. Uylenbrock in 1838 that they were made by Constantine, the elder brother of Christian Huygens. A photograph of the signatures of the two brothers shows clearly that the signature on the face of each lens is that of Constantine.—**W. J. McCallien**: The metamorphic rocks of Kintyre. The metamorphic rocks of Kintyre belong to the following groups, which are arranged from north-west at the top to south-east at the bottom: Erins quartzite, Ben Lui schists, Loch Tay limestone, Glen Sluan schists, Green beds, Beinn Bheula schists and grits, Skipness schists. The Erins quartzite has not previously been recognised in Kintyre and the Skipness schists have hitherto been included in the Beinn Bheula group. The Cowal anticline is continued through Kintyre to Campbeltown, where the rocks bend eastward across the strike of the fold. To the west of Campbeltown the rocks are folded into the Campbeltown syncline. The schists and limestone of northern Kintyre reappear in the Mull schists. North of Campbeltown the Loch Tay limestone advances relatively farther to the east than the other groups. The structures and unusual associates of many of the groups can only be explained with the use of slides.—**T. M. Finlay**: The Old Red Sandstone of Shetland (north-western area). A wide variety of rock types is represented in this area. A sedimentary series, mainly sandstones, is faulted against the gneiss to the north and east, forming a deep synclinal trough. These sediments are, in part, greatly altered by a later intrusive complex, the contact rocks showing a high degree of hornfelsing. Their exact horizon in the Old Red is indefinite, as the only fossils found in them are plant fragments too badly preserved for identification. Interbedded with the sediments is a volcanic sequence, the members of which include basalts, a rhyolite, and andesites with associated tuffs. Both augite and hypersthene andesites occur. About half the area is occupied by an intrusive igneous complex. It is sheet-like in form, and includes rock types ranging from gabbro to granite. The final phase of intrusive activity in the area is represented by a system of dykes cutting the complex. These may be of widely different age.

Paris.

Academy of Sciences, July 1.—**Marcel Brillouin**: The dynamic tides of an ocean comprised between two parallels. Law of any depth in latitude and longitude.—**P. Villard**: Associations of clouds.—**Ch. Gravier**: The secondary sexual characters of *Limulus*.—**E. Mathias** and **Ch. Jacquet**: The variations of the terrestrial field at the Station du Sommet of the Puy de Dôme. The field is stronger in the day than during the night: the minimum was about 130 volts; maximum, 184 volts.—**A. Marchaud**: Continuous curves of limited order.—**Z. Horák**: The fundamental problem of the absolute integral calculus.—**Miécislas**

Biernacki: The directions of Borel of meromorph functions.—**Charles Platrier**: Solids with respect to which a material system is submitted only to internal forces.—**Jules Schokalsky**: New comparative mean levels of the White Sea, the Baltic, the Black Sea, and the Pacific Ocean.—**V. Fock**: The equations of Dirac in the theory of general relativity.—**Stefan Vencov**: The critical potentials and low tension arcs in hydrogen. The four critical potentials are given as 11·5, 13·6, 16·5, and 29·7 volts, attributed to resonance of the molecule, atomic ionisation, dissociation of the molecule and dissociation followed by double ionisation respectively.—**Mendousse**: Measurement of the effective wave-lengths of screens utilised in pyrometry.—**Mlle. W. Czapska**: The Raman spectra of the para-, ortho-, and metaxylenes.—**A. P. Rollet**: The precipitation of manganese dioxide by electrolysis with an alternating current. In the presence of nickel, manganese is completely precipitated as peroxide by an alternating current, and this precipitation takes place whatever the nature of the manganese salt. The precipitate was proved by analysis to be $MnO_2 . H_2O$.—**G. I. Costeanu**: Batteries with a fused electrolyte. The battery: copper oxide, fused caustic soda, zinc. At 400° C., this cell has, in air, an E.M.F. of 1·322 volts.—**Emile Rousseau**: The displacement of iodine from an iodide by an oil solution of cholesterol or of ergosterol irradiated by sunlight.—**E. Rinck**: The densities of liquid sodium and potassium. The experimental results found, for temperatures between the melting points and 650° C., were for sodium $d = 0{\cdot}9835 - 0{\cdot}00026(t - 96{\cdot}5°)$ and for potassium $d = 0{\cdot}826 - 0{\cdot}000222(t - 62{\cdot}4°)$. These data can be used for calculating the constant of Lorentz's law applied to the system $Na + KCl \rightleftharpoons K + NaCl$.—**René Dubrisay, Jean Trillat, and Astier**: Suspensions of kaolin in various media. The deposits from solutions containing soda, lime, or sulphuric acid were examined from the point of view of composition and crystalline structure.—**Ch. Bouhet**: The elliptical polarisation produced by reflection at the surface of solutions of fatty acids in water. The results confirm the hypothesis of the orientation of the molecules perpendicularly to the surface of the liquid, in a manner completely independent of Gibbs's adsorption equation.—**J. Cluzet and Kofman**: The photographic effect produced by the sterols after exposure to ultra-violet light. The experiments described do not agree with the hypothesis of phosphorescent phenomena, but support the view that the effect is due to the production of gaseous substances by the irradiation.—**L. Hugounenq and E. Couture**: The photochemical activity of various sterols and the nature of their action. The cause of the phenomenon appears to be chemical, possibly the formation of ozonides of the sterols.—**Paul Pascal and René Lecuir**: Complexes derived from triazinetricarboxylic acid.—**D. Ivanoff**: True mixed organo-magnesium carbonates. The author regards the name of mixed organo-magnesium carbonate for the substance MgXO . CO . R as inexact, and considers it should be kept for substances of the type MgXO . CO . OR. The preparation of some substances of the latter type is described.—**A. Lepape and G. Colange**: The relation between the proportions of ozone in air from the ground level and of air from the upper atmosphere.—**Pierre Auger and D. Skobelzyn**: The nature of the ultrapenetrating rays (cosmic rays). There are two hypotheses concerning the origin of these rays, one that they are primary and arrive directly from cosmic space, or at least from the upper atmosphere, the other, that there exists an ultra-γ radiation not directly ionising, which gives rise to the secondary β-rays observed. The observations described agree best with the latter view.—**Louis Dangeard**: The Foraminiferæ enveloping ooliths and pisoliths.—**Edouard Chatton and Mme. M. Chatton**: The state of fasting, a necessary but not sufficient condition of the experimental conjugation of the infusorian *Glaucoma scintillans*.—**L. Lutz**: The soluble ferments secreted by the Hymenomycetes fungi. The phenolic constituents of essential oils and the antioxygen function.—**G. Ramon and Robert Debré**: Attempts at the immunisation of man by means of an anatoxin of the scarlatina streptococcus.—**C. Levaditi and P. Lepine**: The mechanism of the natural refractory state of the lower apes with respect to the herpeto-encephalitic virus.

Official Publications Received.

British.

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. No. 1, March. Compiled by Agnes Elisabeth Glennie. Pp. iv+85. (London: H.M. Stationery Office.) 2*s.* net.

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 22: On the Local Application of Radium in Therapeutics. 2: Bi-Radiant Needles. By Dr. J. Joly. Pp. 273-276. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 4, No. 3, July. Pp. 209-306. (Cambridge: At the University Press.) 12*s.* 6*d.* net.

Victoria. Report of the Advisory Committee on Cancer. Pp. 13. (Melbourne: H. J. Green.)

The Public Debts of Australia. By J. R. Collins. Pp. 24. (London: Australia House.)

Proceedings of the Royal Society of Edinburgh, Session 1928–1929. Vol. 49, Part 3 (No. 21): The Influence of Air and Moisture on the Budde Effect in Bromine. By Dr. E. B. Ludlam and R. B. Mooney. Pp. 256-263. 9*d.* Vol. 49, Part 3 (No. 22): The Theory of Skew Determinants and Pfaffians from 1891 to 1919. By Sir Thomas Muir. Pp. 264-288. 2*s.* Edinburgh: Robert Grant and Son; London: Williams and Norgate, (Ltd.)

Indian Forest Records. Silviculture Series, Vol. 13, Part 10: Yield Tables for Blue Pine (*Pinus excelsa*, Wall.). By H. G. Champion, Parma Nand Suri and Ishwar Das Mahendru. Pp. vii+29+13 plates. (Calcutta: Government of India Central Publication Branch.) 1.9 rupees; 2*s.* 6*d.*

Foreign.

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 83: The Hydrogen-Ion Concentration of Egyptian Soils, Parts 1 and 2. By Dr. R. R. Le Geyt Worsley. Pp. 33+12 plates. 5 P.T. Bulletin No. 84: The Effect of Locality on the Halo Length of various Strains of Egyptian Cotton. By C. H. Brown. Pp. 3+17 plates. 5 P.T. Bulletin No. 85: The Operation of the Seed Control Law upon the Pedigree of Cotton Seed in Seasons 1926–27 and 1927–28. By Dr. W. Lawrence Balls and Armenag Eff. Bedevian. Pp. 61+27 plates. 5 P.T. Bulletin No. 86: Su di un piroplasma osservato nei Polli in Egitto (*Ægyptianella pullorum*). Nota preventiva del Prof. Dott. M. Carpano. Pp. 12+3 plates. (Cairo: Government Press.) 5 P.T.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 8: Neogene Shells from some Provinces of Chūgoku. By Matajiro Yokoyama. Pp. 363-368+1 plate. 0.40 yen. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 1: Über die Anzahl der Idealfaktoren von *n* in einem algebraïschen Zahlkörper. Von Zyoiti Suetuna. Pp. 24. 0.60 yen. (Tokyo: Maruzen Co., Ltd.)

State of California: Division of Fish and Game. Fish Bulletin No. 14: Report on the Seals and Sea Lions of California, 1928. By Paul Bonnot. Pp. 62. Fish Bulletin No. 15: The Commercial Fish Catch of California for the Years 1926 and 1927. By the Bureau of Commercial Fisheries. Pp. 94. Fish Bulletin No. 16: The Life History of the California Jack Smelt, *Atherinopsis californiensis*. By Frances N. Clark. Pp. 23. (Sacramento: California State Printing Office.)

Catalogue.

New Zealand. (Catalogue 518.) Pp. 34. (London: Francis Edwards, Ltd.)

Diary of Societies.

SATURDAY, August 17.

North of England Institute of Mining and Mechanical Engineers (Newcastle-upon-Tyne), at 2.30.—Annual Meeting.

CONGRESS.

August 29 to September 1.

Swiss Society of Natural Sciences (at Davos). In seventeen Sections. Lectures:—Dr. W. Mörikofer: Problems of Meteorological Radiation Research.—G. Bener: Mountain Road Construction and Science.—Prof. R. Staehelin: The Physiology of High Altitudes.—Prof. E. Guyénot: The Hypothesis of Morphological Territories in Biology.—Prof. R. Doerr: The Submicroscopic Forms of Life.