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Ottawa and After

THE Ottawa Conference has been a success: how great a success it will be for posterity to decide. There were many who seriously believed that its failure would inevitably mean the break up of the British Empire. This view, indeed, was frankly stated at Ottawa, and it is a significant fact that almost everyone there was concerned to make every possible sacrifice to prevent such an eventuality. That particular danger, real or imaginary, is past, and there exists instead a definite acceleration of the Empire spirit, which is soon to be translated into action both in the mother country and in the Dominions.

Perhaps—nay, we would rather say definitely—this Ottawa spirit is of even greater value than all the practical concessions and agreements. It is for every Briton to foster and develop it to the advantage of all parts of the Empire. The Dominions are to-day equivalent to full-grown men and are no longer in the stage of infant colonies to be watched over with navy and army and lent a machinery for government: those who have not visited and spent some time in the Dominions fail very largely to understand that they are nearer the realities of life as enforced by climate, by long distances between towns, and by a spirit of democracy and freedom. The standard of living in the Dominions is higher, though their standard of culture may be less, than in England. In short, their habits in many respects are not the same as ours. We cannot change them, and therefore the mother country must study them and sympathise with them if we essay to sell to them our manufactured articles.

The details of the arrangements made at Ottawa between Great Britain and the Dominions have not yet been divulged, but it is known that they include substantially increased British preference by the Dominions on a very large number of articles, sufficient to place us in a most favourable position in competition with foreign nations, together with an amelioration of Customs regulations and the like.

In very general terms it was possible to distinguish at Ottawa between a background of experts and industrial representatives and a foreground of politicians. The former were engaged in surveying fields of industry, in establishing facts, in making contacts, in bringing into being potential agreements up to the point of signature.

They created an atmosphere which might almost be described as scientific in its attitude, and it is not impossible to conceive that had they been given plenary powers many fair and wise and acceptable understandings could have been implemented without difficulty, and that even the points of disagreement, when once tabulated, could have been reduced to a minimum. The political atmosphere was of another kind. The item of bargaining had been introduced, and all those other factors which constitute what is called politics and are responsible for so much of the crazy anomalies of the present world.

It is difficult for people engaged in scientific pursuits to understand why membership of a political party, largely for hereditary reasons, makes the individual resolutely shut his mind to facts or consequences and impels him to work for a traditional policy, without reference to its merits or demerits, its repercussions on himself, his family, his friends or his country, or civilisation at large. The world is in labour: sacrifices are necessary from everyone: old policies have failed: new ones must be investigated. It may even be that the day of the individual has passed. Governments to-day listen only to associations, whether they be large bodies of voters or organised associations representing traders. No one individual or firm can be allowed to sacrifice the community to personal ends. Limitation of personal output as practised by the trade unions has few defenders, but limitation of production has been held up as a solution of the economic crisis, and will be again, though it has been tried and has failed this time. It is not enough to limit production: a check must also be placed on the uncontrolled extension of the capacity to produce. A new invention, a new method of making something results in the erection of a factory to make an article, in spite of the fact that the existing factory or factories are fully able to meet the demand. The new nationalism, one of the worst diseases resulting from the War, has caused every country to engage in manufacture for itself, largely unnecessary, often uneconomic and only existing as the result of tariffs. Hence the destruction of international trade, the cessation of exports, the disturbance of the channels of credit, the upset of exchange, and the inevitable unbalanced budgets.

Reason must prevail if we are to return to normality. There must be some agreement to restrain the erection of new factories or the enlargement of old plants, when abundant up-to-date capacity for production already exists. There are already examples in Great Britain of restricted industries which are half monopolies, and which can only extend at the will of Parliament and after relevant opposition has been heard. Such is the gas industry, which offers continuous and regular employment, with pension privileges, to its staff and workpeople, and yet is technically and commercially abreast of the times. A local gas company is still in the fiercest competition with electricity and oil, but it is spared, however, competition with another gas works in the vicinity which, if allowed, would reduce both factories to fifty per cent load, with evil consequences to half the staff of each, and imperil the economic future of both concerns. A synthetic ammonia works has no such protection against duplication of production, and unreasoning competition, yet the provision of fertilisers is an essential national industry, which should be capable of being stabilised.

We have strayed from the subject of Ottawa, but such ideas as are contained in the above were under discussion there, if only in the background. Canada, Australia and South Africa are determined to have certain manufacturing industries, but before venturing into what are for them new fields of industrial activity, they are prepared to ask the question—Is it economic? It is here that the mother country has an opportunity, if we are willing to profit by the spirit of co-operation with our fellow Britons.

There are factories enough in England: the Dominions will give us ample preference for their manufactures. It remains to get together to ascertain the needs of the Dominions, satisfy them as to price, quality, time of delivery—above all, give to them, the buyers, all that is understood in the term 'sales service', which is a word scarcely known in its true sense in Great Britain but which is the key to commercial success across the seven seas. Only in this way can we prevent in the future the erection of unnecessary new factories within the Empire, though at the same time we must take care at home, through our trade organisations or, failing them, our Government, that unnecessary factories are not built here either. The day has come when the industrial worker can and will claim some measure of stability in his employment and not allow the industry which supports him to be at the mercy of the adventurer or the foreigner.

The Dominions are alive to the need for education—schools, universities, training colleges, research institutions exist, if anything, ahead of the needs of the population, and it is partly the attractions of an outdoor life in a superior climate which retard the spread of higher culture in home life. What the Dominions need more than anything else if they would have a real regard for the future is to attract and retain the very best first class men possible for their university professorships. Many such men have been there in the past and some are there at present, but there is need and room for more. The Dominions are but sparsely populated with picked men and women; they must pick their leaders too, and they can afford none but the best.

Biological Teaching

(1) *Fundamentals of Biology.* By J. W. Stork and L. P. W. Renouf. Pp. xv + 448. (London: John Murray, 1932.) 6*s*.

(2) *Biology for Medical Students.* By C. C. Hentschel and Dr. W. R. Ivimey Cook. Pp. xii + 618. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 18*s*. net.

(3) *Animal Biology.* By Prof. Lorande Loss Woodruff. Pp. xii + 513. (New York: The Macmillan Co., 1932.) 18*s*. net.

(4) *Invertebrate Zoology.* By Prof. Harley Jones Van Cleave. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xiv + 282. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 18*s*. net.

(5) *A Textbook of Embryology.* By Prof. Mary T. Harman. Pp. 476. (London: Henry Kimpton, 1932.) 18*s*. net.

(6) *The Essentials of Biology.* By Prof. James Johnstone. Pp. xv + 328. (London: Edward Arnold and Co., 1932.) 16*s*. net.

IT is not many years since biology teaching in schools, with very few exceptions, was practically confined to the top form and then was only provided for boys who intended to become medical men. Possibly a little nature study or even botany was taught in the lower school but anything in the nature of a continuous course in natural science throughout the school such as has been planned for mathematics or the literary subjects was not thought of. Even now a course of science in which biology plays a part commensurate with its importance to man is a dream of the future. However, a change has come over the scene, and an indication of it is the fact that all the university examining bodies, in deference to a popular demand, have provided syllabuses in biology for the School Certificate examination.

This is a step in the right direction. All the hard words which are uttered against examinations do not obscure the reason for which they exist, namely to afford some indication that candidates are acquiring sound knowledge and a broad view of their subject; and the syllabus for this examination is drawn up with this end in view. The syllabuses for School Certificate biology are all modifications of the 'type system'; that is, by examining in some detail a number of organisms the essential unity of life as well as a little of the diversity of organic beings becomes apparent. So in the book before us—"Fundamentals of Biology" (1)—an account of the anatomy and physiology of a single vertebrate animal, man, and the flowering plant form the central part of the book, and starting from this basis a survey of the animal and plant kingdom is taken, not very full but enough to give some idea of the evolution of the vertebrates and the land plants. While practical work cannot be insisted upon to the same extent as in post-Certificate work, it is regarded as important that a knowledge of the type shall be obtained by direct observation, and this involves, at any rate, an inspection of dissections of animal types (the frog, the earthworm and the cockroach) which have been made for the class by the teacher. Also a knowledge of the functions of organs is fostered by encouraging the staging of simple physiological experiments in class. Examples of such experiments are cited at the end of the chapters: the development of this side of biology teaching will contribute very largely to its success.

A very elementary introduction to the use of the microscope may be made at this stage. The study of *Amœba* and *Hydra* is prescribed but it must be realised that in many schools there are not enough microscopes for the needs of large classes, and in nearly all, the exigencies of the time-table do not allow enough time for the cultivation of the patience necessary for microscopic work in boys and girls of the Certificate age. Lastly should be mentioned the part which the 'natural history' of animals, or the 'associations' of plants, may play in the early stages of biological education. Little equipment is needed for these branches of study

but a good deal of time outside regular school hours. Unfortunately compulsory games and other occupations claim so much of a boy's leisure that he must be a 'red-hot' enthusiast to pursue the study of field work, and this is why the part of syllabuses which deals with it only appears in examination to have been covered by isolated individuals.

From what has been said it will be seen that the teaching of biology to boys and girls between say fourteen and sixteen years of age is on a period of trial. Though the framers of syllabuses have agreed wholeheartedly to embrace the type system the treatment by the teacher must be very different from that necessary in the case of the post-Certificate student, and for that reason the writing of a textbook by an author who has already had experience is exceedingly welcome. Mr. Stork is a master at Charterhouse, where under O. H. Latter so much spadework in the service of biological teaching has been done. The result of his collaboration with Prof. Renouf is a very useful book which contains, besides the clear exposition of the main theme, admirably illustrated by drawings which are largely new, a number of appendixes. Of these, one contains a number of very elementary facts about chemistry and physics which may be useful to beginners in science, a second deals with such practical things as the source of supply of material for classes and the making up of various solutions, and a third gives a number of questions which have been set in School Certificate and Matriculation examinations. In conclusion, one criticism may be perhaps made—that the book might be a little shorter and less packed with fact, with advantage to most students.

(2) The general character of the next examinations in biology, namely, those for the Higher Certificate and the First M.B., is the same for all the examining bodies. The student deals with a larger series of types with more or less thoroughness. What is, however, a desperate affair for the schoolmaster, who has in his class candidates who are going to several universities and medical schools, are the minor variations in the syllabuses, especially where types are concerned. It is earnestly to be desired that the English examining bodies at least should agree upon a list of identical animal and plant types, nor could such an agreement possibly interfere with the general efficiency of the examination. Thus "Biology for Medical Students" is written for the examinations of the University of London and the Conjoint Board. There are so many excellent textbooks which cover almost the same field, that a newcomer must expect critical examination. The authors point out that in most cases separate textbooks in zoology and in botany are recommended at this stage, a division which is also seen in the teaching of biology in separate zoological and botanical departments. However, the duplication of teaching becomes increasingly difficult to avoid, and probably the best that can be hoped for is for botanists and zoologists to collaborate as closely as in the present case. This book has much to recommend it. The descriptions are clear and the illustrations are excellent, particularly in the botanical part where many microphotographs have been utilised. There is a very good section on embryology, concise and yet comprehensive. Still there is nothing very distinctive about the method of treatment while recent research does not always receive its due meed. In *Paramecium*, for example, the rôle of the trichocysts is quite other than that suggested here, and surely the assumption that the contractile vacuole is a mechanism directly concerned with the rate of katabolism has no foundation in experiment. It has often been pointed out, on the other hand, that it is primarily an organ regulating osmotic pressure.

(3) Prof. Woodruff's "Animal Biology" is a version of his well-established textbook, "The Foundations of Biology", designed "for courses in animal biology and general zoology in which plants are considered only incidentally in their relations with animals". It deals with general biology and so must be read with a book which supplies "the details of morphology and physiology of selected types as well as direction for their study in the laboratory". It is in fact the complement of the last-mentioned book. It has many excellent points. The reviewer, however, cannot help thinking that the survey of comparative anatomy and the morphological distinctions of the animal groups is too superficial even at this stage. The sections on development, inheritance and organic adaptation are, however, admirable.

(4) Prof. Van Cleave in his "Invertebrate Zoology" demonstrates very clearly how difficult it is in a book of 280 pages to give an adequate idea of the comparative morphology and relationships of the various 'invertebrate' groups. To take the Coelenterata as an example, while there is a formidable classification at the end of the chapter no clear idea of the difference between polyp and

medusa is given, of the methods of skeleton formation throughout the phylum or even the structure of the threadcell. The reviewer can find little to recommend this book.

(5) There is no doubt as to the importance of including embryology in a general biological course. A general knowledge of the development of the frog and the chick at least ought to be obtained by zoological students, the foundations being laid in the Higher Certificate or First M.B. part of the course and built upon during work for the university degree. Prof. Mary Harman in her "Textbook of Embryology" has written a handy volume, well planned and carried out, and full of useful detail. It deals principally with mammalian embryology and especially human development and should be of value as a book of reference to zoological students. It is, however, rather surprising to learn that the author is accustomed to use the material of this book in her lectures to students in home economics and physical education and "those taking embryology as a cultural subject".

(6) Prof. Johnstone's remarkable analysis of biological data and theory is a book of a very different category from those which have been mentioned above. The field which is surveyed is so vast and the survey is so concisely worded that a student who attempts to use it must have a good deal of previous knowledge, and certainly have experienced some of the "discipline of practical laboratory work on animal types". The 'non-professional' reader could scarcely be satisfied by the meagre summary account of animal morphology which is given. But for a thoughtful undergraduate who wants to take stock of his knowledge of zoology and the place which the science occupies amongst its sisters we cannot too strongly recommend this lucid statement of progress, which contains compressed into less than 300 pages a discussion of zoology in all its bearings. Prof. Johnstone's own points of view with regard to biological theory are indicated in the introduction. "Not only the 'Weismannism' of a former generation, but also the 'Morganism' of to-day have proved unsatisfactory." His hopes for the future are expressed there likewise. "A survey of biological science gives us certain indications that its growing point, at present, is in biochemistry and that this growth of significant theoretical knowledge will be accelerated when it will have been possible to press new physical results into the service of biology."

History of Public Health

(1) *Towards National Health: or Health and Hygiene in England from Roman to Victorian Times.* By J. Anthony Delmege. Pp. xiv + 234. (London: William Heinemann [Medical Books] Ltd., 1931.) 21*s*. net.

(2) *Devils, Drugs and Doctors: the Story of the Science of Healing from Medicine-Man to Doctor.* By Prof. Howard W. Haggard. Pp. xxii + 405 + 16 plates. (London: William Heinemann [Medical Books] Ltd., 1931.) 21*s*. net.

HERE are two attractively written and generously illustrated volumes by an Englishman and an American respectively, which form an excellent introduction to the history of medicine in general and of public health in particular.

(1) Dr. Delmege sets out to trace the development of those factors which influence most directly communal health, and surveys those changes in scientific knowledge which have brought about the formation of sound hygienic principles and their practical application to our national life. His work is divided into six chapters dealing respectively with hygiene in the early civilisations, the Dark Ages and the Middle Ages, the sixteenth, seventeenth and eighteenth centuries, and the period 1800–75, the date of the passing of the great Public Health Act.

In his first chapter Dr. Delmege gives a short survey of public health in ancient Crete, Egypt, Palestine, Greece, Rome and Roman Britain. In spite of the baneful effect of medieval Christianity on hygiene, the Dark Ages, by way of compensation, are shown to be responsible for the erection of hospitals, homes for the aged, orphanages and foundling homes, and the establishment of nursing confraternities. In the sixteenth century the State relief of pauperism, which had hitherto been left to private charity, began to develop in Britain, and more attention was paid to personal hygiene, especially by the upper classes, but the sanitary condition of the streets in London and the other large towns was deplorable.

In the seventeenth century urban conditions still remained very largely medieval, but certain diseases such as plague and leprosy which had been prevalent in the Middle Ages, died out, and syphilis was no longer epidemic. Smallpox, however, was assuming an epidemic form and outbreaks of scarlet fever and measles were occurring.

In spite of peace and general prosperity during the eighteenth century, the health of the people

was bad during the first fifty years, but afterwards showed considerable improvement as the result of better urban sanitation and vigorous efforts to prevent the spread of typhus fever as well as attention to maternity and child welfare. Owing to widespread scarcity and poverty, the social conditions of the first half of the nineteenth century were by no means favourable to health and sanitary reform, but thanks to the work of Shaftesbury, Chadwick, Southwood, Smith, John Simon and others, important reforms in public health including the training of nurses, inaugurated by Florence Nightingale, were introduced.

The diseases prevalent in each of these periods are noted, and a description of each is given in an appendix for the benefit of the lay reader. Another appendix contains a table showing the dates of the principal events in the history of hygiene from the third to the nineteenth centuries.

The text is accompanied by contemporary illustrations of various buildings connected with sanitation such as hospitals, dwelling houses of different types, sewers, aqueducts and baths, and portraits of eminent physicians and sanitary reformers.

(2) Dr. Haggard's work, the unconventional and lively character of which is indicated by its title, is divided into six parts. Part I, which is entitled "The Conquest of Death at Birth", deals with the progress of midwifery throughout the ages, with illustrations of childbirth in ancient Greece and Rome, the Middle Ages and savage tribes, the story of the midwifery forceps, and the campaign against puerperal fever. Part 2, which is devoted to the history of anæsthesia, contains an account of the discoveries in this field of Sir Humphry Davy, Horace Wells, William Morton and Sir James Young Simpson.

Part 3, in which the progress of surgery from the earliest times until the present day is considered, is divided into two chapters, the first dealing with the study of anatomy and particularly the difficulty in obtaining bodies for dissection, and the second with the work of Ambroise Paré, the introduction of the trained nurse, and the change in surgery caused by the discoveries of Pasteur and Lister.

Part 4, which is entitled "The Passing of Plague and Pestilence", consists of four chapters, the first of which contains the history of the Black Death, the second deals with smallpox and cholera, the third with syphilis and the fourth with the problem of prostitution.

Part 5 contains five chapters dealing with various modes of treatment of diseases including not only scientific methods such as those of Pinel, Pasteur, Behring and Ehrlich, but also different forms of quackery and faith-healing from the earliest times until the present day. In Part 6 the debt which civilisation owes to medicine is illustrated by numerous striking examples.

As in Dr. Delmege's work the text is freely interspersed with numerous well chosen contemporary illustrations.

French Colonial Ethnology

(1) *Notes d'Ethnologie Néo-Calédonienne.* Par Maurice Leenhardt. Pp. ix + 340 + 36 planches. 120 francs.

(2) *Documents Néo-Calédoniens.* Par Maurice Leenhardt. Pp. iv + 514. 125 francs.

(3) *Les Tribus du Rameau Lobi.* Par Prof. Henri Labouret. Pp. vii + 510 + 31 planches. 150 francs.

Université de Paris: Travaux et Mémoires de l'Institut d'Ethnologie. Tomes 8, 9 et 15. (Paris: Institut d'Ethnologie, 1930, 1931.)

ATTENTION has been directed from time to time in the columns of NATURE to the excellent work on matters of ethnological interest which is being done through its publications by the Institut d'Ethnologie of Paris. The works here under notice deal, on rather broader lines than the publications hitherto noticed, with peoples in two widely separated areas of the French colonial possessions.

(1) In "Notes d'Ethnologie Néo-Calédonienne", the author, a member of the Evangelical Mission of Paris who has lived in New Caledonia for twenty-five years, gives a great deal of valuable and welcome information relating to the sociology and religion of the people. Attention may be directed in particular to his account of the *pilou pilou*, the most important ceremony in the life of the people, involving preparations lasting more than three years, which has not hitherto been recorded in such detail as it is here. Other matters with which the author deals at length are the houses, currency, warfare, initiation, totemism, in which the totem of the mother is all-important and that of the father has no part, magic and the gods.

(2) M. Maurice Leenhardt follows up his study of the customs of the New Caledonians with a

collection of traditions and folk-tales. The original text is given with an interlinear translation and a free translation at the foot of each page. The author has annotated the tales fully with notes which expound the text where necessary and explain the allusions. The value of these annotations is considerable as these tales, more than most, contain allusions which would escape the notice of all but those who have a close acquaintance with custom and practice, as well as mode of thought. The author points out that it is an indication of the growing decay of tradition that in the later narrations, the teller of the tale inserts explanations of obscure expressions for the benefit of the younger generation.

Among these tales, those which the author groups as a lizard-totem cycle seem to belong to a remoter stratum of tradition; while those dealing with matrimonial infelicities, with the aid of the author's notes, throw some interesting sidelights on native mentality, such as, for example, in the resort to suicide as a method of retaliation through the spirit thus disembodied. The attitude of mind attributed to the wife who resents the adultery of her husband on the ground that he might thereby do harm to the ancestral element in her body is significant.

(3) In this volume M. Labouret has embodied the results of eleven years of observation among the Lobi, which began with his appointment in charge of the administrative district of Diébougou in French West Africa. It is a record of exceptional value, for as the author explains in describing his method of working among the natives, a great part of the material is recorded virtually by the natives themselves.

M. Labouret has been very thorough in the range of his observations, for there would appear to be very little in the life of the peoples that he has not covered. He begins with their history and then proceeds to the technology, arts, the social organisation, economics, law and morality, religion and magic. He confines himself, in the main, to a record of fact, without any attempt at cultural analysis; but he suggests tentatively that the Lobi, who live on the upper waters of the Volta in the south of the Cercle de Gaoua, may be a part of the great culture area which extends from the Bauchi plateau of Nigeria to Sikasso in the French Sudan. This is a culture of agriculturists, of which the common characteristics are absence of clothing for both sexes, the use of the labret among the women, a special type of rectangular dwelling and a common technique in metal working and pottery making (including a knowledge of the *cire perdue* process in casting), a village organisation, religious and secret societies, the use of poisoned arrows and a knowledge of the bull-roarer. The volume is illustrated by a long series of excellent plates.

Short Reviews

A Manual of Embryology: the Development of the Human Body. By Prof. J. Ernest Frazer. Pp. viii + 486. (London: Baillière, Tindall and Cox, 1931.) 30*s.* net.

FOR a quarter of a century Prof. Frazer has devoted himself to an intensive study of human embryos and from time to time has published brief accounts of special investigations, more especially on organogeny. He has now rendered a great service to anatomists and students of embryology by providing this full report on his life's work. It is a very personal record, for Prof. Frazer does not pretend to review the literature or make references to what others have done.

The interest and value of the book depend on the fact that it is a detailed report of what the author himself has seen in actual human embryos, illustrated by his own drawings. It is a great record of minute and prolonged observation.

So this is Science! By H. F. Ellis. Pp. x + 109. (London: Methuen and Co., Ltd., 1932.) 5*s.* net.

BOTH wit and humour are to be found in the travesties of scientific description included in this book. Mr. Ellis evidently knows something about scientific subjects and people, and is ingenious in presenting them in new and unexpected aspects; such, for example, as his definition of the stratosphere—"Said to be full of balloons hoist with their own Piccard". His clever play with words, and his inversion of ideas, make science laughable rather than ridiculous. Many college magazines have, however, contained contributions in similar style; and some of the Red Lion dinners of the British Association have provided burlesques just as amusing as any to be found in this book. Whether scientific readers will consider the hour's entertainment which it offers to be worth five shillings is another matter

Water Diviners and their Methods. By Henri Mager. Translated from the fourth edition of "*Les Sourciers et leurs Procédés*" by A. H. Bell. Pp. xi + 308 + 8 plates. (London: G. Bell and Sons, Ltd., 1931.) 16*s.* net.

THE origin of the divining rod is lost in antiquity, and man, in his efforts to peer into the unknown, has made use of this device from very early times. Not only has it been employed to locate water, valuable minerals and buried treasure, but also

in some instances to trace wrong-doers as well as to discover and diagnose disease in animals and human beings. In all its forms, it has been the "subject of much acrimonious discussion", as the "scientist has naturally shown an inclination to reject the reality of phenomena which he cannot explain on orthodox lines". It is noteworthy that the author considers he has at last discovered the physical causes of the movements of the rod, and concludes that they "are governed by the laws of electrodynamics as formulated by Ampère in 1820".

Apart from a general looseness of phraseology, the author puts forward what is perhaps the best case possible for the divining rod, and quotes a mass of apparently incontrovertible evidence of the reality of the water diviner's powers. It is, however, when he attempts a technical explanation of the behaviour of the divining rod, and a description of the methods employed, that his arguments become unconvincing.

As an up-to-date exposition of the application of the divining rod in all its forms to the location of water, and a description of the new methods recently introduced by the author, the book is both informative and interesting, but many of the statements and conclusions put forward lack conviction and will not be accepted by the physicist without further evidence.

Die experimentellen und theoretischen Grundlagen der Elektronenbeugung. Von H. Mark und R. Wierl. (*Fortschritte der Chemie, Physik und physikalischen Chemie*, herausgegeben von Prof. Dr. A. Eucken, Band 21, Heft 4.) Pp. iii + 126. (Berlin: Gebrüder Borntraeger, 1931.) 16 gold marks.

THIS monograph is, like others in the same series, an account of the subject which will be of use mainly to research workers in other branches of physics. After a short section on the theoretical basis of electron diffraction experiments, about eighty pages are devoted to the experiments themselves. Many of these will be familiar to readers of NATURE through references to them which have been made at various times in "Research Items" and elsewhere. The authors remind us, by their treatment of the subject, that the fundamental work in electron diffraction is now almost as well established as the methods of using X-rays; this, of course, is only natural, as much of the well-developed technique which had been acquired for X-rays was immediately applicable to the newer problems when they arose. Problems which could not be so treated, as, for example, diffraction by single atoms and by adsorbed films, presented little more difficulty, if any, owing to the present widespread knowledge of good vacuum technique.

There is a bibliography of papers up to April 1931, and the usual indexes. The book is, however, scarcely likely to come into the general use to which its merit would entitle it, as it is unjustifiably expensive for such a small production.

Physikalisches Handwörterbuch. Herausgegeben von Arnold Berliner und Karl Scheel. Zweite Auflage. Pp. vi + 1428. (Berlin: Julius Springer, 1932.) 99·60 gold marks.

IT is difficult to see how there can be a demand for a volume such as this, although it apparently exists, as we have here a second and enlarged edition. It falls between two extremes, and provides information which is too technical to be appreciated without a good knowledge of physics, and yet is not sufficiently detailed to be of much value to, say, an honours degree student. In the latter respect it differs markedly from its nearest equivalent in English, Glazebrook's "Dictionary of Applied Physics", which serves this purpose rather well. The list of contributors is, however, imposing, and promises an accuracy in their respective sections which is borne out by the perusal of a number of articles chosen at random. The articles are also, so far as can be judged in this way, reasonably up to date, and include such relatively new topics as wave-mechanics and Debye's theory of electrolytes. In one connexion it may have a quasi-permanent value—it may serve later on as a concise record of a good deal of the present state of knowledge in physics. The price of the book, although high, is not, one imagines, out of proportion to the labour involved in preparing it, and the binding and printing are, as is usual with Springer's books, all that could be desired.

The Automatic Stabilisation of Ships. By T. W. Chambers. Pp. x + 114 + 8 plates. (London: Chapman and Hall, Ltd., 1931.) 10*s.* 6*d.* net.

THE gyroscope has been applied to many purposes undreamt of by its distinguished inventor and were Foucault to visit the stabiliser-room of the Italian Atlantic liner *Conti di Savoia*, he would not know his own child, and would probably feel much as Faraday did when visiting a great chemical works. That ship of 45,000 tons is being fitted with three separate Sperry gyro-stabilisers, each of which has a wheel 110 tons in weight, which in order to keep the ship steady, will be revolved at 910 revolutions per minute. How the plant is constructed and fitted in the ship and how it is controlled and driven is fully explained in two articles in the *Engineer* for Jan. 8 and 15, 1932. Not long before, the same journal published a series of articles on the stabilisation of ships by means of water chambers and gyroscopes, and it is these articles which have been collected and published in this book.

Mr. Chambers deals clearly with both the theory of the gyroscope and the practical application of gyro-stabilisers and his book will, we believe, find its way into many shipbuilders' drawing offices. The subject is a fascinating one, and is but another example of a purely scientific invention which has been applied successfully to a practical engineering problem. E. C. S.

The Pioneer Work of the Systematist*

By The Right Hon. LORD ROTHSCHILD, F.R.S.

THE inquiry into the secrets of organic Nature may be divided into three categories of questions: (1) what organisms creative forces have produced on earth; (2) how they have produced them; and (3) what is the nature of the creative forces. It was at the time of Linnæus a comparatively simple achievement for one man to have enumerated all the animals then known, his "Systema Naturæ" of 1758 containing altogether fewer than 4300 species. That task is in our days a hundred times more difficult, not only on account of the vast number of species which have poured into collections, are still pouring in and will continue to do so for a long time, but also because research in systematics requires a much deeper knowledge of the morphology and bionomics of the animals classified. At the time of Linnæus and after, when systematics were in their infancy, individual specimens showing marked differences were as a rule diagnosed as representing distinct species, the unit called species being looked upon as essentially a constant.

Experience has now furnished a guiding principle in the facts that similarity does not necessarily mean relationship of the forms under observation, that dissimilarity is not necessarily evidence of specific distinctness, and that variability obtains in every species and every organ; and if these facts are kept in mind by the systematist, the reproach of superficiality often justly levelled at work in taxonomy can be borne with equanimity.

Variability is an essential character of everything alive. The concept of the constant species of former days is replaced by the concept of the flexible species, and the saying that like breeds like requires modifying into the statement that a population breeds a population with the same extent of variability. If like breeds like were being taken literally, we should have to alter it into like breeds unlike. For, strictly speaking, individuals are never alike whatever their relationship to each other. A calculation, for example, of the number of specimens required of the commonest British mouse-flea (*Ctenophthalmus agyrtes*) in order to find among them two absolutely alike in the number and position of the bristles on the body arrives at the amusing figure of many million billions, a figure certainly in excess of that of the whole flea-population of Great Britain, and tantamount to proving that there are no two specimens alike.

In studying the characteristics of each specific unit and drawing up diagnoses for purposes of recognition, the systematist renders service in two quite different spheres of work and thought. Being alone able to identify the species in the difficult group in which he specialises, he assists defensive biology in its task of safeguarding humanity against the ravages of health- or food-destroying organisms. Applied biology can only be a science if based on sound systematics. For example, when the Commission investigating bubonic plague in India had become definitely convinced that the plague was a rat disease transmitted to human beings through the agency of a particular species of rat-flea, no satisfactory explanation could be found why in Colombo and the city of Madras an outbreak of plague did not last long, although rats and rat-fleas abounded. The puzzle was solved when Dr. Hirst took the matter up and sent to my brother the flea material collected in the towns mentioned during a period when there was no plague and again when an outbreak occurred. The examination of the material proved that the flea ordinarily infesting rats at Colombo and at Madras was not (as the Commission had assumed) the plague-flea *Xenopsylla cheopis*, but *X. astia*, a very similar, but different species, which, by experiments, Dr. Hirst proved to be an inefficient carrier of the disease. When during the campaign in Mesopotamia camps became infested with rats, the British Museum could give the reassuring answer to an inquiry that there was no danger of a serious outbreak of plague, because the rat-fleas collected were *X. astia*, none belonging to *X. cheopis*.

The help which the systematist can extend to applied biology, however, is for him only a side-issue or a by-product; he is a student of pure science, devoting his time to the discovery of new species, of new connexions between them and of new facts bearing on the relation between the species and its surroundings, the driving force in this pursuit of knowledge being the irresistible attraction which the subject has for him.

The describing of new species and finding the right place for them in a given scheme of classification and the identifying of species may seem work of an elementary kind, necessary and useful, but nevertheless rather superficial. If systematics ended there, they might satisfy the collector perhaps, but scarcely the scientific mind. But this preliminary work is only a part of systematics. A natural classification is based on blood-relationship, and therefore entails an inquiry into the evolution of the species classified. Systematics change from a static study of form into a dynamic study of evolution. A species is like a book, which must be read critically and in its entirety. Unfortunately the systematist is much handicapped, as in the case of mammals, birds, insects and some other classes he has to be content with the portions of the animal which it is customary to preserve in collections. But even so, the contemplation of the skins and skulls of mammals, of the skins of birds, and of the dried insects reveals to him the

* From the presidential address to Section D (Zoology) of the British Association delivered at York on Sept. 1.

latitude and the kind of variability and variation in the species of which he has adequate material, and enables him to compare results with the biologists who have studied the flexibility of species with the view of ascertaining whether the variability is purely fortuitous or whether there is system in the apparent confusion, many so-called laws of development having been discovered in the course of such inquiries.

Now, according to the experience of the systematist, such laws are rules with exceptions, sometimes the normal and the exceptional balancing each other, and it may be stated in general that the opposite must always be expected to occur. Exceptions have a certain fascination, not only for the writers of novels and plays, which are mostly based on exceptional characters or exceptional situations, but also for the biologist. As exceptions are comparatively rare, it requires large collections or long observation to discover them, and if there is no known exception to a certain rule of development, one has the feeling that it will some day be discovered. Take as an example the gallinaceous birds; among these game-birds are found the most striking instances of sexual dimorphism, the cocks exhibiting an often marvellous display of colours, as in the peacock, pheasants, fowls and others, the females being comparatively inconspicuous. It is therefore somewhat startling to find just in this order a genus in which the colours and behaviour of the sexes are reversed. In most species of the Oriental genus *Turnix*, a kind of quail, the females are larger than the males, bear a much brighter plumage, utter the call-note, fight each other for the possession of a male, and leave it to the male to incubate the eggs and to take care of the young.

Of the two classes of animals which I have studied more particularly, birds and Lepidoptera, the coloration is on the whole more constant in birds within the species at the same locality, apart from differences of sex and age, than in butterflies and moths, and individual di- and polymorphism is decidedly more common in the insects than in birds, but it is by no means absent among the latter. Dark and light phases long known to occur regularly among certain raptorial birds, for example, harriers, have during recent years been discovered to exist also here and there in other groups of birds, where they have formerly generally been described as distinct species. Such a correction had also to be made in the systematics of the American genus *Rhamphocœlus*, where red and yellow forms differing only in colour are now regarded as being individuals of one species, intermediate examples of an orange colour also being known, as well as very exceptional examples, such as the aberration *Rhamphocœlus dunstalli* Rothsch., in which the red and yellow colours extend to parts of the body other than those normally so coloured. The gaily coloured parrots furnish other examples of dichromotism; for example, the parakeet, *Eos fuscata* Blyth, which is a fairly common bird in New Guinea, appears in a red and a yellow form in the same place, both forms being about equally frequent, the red one slightly preponderating, and the lory *Charmosyna stellæ* Meyer, which appears in a black as well as a red form.

Besides colour and pattern, the size and shape of the specimens and their appendages and the structure of the secondary sexual characteristics of many kinds are found to be of great help in species classification, but experience has shown that none can be relied on unreservedly any more than colour or pattern. The comparison of the frequently exaggerated distinctions of the males, such as the horns of stags and beetles, the long forelegs of beetles, the stalked eyes of certain flies, etc., has led to the discovery that the size of these organs is not always proportionate to the size of the body, but that the ratio in the development of such appendages increases disproportionately with the size of the specimens; in a small male of a species of Longicorn beetle the antenna may be a little longer than the body, while in a large specimen of the same species it may be several times longer than the body. Collections bear out this law of growth almost completely, but only almost. The stag-beetles are one of the families that have early directed attention to the remarkable development of their mandibles, which are sometimes so large, and the point of gravity therefore placed so far forward that the specimen has to assume a semi-erect position in order to keep its balance.

Such exceptions from general rules are of great interest, and it is therefore the duty of the systematist who comes across an exception—generally accidentally—fully to record it. Does it not seem evident from the cases mentioned that Nature can break a rule of development, just as Nature has created species and destroyed them? After all, the law is only our deduction based on the organisms we find provided by working methods of Nature we endeavour to discover. Circumstances may arise which interfere with the usual 'routine' of growth. The rule of growth illustrated by the stag-beetles, and corroborated by breeding of plants and animals, leaves no doubt that the characteristics in size and weight of an individual are not inherited and therefore are of no importance in the evolution of species. The test can be made in collections by comparing the closely related species of a genus with each other.

It must be clearly understood that in speaking of the unimportance for evolution of the bulk of individuals and the size of certain appendages, we referred to specimens of the same country, that is, individuals belonging to the same interbreeding population. In comparing the populations of two different countries the question assumes quite another aspect. In the systematics of birds the study of subspecies or geographical races has developed into a fine art. Size and shades of colour furnish the main distinctions between subspecies, and here we observe this important contrast that, while the difference of, say, 6 mm. in the wing-lengths of specimens from the same country is of

no importance, because not inheritable, the difference of 2 mm. between the populations of two countries is an inheritable quantity and therefore qualifies the two populations as being subspecifically distinct from one another. The evolution of the subspecific size-difference evidently starts with a shifting of the *average* size.

In our researches on the swallowtail butterflies we came across a combination of distinctions which is most instructive in an inquiry how the subspecies have come into existence. In a large number of species of butterflies and moths the geographical forms are separated by differences in the structure of the organs of reproduction and in colour and pattern. The important point is this, that the two sets of differences vary independently of each other within each subspecies.

The individual characters of the ancestral specimens do not influence the formation of the new race, only what is inheritable is of importance, and what is non-pathological and therefore adaptable to new and possibly less congenial surroundings.

Systematics and morphology are different expressions for the same kind of research, and I have no doubt that experimental biology will likewise have such a deepening influence on systematics that the superficial gap existing between the two lines of research will disappear too. Knowledge *begins* with the observation of phenomena, not with the experiment. The areas inhabited by the geographical forms of the species we have studied are either strictly separated, as in the case of island forms, or they are contiguous, there being between the areas no gap uninhabitable for the species, such as water would be for a dryland species, or a desert or savannah for a woodland species ; or the areas may overlap. What happens when the areas touch or overlap and the geographical forms come in contact with one another ? In a critical survey of the birds of Kenya Colony, lately published by Dr. van Someren in the Tring Museum periodical,[1] every now and again the author records the observation that perfectly distinguishable subspecies intergrade in the intermediate district, where the two evidently have interbred and produced an impure population, not strictly distinguishable from, or identical with, either present subspecies. The phenomenon occurs very frequently, as must be expected ; for the breaking-up of a species into geographical units cannot at once result in sexual aloofness. This, however, is a point which should be further investigated.

Not all geographical races amalgamate when they come together. Many of them have become so different that they can live side by side, each being an independent community not interbreeding with the other. Sometimes we find both amalgamation and specific distinctness among the forms divided from a parent stock, as is the case in the sister species cat-flea and dog-flea. The home of the genus *Ctenocephalides* to which both belong is Africa. Tropical and South Africa are inhabited by a subspecies with short head, and the Nile countries by one with a long head, the two intergrading in the Sudan and Uganda. From India to the Papuan countries, with the exclusion of Australia, a third race occurs, and in Europe and Central and North Asia the cat-fleas were represented by the flea occurring on dogs and wolves. When the Egyptian house-cat came to Europe, it brought with it the long-headed form of *Ctenocephalides felis* Bouché, which thereby came into contact with the palæarctic shortheaded dog-flea. One might have expected that they would hybridise and amalgamate, but they did not. The morphological differences are but slight, but a physiological barrier had arisen which kept and keep the cat- and dog-fleas as species, although they may occur together on the same individual of the host.

Systematics are not concerned with the study of species and their variations only. The species have to be grouped into genera and then into higher categories, all according to relationship, that is, according to descent. As in the study of subspecies the systematist must enter upon geography, so in the search for the past connexions between genera and families his research becomes linked with the past history of the earth and sometimes throws light on this history. If he can prove that two genera now widely separated geographically are really of common stock, then there must have been a means of communication in former times which is now absent. If I may draw again on my brother's studies for an illustration, we will take the distribution of the queerest-looking fleas as yet discovered, the Australian *Stephanocircus* and the American *Craneopsylla*, in which the anterior portion of the head is divided off as a laterally compressed helmet. They are closely related, and the group originated in South America, where occur several allied genera and a genus connecting the group with more normally built fleas. They are only found in the Andesian countries from Patagonia to Ecuador (possibly occurring farther north), and in a modified form as *Stephanocircus* in Australia, nowhere else. The assumption that there was at one time a bridge between South America and Australia is the only explanation at all satisfactory. This conclusion is supported by another genus (or group of genera), *Parapsyllus*, which is plentifully represented by species in the same Andesian countries (not in eastern Brazil, the Amazons and Guianas), and recurs in one species on the islands in the South Polar Sea and in southern districts of Australia. The distribution of both genera evidently took place from west to east.

Although the systematist is primarily concerned with the organisms as produced by Nature, and not with the creative forces which have evolved them, his researches extend to so many different species that he is bound to collect evidence bearing on those forces and their working. There are, in fact, many questions which can only be answered with the help of extensive systematic collections.

[1] *Nov. Zool.*, **37**, 292; 1932.

A New Indian Academy of Sciences

IN the fog of political turmoil in which India has for so long been enshrouded, the remarkable scientific developments which have taken place in recent years have been somewhat overlooked. To those acquainted with the conditions prevailing at the beginning of the century, when scientific research was confined almost solely to the specialist Government departments, such as the Survey of India or the Geological Survey, and to the two veterans, who are still happily with us, Sir J. C. Bose and Sir P. C. Rây, the present conditions must appear remarkable.

The scientific renaissance of India dates from the reorganisation of the universities about twenty years ago following on the report of the Curzon Commission. Prior to this the university colleges were little more than high schools, and even so late as 1910 it was possible to take a degree in physics without undergoing any laboratory instruction. With the introduction of honours courses and the consequential increase of staff, the value of scientific research was gradually recognised, so that at the present time the output of original work from the Indian universities compares not unfavourably with that of the West. An outcome of this development has been the formation of new specialist societies which may all be regarded as the offspring of the Indian analogue of the Royal Society, the Asiatic Society of Bengal, which celebrated its centenary in 1913. This old society, full of vitality as it still is, has the disadvantage that its influence is confined practically to Calcutta and its environs. In 1914 the Indian Science Congress was founded, a peripatetic body modelled on the lines of the British Association. This body met with immediate success as is testified by the large attendance at its meetings and the large number of scientific communications read before it. The Indian Science Congress does not, however, undertake the publication of these communications except in abstract, and a natural nationalist spirit, coupled with the long delay associated with publication in European and American journals, has resulted in the foundation of the Indian Chemical Society and of the *Indian Journal of Physics*.

The most recent development is the formation of the Academy of Sciences of the United Provinces, with its seat at Allahabad. A movement for the creation of an Academy was started by Prof. M. N. Saha in 1929, and advantage was taken of the meeting of the Indian Science Congress in 1930 in Allahabad to discuss the functions of the proposed Academy. As a result of the interest and sympathy shown it was registered in December of that year. The first volume of its *Bulletin* has now been published, and this contains an account of the inaugural meeting held on March 1. The main objects of the Academy, of which Prof. Saha is the first president, are the encouragement of science in its various branches, more especially in the United Provinces, and the publication of the results of scientific research, either in its *Bulletin* or in the form of *Transactions* and *Memoirs*. The membership of the Academy, as in the case of the Asiatic Society of Bengal, is divided into two classes, fellows elected for their scientific eminence, the number being limited to thirty, and ordinary members of whom no special qualifications are required. The successful inauguration of this body is welcome evidence of the increasing value now attached to scientific research in India, but it seems somewhat questionable if the publication of a new journal is desirable.

The first *Bulletin* contains twenty-seven original memoirs and it is divided into the following heads :—mathematics, physics, chemistry, industrial chemistry, zoology, botany and general. Under the last heading there is an interesting paper by Sir C. V. Raman on "Spin of Light". Many of the communications could with equal advantage have appeared in the *Indian Journal of Physics* or in the *Journal of the Indian Chemical Society*, and it seems likely that some of them will be published *in extenso* elsewhere, since they are only short abstracts and are so headed. Time will show if there is a real need for the *Bulletin*, but with so distinguished and energetic a president and with such admirable secretaries as Prof. P. S. MacMahon and Prof. A. C. Banerji, the future success of the Academy seems assured, and there is little doubt that it will do much to stimulate the research spirit in the Universities of Allahabad, Lucknow, Aligarh and Benares.

The Colloid Aspects of Textile Materials

EIGHT years ago, the Faraday Society made an interesting experiment in devoting one of its discussions to "Physical and Physico-Chemical Problems Relating to Textile Fibres". At that time the study of fibres was in its infancy, with an uncertain future, and all workers in the subject owe the Society a debt of gratitude for early encouragement during difficult years. Courageous patronage deserves a rich reward, and this the Society achieved in the outstanding success of the second discussion on "The Colloid Aspects of Textile Materials", which was held in the Chemistry Department of the University of Manchester on Sept. 21–23. The meeting was noteworthy for the number and distinction of its overseas visitors and contributors, among whom were included E. H. Büchner (Amsterdam), E. Elöd (Karlsruhe), R. O. Herzog (Berlin), G. van Iterson (Delft), J. R. Katz (Amsterdam), P. Krais (Dresden), H. Mark (Ludwigshafen), M. Mathieu (Paris),

O. Roehrich (Paris), S. E. Sheppard (Rochester, N.Y.), H. de Witt Smith (New York), H. Staudinger (Freiburg), and J. J. Trillat (Paris).

During the years which have intervened between the two discussions, textile fibres and related substances have been studied by a wide variety of methods, and whereas in 1924 the properties of fibres could be explained only in terms of mechanical analogies, a much closer molecular interpretation of fibre structure has now become possible. It is generally recognised that fibres are constructed from long-chain molecules in which a definite unit is regularly repeated. In the case of cellulose fibres, the macromolecule consists of a chain of glucopyranose units linked through positions 1 and 4, while the corresponding units in the case of protein fibres are -CO-CHR-NH- groups, the constituent α-amino acids being linked in this way to form a long peptide chain possessing side chains which vary in character according to the nature of the protein.

The real existence of such long-chain molecules has, in the case of cellulose, been demonstrated by Haworth using an ingenious application of the methylation technique. If the long molecules are not looped, hydrolysis of methylated cellulose must yield, in addition to trimethyl glucose, a small amount of tetramethyl glucose from the terminal glucose units. The relative proportions of the two compounds gives a measure of the length of the chain and its molecular weight. In the case of cotton cellulose the mean molecular weight was found to lie between 15,000 and 30,000. It is satisfactory to note that Stamm, using Svedberg's ultracentrifugal technique, obtained a value of 40,000, but Haworth's determination acquires exceptional significance because the molecular weight can be referred definitely to a single cellulose chain. By means of the ultracentrifuge, Svedberg has also determined the molecular weight of the monodisperse, soluble proteins and obtained values which were 1, 2, 3 or 6 times 34,500. Similarly, in the case of derivatives such as cellulose acetate, the beautiful technique used by Büchner in measuring osmotic pressure has given values of the order of 35,000 for the mean molecular weight. Herzog pointed out, however, that the cellulose acetate used was probably not homogeneous and in a case which he had examined, the crude product gave fractions varying in molecular weight from 20,000 to 140,000.

The point is important because Staudinger, from viscosity measurements with cellulose solutions, concluded that the molecular weight of cellulose was of the order of 120,000. The validity of his viscosity law for compounds of high molecular weight was the subject of detailed discussion, a point of difficulty being the insistence that the molecules must be regarded as long rigid rods. Evidence for their flexibility was adduced by Adam from the properties of monomolecular films of long-chain compounds on a water surface, and it was further indicated by Sidgwick and Rideal that flexibility of the chains need not invalidate the viscosity law. While some difference of opinion still exists as to the precise magnitude of the molecular weight of the long-chain molecules of animal and vegetable fibres, it is satisfactory that all methods agree in giving a molecular weight of the order of 30,000. That such widely different substances as cellulose and the proteins should have molecular weights of the same order of magnitude seems to suggest the existence of a common determining mechanism.

As regards the structure of the fibres composed of such molecules of high molecular weight, there has been a certain difference of opinion. On one hand, Mark has suggested that the molecules are arranged in bundles to form discrete micelles which are the secondary units of fibre construction. Neale and others see no necessity to postulate anything other than long-chain molecules which crystallise with varying degrees of perfection in the same fibre. Actually, there appears to be no essential difference between the two views, and a possible mode of reconciliation is to be found, as Astbury indicated, in Zwicky's recognition of a mosaic or secondary structure in the more familiar crystals. In the case of animal fibres at least, the real existence of micelles, less permeable to water than the fibre as a whole, has been abundantly demonstrated by swelling experiments which have been developed to give a measure of micellar thickness in good agreement with that derived from X-ray and other evidence. With reagents other than water, the micelle structure may be dispersed, as in the case of wool fibres in acid solution, but removal of acid results in its reappearance.

The swelling of fibres, as suggested by Katz, may therefore be intramicellar, intermicellar or permutoid. In the case of wool, rigidity experiments and X-ray studies have clearly indicated that swelling occurs both by intra- and intermicellar water adsorption, and it was argued from the hysteresis phenomena in Marsh's determinations of the influence of adsorbed water on the electrical conductivity of wool, that intra- and inter-micellar water must function very differently in conductivity measurements. A possible method of discriminating between the two was suggested, based on the fact that the first five per cent of water adsorbed by wool is intramicellar. Similar considerations apply to cellulose, and Miles and Mathieu agree in concluding that nitration of cellulose does not proceed on an impervious micelle, but that it is penetrated by acid and nitrates throughout its whole structure simultaneously.

As regards the existence of micelles in solutions of cellulose and its derivatives, Adam showed that the ethers spread completely on water and if micelles exist in the original solution, cohesion is insufficient to prevent the formation of a monomolecular film. The esters and nitrates, on the other hand, showed incomplete spreading, while cellulose in cuprammonium solution was precipi-

tated and not spread on water. Thus no decision can yet be made as to whether or not the micelles of cellulose retain their existence in solution.

Cohesion within the micelles of the wool fibre was shown to depend partially on salt formation between the acid and basic side linkages of the long chain molecules, as well as cystine linkages which are far more resistant to chemical attack. By analogy with the proteins, Mark was led to hint that the subtle differences between native and treated cellulose might depend on similar cross-linkages between the long-chain molecules of native cellulose, such linkages being opened by subsequent treatment. His hypothesis must be regarded as an extension of the views of Neale, who discriminated between two methods of modifying the properties of cellulose—by reactions which alter the reactivity of the hydroxyl groups associated with the long molecules, and those which modify the properties of cellulose by fission of the glucose chains.

In the case of wool and related fibres, the side linkages which have been identified as salts of arginine and glutamic acid, play an important part in determining the configuration of the long peptide chains. These have been shown by Astbury to be coiled into a series of pseudo-hexagons, whereas the peptide chains of silk are normally in the extended form. Since the side chains of silk are mainly non-reactive, it is reasonable to refer the coiled character of the peptide chains in wool to the endeavour of the more reactive acid and basic side chains to realise a condition of minimum potential energy by salt formation. Actually, a regular transition exists from silk with non-reactive side chains, through wool with salt-forming linkages, to feather which, according to Astbury, consists of long peptide chains bridged across by true peptide linkages. The importance of such side chains in determining the physical and chemical properties of proteins has now been fully recognised. For example, Miss Lloyd emphasised the part played by their length and reactivity in determining the extent of protein hydration and swelling. Similarly the salt linkages of wool are of fundamental importance in dyeing processes, and if Elöd's exhaustive application of the Donnan theory of membrane equilibria to the dyeing of wool with acid dyes is combined with the recognition of salt linkages, a precise interpretation of the mechanism of dyeing is possible. There can therefore be no doubt that the ingenious technique developed by Hughes for the study of protein films on water will prove invaluable as a simple and direct method of determining the properties of the fundamental long-chain protein molecule and its associated side chains.

J. B. SPEAKMAN.

News and Views

The Wren Tercentenary Celebrations

SIR CHRISTOPHER WREN was born at East Knoyle, Wiltshire, on Oct. 20, 1632; and to mark the three hundredth anniversary of his birth a special service will be held in St. Paul's Cathedral on Oct. 20 at 4 P.M., and will be attended by the Lord Mayor and Sheriffs in state, and by representatives of the Royal Society, the Royal Academy, the Royal Institute of British Architects, the London Society, the Wren Society and other bodies. The service will be broadcast. The Dean and Chapter are also arranging an exhibition of portraits, models, documents, relics, etc., in the Trophy Room in the Cathedral which will be opened by Sir F. G. Hopkins on Oct. 10, and will be open to the public from Oct. 16 until Nov. 12 at 11 A.M. to 4 P.M. Though it was the rebuilding of the City of London after the Great Fire of 1666, which gave Wren a unique opportunity of displaying his genius as an architect, he had even before then designed the Pembroke College Chapel, Cambridge, and the Sheldonian Theatre, Oxford. His plans for rebuilding the City of London with a series of streets crossing each other at right angles, it is true were not adopted, but he was responsible not only for the design of St. Paul's Cathedral but also for the plans of some fifty churches, besides the Royal Exchange, the Custom House, Chelsea Hospital, Hampton Court, Greenwich Observatory and Buckingham Palace. The first stone of St. Paul's was laid on June 21, 1675, and the last stone set in 1710, thirteen years before Wren's death, which occurred on Feb. 25, 1723.

Wren's long life covered a part of the reign of Charles I, the period of the Commonwealth, the reigns of Charles II, James II, William and Mary, Anne, and the first nine years of the reign of George I. With the great social and political movements of the time he had little to do, but he will always be remembered as a distinguished man of science and England's greatest architect. From the days he was taught by Busby at Westminster School and came under the influence of Wilkins at Wadham College, Oxford, he gave evidence that he possessed unusual powers of mind, and at Oxford he quickly took a place among the devotees of science through whose efforts the Royal Society was founded. Like most of his contemporaries he made experiments in many branches of physics, and was particularly noted for his mechanical skill. At the age of twenty-five years he was appointed to succeed Rooke in the chair of astronomy at Gresham College, London, and four years later he succeeded Seth Ward as Savilian professor of astronomy at Oxford. This post he still held when he began his great career as an architect. The Royal Society was indebted to him in many ways. It was he who drew up the preamble to the charter of incorporation granted by Charles II in 1662; in an address in 1664 he urged the members not to flag in their efforts for it should be the aim of the Society to "plant Crabstocks for posterity to graft on", and when deeply engrossed with plans for a dozen churches he yet found time to serve as president. Many tributes to his genius

have been paid, and here it may be recalled that Newton placed him beside Wallis and Huygens as one of the leading geometers of the age.

Sir Philip Magnus, Bt.

THE many friends of that veteran educationist, Sir Philip Magnus, Bt., will be interested to learn that on Oct. 7 he celebrated the ninetieth anniversary of his birth. Sir Philip attended University College School, London (possibly he is now the oldest of its scholars), graduating afterwards at the University of London. He was secretary of the City and Guilds of London Institute from 1880 until 1888, and within this period was a member of the Royal Commission on Technical Instruction. Afterwards, for some thirty years, he was superintendent of the Department of Technology, City and Guilds of London Institute. Long devoted to the interests of the Royal Society of Arts, Sir Philip was elected its chairman of council in November 1927, succeeding Sir Thomas Holland. An inaugural and most comprehensive address delivered in that capacity was entitled, "The Royal Society of Arts : its Services to Trade and Training".

Prof. H. L. Le Chatelier

CONGRATULATIONS are also extended to Prof. Henry Louis Le Chatelier, the distinguished French chemist, who this week (Oct. 8) celebrates his eighty-second birthday. Elected a foreign member of the Royal Society in 1913, the distinction of the Davy Medal was conferred on him in 1916. As the result of prolonged investigation, he introduced the Le Chatelier thermoelectric couple, and inaugurated a new period in the measurement of high temperatures. One of the pioneers of micrometallurgy, he was among the first to provide exact methods in the science of industrial silicates. His scientific work has always been closely related to practical applications. Prof. Le Chatelier is the author of many memoirs and papers in scientific journals.

The Gregorian Reformation of the Calendar

THIS week is the 350th anniversary of the reform of the calendar ordained by Pope Gregory. The day following Oct. 4, 1582, was called Oct. 15. It is not always remembered that, in addition to the calendar changes, greatly improved lunar tables were introduced for the purpose of computing the date of Easter. An article in the *Southwark Record* notes that the necessary calculations were executed by Luigi Giglio (Aloysius Lilius), Ignatius Danti, and Christopher Clavius. It also points out that the ten days stolen from October are now being slowly repaid, as the 'Summer Time' reckoning gives October an additional hour each year.

Lighting of Picture Galleries

MANY visitors to picture galleries must have noticed that pictures are often hung on the walls of most galleries in such a way as largely to defeat the very object for which these expensive institutions exist. It is about 120 years since Prof. Henry in America first directed attention to the need for collaboration between architects and men of science in planning buildings suitable for music and speech. Gradually the inertia of professional conservatism in this matter has been partially overcome ; there remain, however, important optical problems relating to the lighting of rooms in which pictures are to be displayed. Here the physicist can help, and already authorities in London are making experiments. At the Tate gallery, for example, may be seen the advantage of hanging pictures on only one wall of a room, and various schemes of artificial lighting are being tried at the National Gallery itself. It is now generally agreed that pictures in London should be glazed if only to keep them clean and free from deleterious gases. But there are other reasons too ; experience has shown that enthusiasts cannot refrain sometimes from touching a canvas, and that pins or other things projecting from the headdress of lady visitors to a gallery have been known to scratch the pictures and do incalculable damage. Since it is the practice to hang all pictures flat against the walls, the reflection of those on the opposite wall, as well as that of an observer, frequently renders it very difficult to make out detail in a painting. For example, in Room 25 of the National Gallery, Trafalgar Square, the large equestrian portrait of Charles I reflects well all the other pictures in that room, a good deal of the roof and the large and extremely ugly warming device and seat in front of it.

Reflection from Glazed Pictures

IN directing attention to the question of avoiding reflection from glazed pictures, Mr. Robert Howden has rendered a useful service both to artists and the public. His paper, read before the Royal Society of Arts on Oct. 3, clearly stated the elements and difficulties of the problem, and it is significant that Sir Edwin Lutyens was in the chair. Mr. Howden recommends replacing the usual flat glass by a sheet bent into a parabola. The adaptation of this device to shop fronts has recently been developed by Mr. G. Brown, and the effectiveness of such a scheme may be seen by viewing the interior of a motor show-room at 88 Regent Street, London, through the curved plate glass windows. No reflection of the street can be seen and only the contents of the show-room is visible from without, so that the window itself does not seem to exist. If this could be applied to pictures in public galleries, it would indeed be a boon. But there is the question of cost and the ever-haunting thought that perhaps some other and simpler solution of the problem may not be out of reach. In order to be effective, pictures hung high up would require a different curvature of glass from those on a level with the eye, and then all the varieties of sizes and shapes of canvases or panels would offer further difficulties. Would it not be as well to try first the simple device of tilting the pictures a little forward ? Why is that not done in the public galleries ? We think this would at least be an improvement on existing conditions and, if sufficiently successful under the usual system of lighting, the walls of new galleries could be built so as to lean a little

inwards. It might be worth while to construct a light wooden framing that would cover one of the smaller walls of the National Gallery, to hang upon it pictures with dark backgrounds and then to tilt the screen forwards and note the improvement in visibility under the conditions of top lighting in use there.

Museum Improvements

Two articles of real value to museum curators appear in the *Museums Journal* for September. The first, by Dr. L. J. Spencer, discusses the artificial lighting of museum cases, and recommends the use of strip lights along the upper portion of the case, and the painting out of shadows cast by solid shelves. The assumption in such a case is that ordinary daylight lighting is ignored. Diagrams illustrate some of the cases of minerals in the British Museum lit by the method described, one tall (10 ft.) case showing a specially neat method of making use of the otherwise useless upper portion, by the fitting of transparent pictures illuminated from behind. In a second article, Mrs. Jean C. Stevens suggests a way of replacing the very expensive jointed figures used (where they can be afforded) for the display of costumes. With a little ingenuity effective figures can be made at a small cost, with cylinders of rabbit netting. The cylinders, head, arms, body, etc., can be 'bent' into shape as desired, and in proper position can be supported by strengthening struts of wire or wood. If the illustrations represent the results of this process, the home-made figures should find a comfortable home in many a museum, impoverished or otherwise.

British Commercial Gas Association

THE British Commercial Gas Association, founded for co-operative publicity effort in the gas industry, held its coming-of-age meeting in Leeds during the past week. Prince George, after seeing something of the manufacture of gas and gas appliances in the city, attended the dinner on Tuesday evening and gave an interesting review of the achievements of the industry. Major Geoffrey Kitson, in his presidential address, set forth further particulars of the present conditions, stating among other things that there are now five million 'slot consumers' on the books of the industry; that £180,000,000 of money and a yearly consumption of 18,000,000 tons of coal, are involved; and that 100,000 workmen are employed. He alluded to the advances being made in new directions, and in the afternoon, Mr. A. W. Smith, general manager and secretary of the Birmingham Gas Department, stated in his paper that authority has been obtained from the Home Office to run a test vehicle on the road with special steel cylinders containing gas at a pressure of 3000 lb. a square inch. It is hoped that gas so supplied may also be used for country houses and farms in districts remote from gas mains.

The executive chairman, Sir Francis Goodenough, at the opening of the Conference, spoke of the difficult days sure to follow upon the completion of the electricity grid, controlled by the Central Electricity Board. He foresees a desperate effort to get business for the grid "backed up more and more from Whitehall". It was in the gas industry that Sir Francis gained his first laurels as an authority on salesmanship and he insisted on the importance of perfecting the commercial side and of practising individual as well as collective enterprise. Major Kitson, who is chairman of the Leeds City Gas Department, urged the importance of gas and electricity, by co-partnership and concentration, setting themselves at once to achieve a national ideal of service in the most economical extraction of the potential heat, light and power from the great reservoir of energy—our sole native source—the coal fields. If the spirit and demeanour exhibited by Major Kitson prevailed more generally it would be a matter for congratulation. Extravagant *ex parte* statements by the advocates of the two agencies where their services overlap are greatly to be deplored, and they appear to be increasing. Among other things it is to be remembered that the exact measurement of the efficiency of heating appliances is still a subject of difficult scientific investigation. It is appropriate to say that in this and other technical problems, the University in the city where the Conference was held has long co-operated in a fruitful way with the Institution of Gas Engineers and that it has a chair of coal gas and fuel industries founded as a memorial to a great gas engineer, the late Sir George Livesey. In this and one or two other university centres in Great Britain, the scientific education of the gas engineer is now seriously taken in hand and is producing a long-needed type of recruit.

International Scientific Investigation of Population Problems

THE first World Population Conference was held under the auspices of the International Union at Geneva in 1928 and the second Conference at London in 1931. The proceedings of these Conferences have been published. In addition, three standing committees organise and to some extent subsidise research (The International Union for the Scientific Investigation of Population Problems: its Foundation, Work, Statutes and Regulations. Pp. 28. London: c/o Royal Geographical Society, 1932). It might perhaps be a matter for debate whether the results so far published justify a new and cumbrous organisation. But it is another matter when we take into account the value of an attempt to look at population problems from an international angle. All population problems have two aspects—a domestic and an international. The problem of emigration is a case in point. It may be that too much importance has been sometimes attributed to population movements, when, for example, war has been traced to over-population. But there can be no doubt that in many subtle ways population movements do affect international relations very profoundly. Thus if the Union can keep international aspects to the front, it will be justified whatever may be the value of the research which it directly advances. It may perhaps be said that in the long run the successful

ordering of world affairs will depend upon the international handling of such matters as emigration and others with which the Union deals, and it may be hoped that the Union will prosper under the chairmanship of Sir Charles Close, who has succeeded Dr. Raymond Pearl in that office.

Greek Earthquake of Sept. 27–28

DURING the night of Sept. 27–28, a severe earthquake occurred in the Chalcidice district of Greece. Seven villages were entirely destroyed, more than 3000 houses were ruined, and 141 persons were killed and 403 wounded. In Salonica, several of the public buildings were damaged. From the brief accounts so far received, the epicentre seems to lie between Salonica and Mount Athos. Montessus, in his "Géographie Séismologique" (p. 253), defines three seismic zones in this part of Greece, near the towns of Salonica, Izvoro and Kavala, respectively, the recent earthquake being probably connected with the second of these zones. The shocks were strongly felt in Bulgaria, in the Strumitza valley, in or near which the great earthquakes of April 14 and 18, 1928, occurred, but the epicentres of these earthquakes lay about eighty miles to the north of the area recently disturbed.

West Indian Hurricane Season of 1932

THE West Indian hurricane season of the present year will rank as one of the notable ones, since two storms of the first magnitude have already been reported. The particulars of the more recent of these that have appeared in the *Times* of Sept. 28 indicate a phenomenon of an intensity very much above the average, the speed of the wind being said to have reached 120 miles an hour at times in Puerto Rico on Sept. 27, where at least two hundred people have been killed. The storm is said to have been even more destructive there even than that of Sept. 13, 1928, and to have been the worst in the island's history. An official figure for the maximum speed of the wind will unfortunately not be available owing to the fact that the anemometer on the roof of the Weather Bureau at San Juan was destroyed with the tower on which it was mounted. The particulars given of the track do not indicate anything very abnormal. Many September storms pass to the south of San Domingo, as did the recent storm; they generally move towards west-north-west. In this case, however, the centre passed near the Virgin Islands and was on Sept. 28 apparently moving directly towards Jamaica, which suggests a nearly due westward motion. Such tracks are more common in August than in September and have generally passed close to the north coast of Yucatan to Mexico, without having begun the 'recurve' to a north-eastward movement characteristic of northern tropical hurricanes, which carries so many West Indian storms into the Gulf States.

Cloudburst near Bakersfield, California

A CLOUDBURST is reported to have occurred late in the night of Oct. 1 near Bakersfield, California, and to have caused water to advance like a tidal wave 40 feet high down a narrow cañon, sweeping away fifteen bridges, destroying railways and overturning locomotives, with considerable loss of life. Bakersfield lies within the American counterpart of the northern Sahara and the subtropical deserts of Arabia and Persia. The disaster must have occurred within or very near to an area with a mean annual rainfall of less than ten inches, which makes it appear at first sight the more remarkable. Cloudbursts are, however, regarded by meteorologists as nothing more than extreme examples of 'instability rainfall' of the thunderstorm type—they are in fact often accompanied by thunder—and their incidence in normally dry regions has therefore nothing very anomalous about it. The disastrous floods at Louth (Lincolnshire) on May 29, 1920, due to an exceptionally severe thunderstorm combined with an unfortunate accidental blockage of the narrow valley down which the water might otherwise have passed with little damage, occurred in one of the driest parts of the British Isles. The extent of the damage is often governed by such accidental circumstances, and it is interesting to note that a fall of rain at Cranwell (Lincolnshire) on July 11 of this year almost exactly equalled the heaviest fall measured in and around Louth on May 29, 1920, and came in a shorter time, without disaster.

Climatic Changes in Central Asia

THE theory that Central Asia, particularly the Tarim basin, furnishes evidence of progressive desiccation during historic times is refuted by Lieut.-Col. R. G. F. Schomberg in a paper on alleged changes of climate in Southern Turkestan in the *Geographical Journal* for August. Lop Nor, he maintains, is not drying up. Its change of level is due to the loss of the Qurug River water. That river changed its course and though its waters reach the lake they do so by a longer course via the Tarim River and so presumably are partly lost on the way. The Qurug is said now to have returned to its old course. Col. Schomberg gives reasons for denying that any of the rivers are drying except where increased cultivation calls for more irrigation water. He lays no value by the so-called evidence of depopulation in a land where the population is always sporadic and insecure. Dust storms, moving sand, and insect pests may easily cause abandonment of peopled sites. He denies that the many dead *toghraqs* or desert poplars necessarily imply want of water. Sometimes they are killed by the rapidly growing tamarisk, sometimes by disease and sometimes even by too much water. The paper is full of valuable arguments bearing on this much-debated problem.

New Antarctic Lands

AFTER about a century's neglect the Enderby Land area of Antarctica was revisited in the summer of 1929–30 by Sir Douglas Mawson in the *Discovery*, of the British, Australian and New Zealand Antarctic Research Expedition, known for convenience as B.A.N.Z.A.R.E. The *Discovery* continued her work

in 1930–31. A map of the numerous discoveries accompanies a paper by Sir Douglas Mawson in the *Geographical Journal* for August. Mawson's map extends from about long. 45° E. to long. 75° E. Along almost the whole of that extent the coast line is now charted, and a number of prominent peaks have been fixed. During roughly the same period the Norwegian vessel *Norvegia* was in the same waters. Their map with less detail is published in a paper by Major G. Isachsen in *Norges Svalbavd og Ishavs-undersökelser, Meddelse* Nr. 12. The two maps overlap east of Enderby Land and the names are different. There was, however, an agreement between the two explorers, Sir Douglas Mawson and Captain Riiser-Larsen, made in a meeting in antarctic seas, to regard the meridian of long. 45° E. as roughly dividing their respective spheres of work. The *Discovery* thus limited her work towards the west. It is to be hoped that the confusion of two sets of new names will not be perpetuated.

Scientific Investigations in East Greenland

GOOD progress is reported in the Danish three-year programme of scientific investigations in East Greenland, which began last year under the direction of Dr. Lauge Koch. The entire expedition comprised 96 members and they had at their disposal two ships, twelve motor-boats and two aeroplanes. Twenty-six members of the expedition are spending the winter in Greenland: the others returned to Copenhagen on Feb. 19. According to the *Times* of Sept. 21 Dr. Koch announces that already 240,000 square kilometres of the east coast lands between lat. 70° and 77° N. have been surveyed largely with the help of aeroplanes. Important geological investigations have been carried on around King Oscar and Franz Josef fjords. During the coming winter the chief bases are to be at Scoresby Sound, Ella Island, Clavering Island and Hochstetter Sound. Each station will be provided with wireless and will serve as a base for seaplane flights as well as ground survey parties. Hydrographical investigations were also carried out in coastal waters and will be continued next summer. Biologists are attached to each field party.

Relevelling of London

THE adoption of the Newlyn datum for Ordnance levels in place of the old Liverpool datum involved a change in levels on the Ordnance maps throughout Great Britain. The difference, however, is not constant owing to errors due to imperfections of instruments in the past. In certain areas surface movements may also be responsible. A network of relevelling along twenty-one lines was completed for the London area in March 1932, involving about 2400 bench marks between Hemel Hempstead and Ware on the north, Godstone on the south, Windsor on the west, and Stroud and Chelmsford on the east. The new heights, as well as the old, with the location of the bench marks, are published in advance of the sheets involved in a volume entitled "Relevelling of London, Abstracts of Secondary Lines" (Ordnance Survey 1932, 7*s.* 6*d.*) The difference between the old and new levels appears generally to be about a foot or a little more, the new levels showing the reduction.

Aerial Photography in Map-making

THE progress made of late years in topographical surveying by means of aerial photography is strikingly illustrated by a recent report from the Canadian Department of the Interior. The Dominion of Canada with its vast expanse of hyperborean territory, the accessibility of which is rendered extremely difficult by the physical conditions, has proved a splendid field for this modern method of planimetry. Within the last decade, a total area of 402,500 sq. miles has been covered by aerial photography, comprising 125,000 sq. miles by vertical photographs and 277,500 sq. miles by oblique photographs. Vertical photographs are serviceable for mapping to fairly large scales, or in districts where the country is rough and mountainous, while oblique photographs are more particularly adapted to the exploratory mapping of extensive areas of forest and lakeland of fairly uniform level, such as constitute so large a proportion of northern Canada. Indeed, the oblique method is known as the Canadian method and has been adopted in other countries where the conditions are similar. Its moderate cost, flexibility and the small amount of ground surveying required render it particularly applicable to northern latitudes. During the last ten years, forty map sheets on a scale of four miles to the inch, each covering an area of 5,000–6,500 sq. miles, and three map sheets on a scale of eight miles to the inch, each covering an area roughly four times as great as the 4 mile-inch maps, have been compiled from oblique photographs and published in a National Topographic Series designed to cover eventually the entire area of Canada. Other map sheets have been issued which have been compiled from vertical photographs on larger scales of 1 or 2 miles to the inch.

The Worker's Point of View

THE *Human Factor*, vol. 6 No. 8, contains an article by Mr. Louis Katin, a non-apprenticed workman, on "Craft Distinction in the Factory". He demonstrates the importance within the factory of the 'class-feeling' arising over apprenticeship. He explains the worker's prejudice against non-apprenticed companions as due to pride of craft, collective desire to produce better work than any other factory, and consequent dislike of anyone likely to lower general efficiency. He suggests that apprenticeship should be compulsory for all boys leaving school, and possible, without indentures, for those already in the industry. The employer should then make sure that each was taught by a skilled foreman. He cites as difficulties parental disapproval, the length of time involved, and the trade union and employer agreements which unduly limit the number of apprentices in some trades. Yet he thinks that the three parties concerned, consulting with the young people, should find a solution, and with the facilities now afforded by the technical schools the term of apprenticeship might be shortened. Mr. Katin deals convincingly with apprenticeship as a source of disharmony and

social differentiation amongst the workers. It would be interesting to have his opinion on the formidable social hierarchies still to be found in factory and business organisations where apprenticeship is non-existent.

University of the Witwatersrand Fire

WE are glad to learn from Dr. W. Cullen, honorary secretary of the committee formed to restore the library of the University of the Witwatersrand, which was destroyed by fire last Christmas Eve, that satisfactory response has been made to the appeal for funds and books. So far, about 6000 volumes have been despatched to the University and 4000 have still to go. Mr. J. G. Gubbins, whose name is most intimately associated with the 'Africana Collection', has been in England for several months and, as a result of his efforts, a very remarkable collection of historic material connected with South Africa and the Rhodesias has been brought together, which, if circumstances permit, will be exhibited in London this autumn. Lieut.-Commander Tufnell, nephew of Mr. Gubbins, has generously given £500 for some exceedingly rare books and prints which Mr. Gubbins has procured for South Africa. The committee has also received from the Imperial Chemical Industries and its subsidiary companies a very useful donation of 1000 technical and scientific books, and from Lord Melchett the residue of his late father's library, which numbers about four hundred volumes. The University authorities have informed the appeal committee that, though funds are limited, they have decided to start building the new fire-proof library, but will only complete it as the necessary money becomes available.

The Children's Museum in Brooklyn

THIS interesting venture made unprecedented growth and expansion in attendance and activities in 1931. The city's effort to find emergency employment resulted in a welcome temporary addition to the workers, who at one time numbered so many as a hundred. The Museum has three main aims: to give children joy and satisfaction through wholesome activity; to make their education fun; and to give them a consciousness of ability to succeed (Museums of The Brooklyn Institute of Arts and Sciences—Report for the Year 1931). It follows these aims through six divisions of activity—lectures, docentry, loans, boy scouts, mineralogy and the library—and much ingenuity is shown in the methods of laying hold of the childish interests. For example, there is the jig-saw puzzle section, where the puzzles, made in the Museum and related to the exhibits, now number 1000, and were used by 111,727 children. But this ploy demanded a preliminary, and we are told that one coloured woman, Estelle Hall, presided at the washing of 143,577 pairs of [coloured] hands in preparation for assembling puzzles and handling books. The loan division now owns 3812 exhibit cases, many boxed by emergency workers, and during the year these loans made 2,350,260 contacts in the 688 schools which borrowed them.

Extension of the Piccadilly Railway

THE Piccadilly railway originally ran from Hammersmith to Finsbury Park, a distance of 8½ miles through the centre of London. It is now being extended and on completion next year will be 25 miles long and will run from west to north across Greater London. The section from Hammersmith to Acton Town has been running for some weeks. The section from Finsbury Park to Arnos Grove, Southgate, was opened on Sept. 19. Each station with the exception of Arnos Grove is fitted with three escalators. The running of the trains will be notified to passengers by 'describers' showing the destination and the stations at which stops will be made. Although there are twelve different stations, only two connecting wires are required for operating the describers. A 2¾ minutes service will be run to and from Wood Green and a 5½ minutes service to Arnos Grove. This requires 347 trains each way between Wood Green and Hammersmith and made it necessary to provide 275 new cars. The motor cars are equipped with two 240 horsepower motors and the average speed including stops is 25 miles per hour. The electrical energy is obtained on the three phase system from the North Metropolitan Electric Power Supply Company. There are three substations each of which contains three 1500 kilowatt mercury arc rectifiers for converting the power to the direct current system required by the motors. These converters have been made by the British Thomson-Houston Company at Rugby and embody improvements. The line is equipped with automatic signals of the colour light type. These are controlled by track circuits and provided with train stops.

Announcements

IT is announced that Dr. G. C. Anderson, deputy medical secretary of the British Medical Association since 1919, has been appointed medical secretary of the Association in succession to Dr. Alfred Cox, who has retired.

THE following awards were made at the Council meeting of the Royal Aeronautical Society held on Sept. 20: Silver Medal, to Senhor Juan de la Cierva, for his work in connexion with the development of the autogiro; Simms Gold Medal, to Mr. P. Salmon, for his paper and work on catapults; Wakefield Gold Medal, to Mr. L. G. Frise, for his invention of the Frise aileron; R.38 Memorial Prize, to Mr. D. H. Williams and Mr. A. R. Collar for their joint paper on "The Motion of an Airship under Certain Conditions"; Pilcher Memorial Prize, to Mr. Dowsett, for his paper on "The Design of Aeroplane Controls and Control Systems".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant investigator in the Safety in Mines Research Board tenable at Sheffield—The Under-Secretary for Mines, Establishment Branch, Mines Department, Cromwell House, Dean Stanley Street, Millbank, London, S.W.1 (Oct. 22). A biochemist at the Queen's Hospital, Birmingham—The House Governor (Oct. 31).

Letters to the Editor

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

Fertility of Bees and Vitamin E *

THE question arises as to how in the bee colony certain larvæ are turned into queen bees with extraordinary powers of fecundity while the larvæ which become worker bees normally are sterile. The larvæ start equal, for both queen and worker larvæ are incubated from fertilised eggs, and it is known that a worker larva not more than three days old can be converted into a queen. The suggestion was made by one of us that the larva destined to be a queen bee was given a diet rich in vitamin E which is necessary for fertility, while this vitamin was withheld from the worker larva. The queen larva is fed solely on what is termed 'royal jelly', and when the queen is actively laying (for example, 2000 eggs a day) she is fed by her attendants with the same rich food. Royal jelly is generally accepted as being a secretion from the pharyngeal glands. Worker larvæ are supposed to be fed on royal jelly up to the age of three days when they are weaned on a diet of honey and pollen. According to von Planta (Cowan's "Honey Bee") the larval foods of the bees have the following average composition :

	Albumen. (per cent)	Fatty Substances. (per cent)	Sugar. (per cent)
Queen	45·14	13·55	20·39
Worker			
Under 4 days	53·38	8·38	18·09
Over 4 days	27·87	3·69	44·93
Average	40·62	6·03	31·51

To try to prove whether royal jelly contains an amount of vitamin E which is not present in honey and pollen the following research was undertaken :

Ten young female rats in separate boxes with their first new-born litters were put on a vitamin E-free diet on May 20, 1932. The diet was prepared in the chemical department of British Drug Houses Ltd. and a sufficiency of yeast and cod liver oil was added to keep the rats in good condition and maintain the growth of the young. It was considered that by suckling their young up to the weaning period the mothers would be drained of any store of vitamin E in their bodies ; experience has shown that the power of such mothers to breed is lost by the continued feeding on the vitamin E-free diet.

On May 26 mother rats (1 and 2) with their young were given in addition each day about 2 gm. of pollen and honey, while mother rats (3 and 4) and their young received about 2 gm. of honey and pollen a day, the pollen in this case having been first soaked in honey and water for 24 hours. The rats eat the pollen and honey well. On June 27 a supply of royal jelly (queen bee food) collected from colonies about to swarm was available, and mother rats (5, 6 and 7) and their young were given about 0·05 gm. of this jelly in addition to their diet. The royal jelly was put at the back of the tongue of each rat so that it was all swallowed. It was soon realised that the supply of royal jelly would not be adequate for these mothers and their young, so on July 6 the young were removed, and the experiment continued on the mother rats alone ; the young from the other mother rats were removed also. Mother rat (9) had killed her litter soon after birth : from July 6 onwards she was given in addition to the vitamin E-free diet about 2 gm. of worker larvæ bee comb, so that she got both the young larvæ and their food to eat. Mother rats (8) and (10) were kept as controls on the vitamin E-free diet without any addition from the hive.

Healthy bucks kept during the night on a normal diet of bread and milk, oats and green food, were from now onwards put to the mothers during the day time ; the bucks were changed so that every mother rat had an equal chance of fertilisation.

On July 29 one of the royal jelly rats had a litter of five healthy young. She killed these after two days' suckling. The supply of royal jelly having now given out, on Aug. 3 any addition of honey and pollen was also stopped. A few days later another of the royal jelly rats had a litter of fully developed young, but killed them just after birth. One of the other mother rats which had received an addition of pollen and honey to the diet was found with one immature dead fœtus. All the others having failed to conceive, the experiment was stopped on Aug. 12. Each of the mother rats had increased in weight during the experiment, the royal jelly rats by about 25 gm. each, the others by 30–38 gm. and all were in good condition at the end.

The results show that the daily addition of about 0·05 gm. of royal jelly during one month effected the production of two full term litters among three rats, while the addition daily during two months of 2 gm. a day of honey and pollen or for one month of worker larvæ comb was ineffective, only one immature fœtus being produced among five rats.

It is proposed to continue the research next summer, but the evidence so far appears to justify the conclusion that the bees add vitamin E to royal jelly, on which queens are raised, and withhold it from worker larval food. It is surmised that the vitamin is obtained from pollen and concentrated by the workers possibly in the secretion of their pharyngeal glands, which may produce royal jelly.

These experiments may open up a new avenue of research for bee-keepers and lead to better agreement on matters appertaining to the biology of the honey bee (*Apis mellifica* L.).

The expense of this research has been met by a grant from the Royal Society Government Grant.

LEONARD HILL.
E. F. BURDETT.

* From the laboratory of the London Light and Electrical Clinic.

Constitution of Cholesterol

ON account of the biological importance of the sterols and bile acids, and the relation of the group to vitamins and hormones, particular interest is attached to a knowledge of their molecular structure ; and I have recently reviewed the whole of the chemistry of these substances from the point of view of the hypothesis that the carbon skeleton of cholesterol is terpenoid, that is, made up of isoprene units with the extrusion of three carbon atoms from one of the units. It has been found possible to devise a formula which identifies the cholesterol carbon skeleton with that of

the hydrocarbon squalene less three carbon atoms, and it is believed that the new expression offers a satisfactory explanation of the complex relations brought to light by the combined work of Windaus, Wieland, Borsche and many other chemists.

It is suggested that cholesterol may be 2:6:22-trimethyl-(7:24) (8:22) (12:21) (16:20)-tetracyclo-tetracosene-$\Delta^{16:17}$-14-ol and those who care to decipher this rather striking example of organic nomenclature will find a carbon skeleton consisting of two seven-membered rings fused together as are the benzene rings in naphthalene, and again two five-membered rings, one fused to each of the seven rings, as close together as possible but avoiding the formation of any quaternary carbon atom. The secondary alcoholic group and the double bond of cholesterol may be in the usually accepted positions, but it is much better to move both groups one position to the left in the graphic formulæ as usually printed. This is compulsory in the case of all sterol constitutions on the lines of Rosenheim and King[1] and Wieland and Dane[2] and it makes the position of the hydroxyl identical in the sterol and bile acid molecules.

With this altered position of the hydroxyl group the recently proposed formula of Wieland and Dane covers the ground remarkably successfully, except that Wieland's own explanation of the nature of pyrocholoidanic acid cannot be utilised in the new system.

A more complete and yet brief account of this subject has been incorporated in a paper recently communicated to the Chemical Society, but in view of a discussion on the chemistry of the sterols to be opened by Prof. Heilbron at a meeting of the Chemical Society in December, it is thought that the protagonists will appreciate the opportunity to consider in advance the theory now put forward.

R. ROBINSON.

The Dyson Perrins Laboratory,
Oxford.

[1] *Chem. Ind.*, **51**, 564; 1932.
[2] *Z. physiol. Chem.*, **210**, 268; 1932.

Variations of Latitude and Great Earthquakes

MILNE, Cancani and Sieberg have studied the connexion between the latitude variation and earthquakes statistically, by considering the pole shift to strain the earth; the stress called forth by the shift was discussed by Spitaler. Dr. H. Kimura has published, in recent volumes of the *Proceedings of the Imperial Academy, Tokyo*, the results of direct observations of latitude made at the international stations. Plotting the *unsmoothed* mean values of morning and evening groups of observed pairs of stars, I find sharp bends almost simultaneous with many disastrous earthquakes, as given by Prof. A. Imamura in his catalogue. The accompanying diagram (Fig. 1) for the interval 1928–31 illustrates the features—time is marked in dots, great earthquakes by x, minor world-shaking earthquakes by short transverse lines, and deep earthquakes by o.

A glance at the diagram shows that: (1) great earthquakes change the course of pole shift and mostly form angular points: (2) the effect of earthquakes is much felt when the amplitude of latitude variation is small (see the course for 1928): (3) the velocity of the pole changes before and after great earthquakes: (4) curvature is diminished before or after great earthquakes—the path becomes straight or even concave outwards: (5) deep earthquakes, though feebly felt on the surface, sometimes affect the pole shift (see 1928.39 and 1930.14).

Considering that the path before the earthquakes of Khorassan (1929.33) and Newfoundland (1929.89) was nearly straight for about two months, such subterraneous process seems to have been going on for many weeks. It therefore seems likely that there is some foreboding of the earthquake, if daily observation of latitude variation be examined; the change

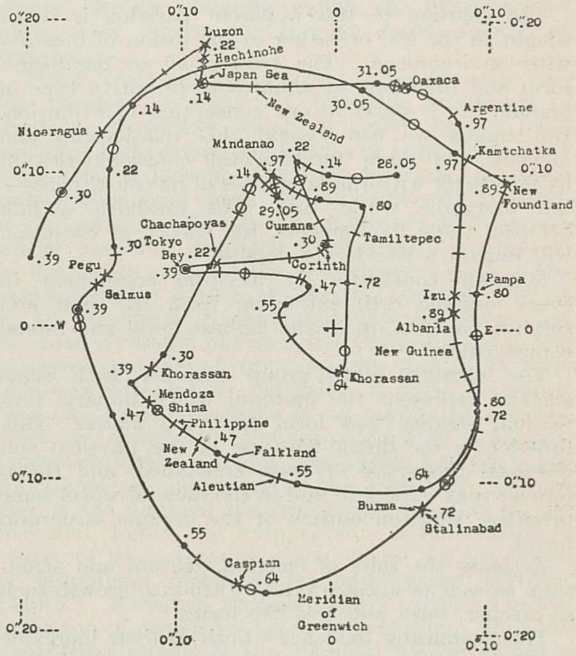

FIG. 1.

of velocity gives another hint to prediction, though the locality cannot be stated.

The readjustment of the principal axes appears sometimes to take place by roughly antipodal earthquakes. There are numerous examples, but the earthquakes of Kansu (1920.96 and 1927.39) and Mendoza (1920.96 and 1927.28), following one after another, are typical examples. If the pole be shifted by earthquakes as here described, the nutations following them are likely to be detected; if the core be liquid, it would act as a damper and make the motion aperiodic. Quantitative discussion can only be made by examining the result of daily observations, of which we have the *Berichte* of the Potsdam Geodetic Institute, but those of recent years are not yet published.

H. NAGAOKA.

Institute of Physical and
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Tokyo, July 29.

Twisted Trees—Real and Mineral

AMONG the Research Items in NATURE of July 23, 1932, p. 136, reference is made to an interesting paper on twisted trees by Knorr (*J. Heredity*, 1932, **23**, No. 2). From a systematic survey of twisting in various types of trees, the regional distribution of this deformation and the statistical data as to the clockwise and anti-clockwise twisting, Knorr discards light-tropism and influence of winds as possible causes of

this phenomenon. He concludes tree twisting to be genetic in origin, and therefore regards the lumbermen's practice of sparing twisted trees as likely to perpetuate and even enhance the existing evil. To the biologically inclined forester this naturally represents a well-cut and working hypothesis; and yet, I am not convinced.

We can eradicate every vestige of these unfortunate trees and still a new and even more luxurious growth of twisted trees may spring up in the course of time on the ashes of the old.

The solution to this apparent paradox is to be sought in the soil or rather in the fusion of heredity with environment. The tracing of an organism's form and functions to some more primitive type of organic life is basic to our conception of evolution. But unless we can extend this relationship and identify the more fundamental characteristics of living matter with the properties of its constituents—the inorganic world—and thus establish a link between these two spheres, the theory of evolution will remain a wandering derelict.

Minerals constitute an intrinsic component in every organic cell, extending from the iron and sulphur bacteria up to the highest floral and faunal complexities.[1]

The alkaline earth group together with some silicates represent the material which imparts protection, rigidity and form to living matter. This function is the direct outcome of the physical and chemical properties of these substances and therefore we may expect to find in the mineral world some primitive skeleton outline of the organic structural forms.

Actually the salts of calcium, barium and strontium as well as silicates produce arboreal growth such as creeper, bush and tree-like forms.[2]

This stabilising tendency—both in their inorganic condition and in organised matter—is undoubtedly due to the transitory colloidal state of these substances and the peculiar character of osmosis resulting from it.

A more detailed study has shown that this characteristic is even more specific and the growth is typical to each individual radicle or group.

So we find the calcium salts yield upright tree-like formations with a corrugated surface, barium salts give straight growth with a spiral surface, strontium salts form beautiful spirals of a smooth tape-like growth, whilst silicates produce bamboo-like formations.

Again, our experience with the introduction of such groupings as sulphates, carbonates, phosphates and oxalates shows that the increase in constitutional complexity of the radical combinations, especially organo-metallic associations, is followed by a remarkable impetus in arboreal growth and general functional augmentation.

The gradual substitution of these substances by one another in the organism without impairing general metabolism seems to be well established. The silicious matter of the lower organisms gave way to calcium carbonate which in its turn was substituted by calcium phosphate in the higher forms.

Our study of bacterial culture media, general nutrition and such plants as loco-weed, tobacco leaves, etc., shows that this substitution is applicable to barium and possibly strontium.

Considering all these facts it seems to me that tree twisting is primarily due to local soil peculiarities which have in course of time modified the structural constituents of the plants.

Knorr's observation as to regional distribution of tree deformation is as much in support of his genetic idea as the one presented here—his record of a balance in clockwise and anti-clockwise twisting is, however, certainly in full agreement with the view advanced in this letter.

Such an equilibrium seems to be fairly general in periodic formations and is due to boundary influences as well as progress of diffusion in the direction of least resistance. This symmetry was observed in the spiral formation of several inorganic and organic substances.[3]

Whilst emphasising this genetic rôle of mineral matter and its substitution—it is obvious that the cell adaptation to a new or modified environment becomes slower and more difficult with the increase in its differentiation and specialisation; in other words, heredity influences become more accentuated as we ascend the scale of organic life.

Heredity thus appears as a moulding, an incarnate history of successive environmental stages transmitted from the past.

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[1] Copisarow, *Chemical News*, **134**, 305, 323, 338; 1927.
[2] Copisarow, *J. Chem. Soc.*, 233; 1927: *Koll. Z.*, **47**, 60; 1929.
[3] Copisarow, *Koll. Z.*, **54**, 257; 1931.

Human Pathological Conditions Determined by Any One of Several Genes

IT is a striking fact that in many inherited human pathological conditions more than one type of inheritance is found. To quote only two examples, retinitis pigmentosa may be either dominant or recessive, and congenital stationary night blindness may be dominant, recessive, or sex-linked.[1] In a collection of human pedigrees of a condition showing dominant inheritance there is no possibility of determining whether a single dominant factor is involved in all cases, or whether the condition may be determined by any one of several dominant factors. This is also true of sex-linked inheritance, but in the case of a condition which behaves as a recessive, a test is available. The incidence of first-cousin marriages amongst the normal parents of affected offspring can be related to the incidence of the condition in the general population. The formula in use was proposed by Lenz[2] and Dahlberg.[3]

If a be the incidence of cousin marriages in the general population, and p^2 the incidence of the recessive defect in the general population, the proportion of cousin marriages amongst the parents of affected offspring is given by

$$\frac{a}{a + 16p}$$

The value of a may be taken as 0·008 in European communities. Hogben summarises the data on albinism collected by Pearson, Usher and Nettleship.[4] Excluding non-European cases, partial albinism, and uncertain sibships, the data fit the hypothesis of simple recessivity reasonably well. For these cases the percentage of first-cousin marriages amongst the normal parents of albinos is 17. This corresponds to an incidence of albinism in the general population of 1 in 168,000. But, the incidence of albinism in Europe is known to be of the order of 1 in 10,000 to 20,000. It is very difficult to account

for this discrepancy except by postulating that albinism is determined, not by one recessive gene, but by any one of several.

Retinitis pigmentosa presents the same phenomenon. The percentage of cousin marriages in the Usher[5] pedigrees, as summarised by Hogben,[1] is also 17. The incidence of the condition, even excluding cases determined by dominant inheritance, must be much higher than 1 in 168,000. It is to be noted that the exclusion of certain cases by Hogben cannot affect the result. The incidence of consanguineous unions is at least as high for the unselected material. This applies to albinism also. Juvenile amaurotic idiocy may be taken as a third example. In Sjögren's[6] families, the percentage of cousin marriages is 15·3, corresponding to an incidence of the condition in the general population of 1 in 130,000, again an excessively low value.

Alcaptonuria provides an interesting contrast. The data have been recently summarised by Hogben, Worrall and Zieve.[7] The incidence of first cousin marriages is 42 per cent. This corresponds to an incidence of the defect of 1 in 2,330,000. The figure of 42 per cent may be too high as it is based only on those families in which the relationship of the parents is definitely stated, but the authors point out that even if it were not too high, the figure of 1 in 2,000,000 is probably not too small for this very rare condition.

It seems very probable, therefore, that many human defects may be conditioned not only by one of two or three factors differing in their transmission, but also by one of several factors exhibiting the same type of transmission. The crucial test would be provided by the marriage of unrelated affected persons, but such marriages are, unfortunately, very rare.

The reason why it should so frequently happen in human records that the same end result may be due to one of several factors is not difficult to understand. In laboratory material, or in domesticated animals and plants, the observer is usually dealing with one strain, or with a stock in which inbreeding has taken place. In the case of human defects, on the other hand, countless observers all over the world are constantly putting on record a substantial proportion of the rare deformities occurring in a race in which random mating is the rule.

The implications, if the phenomenon is accepted as one of general occurrence, are of considerable theoretical and practical importance, but it is unnecessary to discuss them here. The value of studies on consanguinity is emphasised especially in the case of conditions that are too common for a significant excess to be expected if only one factor were concerned. It is also becoming increasingly evident that an adequate human genetic prognostication demands a close study of the individual family concerned against the background of cases recorded in the literature, these being sifted, classified and analysed by appropriate methods.

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Institute of Animal Genetics,
University of Edinburgh,
Aug. 29.

[1] Hogben, *J. Genet.*, 25; 1931.
[2] Lenz, *Münch. Med. Wochen.*, 66; 1919.
[3] Dahlberg, *Hereditas*, 14; 1930.
[4] Pearson, Usher and Nettleship, *Drapers Co. Res. Mem.*, 1–4; 1913.
[5] "Treasury of Human Inheritance". 2; 1922.
[6] Sjögren, *Hereditas*, 14; 1930.
[7] Hogben, Worrall and Zieve, *Proc. Roy. Soc. Edin* 52; 1932.

Evolution of Hormones

IT is clear that the integrative mechanism implied in the word 'hormone' or its synonyms consists of two parts: there are on one hand the cells which elaborate the specific chemical substance, on the other, the cells which respond to the presence of this substance when it is brought to them. The object of this letter is to point out that evidence exists that some at least of these linkages have been established by the evolution of a tissue responsive to a substance already produced within the organism for some other purpose or through some vagary of metabolism.

There are several examples of the apparently useless presence in relatively primitive organisms of chemical substances which in higher groups have acquired a physiological function as hormones. That adrenaline is present in certain annelids[1] is much more certain than that it has any endocrine function in this phylum. The specific substance of the mammalian posterior pituitary which causes contraction of the uterine musculature is represented even in the elasmobranch,[2] though it must be admitted that it is by no means certain that this substance has acquired a natural physiological function even in the mammal, and it is of course possible that it has some unknown function in the fish. A better example, therefore, is the presence of an oestrin in insects,[3] since the occurrence of sharply-delimited gynandromorphism makes it highly improbable that there are functional sex hormones in this class. A converse case is the vestigial survival in the pituitary of the mammal, despite the disappearance of the responsive tissue, of the substance which causes the expansion of amphibian melanophores and teleost erythrophores.[4] Moreover, there are many examples of the extension of responsive tissue in evolution; thus the ventricular muscle of the mammal has developed a sensitiveness to adrenaline which is absent in the reptile.[5] Is it too fanciful to regard the refractoriness of the genital organs of very young female rodents to stimulating hormones,[6] or of the beating heart of the two-day-old chick embryo to adrenaline and acetyl-choline,[7] as instances of phylogenetic recapitulation?

The most striking illustration for the present argument, however, is the demonstration[8] of a substance in the anterior pituitary which stimulates the development of the mammary glands in the guinea-pig and of the crop gland in the pigeon, two analogous but by no means homologous organs, which must have developed separately their responsiveness to this (apparently) single substance.

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McGill University,
Montreal, Canada,
Sept. 8.

[1] J. F. Gaskell, *J. Gen. Physiol.*, **2**, 73; 1919.
[2] L. T. Hogben and G. R. de Beer, *Quart. J. Exp. Physiol.*, **15**, 163; 1925.
[3] S. Loewe, W. Raudenbusch, H. E. Voss and W. C. van Heurn, *Biochem. Z.*, **244**, 347; 1932.
[4] B. Zondek and H. Krohn, *Klin. Wochenschr.*, **11**, 405; 1932.
[5] T. R. Elliott, *J. Physiol.*, **32**, 401; 1905.
[6] B. P. Wiesner, *J. Physiol.*, **75**, 39P; 1932.
[7] C. Markowitz, *Amer. J. Physiol.*, **97**, 271; 1931.
[8] O. Riddle, R. W. Bates and S. Dykshorn, *Proc. Soc. Exp. Biol. Med.*, **29** 1211; 1932.

Has Physics Discarded Mechanism?

IN his British Association presidential address of 1931, General Smuts pointed out that "the older mechanistic conception of Nature is being modified". This is undeniable; but to what extent does it justify the accompanying statement that "the very basis of mechanism is undermined"? This has been repeated frequently, with applications to psychology, ethics and philosophy that are as obvious as they are debatable.

What then is the meaning of 'wave mechanics' and 'quantum mechanics'? If we define mechanisms as systems, of any kind, in which their constituent parts or factors co-operate definitely, precisely, and in most cases repetitively, in such a way that energy is transmitted, transferred, or transformed, is not some such concept not merely legitimate, but indispensable to physics, as distinct from pure mathematics, which may, or even must, dispense therewith?

To cite specific examples, are not the rotating galaxy, the solar system, crystal oscillators, vibrating atoms, and possibly also electrons and protons, mechanisms in the same sense as a clock is a mechanism? Further, if we regard any series of periodic changes as a wave series, may we not include under 'wave' a swinging pendulum, a water wave, and an electron?

It should be observed that purpose, in any form, is neither implied nor excluded, while the uncertainty principle may express only the limitations of knowledge, not necessarily the character of Nature.

Is not the 'older mechanistic conception' being replaced by the concept of mechanisms which are so much more complex, delicate and precise than earlier models that only mathematical expressions are adequate for their description and explanation? But it does not follow that, because such mechanisms cannot be imaginatively represented, they are therefore non-existent; it simply implies that they are too complicated for imagination to grasp. The advance in theory, then, does not justify the complete discarding of mechanism, as such.

J. E. TURNER.

The University of Liverpool,
Aug. 22.

Change of Paramagnetic Susceptibility due to Absorption of Light

WE have already published in NATURE[1] a note giving the results of our observation on the change in susceptibility produced in paramagnetic solutions like that of chromic chloride, etc., due to light absorption. Following the suggestion of S. Kato, we had assumed that the absorption maxima at λ 4300, 6100 in a given solution of chromic chloride were due to the transition of the Cr+++ion from the $^4F'$ to ^2G resp. ^2H state. On the supposition that both in the initial and in the final state the magnetic moment of the ion is due only to the spin moments of the magnetic electrons, such transitions would be accompanied by diminution in the magnetic moment of the ion. We reported that the result of our observation indicated a diminution in the susceptibility of the chromic chloride solution and therefore was in agreement with our theoretical assumptions.

Recently Gorter[2] reports that he has observed a similar diminution of susceptibility in a solution of chromic chloride due to absorption of light, but he finds that this diminution is to be attributed to rise in the temperature of the solution. Since the publication of our letter in NATURE, we have found that the deflection of the bulb containing the chromic chloride solution corresponded to an *increase in its paramagnetic susceptibility* and not to a diminution. A paper containing the results of our investigation was sent about two months ago to the *Zeitschrift für Physik*, where the experimental details will be found. We may mention here that we used a torsion balance of period 3–5 sec., and neutralised the effect of the field on the bulb containing the concentrated solution, by attaching a bismuth ball of suitable size below it. The response to the incident light was almost instantaneous, and after a prolonged exposure the light spot gradually returned to its original position and then moved over to the opposite side. Specchia[3] has also observed this quick increase in magnetic susceptibility due to light absorption.

In using the torsion balance, the bulb has to be placed almost in a position of instability in the inhomogeneous magnetic field, and for each set of observations a new adjustment has to be made. Under such conditions it is difficult to obtain reproducible results. We have, therefore, tried other methods of making this effect measurable. The following one we think will give fairly consistent results. A modified form of the inclined capillary tube arrangement used by Liebknecht and Wills[4] is filled with chromic chloride solution and the meniscus is placed between the pointed poles of an electromagnet. Light from a mercury arc, after passing through an infra-red filter, is focused from the top on the meniscus. Observation of the position of the latter in the magnetic field is made, once when the incident light from the arc is further filtered through a concentrated solution of chromic chloride, and again when this filter is taken off. Deflections of about 1·5 scale divisions of the micrometer scale in the eye-piece of the observing telemicroscope, indicating an increase of susceptibility, were noted.

Since the transitions from the $^4F'$ to the ^2G resp. the ^2H state represent diminution of the spin moment of the ion, the observed increase in susceptibility can only be interpreted as being due to the temporary break down of the *l*-coupling between the Cr+++ion and the associated water molecules. Some interesting applications of this result are given in another paper which appears in the *Zeitschrift für Physik*.

D. M. BOSE.
P. K. RAHA.

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92 Upper Circular Rd.,
Calcutta, Aug. 3.

[1] NATURE, **127**, 520, April 4, 1931.
[2] NATURE, **130**, 60, July 9, 1932.
[3] Specchia, *Phys. Ber.*, 547; 1932.
[4] Liebknecht and Wills, *Drude's Ann.*, 1, 178; 1900.

Iodine in Cod Liver Oil

THE purpose of this note is to indicate to British workers in the field of endocrine secretions and nutrition certain experimental work which we have thus far withheld from complete publication pending studies which we are now ready to report in detail.

We showed[1] that ferrous iodide mixed with the food would benefit rats on a diet deficient in vitamin A. Later we demonstrated that unsaturated fatty acids were apparently indicated in addition.[2] More recently we have summarised our findings.[3]

Studies made during the past winter and spring in which we induced leg-weakness in chicks by the intravenous injection of anterior pituitary extract, but prevented it in other animals by orally adminis-

tered thyroid extract, have led us to interpret correctly the findings of a poultryman who reported to us the remarkable success secured by him in administering iodine to a number of chicks that had developed leg-weakness on a diet apparently adequate so far as cod liver oil and fish meal were concerned, but containing an excess of wheat. In an extensive report, which will shortly appear in *Endocrinology* (Chidester, Ashworth, Ashworth, and Wiles), we are describing our results, which seem to emphasise the rôle of the iodine in cod liver oil in the prevention of rickets. We suggest that since ergosterol and ultra-violet light may induce excess calcifications and even set up a profound calcium-iodine unbalance, it may be wise to utilise cod liver oil, which we have found it possible to super-iodise and otherwise mineralise in the treatment of certain diseases.[4] Several investigators, including our group, have shown that iodine will prolong the lives of rats that have had an excess of vitamin D.

We have already credited (loc. cit.) Col. McCarrison with his initial emphasis on the iodine-fat balance in nutrition, and consider ourselves fortunate in having been able to point out the rôle of ferrous iodide and unsaturated hydrocarbons and fats in several so-called vitamin deficiencies. We are especially interested at present in the fact that a variety of substances of benefit to the organism can be carried into the cells by cod liver oil. We are attempting to have others repeat our observations and make clinical tests with super-iodised cod liver oil in tuberculosis and the common cold and also to compare the results obtained in leprosy with ordinary chaulmoogra oil, with those secured by iodising it.

If our studies are significant—and we believe that long-continued experimentation makes them so—we have evaluated the rôle of the iodine of cod liver oil in the treatment of nutritional diseases and furnished an explanation of the activity of many iodine-containing medicaments.

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A. L. ASHWORTH.
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I. A. WILES.

Department of Zoology,
University of West Virginia,
Morgantown, Aug. 29.

[1] Chidester, Eaton and Thomson, *Science*, **36**, 641; 1912.
[2] Chidester, Eaton and Speicher, *Anat. Rec.*, **47**, 304, 1930; Chidester, *Med. Times*, **59**, 138; 1931.
[3] *Science*, **75**, No. 1934, 106; No. 1941, 286—287; *Collecting Net*, **7**, No. 9, 227–230.
[4] Chidester, F. E. "Zoology", D. Van Nostrand Co., New York, 1932.
* Aided by a grant from the Society of Sigma Xi.

Causes of Ionisation in the Upper Atmosphere

SINCE May 1931, I have taken numerous measurements of the virtual reflection height of radio waves 40–140 m. long; at the same time, I have, at different times during the day, determined the short wave limit for vertical reflection in the ionosphere. Some of the principal results which I have obtained are summed up here:

In the *E* region, by day, the maximum electronic density does not exceed 6×10^5 (electrons per c.c.) in summer, and $3{\cdot}7 \times 10^5$ in winter.

In the *F* region, at sunset, the maximum electronic density is 9×10^5 in summer, and 6×10^5 in winter.

After sunset, in the *E* region, the maximum electronic density varies irregularly, since there are sometimes remarkable increases, even several hours after sunset. These happen when barometrical depressions occur at the place of observation or to the north of it.

In the *F* region, during the night, the maximum electronic density is sometimes observed to be decreasing regularly, which made it possible to calculate a value from 1×10^{-10} to 2×10^{-10} for the coefficient of ionic recombination; at other times, on the contrary, rapid increases of the maximum electronic density are noticed, which are followed by diminutions, and that also for many times successively during the night.

The increases of ionic density in the *E* and *F* regions appear by no means connected with one another.

Corresponding with perturbations in the earth's magnetic field, the virtual reflection height in the *F* region is increasing: no perceptible variation occurs in the *E* region.

During the solar eclipse of Oct. 11, 1931 (13^h 6^m G.M.T.) not visible in Italy, I observed a perceptible diminution of electronic density in the *E* region and in the *F* one.

These facts can be explained by admitting the arrival, in the ionosphere, of electrons from the sun, which would invest even the shaded hemisphere (after A. Dauvillier's recent theory[1]).

Chapman's theory[2] (concerning the arrival of swiftly moving particles) does not appear to interpret easily the night increases of ionic density and the magnetic correlations regarding the *F* region alone.

Physical Institute, IVO RANZI.
University of Camerino,
Italy, Aug. 26.

[1] *Comptes rendus*, **193**, 348, 1931.
[2] *Mon. Not. Roy. Ast. Soc.*, **92**, 413–420, 1932. *Proc. Roy. Soc*, A, **132**, 353–374, 1931.

Ball Lightning

ON the afternoon of Aug. 31 I was at Portofino watching across the bay a succession of heavy thunderstorms that drove up from the south over the Ligurian hills east of Rapallo. At about 3.30 P.M. a rain-curtain a couple of miles wide was moving northwards, completely obscuring a section of the coast-line. While this was opposite Chiavari two appearances of 'ball lightning' were seen by myself and two companions. (A third earlier one of brief duration was seen by one observer.)

Lightning flashes were frequent: at the time mentioned the rain curtain was pierced by two independent vertical flashes, one-half to one mile apart, which appeared not to reach the ground (or sea). Then, in the gaps between the lower ends of the flashes and the ground, two brilliant stationary lights appeared, lasting about five seconds in one case and at least eight seconds in the other, as though two powerful arc lights had been turned on. In both cases a second or so was required to attain maximum brilliancy, which was then maintained constant until the last second or so when the lights gradually dimmed and suddenly went out. This change in light intensity at the beginning and end may have been due to variation in thickness of the obscuring rain curtain. No specific sound was associated with the phenomenon, but this may have been due to the distance (probably ten miles) and to the almost continuous roll of thunder at the time. That the 'ball' discharges appeared stationary may also have been an effect of distance.

I have had no opportunity to inquire whether any record of these facts has appeared in the Italian Press or meteorological reports.

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Research Items

Co-operation in Dahomey.—Mr. Melville J. Herskovits publishes in *Africa*, vol. 5, No. 3, a study of Dahomean ethnology, based on field-notes collected during a trip to Dahomey, Nigeria and the Gold Coast in January–September, 1931. The civilisation of Dahomey is based upon an agricultural economy. Everyone must know how to cultivate the ground, whatever his rank. Women play an active part in economic life, cultivating, harvesting and marketing the crops. There is a class of 'free' women, due to this economic activity, who play the rôle usually assumed by men as the heads of families and become titular 'husbands' to their 'wives'. Dahomean men are organised into family vocational guilds, working in iron and brass, weaving cotton, etc., an exception being wood-carving which is an avocation exercised by all who have the necessary skill. The women's contribution to the crafts is the making of pottery, which is organised in districts according to the distribution of suitable clay, rather than in families, the guild organisation, however, persisting as in other vocations. The co-operative aspect of organisation pervades all Dahomean economic activity. The major expression of this is the *Dokpwe*—a term applied equally to the organisation and to the individual member. It is neither a guild nor a society, but is regarded as a 'force', the man power of Dahomey, as it embodies all 'young' men. The control is vested in an official known as the 'Chief of the Dokpwe' who is concerned not only with the control of the men under him in communal tasks, but also with funerals. The working of the organisation may be illustrated by the following example. If a man is ill at the time of the clearing of the fields, the Dokpwe will clear his land for him as no member and his family must be allowed to starve. It is, in fact, an association for mutual aid, so important that no man may be exempted from its call. If a man, even the king, in going along a path, sees a Dokpwe at work he must explain his errand and ask leave to proceed.

Central American Eccentric Flints.—The character and distribution of the so-called 'eccentric flints' of Central America are discussed by Capt. T. A. Joyce in his presidential address to the Royal Anthropological Institute, 1932 (*J. Roy. Anthrop. Inst.*, vol. 62, pt. 1). They are found, so far as known at present, only in the area occupied by the ancient Maya, an inverted triangle with its base lying between Palenque and Belize on the north and its apex at Copan in Honduras. Their meaning is obscure; their technique equals the finest products of prehistoric Denmark and is surpassed only by the finest 'ripple-blades' of Egypt. They are generally associated in groups, occasionally in graves, more often under sculptured stones bearing a date which can be related to our chronology. For example, the British Museum expedition to Pusilhá discovered a deposit of nearly one hundred examples of flint and obsidian under a stela which may be placed at about A.D. 202 (or three hundred years later according to the American scheme of chronology). The large series now in the British Museum shows that these flints can be classed according to type. They served no utilitarian purpose, and are purely ceremonial. The main types are 'blade' type and derivatives—winged, waisted, flanged, cruciform—the 'scorpion' type, the 'centipede' type and 'annulets' and 'crescents'. Some have been flaked to represent human heads; while recently a series of engraved obsidian flakes has been discovered at Tikál, which show the figures of the Maya gods in the style of the Dresden codex. Chert was used as well as flint and obsidian, the source of the last being, probably, Guatemala. The 'eccentrics' suggest several problems, for which at present there are no solutions. They seem to have been deposited in groups as 'foundation deposits' on sites of importance. Each group seems to include every variety in every stage of construction, and no single specimen shows signs of wear on its edges.

Redwing Breeding in Scotland.—More than once, in the northern counties of Scotland, it has been suspected that the redwing (*Turdus iliacus*) may have nested, for birds have been heard singing long after the spring emigration to the usual nesting haunts in Scandinavia and northern Europe had ceased. But only now has confirmation of this supposed extension of range been found (*British Birds*, Sept., 1932, p. 132). In the Moray Faunal Area (for obvious reasons no more definite locality is given) A. H. Daukes saw a pair in early June and later discovered the nest with six eggs in a solitary beech tree. Unfortunately about this stage the nest was robbed, probably by a rook, but the discovery of the greater part of the shell of one egg upon the ground helped, along with the nest, to confirm the identity of the birds. There is perhaps nothing very remarkable in the fact that a bird, common in Scotland and indeed considerably farther south in the winter, should have remained to nest, instead of departing for Norway or the Baltic provinces, but the first authenticated record of breeding in any part of the British Isles has its own special interest and may be part of a general extension of range southward which has been noted in other species.

Development *in vitro*.—C. H. Waddington (*Phil. Trans.*, *B* vol. 221, pp. 179–230, 1932) has cultivated *in vitro*, by the watchglass method, entire blastoderms of chick and duck removed from the egg during the first two days of incubation. Under the conditions of these experiments a chick embryo will remain alive for two to three days and during this time pursues its normal course of differentiation, except that the rates of differentiation and of growth are considerably slower than *in vivo*, the rate of growth being the more affected by the unusual conditions, so that embryos are obtained which are much too small for the stage of differentiation which they have reached. The results of experiments on the presumptive organ-forming regions are described, using blastoderms with a well-formed primitive streak but no head process, which were cut into portions transversely at various places along the primitive streak. The isolated endoderm has not been successfully cultivated. Isolated epiblast, cultivated from young or medium primitive streak stages, yields neural groove, notochord, somites, etc. Two epiblasts, cleaned of endoderm and placed so that their mesoderm faces were in contact, were cultivated and both developed neural grooves, but the lower soon died and degenerated. A normal neural groove may induce an extra neural groove in the other epiblast.

Fragments of the primitive streak, cleared of endoderm, were grafted between the endoderm and epiblast of other blastoderms of similar age, the epiblast not being cut in the operation. Anterior pieces of the primitive streak give rise to neural tissue, notochord and somatic mesoderm; middle pieces give rise to mesoderm, with or without neural tissue; posterior pieces probably never give rise to neural tissue.

Commercial Drying of Wheat.—In view of the probable future extension in the use of the combine-harvester machine in England where the climate renders the use of a drier advisable, the second report (No. 25) on the drying of wheat, issued by the National Research Council, Canada, should prove of particular interest to progressive farmers in this country. The report, which is a continuation and extension of that issued in 1929, deals with the effect of different conditions during the drying process on the subsequent milling and baking qualities of the wheat. The temperature of the hot air used and its rate of flow are factors of the first importance. Since the rate of drying increases with the heat content of the air per unit time, raising the temperature or increasing the speed of flow will dry the grain more rapidly. Beyond a certain point, however, fast drying is to be deprecated since it affects the baking quality adversely. In general, 180° F. is the highest temperature that can be used with safety and even this may cause injury if the rate of flow is too rapid. The temperature attained by the wheat during the drying is another factor that seems to be connected with baking quality. Over-drying or too rapid drying are the main causes of high grain temperatures, a condition which results in impaired baking properties. Milling quality, on the other hand, was unaffected by drying under the different conditions tested. Commercial drying must of necessity be carried out under widely different climatic conditions, and it is satisfactory that tests showed no detrimental effect on the baking quality of the wheat when drying was carried out in cold weather or with humid air.

Virus Diseases of Plants.—Dr. J. Caldwell has published the third of a series of investigations into the physiology of virus diseases in plants (*Ann. App. Biol.*, vol. 19, No. 2, pp. 144–152, May, 1932.) The aucuba mosaic disease of tomato behaves very differently on *Nicotiana glutinosa* and *Datura stramonium* from what it does on *Solanum lycopersicum*. It is very interesting that the virus multiplies very little in the leaves of *N. glutinosa* and does not spread far from the region of inoculation. *D. stramonium* is a 'carrier' and shows no symptoms, but the virus spreads to all parts of the host. An interesting demonstration that rupture or damage of a tissue must take place before virus can infect was given when it was shown that the intercellular spaces of a leaf of *N. glutinosa* could be injected with virus juice without any infection taking place. The damaging of any cells by rubbing the surface of the leaf immediately brought about infection.

Viscosities of Drilling Muds.—Messrs. H. A. Ambrose and A. G. Loomis contribute an article to the *Oil and Gas Journal* for July 7, in which they seek to show that, contrary to prevalent ideas, rotary drilling mud (such as a clay mixture) is not truly viscous. The resistance of mud to flow as expressed by whatever viscosity it may possess, determines the ease with which it may be pumped, and its ability to carry up cuttings and gas. These drilling muds do not have viscosities which are constant at constant temperatures, since this function tends to vary not only with its previous treatment, implying mode of preparation, but also with the shearing stress applied to it. The muds must be regarded essentially as suspensions of clay in water, and consequently the ordinary laws governing the motion of a truly viscous liquid are scarcely applicable. The authors deal with the subject from the point of view of flow in colloidal suspensions, and the mechanism of such flow. They touch on the mathematical analysis involved, and also on certain types of viscometers which have been used for determining this alleged viscosity.

Fatigue of Zinc-coated Steel.—When an iron or steel bar is subjected to repeated stress it breaks under a stress less than its statical breaking stress if the lower stress is repeated often enough. The 'fatigue cracks' which lead to the breakdown are found to originate in pittings on the surface due either to bad finishing or to subsequent corrosion. To prevent corrosion the iron or steel may be galvanised or have zinc deposited electrolytically on its surface and the effect of each of these processes on the durability of the specimen under repeated stress has been investigated by Messrs. W. H. Swanger and R. D. France at the Bureau of Standards and their results appear in the July issue of the *Journal* of the Bureau. Both the loaded beam and the stretched rod methods of test were used, and the specimens were either polished or pickled for galvanising or galvanised or stripped again or electroplated. The fatigue limits of the electroplated specimens were higher than those of the uncoated, those of the pickled, galvanised and stripped were lower than those of the untreated specimens. The authors ascribe this difference in the effects of the zinc coatings to the hardness of the layer of zinc put on by the galvanising process.

Conduction Phenomena in Oxide-Coated Filaments.—The quantum-theoretical study of semi-conductors and rectifying contacts has been developed independently by several workers during the past year. In a paper in the September *Proceedings of the Royal Society* R. H. Fowler and A. H. Wilson apply the theory to the case of conduction in the oxide layers used in dull-emitting cathodes. They calculate current-voltage characteristics which show the general features of the experimental curves—namely, a steep initial rise of current with voltage followed by a flatter portion and a further steepening. In order to explain the form of the i/v curves at the lower voltages they assume that part of the current is electronic (and described by the above analysis), the remainder being electrolytic and approximately ohmic. The authors consider that work along these lines may be developed to account for the lack of saturation observed in the thermionic currents from oxide-coated filaments.

Cosmic Ray Particles.—The *Physical Review* of Aug. 15 contains a further communication by C. D. Anderson on the cloud-chamber photography of cosmic ray particles. The method and results may be compared with those described in the preliminary publication of Blackett and Occhialini (NATURE, Sept. 3, page 363). The advantage of allowing the cosmic ray itself to set off the expansion is evident, since, in Anderson's work, of 3,000 random expansions only 62 gave measurable cosmic ray

tracks. Anderson, using an iron-core magnet, applied a magnetic field much larger than was possible with Blackett and Occhialini's air coils. The most significant difference between the results is the much larger proportion of particles with high energies (above 500×10^6 volts for electrons or 200×10^6 volts for protons) obtained by Blackett and Occhialini. Such particles were quite rare in Anderson's work. At first sight it appears that the Blackett-Occhialini apparatus may tend systematically to miss particles of low energy, or that their estimates of the high energies may be incorrect since they used small magnetic fields. It is important that this divergence should be explained, particularly as the particles of high energy are inconsistent with Millikan's views of the origin of cosmic rays by atom-building. Anderson observes associated pairs of tracks rather frequently, and one of these tracks is always an electron. He ascribes these pairs to disruption of a single atomic nucleus by the cosmic ray and he maintains that these can be explained without postulating neutrons in the cosmic ray stream. He also observes the scattering of the particles in a lead diaphragm. In the same number of the *Physical Review* W. F. G. Swann points out some consequences of assuming that the primary cosmic rays are electrons of very high energies. He suggests that such electrons may be incapable of ionising and may only occasionally give rise to secondary particles. He examines certain asymmetries in the distribution of the secondaries over the earth's surface, assuming that they are particles of energies of the order 10^9 volts.

Corrosion Resistivity of Metal.—Reference was made in NATURE of Aug. 13, p. 245, to a method devised by Mr. Zehnowitzer for determining the velocity of metallic corrosion, based on changes in the conductivity of the corroding liquid. In a letter to the Editor, Mr. F. C. Smith directs attention to a rather similar method worked out some years ago in the laboratory of the Gas Light and Coke Company, and described in a paper published in the *Transactions of the British Junior Gas Associations Joint Proceedings* (Vol. 18, 1927–1928). The special problem under investigation by Mr. Smith was the rate of attack of different varieties of iron by water saturated by carbon dioxide, in the absence of oxygen. The measurements themselves have special importance for gas technologists, but the procedure, which appears to be little known outside the gas industry, may interest a wider circle. The corrosion was carried out in a conductivity cell furnished with the usual platinised platinum electrodes and joined to a Kohlrausch bridge; as the carbonic acid attacked the iron specimen, liberating hydrogen, the formation of ferrous bicarbonate produced a marked drop in the resistance, which, in one experiment, fell, in the course of 6 hours, to about one-third of the initial value. The resistance-change, which blank experiments showed to be solely due to the action of carbonic acid on the metal, proved a convenient measure of the rate of attack. The precautions necessary for good results included a careful control of temperature, the use of water redistilled from permanganate and the strict exclusion of oxygen. The numbers obtained for a series of irons indicate that the anaerobic attack upon iron by aqueous carbonic acid increases with the sulphur content of the metal, although other elements appear to influence the result.

Astronomical Topics

Comets.—Periodic comet Brooks (2) was detected on its return by Prof. G. van Biesbroeck at Yerkes on Sept. $25^d 8^h 14{\cdot}6^m$ U.T., R.A. (1932·0) $0^h 46^m 13{\cdot}8^s$, N.Decl.2°55′10″, mag.12·0. The comet was discovered in 1889 and found to have been very near Jupiter in 1886, when its orbit must have been greatly altered. It was seen again in 1896 and 1903, after which there were no certain observations until 1925; it is doubtful whether a single observation made in 1910 belongs to it. It had again approached Jupiter closely about 1921, but the calculations of Prof. Dubiago led to its recovery. Both he and Mr. F. R. Cripps calculated the present return; their results were almost identical, but the date of perihelion resulting from the above position is Oct. 9·49 U.T., which is about two days later than the prediction. It may be found by going 0·31 of the way from the second ephemeris in the B.A.A. Handbook to the first one. The present apparition is the most favourable possible, opposition coinciding with perihelion. The comet is 1932 *m*; it is the first time that there has been a comet *m*.

Copenhagen Circular 403 contains the following elliptical orbit of the comet Peltier-Whipple from Copenhagen observations of Aug. 10 and 24 and Sept. 9.

T	1932 Sept. 1·86128 U.T.	
ω	38°28′ 31·5″	1932·0
Ω	344 30 35·4	
i	71 42 32·6	
q	1·037175	
e	0·976172	
Period 287 years		

Harvard Card 240 announces that Dr. A. D. Maxwell has found elements which are almost the same as the above, though the observations used were all different; the arc in each case is a month in length. There is no comet in the catalogues that seems likely to be the same. An ephemeris was given in NATURE of Oct. 1, p. 513, which is near enough for finding it. It is now about magnitude 12.

Solar Corpuscular Rays.—A letter from Mr. H. P. Berlage, Jr., of the Royal Magnetical and Meteorological Observatory, Batavia, proposes the question: Are the solar corpuscular rays producing auroræ and magnetic storms identical with the solar component of ultraradiation? He states: "Now that converging evidence points to a corpuscular nature of the ultraradiation, what arguments exist against simply identifying the solar corpuscular rays, which cause auroræ and magnetic storms with the solar component of ultraradiation? The suggestion is that different stars emit differently penetrating ultrarays, and the question, why no appreciable solar component could be detected reduces to stating the fact, that the solar ultraradiation is stopped in a height of 100 km. above the surface of the earth". But this seems to amount merely to giving a name, usually reserved for rays with the great penetrating power needed to reach the ground, to rays of such inferior penetration as to be stopped at 100 km. height. This is very far from being an 'identification', and the suggestion seems to add nothing material to our knowledge.

Training of Electrical Engineers

AT the International Congress of Electricians held in Paris last July, interesting papers were read by various authors describing the training given in their countries to young men desirous of qualifying for the higher posts in the electrical engineering profession. It appears that, as a rule, the degree of B.Sc. in engineering, or its equivalent, is given after going through a three or four years' course in a technical school or college. It is impossible in the workshops of a college to give a student that insight into methods of management and actual operating that can only be obtained in works offering machinery or apparatus for sale. Hence engineering graduates or those possessing recognised diplomas have to undergo a special apprenticeship course in works, railways, power or distributing stations or with communication companies in addition to their academic training.

These apprenticeship courses are usually at least a year in length. It is highly advisable that there should be a close connexion between works and college staff, to whom most of the outgoing students have to look for advice as to the course they should follow. There is naturally a close connexion between many works and engineering colleges. The supervisors of the apprentices make their own choice and are not necessarily impressed by the academic qualifications of the young men they interview. They have to choose men whom they think will qualify rapidly for staff posts. Large companies who take a number of higher apprentices every year take only a limited number from any one country or from any one engineering college. Trade considerations in Great Britain and other countries make it advisable to take overseas students and foreigners. Several of these firms pay their graduate apprentices, generally called 'student apprentices', a weekly wage varying from 10*s*. to 50*s*., but some ask for a premium which is generally more than paid back by a weekly wage. This appreciably lightens the present somewhat onerous burden of the cost of living.

Most of the papers read at the Paris meeting dealt with the syllabuses of training colleges for the early part of the engineering training of students. It seems generally recognised that in the present economic conditions throughout the world and the very varied requirements of engineers in the different branches of the industry, it is necessary that the syllabus should not be overburdened with subjects. In Norway it includes architecture, political economy and finance. In Sweden national and political economy, technical hygiene and the building of edifices are taught. In Poland special stress is laid on methods of electrifying the country with a view to its future prosperity. In Italy, radio technology is in the front rank. It has been introduced into the programme of every industrial school. In the University of Bologna there is a two years post-graduate course for radio engineers. The degree of Ph.D. is awarded for physics and for mathematical physics. Special importance is attached to photo-electricity, television and the technique of radio-telegraphy and telephony. In Spain and many other countries stress is laid on long distance communication by telephony through wires and through space. Technical teachers everywhere are fully aware of the importance of the rapid and spectacular advances in methods of communication between distant stations which have been made during the last few years.

An interesting paper on electrical education in the United States was communicated by Prof. A. E. Kennelly. He divides training institutions into two groups, the collegiate group and the industrial group. The first contains universities and technical institutes of university rank; the second includes the research and training schools of industrial organisations, technical institutes, and professional, commercial, and correspondence schools. Actually there are 150 schools of collegiate type in the United States. These give full instruction in electrotechnics. In addition, there are 750 other schools which give partial courses in the subjects connected with electrical engineering. The complete electrotechnical course usually lasts four years. During the last two years of the course, students can specialise in transmission and distribution of energy, electric traction or electrical communication, but no two engineering colleges in the United States have identical programmes. In 1893, a society was founded for the advancement of technical knowledge. It has now 2,250 members, practically all of whom are professors or teachers in technical schools. Their judgments and decisions influence greatly the nature of the syllabus adopted by a college.

A certain number of American colleges give 'sandwich' courses of training, half the time of the students being spent in college and the other half in works. The student spends a certain number of weeks in works and a certain number in college alternately, the length of the cycle varying between two weeks and a year. For students who wish to take up 'heavy' engineering, this system has advantages. The practical work shows how important theory is and hence students pay closer attention to theoretical work. Some of the large colleges have a regular college course for four years for some of their students and simultaneously a sandwich course for others. One of the advantages is that the college can take more pupils and thus the overhead charges are reduced. There is a great variety of colleges of all kinds in America. Prof. Kennelly thinks that it would be a calamity not only for the United States but also for the world if any of these colleges cease to exist. The disappearance of a good school, whatever its type, may mean that those students who had intended to enter it must either go to some other college which is not so attractive to them or else seek to acquire their scientific knowledge by experience and private study, a method sometimes successful but more often leading to a great waste of energy.

Prof. C. L. Fortescue read a useful paper on the education of electrical engineers in Great Britain. Those students who intend to qualify fully as engineers in Great Britain usually leave their secondary or public school at the age of eighteen years, spend three or four years at a university or technical college and finish up with two years as a 'student apprentice' in works, power stations or railways. It will be seen that the training is an expensive one as during the five or six years the student is not self-supporting.

In Great Britain, the Institution of Electrical Engineers looks after the interests and maintains the standard of the profession as a whole. It divides

young electricians into two groups, students and graduates. The students of approved colleges and apprentices and assistants in engineering works can become 'students'. When a student has passed certain qualifying examinations and has attained the age of twenty-one years, he can be elected a graduate. A graduate, however, is not a 'chartered electrical engineer'. This status can only be attained after his training and experience exceeds seven years, two of which must have been in a position of superior responsibility in the profession. He has to send in an election form signed by five members and giving a complete account of his training and experience, which is scrutinised by an election committee. He must also be twenty-six years of age. When he fulfils all these somewhat onerous conditions, he is elected an associate of the Institution, and can call himself a chartered electrical engineer.

It will be noticed that there is a discontinuity in the training of an electrical engineer, namely, the gap between the university or technical college and works. Most students have no connexion with engineering and so have to make their own arrangements with manufacturing firms. Naturally, they want to go to the best-known firms, but it generally happens that these firms have already all the student apprentices they want. Hence they have to try to get into works about which they know nothing.

This has led to the adoption by a few colleges of the 'sandwich' system of training. The best-known of these colleges is Faraday House, London, which was founded more than forty years ago and now has about four hundred students. The course lasts for four years. The first year is a purely collegiate course in general engineering. During the second year the student is apprenticed under supervision to a mechanical engineering works either in Great Britain or abroad, the college making all the arrangements for him. The college is affiliated with 170 works and railways in Great Britain and abroad, for teaching purposes. Advanced theoretical training is given in college during the third year, and for the final year the students go to electrical manufacturing works and power stations throughout the country and to railways, and communication companies, etc. Those who have passed successfully through the course, several of whom also take the London B.Sc. (Engineering), receive the diploma which enables them to become graduates of the Institution of Electrical Engineers without further examination. The advantage of the system is that the student is under the same supervision throughout his course.

The recent extension of research laboratories in connexion with works has led to a limited demand for men who have done post graduate research work in university laboratories. These men usually write theses which he o them to get the higher degrees of M.Sc., Ph.D. and D.Sc. Research laboratories also take young graduates whom they train specially in their own methods of research so as to qualify them for posts on their staff.

A.R.

Solid Solutions and Liquid Mixtures

THE discussion arranged in Section B (Chemistry) on Sept. 6 at the York meeting of the British Association, was finally divided into two parts as it was agreed that the differences between solid solutions and liquid mixtures were too great for the subjects to be covered usefully in a single discussion. Prof. C. H. Desch in his paper on re-arrangements in the solid state referred to the importance of solid solutions in metallurgy and said that systems in which a series of solid solutions, stable at high temperatures, resolves itself into two or more phases on cooling are of frequent occurrence. Such systems are of two types. In the first, and most usual, the change takes the form of the separation of a new phase from solution in the same manner as the crystallisation of a salt from water. A solubility curve can be drawn and eutectoid structures similar to the eutectics produced from liquid solutions are produced. Familiar examples are the iron-carbon and iron-nickel systems, and analysis of the constituents shows that a definite migration of nickel has taken place in the solid phase. In the second type of re-arrangement which has been observed in recent years, a solid solution homogeneous at high temperatures and having the solute atoms statistically distributed throughout its lattice assumes a new arrangement on cooling through a certain point, the solute atoms taking up regular positions and so forming a super-lattice. The change is reversed on heating. A typical example is furnished by the gold-copper alloys. The equilibrium is attained very quickly and the change can be followed by electrical resistance tests. Magnesium-cadmium alloys give a similar series and the changes are at present largely unexplained although the number of such systems may be considerable.

The discussion on mixed liquids was opened by Prof. Irvine Masson who indicated that its scope is limited to mixtures of non-electrolytic fluids. The main chemical interest in such liquids lies in the formation of inter-molecular compounds but Prof. Masson pointed out that before deviations of liquid mixtures from an ideal mixture law can be interpreted as evidence of chemical interaction or compound formation, the effects of the other possible causes of combination between either similar or dissimilar molecules must be disentangled, namely, the van der Waals' cohesion forces and electrical coupling between polar molecules. In each of these alternatives as in chemical combination we have also to contemplate the reverse process of dissociation. In actual fact van der Waals' cohesion is present in every mixture of any two liquids. Electrical coupling between polar molecules occurs in all mixtures except the 'normal' liquids. Thus where chemical combination occurs it is invariably accompanied and complicated by the other two forces.

Discussing the criteria for a normal liquid Prof. Masson pointed out the danger of assuming that those liquids are normal which when mixed together give straight line property-composition curves. The use of the Ramsay-Eötvös rule concerning surface energies, Trouton's rule concerning latent heats, and Debye's polar moments, leads to the characterisation of a normal liquid as one the molecules of which remain sufficiently independent to attract one another by no forces other than the van der Waals' cohesion which they show in the vapour state. A normal liquid thus has the characteristics of a non-polar but imperfect gas. For properties such as specific volume, viscosity, vapour pressure and heats of mixing, all of which are strongly influenced by cohesion and give

indirect measurement, fundamentally, of intermolecular cohesion, the simple mixture law does not hold. We are dealing with two opposing actions, the influence of the cohesion of each kind of molecule with others of its own kind being attenuated by the dilution, while on the other hand the attenuation is counteracted, more or less, by the mutual cohesion set up between the two kinds of component molecules. We cannot state precisely what the normal behaviour of mixtures of two non-polar substances would be but the deviations from the straight line due to cohesion reach their maximum, for a given pair of components, at a composition not far from equimolecular.

With regard to electrical coupling between polar molecules, after referring to the view which attributed the van der Waals' forces to transient polarisation of non-polar forces Prof. Masson pointed out that as before the magnitude of the deviation depends on two opposed influences. In addition while the end-to-end coupling of polar molecules gives a complex of larger electric moment, in the side-by-side coupling the two individual polarities tend to neutralise each other, and accordingly caution is required in interpreting data for electric moments. Quantitative interpretation of the cohesions displayed by polar molecules is very difficult and Prof. Masson considers that Langmuir's presentation of the mutual cohesions of compound molecules as additive functions of their chemical constituents is inadequate. Evidence based purely on deviations from the mixture-law which might be accounted for by the relatively strong deviations due to mutual dipole cohesion is accordingly insufficient to establish the formation of chemical compounds, short of the isolation of a solid compound with distinctive properties.

Prof. G. Kendall in his paper on compound formation in liquid mixtures classified compounds existing in liquid mixtures in two types, addition compounds and substitution compounds. In the former, of which acetic acid-aniline forms an example, there is a definite increase in molecular complexity and a wide deviation in physical properties from the mean of the components. In the second type, of which phenol-cresol is an example, there is no increase in molecular complexity and the physical property-composition curves are more nearly linear. Formation of compounds of the first type depends mainly on the diversity in electrochemical character of the radicals of the components, the extent of compound formation increasing with such diversity. The reverse holds with compounds of the second type, similarity in the radicals being the dominant factor, part of the associated molecule being replaced by essentially equivalent groups. The results of a detailed examination of the two ternary systems ethyl acetate-water-alcohol and ether-water-alcohol were discussed in relation to these generalisations.

Discussing dipole association in liquid mixtures Dr. N. V. Sidgwick pointed out that in contrast to non-associated substances, associated substances give a molecular polarisation curve which rises to a maximum and then falls with increasing concentration; with non-associated substances the molecular association decreases from infinite dilution as the concentration increases. The dipole association may be due to an orientation of the molecules by the dipole forces, or to their polymerisation, and molecular weight determinations and determinations of the molecular polarisation enable the degree of association, x, to be calculated on the assumption that non-polar double molecules are formed. Thus the values of x obtained for nitrobenzene, which has a molecular polarisation five times as great at infinite dilution as in the pure liquid, by electrical and cryoscopic methods in benzene agree roughly up to about $2N$. solutions (0·46 by polarisation, 0·57 by cryoscopy). The mass-action association constant rises considerably from 0·26 at $0{\cdot}1N$. to 0·39 and 0·77 at $2N$. showing that the association is not due to a definite polymerisation but to an orientation of the polar molecules which diminishes their activity. The values of x obtained for nitrobenzene in different solvents, decrease with the dielectric constant of the solvent as is shown in the table below:

Solvent.	Dielectric constant.	x at $1N$.
Carbon disulphide	2·63	0·353
Benzene	2·29	0·313
Carbon tetrachloride	2·24	0·284
Cyclohexane	1·88	0·269

Oceanographic Instruments*

THE most complete survey of the physical oceanography of an ocean was carried out by the German research vessel *Meteor* in the South Atlantic. The plan of the expedition centred largely upon discovering the general movement of the water masses, the circulation theory of Bjerknes having provided an additional means of attacking this problem. This necessitates exact data of the distribution of density of the water throughout the ocean, as do all hydrographic calculations. These values of density are obtained by calculation from the temperature and chloride content of the water at various depths and the greatest attainable accuracy is sought, since the final picture rests on very small differences. The years 1925–27 were spent by the *Meteor* in collecting such data at more than three hundred positions down to depths often exceeding three miles. Gear and instruments must stand up to their work under severe conditions, so it says much for their efficiency that the original plans were fully carried out.

The results of the expedition are now being published. Part I of vol. 4, "Ozeanographische Methoden und Instrumente" by Wüst, Böhnecke and Meyer, gives a very full account extending over 300 pages with numerous illustrations of the instruments—thermometers, water bottles, winch and current meters. A final chapter is devoted to the technique and organisation of chloride titrations carried out on board.

Two types of deep-sea reversing thermometers were used, one with an outer casing protecting it from the effect of pressure, the other not so protected. The latter acts as both thermometer and manometer. It was found in calibrating to have a constant pressure coefficient and was used to calculate the actual depths at which water samples and tempera-

* Deutsche Atlantische Expedition auf dem Forschungs—und Vermessungsschiff *Meteor*, 1925–1927. Wissenschaftliche Ergebnisse, herausgegeben im Auftrage der Notgemeinschaft der Deutschen Wissenschaft von Prof. Dr. Albert Defant. Band 4, Teil 1: Ozeanographische Methoden und Instrumente. Von Dr. Georg Wüst, Dr. Günther Böhnecke und Dr. Hans H. F. Meyer. Pp. xii+298+9 Tafeln. (Berlin und Leipzig: Walter de Gruyter und Co., 1932).

tures were taken. The following table shows the maximum and mean error of the depth as obtained by this means.

Actual Depth.	Maximum Error.	Mean Error.
100 metres	± 6 metres	± 3 metres
500 ,,	± 9 ,,	± 4 ,,
1000 ,,	±14 ,,	± 6 ,,
2000 ,,	±23 ,,	± 9 ,,
3000 ,,	±32 ,,	±12 ,,
5000 ,,	±49 ,,	±19 ,,

In taking soundings or samples from great depths, a material time is occupied by the lead and apparatus sinking to the desired depth. Meanwhile the ship may have drifted some distance, however skilfully manœuvred, and the line strayed from the ship making an angle to the vertical. During the expedition the angle of stray was observed and the effect of stray upon the actual depth reached investigated from the numerous data available.

A chapter is devoted to the protected type of reversing thermometer, in which an improvement was effected by using a thermometer tube of semi-circular section, the graduations being marked on the flat. The zero point of the thermometers in use was found at frequent intervals and diagrams are given showing the change in zero point with time.

There is no doubt that this volume will be of great assistance to anyone equipping an expedition for similar work.

Preservation of Timbers

IN *Forest Bulletin* No. 75 (Economy Series, 1931) of the Research Institute, Dehra Dun, India, Mr. F. J. Popham discusses the "Preservation of Indian Timbers—the Open Tank Process". This process consists essentially in submerging timber for a sufficient length of time in hot preservative and in keeping it submerged whilst the preservative is allowed to cool. A modification of this treatment, known as the butt treatment, is considered in Chap. ii of the *Bulletin*. In describing the method, the following considerations are dealt with by the author: (1) the vessel used for the treatment; (2) method of heating the preservative; (3) method of submerging the timber; (4) the preservative to be used; (5) the temperature of the preservative; (6) length of time to obtain desired results; (7) should the wood be seasoned before treatment; (8) varying treatment for different timbers; (9) cost of treatment.

It is recognised that although the open tank process of treating timber has many limitations, it also has much value, especially in India; and, it may be added, in many other parts of the British Empire, where there are many small users of timber who cannot afford a pressure plant. The capital outlay required for a full-sized pressure plant restricts the application of the pressure process considerably and leaves a wide field untouched. The open tank process, on the other hand, is cheap, and can have a wide application in regions and under conditions where the more expensive process is out of the question. The *Bulletin* is accompanied by five plates of line drawings illustrating the text descriptions. In an appendix a list of species of timbers not treatable in the heart wood by the open tank process is given.

Under the auspices of the Council for Scientific and Industrial Research, Commonwealth of Australia, Mr. J. E. Cummins has drawn up a small treatise entitled "The Preservative Treatment of Fence Posts (with Particular Reference to Western Australia)" (*Pamphlet* No. 24, Melbourne, 1932).

M. J. H. Boas, Chief of the Division of Forest Products, in a foreword, points to the inevitable experience of all countries which commence with what appears to be inexhaustible forest resources. Australia was fortunate in possessing timbers of remarkable durability under general conditions of service. These timbers were at one time plentiful; but as experience proved their value, the demand for them naturally increased. Supplies have in consequence become scarcer and prices are rising. Under these conditions the preservative treatment of less durable species becomes, not only economically possible, but also desirable. This is the seemingly inevitable cycle in all timber-producing countries. By the time experience has shown the true value of certain species for particular purposes, the demands of settlement and exploitation of the forests cause a serious depletion in the supply. Fortunately it is possible to treat many less durable species in such a way as to render them highly resistent to the attacks of fungi and white ants. On a farm there are generally supplies of fence post timbers which, when treated with preservatives, will have a length of life several times that of the untreated wood. The pamphlet sets out methods of treatment which have been shown to pay and can be practised by the farmer; the plant is cheap, can be easily and quickly erected, and the methods of treatment are simple. They are based on the treatment of 1,800 fence posts in West Australia.

Mr. Cummins points out that from the earliest days of farming in Western Australia the raspberry jam or jam post (*Acacia acuminata*) was recognised as the ideal timber for fencing posts and that fences constructed fifty to sixty years ago are still in a perfect condition. Jam, however, generally grows on good wheat land. In addition to an increase in farming areas in the jam country adjoining the Great Southern and Midland Railways, the so-called eastern wheat belt has been developed. This country carries little, if any, jam but several non-durable timbers. Jam posts were obtained, therefore, for the fences whenever possible, with the consequence that supplies are becoming scarcer and will become more so in future. With the increased price and reduced supply, the eastern wheat-belt farmer had to add a heavy freight to the initial cost of his fences.

As in the past in Australia, and elsewhere in the Empire, in clearing the land for the extension of agriculture, tea, coffee, rubber and so forth, the practice was, and is, in Australia, to destroy the greater part of the standing non-durable timber. The author's aim is to show that at very little extra cost fence posts could be cut from this material. Mr. Cummins deals with this question, as also that of material from thinnings from woods under proper management. He then discusses the main causes of timber deterioration and the reasons for differences in durability in different timbers. Preservatives, plant and estimated costs are considered, which merit the close attention of all interested in this question.

University and Educational Intelligence

CAMBRIDGE.—Prof. Walter Langdon Brown, regius professor of physic, and Prof. J. E. Lennard-Jones, Plummer professor of inorganic chemistry, have been elected fellows of Corpus Christi College.

WALES.—The Council of University College, Cardiff, at its meeting on Sept. 30 appointed Dr. W. F. Cassie as assistant lecturer and demonstrator in civil engineering in place of Mr. J. F. Barlow, who has resigned. The extension to the Metallurgy Department is now practically finished, and will be ready for occupation in the near future. Additional accommodation has been found necessary for the Zoology Department. This has been secured by extending the senior laboratory, and by building a new 'honours' laboratory.

SIR C. V. RAMAN, F.R.S., Palit professor of physics in the University of Calcutta, has been appointed director of the Indian Institute of Science, Bangalore, to succeed Dr. M. O. Forster, F.R.S., on his retirement in April next year.

SEVEN demonstrations of specimens in the Museum of the Royal College of Surgeons, Lincoln's Inn Fields, W.C.2, will be given by Sir Arthur Keith, Mr. Cecil P. G. Wakeley and Mr. R. Davies-Colley on Mondays and Fridays, beginning Oct. 17, at 5 P.M. The demonstrations are open to advanced students and medical practitioners.

As the result of a suggestion by the Association of Special Libraries and Information Bureaux, the School of Librarianship at University College, London, has instituted a course of training for special librarians. The course is open to graduates in faculties other than that of arts who desire to train for posts in special libraries, research departments, information bureaux, etc. It includes lectures on English composition, other languages, bibliography, cataloguing and indexing, literary history and book-selection, classification, history of science, palæography and archives, library economy and special library services. To meet the needs of the course, the regulations for the diploma in librarianship in the University have been modified. This course offers a splendid training for those who wish to enter the libraries of research departments, Government works, university and State libraries and other fields of activity, where scientific and technical knowledge, linguistic attainments and special training in the organisation of research are needed.

THE autumn programme of the twentieth annual series of Chadwick Public Lectures begins on Oct. 20 at 5.15 p.m., when Sir Humphry Rolleston will repeat in the theatre of the Royal United Service Institution, Whitehall, the Chadwick Lecture he delivered at the Paris Academy of Medicine last April, on "The Pioneers and Progress of Preventive Medicine". Sir William Collins, chairman of the Chadwick Trustees, will preside and at 5 o'clock will present to Mr. Alasdair Robertson the Chadwick Gold Medal and Prize for excellence in municipal engineering and hygiene, which is annually awarded to a student at University College, London, who has distinguished himself in the technique and sciences of engineering and sanitation. Other Chadwick Autumn Lectures are "Hygiene in the Far East—Progress under Difficulties" by Prof. Kielstra, of Leyden, who has had experience of these difficulties in the Dutch East Indies (Nov. 1); Sir Pendrill Varrier-Jones on "The Employment of Tuberculous Patients" (Nov. 15); and Dr. T. Carnwath, senior medical officer of the Ministry of Health, on "Public Health Administration" (Dec. 1). Discourses will also be delivered by Prof. S. D. Adshead at the Technical College, Bradford, on Nov. 21, on "Some Recent Developments in the Housing Problem" and by Dame Louise McIlroy at the Town Hall, Gateshead, on Nov. 25, on "Maternal and Infant Welfare". All Chadwick lectures are free and no tickets are required for admission. Further information about them may be obtained of the secretary, Mrs. Aubrey Richardson, at the offices of the Trust, 204 Abbey House, Westminster, S.W.1.

Calendar of Geographical Exploration

Oct. 11, 1579.—Sarmiento in the Strait of Magellan

Pedro Sarmiento de Gamboa sailed from Callao. Sarmiento had been many years in Peru, where he had become deeply versed in the ancient traditions of the Incas and had learnt of a voyage which they had made "towards the setting sun". Sarmiento then himself made this voyage from Peru and later, in 1567, discovered the Solomon Islands. His 1579 voyage was undertaken with the aim of intercepting Drake in the Strait of Magellan, it being thought that he would return that way. Sarmiento explored the channels in the Chonos Archipelago and carefully surveyed the Strait of Magellan. On his return to Spain he urged that the Strait should be fortified and colonies set up. In 1581 he sailed to carry out these suggestions, and after meeting many disasters, landed some of the colonists at a spot named San Felipe. He left for Chile, meaning to return with supplies; stormy weather intervened and he set out towards Spain but was taken prisoner by Raleigh. All but one of Sarmiento's colonists perished from famine, Cavendish inhumanly refusing to help those who were still alive when he arrived there in 1587.

Oct. 11, 1492.—Christopher Columbus

After a voyage in which he left Spain on Aug. 3, 1492, and the Canaries on Sept. 9, Columbus sighted land, probably Watling Island in the Bahama group, on this date. He reached Cuba on Oct. 28 and sailed to Haiti, from which island he returned to Spain in March, 1493. Academic controversies have recently raged round his name from the point of view of his aims and of his failure to grasp the significance of his discovery. But no criticism can affect the fact that he made the pioneer voyage across the Atlantic to the islands off the coast of Central America, and thence returned, thus opening up new possibilities in navigation and pointing the way for the rapid series of discoveries which followed his voyage. These subsequent discoveries so widened the outlook on world geography that it is difficult for modern writers to realise the limits of the geographical conceptions of the pre-Columban age. In a second voyage, in 1493, Columbus discovered Dominica and a number of adjacent islands and again examined Cuba, which he quite naturally, considering the fixed ideas of his time, thought to be part of the mainland of Asia. In 1498 he discovered Trinidad, noted the fresh water of the Orinoco River far out at sea and sighted the mainland of South America, near Paria. In a fourth voyage, Columbus in July

1503 sighted the coast of Honduras and followed it southward to the Gulf of Darien.

Oct. 13, 1884.—Sir Thomas Holdich's Surveys

The Russo-Afghan Boundary Commission assembled at Sarrakhs, the point where Russia, Persia and Afghanistan meet. Sir Thomas Holdich, with a very small staff, succeeded in carrying out a detailed and accurate survey from Kandahar to the Helmand, and thence through western Afghanistan to the Hindu Kush near Herat. He had already carried out some work on the north-west frontier of India in 1881–83. In 1889 he surveyed the Zhob valley and explored Makran. The Perso-Baluch Boundary Commission, and the Pamir Boundary Commission worked under his direction and his work and that of his surveyors covered large areas of previously unexplored country in Afghanistan, Baluchistan and the north-western regions of India. In 1902 Holdich directed the work of the boundary commission on the Chile-Argentine frontier in which Francis Moreno took part. Moreno had between 1873 and 1902 carried out a series of explorations in the Andes, Patagonia and Argentina which were of the first importance.

Oct. 14, 1872.—N. M. Przhevalsky's Explorations in Asia

The famous Russian explorer Przhevalsky reached Kuku Nor from Kiakhta, following much the same route as that of the Abbé Huc in 1843–46. In this 1870–73 journey Przhevalsky, with only three companions, crossed the Gobi desert, reached Peking, explored the Ordos, the Ala-Shan and the upper course of the Yangtze Kiang, and got so far as the Di-Chu River in Tibet. In 1877 he re-discovered Lop Nor, in 1879–80 he penetrated the Tsai-Dam and followed the valley of the Tibetan river, Kara Su, approaching within 170 miles of Lhasa. Altogether he made five expeditions into these regions, in addition to an earlier exploration, carried out single-handed, in the Ussuri region, in 1867–69. He died at Karakol on Lake Issyk Kul when he was attempting a further journey to Lhasa. His interests were wide and in addition to their geographical importance, his journeys resulted in valuable collections of plants and animals and of ethnographic data. He discovered the wild camel and the early type of horse now known by his name.

Oct. 15, 1819.—South Shetland Islands

William Smith in the *Williams* sighted the South Shetland Islands and claimed them for Britain. Smith was a trader and had on a previous voyage seen the islands, but had not ventured near them because he feared to lose his cargo. The *Williams* was in the following year chartered by the British naval commander of the Pacific station for a voyage of discovery. Edward Bransfield was put in charge and explored and charted the group between Jan. 16 and March 21, 1820.

Societies and Academies

PARIS

Academy of Sciences, Aug. 17 (vol. 195, pp. 429–448).—Charles Achard and Ho-dac-an: Some observations on the flocculation of suspensions of myxoprotein by electrolytes. The existence of two zones in the flocculation curve of myxoprotein by the two electrolytes studied, $AlCl_3$ and $ThCl_4$, leads provisionally to two hypotheses: myxoprotein contains two different substances or there is a change of sign in the protein.—E. Bataillon and P. Tcherniakofsky: The sterility of the male hybrids resulting from crossing *Molge marmorata* and *Molge cristata*.—R. Risser: The proper dispersion with n errors in the case where each of the component errors is ruled by a simple law. An attempt at an analytical representation.—Jacques Devisme: Certain families of polynomials.—D. Iwanenko: The constitution of the atomic nuclei.—A. Portevin and P. Bastien: Contribution to the study of the ternary system magnesium-aluminium-copper.—Li Shi Lin: Study of some ottrelite schists from China.—Henry Germain: Some fresh-water diatoms living in mucous tubes.

Aug. 22 (vol. 195, pp. 449–472).—E. Bataillon and Tchou Su: Crossings (second generation) between a female hybrid and males of two parental types.—Paul Mentré and O. Rozet: Certain tetrahedral surfaces.—Georges Giraud: An extension of the theory of the Fredholm integral equations, with application.—Gr. C. Moisil: The integration of matrices.—A. Aleyrac: Remarks on the support of a body by (wing) beats.—J. Solomon: The theory of Einstein and Mayer and the equations of Dirac.—G. Bruhat and P. Chatelain: The photoelectric measurement of the rotatory dispersion of some sugars in the beginning of the ultra-violet. Measurements are given for wave-lengths ranging from 5,461 to 3,021: the formula of Lowry and Richards was found to hold over this range.—Michel Polonovski and Albert Lespagnol: The constitution of allolactose. This sugar is shown to be an isomer of lactose.—D. Ivanoff and T. Roustcheff: The alcoholysis of esters by mixed organomagnesium alcoholates and phenolates. A study of the reaction $R.CO_2R_1 + R'OMgX = R.CO_2R' + R_1OMgX$. In the eleven cases examined the yields varied from 0 to 69 per cent.—F. Blanchet and L. Bethoux: The influence of the geological nature of the soil and of the mineralisation of drinking water on the frequency of cancer in man.

Aug. 29 (vol. 195, pp. 473–504).—C. Camichel, F. Beau and L. Escande: The similitude of short hydraulic systems: experiments on the dock of the port of Havre.—G. Tzitzéica: Conformal representation.—Torsten Carleman: The characteristics of the torus.—Georges Bouligand: Various ideas concerning infinitesimals.—Alexandre Ghika: The development in series of uniform monogene functions.—Giulio Krall: The limiting state resulting from the tides for the movement of a planetary system.—P. Vaillant: A device susceptible of increasing the precision of optical spectrophotometric measurements.—J. Prat: The combinations of arsinic acids and hydrochloric acid.—Vale Vouk: The biology of *Codium Bursa*.—A. N. J. Heyn: The method of determining the plasticity of cellular membranes.—G. Viaud: The phototropism of *Daphnia pulex*: the rôle of memory in phototropism.—G. Champetier: A method for determining the composition of addition compounds of cellulose.—Jean Roche: The muscle hæmoglobins. Muscle and blood hæmoglobins are representatives of the same type of pigment the spectra of which are determined by the same laws.

CRACOW

Polish Academy of Arts and Letters, July 4.—Stan. Ziemecki: The Raman spectra of naphthalene derivatives. The spectra of five naphthalene derivatives have been examined. The line 1376 is always

present: it is very intense and evidently characterises the naphthalene nucleus. These results are analogous with those obtained with benzene. Certain well defined types of molecular structure can be established by the Raman spectrum.—L. Marchlewski and Wl. Gabryelski: The absorption of the ultra-violet rays by certain organic substances (27). A description of the absorption spectra of the polysaccharides.—L. Marchlewski and T. Surzycki: The absorption of the ultra-violet rays by certain organic substances. (28)—K. Dziewonski, J. Moszew, Mlle. G. Dortheimer, and W. Rozycki: A new method of synthesis of compounds derived from quinoline.—T. Domanski and J. Suszko: α-Quinidine. By treating quinidine with strong hydrochloric acid and submitting the product to alcoholic alkali solution, a new alkaloid, α-isoquinidine, is obtained.—St. Kreutz: The luminescence of minerals in relation with the places at which they are found and with the conditions of their formation. The differences between the luminescence of minerals of different places of origin is marked, and may be of service in determining the country of origin.—A. Malicki: Changes in relief of the terrestrial globe.—Mlle. A. Cehak: The quantitative determination of the deformations of the longitudinal profiles of the water courses of Pokucie.—H. Bolkot: The hypsographic curves of North America and of South America.—J. Wiertelak: The influence of white rot on the chemical composition of wood. White rot causes considerable losses of lignin, together with a slow decomposition of the carbohydrates. The loss of weight is marked, amounting in one case to 15 per cent.—E. Pischinger: The phosphorus compounds of plants (7). The solubility of the phosphorus compounds of hemp seed.—L. W. Wisniewski: *Cyathocephalus truncatus*, its development, morphology and biology.—L. W. Wisniewski: Two new progenetic trematodes of the Balkan Gammarideæ.—Mlle. J. Ackermann: The innervation of the skin of the frog (*Rana esculenta*).—Mlle. J. Janiszewska: Studies on *Aphidius*, a hymenopteran parasitic on the aphis *Hyalopterus pruni*.—Mme. N. Natanson-Grodzinska: The structure of the tegument of the aquatic larva *Cataclysta lemnata* and its function in respiration.—Z. Grodzinski: Observations on the lymphatic system of *Myxine glutinosa*.—L. Sedlaczek-Komorowski: Man of the age of the caliciform vases in Poland.

VIENNA

Academy of Sciences, June 16.—Leonore Brecher: Butterflies (*Vanessa Jo.* L.) direct from caterpillars. Of ten of these caterpillars, eight formed chrysalides and butterflies in the usual way, whilst the other two kept under the same bell-jar gave rise directly to stunted butterflies.—Karl Huttrer: Means for the analysis of the formation of butterfly markings. From observations made, it is concluded that neither the assumption of sensitive states nor the retardation theory suffices to explain the action of external factors on the formation of these markings.—Erich Murr: Direct dependence of the tail-length of the ferret (*Putorius furo* L.) on the temperature. The increased rectal temperature observed with pregnant ferrets kept at a temperature higher than usual is accompanied by increase in the length of the tails of the offspring.—Hans Przibram: (1) Regeneration of feelers and legs with phasmids (VIII): Attempts to find conditions for orthomorphic, heteromorphic or defective growth after removal of the feelers of *Dixippus morosus* Br. et Redt.—(2) Growth of appendices in allied locusts (*Sphodromantis, Mantis*).—(3) The 'lower' males of the rhinoceros beetle, *Oryctes nasicornis* L. as heat-forms.—Toshihiko Yamanôuti: Coprometry for the measurement of the growth of Orthoptera.—Kasimir Graff: The photometric system of the Holetschek nebula catalogue.—Fritz Kerner-Marilaun: Anisothermy in spring horizons and its geological significance.—K. W. F. Kohlrausch, H. Kopper and R. Seka: The Raman spectrum of organic substances (isomeric paraffin derivatives, ii). Secondary butyl alcohol, isobutyric acid, tertiary anyl iodide, and nine isobutyl derivatives, $(CH_3)_2 . CH . CH_2X$ (X = CH_3, OH, NH_2, SH, Cl, Br, I, NO_2 and NO_3), have been examined. The results show that, in a polyatomic molecule, RX, a physical meaning is attached to the valency frequency C—X, if the substituent X differs markedly in weight from the other groups—CH_2, CH_3—of the substituted paraffin.—A. Dadieu, K. W. F. Kohlrausch, and A. Pongratz: The Raman spectrum of organic substances (isomeric paraffin derivatives, iii). The results furnished by isoamyl and secondary butyl derivatives, in conjunction with those previously obtained, serve for the determination of the frequencies of the valency vibration of the carbon-halogen linking. Duplication of these valency frequencies occurs only and always if the molecule is able to assume different space-forms owing to free rotation. The frequency is related to the number of hydrogen atoms attached to the carbon atom of the carbon-halogen linking.—Gustav Beer: The convexibility of regular curves.—Erich Haberfelner: The history of the development of the monograptids.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 18, 409–480, No. 6, June 15).—P. Debye and F. W. Sears: On the scattering of light by supersonic waves. (See NATURE, vol. 130, 281, Aug. 20, 1932).—Linus Pauling and Don M. Yost: The additivity of the energies of normal covalent bonds. A normal covalent bond is defined as that between two unlike atoms of the same degree of negativity, and it is postulated that the energies of such bonds are additive. Experimental data of other workers is in fair agreement with this hypothesis.—Marston Taylor Bogert and Torsten Hasselström: Investigations in the retene field (2). Alpha-retene carboxylic acid and some of its derivatives.—F. E. Lloyd and T. Cunliffe Barnes: Changes in the cells of *Spirogyra* associated with the presence of water polymers. Ice water from ice formed over running water and also newly condensed steam were used in series of experiments on *Spirogyra nitida*, with and without the addition of nutritive salts in the form of Knopf's solution. Ice water, which contains much trihydrol, promotes reproductive activity at room temperature, as well as at 10° C. as reported previously. In the presence of Knopf's solutions, the filaments became tightly coiled in addition, indicating a high state of vigour.—Edgar Anderson: Character recombination in *Drosophila*. Regarding recombination of genes as a recombination of 'strings of beads' the lengths of which depend on the lengths of the cross-over segments, the effect of length and number of such 'strings' should be morphologically demonstrable.—M. Demerec: Effect of temperature on the rate of change of the unstable miniature-3 gamma gene

of *Drosophila virilis*. Observations on flies reared at 20°, 25° and 30° respectively suggest that at the higher temperatures, the character is more stable; the result is due, however, to the decreased size and crumpled wings produced. The frequency of change is independent of sex although the female carries approximately twice as many 'miniature' genes as the male.—C. R. Burnham: An interchange in maize giving low sterility and chain configurations.—R. A. Brink and D. C. Cooper: (1) A strain of maize homozygous for segmental interchanges involving both ends of the *P–br* chromosome. —(2) Chromosome rings in maize and *Œnothera*. The hypothesis of simple segmental interchange, although giving a satisfactory explanation of the chromosome attachments in *Œnothera*, does not account for those in maize. Other mechanisms are suggested and discussed.—E. B. Fred: The stability of physiological characters of bacteria. Cultures of nitrogen-fixing bacteria, lactic acid bacteria and tubercle bacteria kept in the laboratory for various periods up to twenty years and tested from time to time have shown no appreciable change in character. —Harry Merrill Gehman: Concerning sequences of homeomorphisms.—Edward V. Huntington: An improved equal-frequency map of the normal correlation surface, using circles instead of ellipses. Concentric circles and a family of equally spaced radial lines are drawn, forming a 'cobweb' map which divides the plane into 'townships of equal frequency'. From this map it is possible to make a direct comparison between the observed distribution of dots and the theoretical distribution in the corresponding normal case.—A. W. Tucker: Modular homology characters.—G. A. Miller: Orders for which a given number of groups exist.—Edward Kasner: Geometry of the heat equation: first paper. Heat curves are defined as the loci of constant temperature throughout a given flow of heat.

Forthcoming Events

TUESDAY, Oct. 11

Illuminating Engineering Society.—Lieut.-Commander H. T. Harrison (Presidential Address) at the Lighting Service Bureau, 15 Savoy Street, Strand, W.C.2, at 7 p.m.

Institute of Education, London.—Prof. C. H. Becker: "Educational Problems in the Far and Near East", at 5.30 p.m. (succeeding lectures on Oct. 12 and 13).

King's College, London.—Dr. J. W. Pickering: "Blood Plasma and Platelets", at 5 p.m. (succeeding lectures on Oct. 18, 25, and Nov. 1).

THURSDAY, Oct. 13

King's College, London.—Dr. W. Robson: "The Metabolism of Carbohydrates, Fats and Proteins", at 5 p.m. (succeeding lectures on Oct. 20, 27 and Nov. 3).

FRIDAY, Oct. 14

London Hospital Medical College.—Mr. S. P. Bedson: "Some Recent Work on Filterable Viruses and its Significance", at 5 p.m.

Official Publications Received

BRITISH

Committee of Enquiry on the Post Office, 1932: Report. Pp. 42. (London: H.M. Stationery Office.) 9*d*. net.

The Hundred and Tenth Report of the Commissioners of Crown Lands. Pp. 39. (London: H.M. Stationery Office.) 2*s*. net.

Transactions of the Optical Society. Vol. 33, No. 5. Pp. 189–251+xiii. (London: Optical Society.) 10*s*.

The Newcomen Society for the Study of the History of Engineering and Technology. Transactions, Vol. 10, 1929–1930; with Index to Vols. 1–10. Pp. xii+153+48+19 plates. (London: Science Museum.) 20*s*.

London County Council: Lectures and Classes for Teachers. Handbook for the Session 1932–33. Pp. 72. (London: London County Council.)

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July, 1931. Pp. 90. (Reading.)

Allahabad University Studies. Vol. 8, Part 1 (Arts Section). Pp. iv+252. 7.8 rupees. Vol. 8, Part 2 (Science Section). Pp. v+231+19 plates. 7.8 rupees. (Allahabad: Indian Press, Ltd.).

Union of South Africa: Department of Agriculture. Science Bulletin No. 106: South African Tanning Materials (Part 3). By C. O. Williams. (Division of Chemistry Series, No. 122.) Pp. 92. (Pretoria: Government Printer.)

Newcastle-upon-Tyne Public Libraries Committee. Local Catalogue of Material concerning Newcastle and Northumberland as represented in the Central Public Library, Newcastle-upon-Tyne. Pp. vii+626+1 plate. (Newcastle-upon-Tyne: Andrew Reid and Co., Ltd.)

Transactions of the Institute of Marine Engineers, Incorporated. Session 1932, Vol. 44, No. 7, August. Pp. 323–374+xxviii. (London.)

Economic Advisory Council: Committee on New Industrial Development. Report. Pp. 29. (London: H.M. Stationery Office.) 6*d*. net.

Journal of the Chemical Society. August. Pp. iv+2089–2284+x. (London: Chemical Society.)

The Edinburgh and East of Scotland College of Agriculture. Calendar for 1932–1933. Pp. 98. (Edinburgh.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1358 (Ae. 489—T. 2884 and "a"): Eddy Systems behind Discs. By T. E. Stanton and Dorothy Marshall. Pp. 11+6 plates. (London: H.M. Stationery Office.) 1*s*. net.

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1931. Pp. 199. (Harpenden.) 2*s*. 6*d*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 25: On the Cultivation in Artificial Media of *Catenaria anguillulæ*, a Chytridiacean Parasite of the Ova of the Liver Fluke, *Fasciola hepatica*. By Prof. J. Bayley Butler and Annie Humphries. Pp. 301–324+plates 13–18. 5*s*. Vol. 20 (N.S.), No. 27: A Comparison of some European and American Virus Diseases of the Potato. By Dr. Paul A. Murphy and Robert McKay. Pp. 347–358. 1*s*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Dominion of Canada: National Research Council. Report No. 26: Survey of the Prairie Provinces. By J. M. Manson. Pp. 34. Report No. 27: Weeds and their Control. By G. P. McRostie, L. E. Kirk, G. Godel, W. G. Smith and J. M. Manson. Pp. 15+2 plates. (Ottawa: F. A. Acland.)

FOREIGN

Publications of the Lick Observatory. Vol. 18: A General Catalogue of the Radial Velocities of Stars, Nebulæ and Clusters. By Joseph Haines Moore. Pp. xvi+220. (Berkeley, Calif.: University of California Press.)

United States National Museum. Bulletin 100: Contributions to the Biology of the Philippine Archipelago and adjacent Regions. The Philippine Land Mollusks *Cochlostyla rufogaster* and *Obba marmorata* and their Races. By Paul Bartsch. Pp. 327–342+plates 83–86. (Washington, D.C.: Government Printing Office.)

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 9, No. 1. Pp. 86. (Tokyo: National Research Council of Japan.)

The Science Reports of the Tôhoku Imperial University. First Series (Mathematics, Physics, Chemistry). Vol. 21, No. 2. Pp. 193–297. (Tokyo and Sendai: Maruzen Co., Ltd.)

Proceedings of the United States National Museum. Vol. 81, Art. 14: Two New Land Shells of the Genus Bulimulus from Bolivia. By William B. Marshall. (No. 2937.) Pp. 3+1 plate. (Washington, D.C.: Government Printing Office.)

Carnegie Institution of Washington. Publication No. 434 (Paper No. 38 of Department of Genetics): Anthropometry of Adult Maya Indians; a Study of their Physical and Physiological Characteristics. By Morris Steggerda. Pp. v+101+8 plates. (Washington, D.C.: Carnegie Institution.)

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 695: Surface Water Supply of Hawaii, 1st July,1928, to 30th June, 1929. Pp. v+101. 10 cents. Water-Supply Paper 697: Surface Water Supply of the United States, 1930. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. vii+249. Water-Supply Paper 709: Surface Water Supply of the United States, 1930. Part 12: North Pacific Slope Drainage Basin. C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vi+160. 15 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Geological Survey. Professional Paper 161: Quaternary Geology of Minnesota and Parts of Adjacent States. By Frank Leverett; with Contributions by Frederick W. Sardeson. Pp. v+149. Professional Paper 170–E: The Geologic Importance of the Lime-Secreting Algæ, with a Description of a New Travertine-forming Organism. By Marshall A. Howe. (Shorter Contributions to General Geology, 1931). Pp. 57–69+plates 19–23. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Office of Education. Bulletin, 1932, No. 13: Record of Current Educational Publications, January–March 1932. Pp. vi+108. (Washington, D.C.: Government Printing Office.) 10 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 9, No. 2, August, Research Papers Nos. 461–470. Pp. 115–278. (Washington, D.C.: Government Printing Office.)

Rubber Research Institute of Malaya. Planting Manual No. 4: Latex Preservation and Shipment. By R. O. Bishop and R. G. Fullerton. Pp. 70. (Kuala Lumpur.) 2*s*.

Federated Malay States. Annual Report of the Department of Agriculture, S.S. and F.M.S., for the Year 1931. By Dr. H. A. Tempany. Pp. ii+56. (Kuala Lumpur.)