NATURE

SATURDAY, AUGUST 27, 1932

CONTENTS

Science in Elementary Schools*

THERE has recently been published by the Board of Education a pamphlet summarising the information collected by a panel of H.M. Inspectors since early in 1930 regarding the teaching of science in certain types of post-primary schools, and offering suggestions for further improvement. This pamphlet is of more than usual importance, for the schools concerned are attempting, without the guidance of experience, what amounts to a revolution in educational practice; the aim of the 'Senior School' involving abandonment of the academic tradition in which its own teachers were themselves educated and trained.

Under the general title of 'Senior School' are included Selective Central Schools (308), Non-selective Central and Senior Schools (267), and Higher Tops, Durham (9), giving a total of 584 schools from which information was obtained, and of which about eighty were specially visited by selected inspectors. Of the 144,854 pupils in these schools, 132,199 were returned as taking a science course, the teaching being in the hands of 1391 teachers (913 men, 478 women). The figures make it clear that these new schools as a whole have decided that a course of work in science of some kind is desirable as a part of the normal curriculum for all children. This consensus of practice is a satisfactory sign; but inspection of the details shows that the problem of framing courses suitable for this type of school has not yet been solved, in spite of some praiseworthy efforts.

It must be borne in mind that the ages of the children at these schools generally range from 11+ to 14 years, and rarely to 16 years at the most; and that the great majority of the pupils never again attend any educational institution after they have left school. It is thus obvious that the aim of 'Senior Schools' should be to give a science course as complete as possible in itself as a preparation for ordinary life in the social rank to which the pupils belong; to attempt a course preparatory to more advanced study is a fatal mistake. That the schools have not yet realised this ideal is evident, for while the number of schools in which only one subject is taught is relatively small, no fewer than 264 schools make no provision for teaching biological subjects, and less than half teach both the physical and biological sciences. Boys' schools tend to limit their science teaching to chemistry and physics; and girls' schools, to a

* Educational Pamphlets, No. 89. Memorandum on the Teaching of Science in Senior Schools. (London: H.M. Stationery Office.) 1s. 3d.

less degree, to biology, usually botany; while in many mixed schools, where the happy mean might be expected, the boys take a course of physics, and the girls confine their attention to botany. Briefly, there is too much specialisation, and the outlook is thus narrow and lacking in contact with much of everyday life.

Blame for this unfortunate state of affairs is attributable to more causes than one; but undoubtedly the present condition of the external examinations for which candidates from these schools sit is largely responsible. It is true that the total number of candidates offering science is small—frequently in the single-figure region in any one school; but the examination syllabus inevitably influences, if it does not dominate, that of the whole school. In nearly all these examinations it is possible to present a single science subject; and, naturally enough, this tends to be the only subject studied in the school. Worse still, in physics it is possible to present only one branch; hence boys' schools exist in which the work is restricted to 'heat, light, and sound'.

Another potent factor contributing to the undesirable specialisation lies in the previous education and training of the teachers themselves. Analysis of the qualifications of 599 men teachers whose university records showed them to have attained a reasonable standard in science revealed that 547 have qualifications in physics, 510 in chemistry, but only 30 in botany and 8 in zoology. Among woman teachers the disproportion is less marked; here for every 100 qualifications in physical science there are 67 in biological. It is encouraging, however, to find that science teachers are availing themselves of short holiday courses in order to widen their knowledge and give greater breadth to their teaching.

To solve the problem confronting each of these schools no single cut-and-dried detailed syllabus is possible or desirable. Each school should adapt its science teaching to the special circumstances of its locality, that is, to those of the ordinary everyday life of the great majority of the pupils both during and after the school years. The surroundings and occupations of young men and women in a manufacturing town will be very different from those of persons dwelling in purely rural districts; and it is essential that the school science course should, for each category, be such that the after-school life shall be enriched with intelligent interest in the daily round of work, home life, and recreation.

There is, nevertheless, a certain amount common to the needs of all. Inasmuch as human beings are living creatures and subject to the same laws of life as other organisms, some knowledge of the fundamentals of biology and of the elements of human physiology and hygiene should be given in every school. Such universality would in a short time result in an instructed public opinion in matters of health, and thus in a more healthy, more serviceable, and happier community. Botany, so unreasonably favoured in girls' schools, cannot by itself achieve this. It ought not to be possible in any of the external examinations of these schools for a candidate to offer botany alone or zoology alone. The one subject, biology, embracing the essentials of both animal and plant life, should be compulsory, and should include a few life-histories in both kingdoms, especially of such organisms as are common and of economic or hygienic importance. Details of structure should be introduced and demonstrated only so far as they are needed to render intelligible the more obvious activities of living organisms.

Again, in this age of machinery, 'wireless', and other applications of the various forms of energy, no one, whether in country or in town, can live intelligently without some knowledge of the principles of the physical sciences. The teaching should start from the objects familiar to the child; say, the hot-water radiators or the electric lamps, and should work back to first principles. Interest is thus roused at the outset, and is sustained throughout the series of demonstration experiments designed to find out how the thing acts. In schools of this type, personal practical work by the pupils should not be allowed to occupy more than a small fraction of the time allotted to the science course. It is here that many teachers find it difficult to break away from the tradition in which they themselves were educated, failing to appreciate the great difference between their own past and the pupils' present needs for science. To start a course of physics, as so frequently, with practical mensuration, is a soul-destroying method. Calculation of areas, volumes, and the like is the work of the mathematician: time enough to determine any one of them when the information is actually required in the course of some scientific experiment.

Biology and physics, then, should form the main part of the science teaching in these schools. Chemistry has, of course, claims arising from its importance in industries and in agriculture; but in view of its intrinsic difficulty, of the short time available, and of the tender years of the children, it is recommended that in this subject the teaching

should go little beyond the simple chemistry of air and water, save in special local circumstances.

A further important point is that the several branches of science should not be taught as separate subjects. There are many links and points of contact between them; and teachers should be so trained in the theory and the experimental technique of each as to be able with confidence and success to combine physical and chemical experiments with their biological teaching and demonstrations.

Summing up, the science course in a 'Senior School' should aim at promoting an intelligent appreciation of man and his environment, and for this purpose a new method of approach is necessary. All who are responsible for such courses in Senior Schools should carefully consider the recommendations of this pamphlet; and those in charge at public schools, where the problem for the non-specialist is not widely different from that in 'Senior Schools', might also study it with advantage.

Concerning Mutton and Wool

(1) *Empire Marketing Board. Wool Quality: a Study of the Influence of various Contributory Factors, their Significance and the Technique of their Measurement.* By Dr. S. G. Barker. Pp. 328 + 41 plates. (London: H.M. Stationery Office, 1931.) 21*s*.

(2) *Growth and the Development of Mutton Qualities in the Sheep: a Survey of the Problems involved in Meat Production.* By John Hammond, with a Section in conjunction with A. B. Appleton. (Biological Monographs and Manuals.) Pp. xxvi + 597 + 53 plates. (Edinburgh and London: Oliver and Boyd, 1932.) 42*s*. net.

BIOLOGICAL products are commonly both complex and subject to variability. Research work on their production, whether genetic or nutritional, or even purely an attempt at classification, cannot proceed far before it becomes an urgent necessity to define the nature of the product and to measure its varying characteristics. More particularly is it necessary to consider those differences that are of practical importance.

It is significant that two volumes dealing with mutton and wool respectively should appear at the present time. Both are a response to the need for establishing a precise scientific basis for research upon sheep breeding and sheep nutrition.

(1) The two volumes are widely different in content. This is due to the very different development of knowledge in the two fields. Dr. Barker deals with a subject that has exercised the ingenuity of many workers for well over a century, a subject to which he has himself made important contributions. His book, therefore, is a review of the literature dealing with the wool fibre and its physical and chemical properties, together with related substances such as wool grease and common impurities. The book will undoubtedly prove of the utmost value to research workers in this field, for, until its appearance, there has been no adequate review in English. The literature is peculiarly scattered and many important papers are hidden in volumes that most students find difficult to obtain.

Dr. Barker covers the field with thoroughness, and appends a valuable bibliography. His purpose has clearly been to bring together the material and to give the reader a clear account of the scope and findings of each paper. It is not a critical review and usually each author's conclusions are set forth without much comment. It is more useful to the research worker, however, that the volume should be comprehensive rather than critical.

The book is admirably produced and illustrated and contains numerous tables. The bibliography is made to serve as an authors' index, but there is no subject index. This is an unfortunate omission in a book that will undoubtedly take its place as a very valuable work of reference.

(2) Mr. Hammond's book is the record of nearly twenty years of research. Most workers on animal nutrition have been content to consider only gross weight and chemical composition, and while it is true that much valuable information can be secured in this way, there are many qualitative and quantitative differences that cannot be expressed in these terms. Mr. Hammond states in his preface that he has attempted to approach the problem from the other end by making observations on the product and then working backwards to discover the factors that affect its formation. This novel approach has yielded results of outstanding interest, and Mr. Hammond's observations, fully and clearly set forth in this book, will prove a mine of information to research workers concerned with any aspect of meat production, and will also prove an inspiration to all who are confronted by similar problems in other fields.

In reviewing a book of this size, which contains a mass of detailed tabular information of such an original nature, it is only possible to indicate the scope of the work and to mention in passing one or two of the host of interesting points that are raised.

The book is divided into five parts. The first deals with the rate of growth in live weight in a

flock of Suffolk sheep. Variations are related to a number of factors such as age, sex, number of young, time of lambing, and so forth. In the second part the argument is carried a stage further. Carcase percentage is considered, again in relation to the factors that affect it. This section also includes data on the relative development of organs, and it is clearly shown that each organ follows a growth curve of its own. Breed differences are striking, and Mr. Hammond makes the interesting suggestion that when the size of a species is reduced, the body decreases more rapidly than the head, and that when a species is increased in size, the body increases more rapidly then the head. This is probably due to the fact that the head reaches its maximum rate of growth early. The third part is a very complete account of variations in the rate of development of different parts of the skeleton, that is, of the basis of bodily conformation. Early maturity is regarded in general as a desirable feature in a meat-producing breed, but Mr. Hammond suggests that this is a more fundamental and inevitable trend than the practical man has perhaps realised, for it is pointed out that the most perfect meat conformation will be found in the type that matures early. "Early maturity and ultimate breed improvement go hand in hand."

The fourth part deals with variation in the proportion of muscle, fat, and bone in the carcase, and includes general observations on the composition of the gain made at different ages and the economic considerations affecting age of slaughter. Mr. Hammond suggests that in the early maturing breeds the point has been reached at which the relatively low rate of reproduction of the sheep is becoming a serious limiting factor. He is doubtful whether the sheep can hold its own in intensive farming unless improvement can be effected in this direction.

The fifth part of the book is written jointly with Dr. A. B. Appleton and is entitled "Study of the Leg of Mutton". It is a minute analysis of the anatomical (and chemical) differences that determine economic value. The section that deals with the histology of muscle is of particular interest and importance. The histological differences are surprisingly large and definite, and are undoubtedly closely associated with variations that determine the edibility of meat.

The last section of the book deals with two factors that affect edibility, namely, tenderness and flavour. Seldom can the cooking of legs of mutton in the kitchens of a Cambridge college have been supervised with such anxious care as on the occasions when Mr. Hammond entertained his friends at remarkable feasts! The individual muscles were dissected out, and the guests, all men used to scientific investigation, were asked to place the muscles in order as regards tenderness and flavour. The two characteristics vary independently; for example, the biceps femoris heads the list for tenderness, but is lowest for flavour except for the psoas major. The semimembranosus heads the list for flavour, but occupies a lowly position for tenderness. The correlation between tenderness and small size of muscle fibre is 0·71, and between tenderness and 'fineness of grain' 0·33, whereas the correlation of this characteristic with paleness of colour and amount of marbling (in any one animal) are only 0·20 and 0·11 respectively. The correlation between high flavour and dark colour is 0·45, and between high flavour and coarse grain 0·48, while there is no correlation with fibre size or with amount of marbling. So the book ends with the clear indication that even the most elusive characteristics of a variable product can be related to what can be weighed and measured.

There are full indexes of authors and subjects and a copious bibliography, though one may regret that the usual biological practice has not been followed, in that titles of papers are omitted. The illustrations are admirable and the tables very clearly arranged. The whole arrangement and production of the volume are delightful and reflect the greatest credit on the editors of the series and on the publishers. J. A. FRASER ROBERTS.

Diatoms

Kryptogamen-Flora von Deutschland, Österreich und der Schweiz. Von Dr. L. Rabenhorst. Zweite vollständig neu bearbeitete Auflage. Band 7: *Die Kieselalgen Deutschlands, Österreichs und der Schweiz mit Berücksichtigung der übrigen Länder Europas sowie der angrenzenden Meeresgebiete.* Von Dr. Friedrich Hustedt. Teil 1. Pp. xii + 920. 63 gold marks. Band 9: *Die Flechten (Lichenes) Deutschlands, Österreichs und der Schweiz mit teilweiser Berücksichtigung der übrigen Länder Europas.* Herausgegeben von Dr. Alexander Zahlbruckner. Abteilung 4: *Cladoniaceen und Umbilicariaceen.* Hälfte 2: *Die Gattung Cladonia.* Von Dr. Heinrich Sandstede. Lief. 1, 2. Pp. 531 + 34 Tafeln. 47·50 gold marks. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1930–1931.)

SINCE the publication of Van Heurck's synopsis and Peragallo's treatise on the marine diatoms of France, no comprehensive systematic treatment

of these difficult forms has appeared, for Schmidt's "Atlas der Diatomaceenkunde", most valuable as a work of reference, scarcely fulfils these functions. While the contributions of Meister, Boyer, and especially the new edition of Bacillariales in the "Süsswasserflora" by Hustedt, each serve a useful purpose in their respective fields, a treatment covering the majority of known forms has long been needed. Fortunately, it has fallen to the lot of Hustedt to undertake this work, and the volume now under review amply testifies to the thoroughness with which he is carrying out his task. It comprises introductory matter occupying some two hundred pages, as well as the taxonomic treatment of the centric forms.

The former deals with the structure, life-history, and physiology of diatoms, as well as with the technique involved in their preparation and study. In a taxonomic work most room is naturally given to a consideration of features of major systematic importance, and considerable space is devoted to a discussion of the structure of the cellular envelope. It is unfortunate that details of the author's recent work on the raphe of Epithemioideæ, Nitzschioideæ, and Surirelloideæ could not be included, and one may express the hope that they will find a place in later sections. Some sections (for example, that dealing with chromatophores) would have gained by the mention of more abundant examples. The citation of literature is not always satisfactory; thus, one seeks in vain in the respective bibliographies for the references to Heinzerling and Richter cited in the third and fourth sections, although they are mentioned elsewhere. More particulars as to the occurrence and general biology of diatoms would have been useful; their periodicity is barely mentioned, and there is no reference to Pearsall's work. With most of the views expressed in the introduction one will be in general agreement, but the statement on p. 9 as to the haploid nature of centric diatoms and the occurrence of reduction during germination of the zygote, never very probable, is scarcely in accordance with recent work. As a whole, however, the introduction constitutes a useful summary of present knowledge.

The taxonomic section dealing with Centricæ, the classification of which broadly follows Schütt's system, merits unstinted praise. The keys are well constructed, but in the larger genera the species might usefully have been numbered, so as to facilitate the finding of them in the descriptive part. The numerous difficult forms are illustrated by excellent text-figures, many original and quite as clear as the figures usually furnished on plates. The concise diagnoses are often accompanied by critical remarks, adding greatly to the usefulness of the work, which has clearly been prepared with care by one who is a master of his subject.

Sanstede's monograph of the genus *Cladonia* is a work that will be highly valuable to the specialist. The species are grouped in the three subgenera *Cladina*, *Pycnothelia*, and *Cenomyce*, and are illustrated on a considerable number of plates. A particularly useful feature is the clear distinction of different habitat-forms. F. E. FRITSCH.

Modern Physical Chemistry

(1) *Physical Chemistry: an Elementary Text, Primarily for Biological and Pre-medical Students.* By Prof. L. J. Gillespie. (International Chemical Series.) Pp. ix + 287. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1931.) 16*s.* 6*d.* net.

(2) *Outlines of Theoretical Chemistry.* By Dr. F. H. Getman. Fifth edition, revised and largely rewritten by Prof. F. Daniels. Pp. ix + 643. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 22*s.* 3*d.* net.

(3) *Industrial Chemical Calculations: the Application of Physico-Chemical Principles and Data to Problems of Industry.* By Prof. O. A. Hougen and Prof. K. M. Watson. Pp. vii + 502. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1931.) 28*s.* net.

(4) *The Kinetics of Homogeneous Gas Reactions.* By Dr. L. S. Kassel. (American Chemical Society Monograph Series, No. 57.) Pp. 330. (New York: The Chemical Catalog Co., Inc., 1932.) 6.50 dollars.

(1) PROF. GILLESPIE'S book is a courageous attempt to bring the modern conceptions of physical chemistry within the range of comprehension of what he calls "biological and pre-medical students". If by the latter we understand students preparing for first medical examination in Great Britain, then the book will be found too difficult. For slightly more advanced students of physical chemistry, whether medical or not, it will be found both stimulating and helpful. The emphasis throughout is on biological problems, in which physical chemistry is recognised as perhaps the most important guiding principle, and the range of subjects selected is admirable for this field. More attention might, it is true, usefully have been given to questions of reaction velocity and catalysis, the chapter on these subjects being somewhat inadequate and out of proportion as compared with

the rest of the book. After all, there could be no life if everything were in equilibrium or pseudo-equilibrium.

In many cases deductions of formulæ are given, in some cases by simple and ingenious methods, and this part of the book is well worth study by teachers and students of general physical chemistry. The thermodynamic treatment is the most prominent, the so-called free energy being introduced and used in a very interesting and instructive way. The perplexing question of the signs of electrodes and cells is fully dealt with, the author adopting one of the American conventions in the first part of the book, and the other in the second part (pp. 133, 245). The activity conception is clearly explained and is used throughout, and there is a good chapter on the Donnan equilibrium.

This book is a very good elementary account of certain selected aspects of physical chemistry, and is certain to prove useful both to teachers and students.

(2) Prof. Getman's textbook, first published in 1913, represents, as it were, the extrapolation of the classical type of treatise initiated by Ostwald's "Outlines of General Chemistry" into the modern period. The fact that it is now in its fifth edition shows that it is a highly successful and valuable work, and in its modern form it reflects faithfully the important outlines of the science. Prof. Daniels had a good stock on which to graft the new ideas, and he has performed his duty admirably, the whole organism now being as one.

A very praiseworthy feature is the inclusion of descriptions of experimental methods, which have tended to disappear from some books, leaving the incorrect impression that physical chemistry is a branch of mathematics. The sections of electrochemistry are particularly good, careful attention being given to all points which usually cause difficulty; and the introduction of activities, with good examples of their application, makes this part of the book a real help to teachers and students. The chapter on thermodynamics gives a good summary of the American system of calculations. Many problems are given, and answers to some are provided.

A few minor points of criticism may be mentioned for consideration by the authors when a new edition is in preparation. In considering viscosity, the question of turbulent flow might be mentioned; the so-called 'factors' of energy are introduced (p. 111), but those of thermal energy are surely temperature and entropy, not temperature and heat capacity, and in any event it is not true to say that "all forms of energy may be expressed as the product of two factors", since radiation cannot be so expressed; the derivation of the Gibbs-Helmholtz equation on p. 133 is not clear, although it follows the usual lines, since the student does not see that equation 67 refers to a cycle and equation 69 to an isothermal process; the "approximate form" of Maxwell's distribution law, considering distribution in two dimensions only, although it "may be sufficiently accurate for most work in chemical kinetics", cannot represent the facts, and its use in other fields has led to mistakes; on p. 474 it would perhaps have been better to have given the deduction of the formula for the antimony electrode rather than for a hypothetical case.

(3) Chemical engineering is a branch of applied physical chemistry, as the authors of "Industrial Chemical Calculations" recognise by their sub-title. The change-over from the lecture room and laboratory to the engineer's office and the works is partly a matter of arithmetic, and very few additional ideas or conceptions are involved. The physical chemistry, however, must go somewhat beyond what the student usually learns in a degree course, and it must be brought into intimate relation with practice.

Such a book as the present one will go a long way in helping the student to bridge over the transition period, and it should be valuable to men going into industry. As the authors say, the method of tackling a calculation needs careful consideration. Most students, in working out a gas volume problem in which Fahrenheit temperatures are involved, would first convert these to centigrade and then proceed on the old familiar lines, with needless loss of time and energy. On the other hand, the use of short cuts is often dangerous, and, as the authors say, results only in the saving of time for the calculator who is experienced and proficient. "In industrial practice it is necessary not only to obtain a solution rapidly, but also to present this solution in such form that its correctness is certain." There are well-tried ways of doing this, and they are explained in the book.

Many problems are worked out in the text and several are given for solution. It would have been very much better to have given answers to these, since, unless the student has always a teacher to fall back upon who is willing to work out these problems, he does not know whether he is making progress or not. The authors provide good tables of constants and data, and give references to literature.

The section on fractional distillation, in view of the great importance of the subject, is perhaps a

little inadequate and should be extended in future editions. The book is one which can be recommended as likely to prove very valuable to students and teachers. It is well written, and the authors have spared no pains in making their presentation of the subject both intelligible and authoritative.

(4) The treatment adopted in Dr. Kassel's interesting and useful book is essentially that of statistical mechanics, which he considers has been the most successful in this field, and of which he gives a condensed but clear account in the opening chapters. The theoretical treatment and the detailed consideration of the experimental data are separated, which makes for clearness, the theory being discussed in the first part of the book and the data in the second, larger, part.

This second part of the book is particularly helpful, since the author has examined the data with great care, involving the recalculation of much experimental material and, incidentally, the revelation of no insignificant number of arithmetical errors in the original papers. The theoretical treatment includes a good critical discussion of the wave mechanical method, of intermolecular forces in imperfect gases and their influence on collision frequencies, and on various types of reaction. This part is clear and sufficiently advanced to be of real utility. After a chapter on experimental methods, the discussion of particular reactions is begun, and the field is very satisfactorily covered.

There is a useful appendix giving numerical values of heats of dissociation. Dr. Kassel's book may be recommended as giving a clear and authoritative account of a field of investigation which has attracted a considerable amount of attention in recent years. J. R. PARTINGTON.

Short Reviews

Firedamp Explosions and their Prevention. By W. Payman and Prof. I. C. F. Statham. Pp. xii + 158. (London : Oxford University Press, 1931.) 12*s.* 6*d.* net.

THE steady decline in loss of life arising from firedamp explosions in coal mines of itself bears testimony to the precautionary measures which have been developed to minimise this ever-present danger. The authors have embodied in short compass an account, drawn largely from papers published during recent years by the Safety in Mines Research Board, of the properties of firedamp, its possible means of ignition in a mine, and how, by the construction, maintenance, and testing of apparatus used in coal mines, the hazard of explosion may be minimised.

In outlining the statutory requirements for safety lamps, bells, relays, telephones and shot-firing apparatus, details are given of the tests undertaken at the research stations at Buxton and Sheffield. It is of interest to note that more stringent requirements as to the candle power of safety lamps are indicated, for it is held in many quarters that better lighting would prove a most valuable contribution to increased safety. A large section of the book deals also with the design and testing of flame-proof electrical apparatus, the use of which is rapidly increasing. Thus, between 1912 and 1929, the horse power of electrical plant installed in British mines increased by an average of 35,400 a year ; without the aid of electrical energy many of our mines could not produce coal to-day at an economic price. The final chapters are devoted to coal-mining explosives and their substitutes, the nature of the flames produced by explosives being well illustrated by photographic records. On all these matters comparison is made with United States and Continental practice.

The book is written authoritatively, is free from typographical errors and well produced, and should be in the hands of all associated with mine management. Being mainly a compilation of statutory tests, etc., it suffers somewhat from ' cataloguing ' and would have made better reading had more space been devoted to the historical side. It seems unbelievable that a book on firedamp explosions could have been written without mention of Sir Humphry Davy.

Two Thousand Years of Science : the Wonders of Nature and their Discoverers. By Prof. R. J. Harvey-Gibson. Second edition, revised and enlarged by Dr. A. W. Titherley. Pp. x + 508. (London : A. and C. Black, Ltd., 1931.) 12*s.* 6*d.* net.

THE fact that a second edition of this book has been called for only a year after the publication of the first is sufficient testimony to its general appeal. In its present form it includes much more information relating to the modern period, while the provision of chronological tables aids the reader to arrive at a true perspective. Dr. Titherley has clearly been at pains to check his facts—no light task in a survey of two thousand years—and though some of the judgments expressed are perhaps a little superficial, the book as a whole forms a reliable and readable guide to the principal course of the development of science.

Such ' popular ' accounts of the work of men of science serve a very useful purpose in the modern world, and the pity is that there are so few of them. Admitted that a great deal of present-day scientific theory is beyond the comprehension of the layman, it yet remains true that most of the results, and many of the methods, can be rendered intelligible by skilful exponents ; and that the public is eager for such fare is sufficiently obvious from the excellent reception accorded to simple explanations of scientific achievement when authoritatively written. We hope that the example of the present book may be widely followed : meanwhile, in the interests of accuracy, we may perhaps direct attention to a few minor errors that have eluded Dr. Titherley's

vigilance. Basil Valentine—if he ever existed—certainly did not publish the "Triumphal Chariot of Antimony" about 1430; the discovery of carbon dioxide is generally attributed to J. B. van Helmont, not to his son Mercurius; the Saracens are probably wrongly blamed for burning the library at Alexandria; Mayow's "spiritus nitro-aereus" is not equivalent to the modern oxygen; and the "Summa perfectionis" is scarcely the oldest chemical book.

Simple Determinative Mineralogy. By H. R. Beringer. Pp. vii + 239. (London: Mining Publications, Ltd., 1931.) 10*s*. 6*d*.

THIS is definitely not a textbook of systematic mineralogy, but a handbook intended to assist students and prospectors in the field determination of mineral species.

The method adopted is based on the recognition of two physical characteristics generally easily and quickly determinable—specific gravity and hardness. Accurate determination of these two properties should serve to restrict any mineral to a more or less small group. Further recourse may then be had to the blowpipe and to the description of the other properties of suspected species.

Practical methods for the determination of specific gravity are dealt with in the first part of the book. Two mineral lists make up the bulk of the text. In one the species are grouped according to specific gravity, the members of each group being listed in order of hardness. In the other the minerals are arranged solely in the order of their specific gravity, and a concise account of their other physical properties is given for each species. Notes are added on their chemical properties. There is also a list of the elements, with a short account of their blowpipe and other chemical reactions.

The author has had many years' experience as a teacher of practical mineralogy in the School of Mines at Camborne, and his method has been in use there for more than ten years. This should be sufficient recommendation of the practical utility of his book.

Key to and Primer of Interlingua: or Latin without Inflections meant to be used as an International Auxiliary Language amongst Peoples of various Mother Tongues. Pp. v + 168. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1931.) 4*s*. 6*d*. net.

THIS excellent little book shows the degree of perfection and range of application of the auxiliary language invented by Prof. G. Peano and his friends. Interlingua, or Latin without inflections, is meant to be used as an international auxiliary language amongst peoples of various mother tongues. Yet in reading through the rules of Interlingua, the glossary, and the interesting reading book, one is bound to find that, if this auxiliary language might satisfy the requirements of Latin races, the Anglo-Saxon languages, and the Slav languages, not to mention the extra-European languages, can scarcely look upon it as a helpful auxiliary. On the other hand, scholars would always prefer Latin to the Interlingua owing to the history and the documents which enshrine it. Further, a language which is spoken with difficulty by a band of enthusiasts and has no literature of its own can scarcely appeal either to the pragmatist or to the lover of artistic productions. The admiration one cannot help feeling for the untiring and disinterested efforts of Prof. Peano's school will never outbalance the deadweight of the irreparable curse of the Tower of Babel. T. G.

East Yorkshire: a Study in Agricultural Geography. By Dr. S. E. J. Best. Pp. xv + 189 + 8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1930.) 16*s*. net.

DR. BEST'S book is typical of the surveys which modern students of geography are making for different areas in Great Britain, and shows how closely geography and agriculture are allied. The method is to survey the country from the various geographical points of view, studying its formation, topography, climatic and other factors, and then to set out the agricultural statistics in map form and discuss the agricultural utilisation of the land in the light of its geographical and topographical features. This book is an admirable example of the aid which agriculture and geography can mutually render.

In a future edition it would be helpful if the author would give an index and a bibliography. The literature of the subject is widely scattered and often diffuse; students would be greatly assisted if a list of the best authorities could be presented to them. The author pays a tribute to the work of his distinguished namesake, Henry Best, who in the seventeenth century published an account of farming in Yorkshire; this book was reprinted by the Surtees Society but has long been unobtainable by students: one cannot help wishing that a reprint were available.

The Birds of Tropical West Africa; with Special Reference to those of the Gambia, Sierra Leone, the Gold Coast and Nigeria. By D. A. Bannerman. Published under the Authority of the Secretary of State for the Colonies. Vol. 2. Pp. xxix + 428 + 15 plates. (London: The Crown Agents for the Colonies, 1931.) 22*s*. 6*d*.

THE first volume of Mr. Bannerman's work has already been highly commended in these pages, and the second deserves equal praise. The book admirably combines the two purposes of giving a summary of knowledge of West African birds and of providing a working guide to observers on the spot. This volume has also particular interest for European ornithologists, as it deals with the occurrence and habits of many northern species that are known in Africa as migrants. It has already been remarked that publication of the work is supported by the governments of the British territories in West Africa: further aid from the Gold Coast has now made it possible to increase the number of illustrations as compared with the first volume. These include some beautiful coloured plates and many drawings of excellent clearness.

Scientific Research and Industrial Development *

SO far we have discussed only one aspect of the contribution of science to industry. Equally important is the contribution which science makes in technique, the provision of new technical methods. The importance of this aspect of the service of science to industry was enforced on British industry in the early days of the War, when our dependence on Continental firms for all classes of scientific instruments and glassware imposed a considerable handicap in the expansion of the munitions and other industries to meet the war-time demand. Without the instruments of precision for measurement and control of temperature, pressure, refractivity, and other properties, which have been evolved by purely scientific work, industrial development would have been much more laborious. Modern advances in the measurement of high temperatures paved the way for the developments in the metallurgical industries. The development of the newer industries, such as the radio industry, the manufacture of synthetic resins and rayon, is essentially a record of advance closely related to the utilisation not merely of scientific discoveries but also of scientific methods and scientific instruments for purposes of control.

The significance of such methods as X-ray analysis, ultra-violet light, hydrogen ion determination, thermionic valves for control purposes, including automatic control, in industry is only now being appreciated. In high-pressure reactions as well as low-pressure reactions and distillation in very high vacuum, science has provided industry with a whole range of new technique. Scientific work on the two forms of hydrogen has recently simplified the evaluation of industrial catalysts, while almost simultaneously the discovery of the selective properties of a copper chromite catalyst has enormously increased the possibilities of development in the industrial hydrogenation processes.

X-ray methods themselves provide a striking example of the reaction on industry of scientific technique. The recent application of X-ray methods to textile research has led to discoveries relating to the structure of cellulose, wool, and hair which throw new light on just those typical properties of wool which are of fundamental importance in manufacturing operations. As a result, a correct interpretation of the conditioning, dyeing, and other adsorptive processes has been facilitated and a method elaborated for measuring the surface scale structure of the wool fibre which represents the first step towards placing the important technical operations of milling on a scientific foundation. In addition, the discoveries lead to an interpretation of the structure of cellulose which has a direct bearing on the mercerisation process.

Refinements of technique are not the only factor that is continually changing the relations of science and industry and determining the rise of new industries or decay of others. Almost every year sees fresh compounds, formerly curiosities and accessible only by tedious and costly laboratory processes, produced on the commercial scale at a price which allows their use in industry or in scientific laboratories as the raw material of further researches. The papers published in the journal of any chemical society reveal the way in which the scope of scientific research has been enlarged and influenced by industrial advances. The utilisation of waste materials, the delicate balance between by-product and main product, the fall or rise in price of basic materials like sulphuric acid, methyl alcohol, glycerol, which alone may result in new routes to existing products—the war-time shortage of sulphuric acid, for example, led to the development of alternative methods for phenols and amines which have not been entirely replaced by the earlier methods—these are factors which continually emphasise the dynamic character of industrial research and frequently have far-reaching effects on scientific research.

While science has thus provided industry with instruments of precision and methods of attack on technical problems, an important contribution has also been made in the field of industrial health and safety. Until science had revealed the cause of yellow fever and the methods of its prevention and control, the resources of the engineer were inadequate to construct the Panama canal. Merely to walk through a modern dry battery or accumulator factory is to realise how medical science, by examining the causes of industrial poisoning, dusts, and their prevention, has revolutionised conditions of work. Hundreds of industrial processes operate smoothly every day because the scientific study of the properties of materials has enabled working conditions to be devised which satisfy stringent requirements of safety and efficiency. Industrial health is, however, not simply a matter of securing that adequate precautions are taken in the handling of toxic materials or operating dangerous machinery. Science can do much to eliminate such risks, and the accident rate in works where inflammable, explosive, or highly toxic substances are handled under pressures of hundreds of atmospheres or at very high temperatures is frequently below the average in industry.

In addition, although science cannot altogether eliminate the human factor, which is responsible for ninety per cent of industrial accidents, accidents are, however, always unduly prevalent among a comparatively small number of workers. The evidence shows that absenteeism due to sickness is usually abnormally high among the same persons, and that on an average they are also less skilled at their work. Generally it may be said that those who are most suited to their work or environment react the most healthily to their environment, whether we measure the reaction by working efficiency or skill, tendency to sickness, or proneness to accidents.

It is thus evident that vocational selection is of outstanding importance as much from the point of view of industrial safety as from that of industrial

* Continued from p. 265.

efficiency. No more valuable work is being done by the National Institute of Industrial Psychology than that which the Institute is carrying out in this field, and as a result of the application of scientific methods remarkable progress has already been made. In spite of the cramping influence of unemployment on the application of some of the newer methods of vocational selection and guidance which have been elaborated, it has been demonstrated that we can at any rate avoid placing in dangerous positions those peculiarly liable to accidents, and the policy of eliminating the unfit before and not as a sequence to accidents is not utopian. A classification into risk classes according to personal characteristics has already been indicated as possible.

The part played by science in securing improved and safer conditions of labour is often overlooked, but the work of the Industrial Health Research Board alone would demonstrate the importance of scientific research in this field. Industrial physiology, of course, is only one section of the field of scientific management, but it is the section in which the most important modern developments have occurred. During recent years the study of industrial physiology and psychology has elaborated methods of preventing strikes and of promoting co-operation between the different organisations of production which are to-day part of the scientific organisation of labour in America. These researches have the same object as the strict application of Taylor's principles in factory and workshops. The success of such work is demonstrated by the changed attitude of the workers, who recognise that attempts made to increase production have become more humane and devote more attention to the human side and the health of the operators.

Much of the work of the Industrial Health Research Board is only preparatory, but conclusions have already been reached which involve no revolutionary changes, and, indeed, only place on a scientific and statistical basis the empirical practices of progressive firms. The value of such results is demonstrated by the fact that they have already been adopted in certain branches of industry, and more widespread acceptance would greatly increase their utility. Scientific research in industrial physiology and psychology is continually improving conditions of work so that both the health and efficiency of the worker are improved, and it is now being applied to ensure that, so far as possible, young persons entering industry are fitted into occupations for which they are temperamentally suited.

It is against this background that we have to place the constructive plans of science for our social and industrial future, but the present economic position of the world has led to certain questionings as to the part which science has to play in the future. Leaders like Sir Harry McGowan have perceived that scientific and technical progress have far-reaching reactions not only on industry but also on the finance and economics of the whole State. Scientific discoveries and their application in industry have dislocated the major balance between industrial and agricultural production, and have threatened the whole social, financial, and political structure of our civilisation. Sir Harry McGowan uttered no idle warning when he hinted at the possibility of our common civilisation perishing through our inability to control the forces which applied science primarily has created. Under the influence of science, not only industry but also accepted views of trade and competition are changing their value, and policies such as free trade and protection acquire a new significance.

Sir Harry McGowan has urged that the policy of industrial co-operation which has developed notably in chemical industry under such forces should be extended into the more difficult field of international co-operation—as indeed has already been done in some few branches of industry, though with what success it is difficult as yet to say. As an aid to such control or development, Sir Harry McGowan visualises a Minister of State devoted to the task of promoting the co-ordinated reorganisation of all our industries, and beyond this an international chemical council to provide chemical industry with a world-wide range. The effective rationalisation thus secured would stabilise development and co-ordinate or expedite research.

There is, however, even now much confusion between rationalisation and the processes of mere amalgamation or cartel which involve no scientific planning or management, and this confusion tends to retard progress. In addition it has to be admitted that in spite of the contribution to industrial progress which science has made during the last century, there are still many sections of industry where scientific research has yet to be recognised as one of the principal avenues of progress. Of this fact the annual reports of the Department of Scientific and Industrial Research provide plentiful evidence, and it will be sufficient to refer to the poor response of the shipping and shipbuilding industries to the offer of the Department to provide half the cost, up to £10,000, of erecting a second William Froude Tank at the National Physical Laboratory for research in connexion with ship resistance and propulsion and tests on ship forms, propellers, etc. In consequence of the congestion of work in the existing tank, not only was research being hindered, but also orders for testing were accumulating to such an extent that they were frequently withdrawn and sent to the Continent, where in recent years similar facilities have greatly increased. It is obvious that if the testing of ship designs is better carried out abroad, orders for construction are likely to follow them abroad. By its failure to respond to this offer the shipping industry clearly was committing suicide, and had not the Advisory Council, in view of the vital importance of this industry to the nation, revised its recommendation and suggested that the whole capital cost of a new tank should be provided initially by the State, the depression in the shipping and shipbuilding industries must inevitably have increased to a point from which any recovery of competition with Continental rivals would have been impossible.

If, however, there are important sections of industry which have still to learn that, while scientific research cannot provide a ready-made solution of our present industrial difficulties, it does point the road along which persevering effort may enable industry to find a way out of those difficulties, it is important to remember that there are accordingly industries the difficulties of which are due less to economic conditions than to neglect of scientific method and research in the past. This is essentially the mark of defective leadership. Such industries are unlikely of themselves to evolve any constructive plans on broad enough lines to serve the national and not merely individual interests and to eliminate the more wasteful forms of competition and overlapping. The scientific planning, which Capt. Macmillan and his followers see as a logical necessity under a tariff policy, cannot be expected of them, and there is, on the contrary, the danger that protection will be used by industries of this type to bolster up the inefficiency of the past. There is every reason to insist that protection should only be afforded to these industries on the understanding that they definitely put their house in order and re-orientate their attitude to fundamental research. They must undertake to carry out investigations designed to yield a reserve of fundamental knowledge which can equally assist in tiding over bad times and in strengthening the industry to meet independently competition from abroad.

The Electrification of British Railways

THE International Electrical Congress was opened at the Sorbonne, Paris, on July 5. More than a thousand delegates representing thirty-one countries attended it. There were several papers on electric railway engineering, most of which discussed the history of electric traction and the modern practice of using direct current at 3000 volts on the railway side of the substations. A paper by Sir Philip Dawson discussed the electrification of British railways.

Sir Philip pointed out that two factors have notably influenced the development of electric traction on British railways. The first and most important was the grouping of numerous small railways into four large companies which took place shortly after the War. The Southern Railway serves the south-east and south-west of England, the track being equivalent to 4000 miles of single-line railway. This figure does not include the lengths required for sidings and for garaging railway carriages. The Great Western Railway serves Wales and the west of England, and if we neglect a few small Welsh railways, was practically unchanged by the grouping. The equivalent track length is about 6550 miles. The London, Midland and Scottish Railway serves the west side of the country from London to the north, the equivalent itinerary of track being 13,600 miles. The London and North Eastern Railway serves the north-east of England and Scotland, the equivalent length of the track being 7100 miles.

Many of the companies which were absorbed by these groups were pioneers of electrification and were eager to extend the electrified portions of their lines. So far back as 1904 the Lancashire and Yorkshire Co. electrified the lines between Liverpool and Southport, and just before the War so also were many lines around Manchester. In 1904 the North Eastern Railway Co. had electrified the suburban lines around Newcastle. The London, Brighton and South Coast Railway had very ambitious schemes for electrifying its lines, and the South Eastern and Chatham Railway had actually passed the contracts for electrifying all its suburban services. In several cases the 'grouping' greatly altered the policy of the original companies.

On railway lines where the traffic is heavy or where the gradients are steep, electrification has many advantages. In industrial districts where the density of the population is great, electric railways are particularly useful. These regions generally follow coal seams. In Scotland, for example, there is one from the east to the west between the Clyde and the Forth. To electrify the line between Glasgow and Edinburgh would be a very promising project. In the north of England there are many large coal mines extending through Durham to Cumberland, the coal area covering a space about fifty miles long and twenty miles broad. There are isolated coal mines in other districts, and there is a coal district in South Wales having a length from east to west of about seventeen miles and a breadth of about twenty miles. Leaving the towns out of account, the density of the population varies between 500 to 1000 inhabitants per square mile. No region of the world can compare with Greater London, which within an area of about 460 square miles contains a population of 12 million inhabitants—a population which is greater than a quarter of the total population of Great Britain, more than half that of Belgium, and equal to three times that of Switzerland.

The Southern Railway has little mineral traffic. It serves all the country south of the Thames and depends largely on its local traffic. The Great Western Railway has important mineral and goods traffic. It serves the south of Wales and the tin mines of Cornwall. The London, Midland and Scottish Railway serves Scotland and the Midlands of Lancashire and Yorkshire. It serves the important ports of Liverpool and Glasgow. The London and North Eastern Railway traverses the great industrial regions in the north of England and in Scotland. In these four railways the receipts from the mineral and merchandise traffic are 25, 57, 59, and 64 per cent of the total traffic receipts respectively.

The other important factor affecting the use of electric traction in railways was brought into existence when the Act of Parliament of 1926 created the Central Electricity Board to control the production 'in bulk' of the electricity generated in Great

Britain. The grid now practically joins up all the 'effective' generating stations. The overhead lines are roughly parallel to many of the main railways.

The Southern Railway inherited from the London, Brighton and South Coast Railway a very flourishing suburban electrified system. Had not the grouping altered matters, it was the intention of the directors not only to finish the electrification of all their suburban systems, but also to work electrically the whole of the main lines as far as Worthing, Brighton, Eastbourne, and Hastings. Taking into account the fact that most of the lines were actuated by direct current, the Southern Railway adopted the d.c. system as the standard. It is still engaged in electrifying the passenger lines from London to Brighton and Worthing on this system. Its electrical lines at present are equivalent to about 750 miles of single track, besides the mileage required for side tracks, garaging purposes, etc. It possesses no electric locomotives, using 881 electrified motor carriages. Only a few miles of the Great Western Railway are electrified. The London, Midland and Scottish Railway has electrified the lines between Liverpool and Southport, Lancaster and Morecambe Bay, and Old Broad Street to Watford. The London and North Eastern Railway has only electrified a suburban section at Newcastle and a goods line in the neighbourhood of Sunderland, from Newport to Shildon. On the Newport line, electric locomotives are used. There are also several lines of purely local interest such as the Underground Railways of London.

The Weir Commission was appointed by the last Government to examine the economic and other aspects of the problem of electrifying the main railway lines of Great Britain. The report was published in March of last year, and confirmed the views of those engineers who held that electrification would lead to important economies and would be a boon to the country. The working results obtained by several electric railways in other countries also support this conclusion. In France particularly the electrification of the main lines has been very beneficial. It is pointed out that although Great Britain was the pioneer of steam railways it lags behind several other countries in electrifying its railways.

Sir Philip Dawson has made special studies of the main lines of the London, Brighton and South Coast Railway and of a project for electrifying the greater part of the main lines of the Great Western Railway. He finds that for slow goods trains the mean velocity is increased 30 per cent by using electric traction, and that for ordinary passenger trains the mean speed can be increased 25 per cent. The cost of repairs, renewals, and upkeep of locomotives is approximately 40 per cent of that of steam railways. This agrees closely with the estimates made by other engineers. Adding together the total capital required for electrifying all the railways in Great Britain, the economies directly attributable to this change would show a gain of 7-10 per cent upon the capital employed.

The quantity of energy necessary to supply a railway depends on local conditions and on the 'ton miles' required by different kinds of trains. A rough estimate can be made of the cost by examining the corresponding costs of electric railways abroad. Taking this as a basis and assuming the average cost of the ton mile on British railways, it is estimated that the 'maximum demand' for direct current from the railway substations would be of the order of 1·5 million kilowatts. To get the average load the mean factor is assumed to be 0·5. Hence the annual consumption on the d.c. side of the railway substations would be about 6500 million kilowatt hours a year.

If the electrification of the railways of Great Britain were begun at once, it would be finished by 1950. Assuming that the expected load on the 'grid' at that date is realised, the demand of the railways would be a fifth of the total output from the grid. The maximum of the railway demand from the grid would be about ten per cent of the total demand. To convert the standard three-phase a.c. supply into direct current, mercury rectifiers would probably be employed. Assuming that this is done, the efficiency of the conversion would be 84 per cent. Estimating that the cost of a kilowatt hour at the generating station would be 0·25*d.*, the cost for the d.c. unit supplied to the railway would be 0·495*d.* This compares excellently with the 0·5*d.* unit given in the Weir Report. Adding on the cost of operating the substations, we find that the total cost would be 0·55*d.*

The regular supply of energy taken by the electrified railways from the grid would react most favourably by lowering the general price of electricity. The electrification would necessitate the construction of about ten new power stations, for which the cost would be appreciably less than that of existing stations, thus contributing to the general lowering of the price of electricity. The necessary great increase in the number of substations would make it possible to supply electricity economically for general purposes to new areas. It will be seen that the conclusions Sir Philip Dawson draws will encourage railway engineers to proceed with their electrification schemes.

Obituary

Prof. Graham Lusk, For.Mem.R.S.

An investigator whose enthusiasm in the pursuit of knowledge never waned; a man who never wavered from the high standards of work and conduct which he set for himself in youth, and whose qualities of mind and heart endeared him to all; a teacher who always gave of his best: such was Graham Lusk. As such he will be greatly missed in many centres by a multitude of colleagues, friends, and pupils. From the beginning of his adult life to its end—for more than forty years—he devoted himself to the study of the problems of

animal metabolism and nutrition. His first paper, published in 1889, dealt with human diabetes, and his last, in 1931, was concerned with the influence of the thyroid upon phloridzin diabetes in the dog. Lusk himself found pleasure in remembering that in 1871 a paper of his father's upon diabetes was published, so that in each decennium for sixty years articles on that subject bore the family name.

Graham Lusk was born at Bridgeport, Connecticut, on Feb. 15, 1866. His father, W. T. Lusk, was a physician of high professional and social standing, who before and after the American Civil War, in which he took part, studied at many European centres. On his advice his son refrained from taking a medical degree, as the deafness from which the latter suffered, then and always, would have made professional practice difficult.

The elder Lusk had a firm belief in the importance of chemistry to physiology and medicine, and Graham therefore went to Germany to obtain, as he himself has said, a sufficient knowledge of physiological chemistry to give him a broader background than that possessed by the medical chemists of the day. At the age of twenty-one years he went to Munich to work under Carl Voit, but found that he could not at once enter the research laboratory. He had first to spend a year in listening to Voit's lectures and in attending so-called practical classes, in which students stood for two hours watching the professor perform experiments. After this probation he was allowed to join the research community, and from the first made a good impression upon Prof. Voit and his staff. The first product of his work was the paper on diabetes already mentioned.

Lusk acquired great affection for Voit, and never failed to speak and write of him with praise and gratitude. He displayed equal loyalty to his other great teacher, Max Rubner, with whom he continued a lifelong friendship.

Lusk's own work, carried out first at Yale and then for more than thirty years at Cornell Medical College, where he held the chair of physiology, reflected the influence of the two teachers he so much admired. It combined the methods that each of these in turn had developed for the study of metabolism: Voit's chemical technique and Rubner's appeal to calorimetry. Lusk's employment of the latter came for the most part after the first classical experiments of his American *confrères*, Atwater and Benedict, had been done; but while these were mainly concerned with the energy balance-sheet of human metabolism, Lusk used the calorimeter rather as a control for chemical studies.

Lusk explored very many aspects of metabolism. Among his special interests were the fate of ingested carbohydrates and the sources of endogenous sugar. His first work under Voit had brought evidence against the then current contention of Pflüger that sugar could not arise in the body from protein. In the early 'nineties, controversy on this point was so bitter in Germany that Voit was astonished to hear that Pflüger had consented to speak to the young author of the work in question! It fell to Lusk in later years not only to supply some of the evidence which finally compelled the conversion of Pflüger, but also to give precision to our knowledge of this incident in metabolism by determining with exactness the maximal amount of sugar which each individual amino acid from protein can yield in the animal body. This he did by administering known amounts of each to phloridzinised dogs and estimating the extra sugar which the animal excreted in consequence. He made indeed, during the course of several years, an intensive study of phloridzin diabetes, and thereby acquired important information concerning various aspects of metabolism.

An aspect which long interested Lusk was that which Rubner had termed the 'specific dynamic action' of foodstuffs. As is now so well known, the consumption of food, but especially the consumption of protein, increases *per se* the heat output of the resting body. If what we now call the basal metabolism of a typical animal be taken as 100 calories per day, and if these 100 calories be administered to the animal in the form of each of the several foodstuffs on different days, then the heat production of the still resting animal after receiving meat protein will rise to about 130 calories, after glucose to about 106 calories, and after fat to about 104 calories. These, according to Lusk, are typical average results. Rubner's explanation of the high figure for protein was that the extra heat corresponded to the free heat of certain thermal chemical reactions in *intermediary* metabolism, probably localised in the liver and representing energy not available for muscular or general tissue activity. Protein differs from carbohydrate and fat in that, whatever the current nutritional needs, the products of its digestion promptly undergo change in the body; a fact demonstrated by an immediate rise in the excretion of nitrogen. Unlike fat or carbohydrate, protein when administered in excess of contemporary needs is not stored as such, but only that moiety is stored which is capable of yielding sugar and therefore glycogen. In any event, the nitrogen of its products is removed before they serve as a source of utilisable energy. Such preliminary reactions thus give origin to that output of heat which is independent of activity.

Such was Rubner's view, and Lusk set himself to obtain experimental evidence in support of it. Unexpected results, however, led him to hold for a time a quite different view of his own. He studied the specific dynamic action (in Rubner's sense) of individual amino acids from protein, and established the interesting fact that while the administration of some among them causes a marked increase on the output of heat from the body, others have no such effect. Rubner, rather over-simplifying a statement of his views, had suggested that the extra heat of protein administration might be considered to come from the direct oxidation of that part of its molecule which is incapable of conversion into sugar. Lusk thought he had disproved this. Glycin and alanine, for example, he found

to exert a marked specific dynamic action, while (as could be demonstrated in the phloridzinised animal) they can nevertheless, after de-amination, be wholly converted into sugar. On the other hand, glutamic acid exerts no dynamic action whatever, and yet only three out of its five carbon atoms appear in its yield of sugar. Such results as these, together with other experimental evidence, led Lusk to believe that the extra heat output which follows on protein consumption is due to a direct stimulation of general tissue activity. The stimulus is due to certain constituent amino acids or to certain primary products of their breakdown.

Such a view, if confirmed, would have justified the term ' specific dynamic action ' better than the conceptions of its originator. Nevertheless, further work by Lusk himself, and some by others, has rendered the view untenable. Other explanations have been since advanced, but none seems entirely satisfactory. It is probable that the contributory happenings are complex, and that we at present lack sufficient knowledge of the chemical details of intermediary metabolism for full understanding of the phenomenon in question.

I have dwelt upon Lusk's dealings with this elusive problem because it was one which greatly interested him, and his study of it well illustrates his method of applying calorimetry to matters of detail. He never had any difficulty about giving up a theory of his when it ceased to account for facts. He said it cheered him to remember Marat's characterisation of Lavoisier, " a charlatan . . . who changes his theories as he does his shoes ". In successive editions of his book he is always frank in admitting a personal change of view, and in the last he deals faithfully with all the evidence bearing upon the nature of specific dynamic action so called. This book, the " Elements of the Science of Nutrition ", of which the fourth and last edition was published in 1928, is encyclopædic in its dealings with the literature. It lacks perhaps logical sequence in presentation, and the relative value of conflicting evidence is sometimes left unappraised; but it is written without bias, and contains abundant suggestions which have stimulated research in many quarters.

Lusk was too gentle to be a severe critic, but he was capable of intense indignation upon adequate cause. Certain opinions concerning aspects of metabolism he held with extreme firmness. He would not, for example, admit that fat could be converted into sugar in the body, and refused to believe that sugar is the sole immediate source of energy for muscular activity.

It will be recalled that, together with R. H. Chittenden, Lusk represented America on the Inter-Allied Scientific Food Commission in 1917. He frequently visited Great Britain, where he and Mrs. Lusk had many friends. Shortly before his death, on July 18, he expressed his deep appreciation of his election to the foreign membership of the Royal Society, and the Society itself will be always glad that the honour was offered in time to give him that pleasure.

F. G. H.

Sir William Willcocks, K.C.M.G.

With the death of Sir William Willcocks, on July 28, there passed out of the engineering world and Egyptian everyday life one of the original band of engineers who helped to rescue that country from the financial bankruptcy into which it had been led by Ismail Pasha. Born in India in 1852, Willcocks passed brilliantly through the Thomason Engineering College, Roorkee, and gained his first irrigation experience in that country during eleven years' service with the Irrigation Department of the United Provinces.

Willcocks was brought to Egypt in 1883 by Sir Colin Scott Moncrieff, and at once devoted himself to the reorganisation of the irrigation system on which that country's prosperity almost entirely depends. On arrival he was given charge of the provinces of Gharbieh and Menoufieh, which lie in the Delta between the two branches of the Nile and are among the richest of the provinces. He immediately realised the urgent necessity for the construction of regulating works at the heads of canals so as better to regulate their flow and at the same time reduce the enormous silt deposits which not only impaired their efficiency but also called for intensive work of clearing by the forced labour system known as the ' corvee '. It was not long before this imposition, which had annually compelled 230,000 men out of a total population of 6,000,000 souls to work for about 170 days without pay, was abolished.

Willcocks' district then covered an area of some two million acres. With characteristic energy he used to tramp all over the country on foot, and soon became a familiar figure and almost a household word with the ' fellaheen '.

It was on account of his resourcefulness and courage that Willcocks was entrusted with the diagnosis of the ' disease ' which, since their completion in 1861, had beset the two barrages, or dams, which Mougel Bey had designed and built at the heads of the Rosetta and Damietta branches of the Nile. Before they had been repaired, he courageously used them for raising the water level so as to give the canals a more plentiful supply. This was achieved by throwing a bank of loose rubble across the bed of the Rosetta barrage, thereby reducing the pressure of water which it had to bear, and, although signs of weakness did develop, the country profited for that season. The reconditioning of the barrages then followed. He was responsible for the remodelling of many canals and their attendant regulating works.

Having done so much to improve the system by which water is distributed, Willcocks was asked to devise a scheme for supplementing the supply of water at seasons when the natural flow of the Nile is deficient. His surveys of Nubia which resulted from this campaign, and his measurements of the flow of the Nile, find their parallel in the work done by the ' savants ' of the Napoleonic expedition. The principles which he enunciated were those finally adopted in developing the Assuan reservoir scheme, which has up to the present day been

Egypt's only artificial reservoir. To engineers in Egypt, and in fact all over the world where irrigation is practised, his writings, reports, and principles have provided inspiration and guidance.

In 1901 Willcocks turned his attention to the irrigation of an area of three million acres in South Africa, and in 1911, after he had retired from the Egyptian Government service, he concentrated on the development of irrigation in Mesopotamia. He lost no time in giving practical effect to his schemes for the Hindia Barrage, and its attendant canals were already in operation before the outbreak of the War, and his maps and surveys proved of great value to those engaged in the campaign.

On the completion of the Assuan Dam, Willcocks was made a C.M.G., being later rewarded with the K.C.M.G. for his services in South Africa.

Willcocks was fond of controversy. In consequence of his strong personality he was somewhat intolerant of adverse opinion, and while there can be little doubt that his outspokenness estranged him from many people, subsequent events have vindicated many of his opinions, and the final account, when struck, will probably show a balance largely in his favour. Egyptians and engineers in general will mourn the death of a man to whom they are deeply indebted. A. B. B.

WE regret to announce the following deaths:

Prof. Louis W. Austin, of the staff of the U.S. Bureau of Standards, who was an authority on physical measurements and radio transmission, aged sixty-four years.

Sir William E. Clegg, C.B.E., pro-chancellor of the University of Sheffield and chairman of the Applied Science Department of the University, on Aug. 22, aged eighty years.

Prof. Harold Jacoby, formerly professor of astronomy at Columbia University, known especially for his work in the application of photography to astronomical research, aged sixty-seven years.

Mr. Herbert Knapman, registrar of the University of Reading, formerly lecturer in mathematics in University College, Reading, on Aug. 14, aged fifty-two years.

News and Views

Foreign Guests of the British Association at York

THE following is a list of foreign visitors to the British Association for the York meeting who are attending in an official capacity either as guests or as representatives of foreign associations: *Section A* (Mathematics and Physics): Dr. W. Meissner, Physikalisch-technische Reichsanstalt, Berlin-Charlottenburg; M. le Duc de Broglie, Paris; Prof. W. J. de Haas, University of Leyden, Holland. *Section B* (Chemistry): Prof. J. Meisenheimer, Chemical Institute, Tübingen; Prof. H. Staudinger, University of Freiburg im Breisgau; Prof. Max Bergmann, Technical High School, Dresden; Prof. H. Kessener, The Hague. *Section C* (Geology): Prof. P. Pruvost, University of Lille. *Section E* (Geography): Dr. J. Georgi, Hamburg. *Section H* (Anthropology): Dr. Axel Boethius, director of the Swedish School of Archæology, Rome. *Section J* (Psychology): Prof. R. H. Wheeler, University of Kansas, United States. *Section K* (Botany): Dr. G. E. du Rietz, University of Uppsala, Sweden. Prof. Oswald Veblen, of Princeton University, is attending as the delegate of the American Association for the Advancement of Science, while Prof. D. A. Keys will represent the Royal Society of Canada. The South African Association for the Advancement of Science will be represented by Prof. J. E. Duerden.

Baron von Zach, 1754–1832

AMONG the men of science who fell victims to the epidemic of cholera which raged in Paris a century ago were Sadi Carnot (NATURE, Aug. 20, p. 266), and the Hungarian astronomer, Franz Xaver, Baron von Zach, who died there on Sept. 2, 1832. Born at Pesth on June 4, 1754, von Zach served for some time in the Austrian army, and from 1783 until 1786 was tutor in London in the family of the Saxon Ambassador, John Maurice, Count of Brühl (1736–1809), who was himself an amateur astronomer. One outcome of von Zach's visit to England was the discovery by him, under a heap of rubbish in an old stable at Petworth Castle, Sussex, of some manuscripts of the seventeenth century mathematician, Thomas Harriott. In 1786 he entered the employ of Ernst II. of Saxe-Gotha, and five years later became director of the observatory on the Seeberg at Gotha, afterwards the scene of the labours of the famous Hansen. With Bode, Olbers and Schröter, von Zach did much to revive interest in astronomy in Germany, and the *Monatliche Correspondenz*, which he founded in 1800, is referred to by Miss Clerke as "the first really effective astronomical periodical". He edited both this and other astronomical and geographical journals, and he was largely instrumental in stimulating German astronomers to search for a planet between Mars and Jupiter, a search which resulted in the discovery of the asteroids. The first of these, Ceres, was found by Piazzi at Palermo, but the second, Pallas, was discovered by Olbers at Bremen, while the third and fourth were likewise seen first by the German astronomers. Von Zach was also known as a teacher of astronomy. In 1804 he became grand-marshal of the palace of the duchess-dowager of Gotha, and after her death in 1827 lived for some years at Berne.

Application of Science to Economic Problems

THE recognition of the profound change in the whole structure of our civilisation, in its international relations as well as in the nature of production, is an essential condition for the elaboration of measures of recovery. The pamphlet recently issued under the title "Whither Britain: A Radical Answer" (London: Faber and Faber, Ltd., 1*s*.), and outlining to

some extent policies in development of those suggested in "Britain's Industrial Future" four years ago, frankly recognises these changes and accepts the necessity of adapting the structure and policies of society to meet the problems which arise. The authors of these papers have no quarrel with science as such, but rather recognise that science must play an important part in the planning and reconstruction which are essential for the continuance of our civilisation—that indeed modern science rightly applied could raise the standard of living to heights previously unknown and supply the material resources for a more abundant life for all. This is evident in their emphasis on science as a first major factor in agricultural policy, and their conviction that development of scientific research, its application to farming and improved marketing, are essential to the future prosperity of British agriculture.

THE value of international industrial agreements is recognised, while imperial industrial agreements including imperial research are suggested as a line of promising development. While repudiating a policy of tariffs, this Liberal group advocates a system of national planned development comprising a national industrial commission with industrial and agricultural councils not unlike the Industrial Parliament visualised by Capt. Harold Macmillan in his scheme of creative protection. They argue further, however, that the State should also foster industry by keeping the demands for its products at a high economic level through well-planned social service and a constructive policy of national development. The perils presented by economic nationalism are not overlooked, and a paper on the international framework surveys the various problems such as disarmament, minorities, treaty revision, war debts, population, and migration, in which international co-operation and understanding are essential if progress is to be made. Even those scientific workers who, on the question of tariffs, differ most widely from the authors of these papers, should find much that is interesting and stimulating in their frank and virile statement of policy in the light of the actual facts of the present situation.

World-wide Telephony

AT the International Electrical Congress recently held in Paris, several important papers were read on telephony. B. Gherardi and F. B. Jewett discussed 'world telephony'. The history of the subject illustrates how great discoveries occur at various intervals of time. Each of them causes a revolution in practice and between the intervals the process of applying the new inventions goes on continuously in the economic field. Such epoch-making discoveries were the invention of the thermionic tube, the permalloy series of nickel-iron alloys, and the discovery of paragutta. The use of paragutta has reduced the transmission losses to one-thirtieth of their former value. Many difficulties remain for engineers to overcome. For telephony between North America and Europe, 'long' radio waves are most suitable, but there is the fundamental restriction that there are in practice only twenty 'ways' available owing to the limited breadth of the band of frequencies that can be utilised. With 'short' wave-lengths, the best wave-length to use depends on the hour of the day and the season of the year. Hence three wave-lengths are usually assigned to each circuit, and this limits the number of ways. Short-wave transmission is still in the first stage of its evolution; interruptions due to the vanishing of signals and to magnetic storms occur not infrequently, especially when the waves go through polar regions. The difference in local time between many large towns is a great inconvenience. There may be no overlapping in time between their working days. The language difficulty, although of less importance, is still a hindrance to progress. Many conversations are held between speakers in a language which neither knows well. In this case it is necessary that the clarity of the transmission be much better than when each is speaking his own tongue. Technical progress has now made possible communication between countries and continents. Whether this will be a boon to humanity or not depends on the nature of these communications.

Prof. Piccard's Ascent into the Stratosphere

ON Aug. 10, Prof. A. Piccard, of the University of Brussels, accompanied by M. Max Cosyns, ascended at about 5 A.M. from Dubendorf Aerodrome, near Zurich, in a specially constructed balloon. He rose to a height of 16,700 metres (about 10½ miles), thus penetrating well into the stratosphere, and, after a twelve hours' flight, landed at Cavallaro di Monzambano, which is about ten miles south of Lake Garda. Among the equipment of the balloon was a wireless set, by means of which Prof. Piccard sent messages to surface observers. It will be recalled that this was Prof. Piccard's second ascent, his first having been on May 27, 1931, when he reached a height of 9¾ miles. As was to be expected, the aeronauts suffered considerable discomfort. The greatest trouble was the intense cold encountered in the stratosphere. Prof. Piccard states that he has made a number of observations which he hopes will prove of great value, but of any scientific results it is too early to speak. During his previous flight, Prof. Piccard had hoped to obtain evidence of the cosmic rays under more favourable conditions, and any contributions that he may be able to make in this field, from this flight, will be awaited with interest. Meteorologists look forward to the announcement of Prof. Piccard's results, especially if he has been able to make any observations on the composition of the atmosphere within the stratosphere; for, in spite of the observations already made by self-recording instruments on unmanned balloons, very little is actually known at present about this region.

Trans-Atlantic Flight from East to West

AFTER waiting for some days at Portmarnock Strand, Co. Dublin, for suitable weather conditions, Mr. J. A. Mollison started on Aug. 18 at 11.30 A.M. on a solo flight across the Atlantic. His original intention was to strike the coast of North America, fly on to New York, and, after a short rest, to fly back across the Atlantic, thus making a round trip in about

three days. After thirty hours of flying, Mr. Mollison landed successfully at Pennfield Ridge, New Brunswick; it appears that he had sufficient fuel to go on, but was obliged by fatigue to come down. He was flying a Puss Moth aeroplane with a 120 h.p. Gipsy engine, such as is supplied to private owners, with the exception that the passenger seat has been replaced by petrol tanks. It is stated in the *Daily Mirror* that the direct costs of the flight were only £10 6*s*. 3*d*. for petrol and 15*s*. for oil. Mr. Mollison is the first to cross the Atlantic from east to west in a solo machine, which, incidentally, is the smallest to accomplish the crossing. The flight is a noteworthy tribute to the endurance of both man and machine.

Late Bronze Age Settlement in Shetland

A LATE bronze age settlement of considerable extent has been brought to light by excavation under the Office of Works at Sumburgh, at the southern end of the Shetlands. Previous excavation had revealed an iron age site, dating from about the beginning of the Christian era. During the present season, according to a correspondent in the *Times* of Aug. 19, six weeks' excavation has completely cleared one dwelling, partially cleared two more, and indicated the existence of others. The completely excavated dwelling shows evidence of four occupations, of which the third, as is shown by broken clay moulds, was much taken up with bronze-casting. It is 31 ft. in length, has an original and a secondary entrance, and three chambers with four lesser chambers opening out of them. The walls are three feet high and are built of selected pebbles from the shore, neatly fitted and without filling, except in the lower courses, where clay has been used to keep out the damp. Slate was much in use for tools. Both slate and stone implements show types not in use on the mainland. Of the partially excavated houses, the walls of one pass under those of the excavated house, and are therefore older. Slate was in use here. Though pottery is scarce, the ornament on one sherd gives a bronze age date. The second partially excavated dwelling is older again; but a sword and pottery of the type of Heathery Burn Cave, Co. Durham, still point to the late bronze age. Although the full extent of the settlement is not yet revealed, the existence of several other dwellings has been noted. When excavation is complete, the settlement will probably prove the most elaborate in plan of any known bronze age dwelling-place in Britain.

Roman Villa at Southwick

IT is announced that the Roman villa at Southwick has been given to the Sussex Archæological Trust with the object of ensuring its preservation. The villa is one of a chain of Romano-British buildings, probably farms, on a four-mile belt of fertile land south of the Downs, the others being at Kingston, Portslade, West Blatchington, and Brighton. The site has been excavated by Mr. S. E. Winbolt and others, with the aid of the Sussex Archæological Society. It was found to consist of a triangular block of buildings enclosing a courtyard approximately 200 ft. by 130 ft. The chief rooms are on the north side, where they are protected from the wind by the Downs; while verandahs on the sunny side face the sea. The buildings are solidly constructed, with walls 2 ft. and 3 ft. thick, and consist of rubble cores faced with flint. The site is at present unfenced; but as soon as funds have been raised, the northern portion containing the main buildings, which unfortunately is separated from the southern by the new road, will be fenced and reconditioned to enable the public to be admitted at a small fee. The Trust, to which the site has been handed over, was formed in connexion with the Sussex Archæological Society for the preservation of the ancient monuments of Sussex, and already holds in trust Lewes Castle, Wilmington Priory, the Long Man of Wilmington, the Marlipins at Shoreham, and Oldland Mill at Keymer.

Earliest known Pueblo Dating

DR. FRANK H. ROBERTS, Jr., who is in charge of an expedition of the Bureau of American Ethnology excavating Pueblo settlements on a site near Allentown, Arizona, is reported by Science Service, of Washington, D.C., to have obtained from one of the houses he has excavated beams which, according to the tree-ring chronology, were cut in the year A.D. 797. This is the oldest date for which evidence has been found in Pueblo ruins in the south-western United States. The dwelling was a pit-house, built largely underground, with an entrance through the roof. It had been destroyed by fire, the inhabitants leaving most of their belongings behind them, including much pottery. The oldest dates previously established by means of the tree-ring calendar elaborated by Prof. Douglass were A.D. 919 from a beam at Pueblo Bonito, and A.D. 861 from a piece of timber at Una Vida. Both these sites are situated in New Mexico.

Electric Tramcar Systems

ABOUT the beginning of the present century many local authorities undertook the installation of electric tramway systems in cities and towns, and many workers reaped the benefit of this system of transport. The coming of the petrol bus has led many to think that in a few years' time tramways will disappear. Their immobility often causes tramway congestion, and intending passengers have to cross a stream of traffic in order to board them, unless this stream be temporarily arrested. When one sees the great part played by tramcars in cities like London, Glasgow, and Manchester, and in many cities abroad, where tramcars with two or three trailers attached are continually going through crowded streets, it is obvious that it will be many years before they are obsolete. The large number of tramcars in Austria which were installed more than twenty years ago on the supposition that vehicles would always drive on the left-hand side of the road has led to difficulties in certain districts where one must now drive on the right-hand side. The cost of obtaining uniformity by altering the tramway lines in Austria is prohibitive at the present time. Just as in the case of weights and measures, what has been done in the past makes it

difficult and expensive to introduce uniformity in the future, no matter how desirable proposed changes are. The advent of the trolley bus, which is much more mobile than a tramcar, will doubtless be a great help in the many years which will have to elapse before tramways become obsolete. Their popularity in Great Britain is due partly to the fact that, like electric tramways, they get their power from stations which burn coal obtained at home and not a foreign product like petrol.

Radio Equipment for Deep Sea Trawlers

FEW realise what a great boon radio equipment is to deep sea trawlers. Some of these small vessels fish at all times of the year on fishing grounds many hundreds of miles away from their home ports. Trawlers from Hull and Grimsby regularly fish off Bear Island near Spitsbergen; others trawl in the Davis Straits, 2400 miles from their base, and some off Iceland and in the White Sea. During the winter, which is the best fishing season, it is nearly always dark, and the gales and the intense cold make the work very hazardous. Catches vary considerably and the markets are sometimes glutted and sometimes short of supplies. It is of the greatest importance that the trawlers of the same company should be in close touch with one another, and this they can do by radio telegraphy. In the Engineering Supplement to *Siemens' Magazine* for March a discription is given of a radio station for use on board trawlers. The whole of the apparatus is contained in a teak case which can easily be passed through hatchways of normal size. This can be fitted into quite a small cabin or even into a cupboard. It receives and sends messages on wave-lengths between 20 and 20,000 metres, the required electricity being obtained from primary batteries and a small alternator. The output of the alternator does not exceed 300 watts, but the range with coast stations is often of the order of 1000 miles. In addition, Messrs. Siemens have designed a 'direction finder' which is simple to operate. Many trawlers also have a Marconi depth finder so as to enable them to locate the places where the required fish are likely to be found. Recent inventions have made the life of the trawlerman much easier and much more secure.

A High Voltage Electrostatic Generator

IN the August number of the *Scientific American*, there is a short account of the new electrostatic generator which is being built by R. J. van de Graaff at the Massachusetts Institute of Technology. From this and some notes which have appeared elsewhere, it seems that it is a large-scale elaboration of the Wimshurst type of machine, consuming considerable power in its operation. The discs of the Wimshurst machine are replaced by silk belts, and the separation of charges made regenerative. The charges are collected on enormous metal spheres, sufficiently large to hold an experimenter and apparatus, and capable of being charged to 10-15 million volts without flashover. Details of the power available for such experiments as those of Cockroft and Walton of the Cavendish Laboratory, Cambridge, are not given, but it is to be presumed that calculations have been made on the basis of Gamow's theories of the artificial disintegration of nuclei which justify the undertaking. The return to Faraday's device of sitting within highly charged apparatus is interesting.

Night-Crowing of Cockerels

A COMMUNICATION by D. Sinitsin on the night-crowing of the cock, published in Russian in 1924, in the Records of the Bielorussian Institute of Agriculture, attracted the attention of the late M. Bigourdan, the veteran French astronomer. Shortly before M. Bigourdan's death, Mr. Sinitsin provided him with full information on the subject. Mr. Sinitsin (1750 Wilton Place, Hollywood, California) has now sent to the Editor a record, illustrated by a diagram, of the fourteen nights' crowings of a cock kept in his study at Minsk, Russia, in 1923. Regular crowings occurred between 11 P.M. and 5 A.M., when they could be measured by hours, each crowing coming within ten minutes of the hour; before 11 P.M. there was no crowing, and after 5 A.M. it was not regular. Changes of atmospheric pressure, music, light, and talking in the room did not affect the regularity. The second and third crowings, especially when at 2 and 4 A.M., were the most vigorous and accompanied by flapping. It is suggested that the paroxysms of crowing are caused by something in the atmosphere perceived by the cock in some unknown fashion, and that it is connected with the rotation of the globe, waves from the sun-lighted side of this spreading to the darkened side. It is also put forward that the twelve-system of time-reckoning had its origin from the period when time could only be measured at night by cock-crowing, and that by artificial selection a race of cocks might be produced which would tell the time with clock-like regularity.

Meteorology of the Past, Present, and Future

SIR NAPIER SHAW (*Scientia*, June 1932) characterises the meteorology of yesterday by the accumulation of climatological data, their discussion in connexion with the general circulation of the atmosphere, and their analysis by the methods of harmonic analysis and coefficients of correlation. He emphasises the past concentration of attention on depressions and anticyclones, and the doubts which arise in connexion with reduction of pressures to mean sea level. The meteorology of to-day is essentially concerned with the interactions of air currents of different origin at the surface of separation which is known as the 'polar front', the methods of discussion being associated with the Norwegian school of meteorologists. The meteorology of to-morrow is, in Sir Napier's opinion, to concern itself with entropy as the specification of the qualification of any mass of air for its position. The name 'weather potential' is suggested as another name for entropy. Sir Napier suggests that all motion in the atmosphere, apart from penetrative convection, is along isentropic surfaces, so that these surfaces act as automatic guides to all moving air, in much the same sense that the banks of a river act as automatic guides to the water in the river. He also suggests, though very briefly, that regions of high and low pres-

sure in the atmosphere are created by currents of air associated with straight isobars, in which the velocity is not of the right amount to produce a balance between pressure gradient and the deviating force due to the earth's rotation, and that the effect of gravitational forces on masses of air, the entropy of which differs from that of their environment, can develop a column of low pressure.

The People's Cinema University

A LEADING recommendation of the Commission on Educational and Cultural Films which was set up in 1929 was the establishment of a National Film Institute (see NATURE for June 18, p. 911). One is interested, therefore to observe the scheme evolved by Sir James Marchant and Sir Oswald Stoll for the establishment in London of the People's Cinema University. The university, it is stated, would consist of a central building, from which lecture halls equipped with sound-film installations for the regular exhibition of films would radiate. In the central dome there would be a Zeiss planetarium. There would also be reading rooms, offices, etc., available for film patrons and societies. All these features are combined in an imposing general design prepared by Sir Giles Gilbert Scott. The films would be made in co-operation with an expert educational board to meet the requirements of teachers and scholars, and would be distributed and collected by motor cinema vans throughout the country. Projectors also would be supplied to schools, churches, and institutions. In his broadcast address and in letters to the *Times*, Sir James has directed attention to useful educational work already accomplished. The catalogues issued by Visual Education, Ltd., indeed, list quite an impressive series of educational and cultural films. Sir James believes, therefore, that the time is ripe for such a venture as the People's Cinema University, which, in its own sphere, would attempt work resembling that of the B.B.C.

Change in Colour of Birds due to Exposure

MR. P. J. NORMAN, in *Cage Birds* for Aug. 6 (p. 70), cites a remarkable case in which a black-headed variety of the budgerigar, after being turned out into an outdoor aviary provided with a 'flight' or net-roofed annexe, so that the birds were exposed to rain if they wished it, has resumed the normal yellow colouring of the head. The breeder of this bird, it seems, has stated that all of its nest-fellows were also black-headed, and that these had retained the black head through a moult. The family had been bred indoors, in a cage, and it is suggested that in the case of the bird which reverted, the exposure to open air and rain in its new quarters had brought about the return to normal plumage. It would, however, be well worth while to see whether outdoor treatment would operate in this way with the rest of the brood; or, if they be still kept indoors, whether they will produce black-headed young. It may be noted here that of the first two specimens of the rare East Asiatic Derbyan parrakeet the London Zoological Society possessed, one became black-headed and afterwards reverted to normal, while its companion did not change, though both lived in the same cage indoors in the old Parrot House.

Helminthological Abstracts

ONE of the first fruits of the various agricultural bureaux formed by the Imperial Agricultural Research Conference has been the establishment of a number of abstracting journals, the latest of which to appear being *Helminthological Abstracts*, under the editorship of Prof. R. T. Leiper. This new journal, which is issued as a supplement to the *Journal of Helminthology*, differs in several important respects from the others. Papers are arranged by journals, not by subjects, and each abstract is printed so that the first sentence is in effect an extended title; the remainder is a succinct abstract of the chief results obtained by the authors. The *Abstracts* will be issued in five parts each year, the first of these being in April. This will enable a single volume to cover the entire literature for the calendar year, so that, in addition to keeping the current literature before the reader, it will when bound form a complete summary of the year's work. It is priced at 16*s*. 6*d*. a volume, post paid, and is obtainable from the Institute of Agricultural Parasitology, St. Albans. Another publication from the same Bureau is the "Bibliography of Helminthology" for the year 1930 (6*s*.). This volume contains references to more than 900 titles in 346 different journals. These titles are arranged by journals, with an adequate authors' index. The volume has the same format as the *Abstracts*, and although issued separately could be bound with the completed volumes to form an invaluable index to the journals abstracted and the authors of the papers.

Prof. Richard Willstätter

Die Naturwissenschaften for Aug. 12 is a special issue in honour of Prof. Richard Willstätter's sixtieth birthday. The memoir contains a series of articles by experts upon the fruitful results of his memorable researches in organic chemistry. Prof. F. Haber refers to the successful campaigns which Willstätter has conducted in different branches of biochemistry, for the exceptional skill which he displayed in elucidating chemical structures was principally concentrated upon problems closely related to living matter. Prof. Pummerer reviews the results of forty years of strenuous endeavour. First comes a masterly series of papers upon alkaloids, culminating in the synthesis of tropin and cocaine; then for a while aromatic structures claim attention, particularly quinone-imines, aniline black, and cyclo-octa-tetraene. But Willstätter's interest in plant life led him to the study of the compounds to which plants owe their distinctive colours. Thus chlorophyll, carotene, and the anthocyanins were investigated in turn, and the success attained in each of these branches led him to the further problem of assimilation by plants. This involved the study of enzymes, which has yielded some astonishing results in recent years. Prof. L. Zechmeister describes the main lines of Willstätter's work on carotinoids and the important hydrocarbon carotene, which has come into prominence on account

of its relation to chlorophyll and to vitamins. Prof. R. Robinson discusses in some detail the structures of anthocyanins, the red and blue colouring matter of flowers. Prof. R. Kuhn refers to the influence of Willstätter's work on the development of the theory of heteropolar rings, and Dr. Waldschmidt-Leitz describes the process of resolution of enzyme mixtures from the pancreas and from yeast by a method of selective adsorption. The concluding article upon chlorophyll and its derivatives is by Prof. A. Stoll and Dr. E. Wiedemann.

A New Periodical for Chemical Physics

As a part of its comprehensive programme of physics publications, the recently formed American Institute of Physics (see NATURE for Aug. 6, p. 199) announces that it will shortly begin a new publication to be called the *Journal of Chemical Physics*. The first number will be issued in January 1933. Primary among the circumstances which have led the Institute to undertake the new publication is the increasing number of articles on physical chemistry which have distinct bias on the physical side. These have not found a suitable outlet in any journal now in existence, being perhaps too mathematical for the *Journal of Physical Chemistry*, too physical for the *Journal of the American Chemical Society*, or too chemical for the *Physical Review*. Inquiries or suggestions concerning the new journal should be addressed either to Dr. Harold C. Urey, Department of Chemistry, Columbia University, or to the American Institute of Physics, 11 East 38th Street, New York.

Irrigation in India

THE progress of irrigation and the use of the available water are surveyed in the "Triennial Review of Irrigation in India, 1927–30" (Simla: Government Press, 2*s*. 6*d*.). It would appear that the monsoon of 1927 was almost normal in its time and rainfall except for a slight deficit. In 1928 there was a marked deficiency in the north-west, and in 1929 the principal departure from the average was an excess of 100 per cent in the rainfall of the North-West Province and Sind. During the three years under review, the average area irrigated by Government works in British India was 29,954,000 acres, an advance of more than two million acres on the corresponding figure for the previous triennium. The chief increase was in the Punjab valley, owing to the development on the Sutlej valley canals. It is noticeable that, of the total sown area, 12·7 per cent was irrigated. Among the most important projects now in hand are the Sukkur Barrage and canals in Sind, the Sarda canal and a hydro-electric power scheme on the Ganges canal in the United Provinces, and the Sutlej valley project in the Punjab. The problems of water supply in Baluchistan are being considered in the hope of improving the very poor irrigation facilities.

Commonwealth of Australia Yearbook

THE Yearbook of the Commonwealth of Australia for 1931 contains a mass of descriptive and statistical matter, of which much is of considerable scientific value. The prevalent demand for economy has curtailed to some extent the size of the volume, but there is little evidence of its usefulness being impaired. The figures dealing with agricultural production are particularly full, vital statistics are given much space, and there is a long article, accompanied by distributional maps, on the climate and meteorology of Australia.

Announcements

PROF. R. RUGGLES GATES will deliver three De Lamar lectures at the Johns Hopkins University during the week beginning Oct. 24, on "The Principles of Heredity in Man, and their Application to Society".

IT is announced in *Science* that Prof. Rudolph W. Ladenburg, of the Kaiser Wilhelm Institut für physikalische Chemie und Elektrochemie, has been appointed to the Cyrus Fogg Brackett research professorship at Princeton University, in physics.

THE Society for Cultural Relations with Soviet Russia is considering the possibility of arranging a tour of scientific institutions in Russia, to leave London on Sept. 10. It is proposed to arrange for parties of British scientific workers engaged in physical, biological, and medical research, and for engineers, chemists, and anthropologists, to visit the corresponding institutions in Russia, and to meet Russian workers engaged in similar research. The total cost of the tour is about £35 inclusive, the time being approximately one month from departure to return to London. Further particulars and application forms may be obtained from the Secretary, S.C.R., 1 Montague Street, London, W.C.1.

MESSRS. W. and G. Foyle, Ltd., of 119-125 Charing Cross Road, W.C.2, have recently published a new catalogue of new and second-hand books on technical subjects and applied sciences. More than 450 subjects are represented. About three thousand books are catalogued, and the list should prove a source of help. The majority of the standard works are available, many of them being obtainable second-hand as well as new.

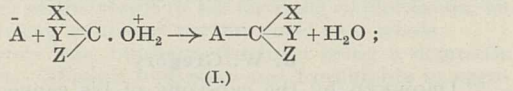
APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A headmaster for the Netherton Farm School, near Morpeth, Northumberland—The Secretary, 18 City Road, Newcastle-on-Tyne (Sept. 3). An assistant conservator of forests in the Department of Agriculture and Forests, Sudan Government—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, S.W.1 (Sept. 5). A professor of zoology at the University of Bristol—The Secretary and Registrar (Oct. 1). A resident tutor of chemistry, rural science, and school hygiene at the Winchester Diocesan Training College—The Principal. A headmaster of the Incorporated Thames Nautical Training College, H.M.S. *Worcester*—The Secretary, Ingress Abbey, Greenhithe, Kent. An assistant (woman), with analytical experience in organic and inorganic work, at the Air Ministry, Kidbrooke—The Secretary, (I.G.), Air Ministry, W.C.2.

Letters to the Editor

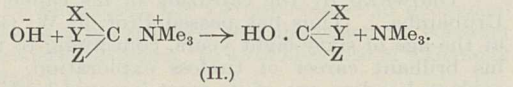
[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A Correlation of the Walden Inversion with the Pinacone and Beckmann Changes

THE esterification of an alcohol may be represented as involving decomposition of an oxonium salt (I.), which corresponds closely to a reaction of quaternary ammonium hydroxides (II.):



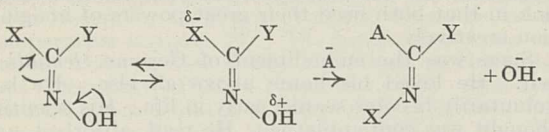
(I.)



(II.)

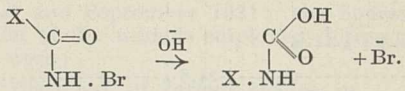
These reactions very possibly proceed by extrusion of a molecule of water or tertiary amine, consequent upon attachment of anion in virtue of a positive charge on the carbon atom derived from, or induced by, that on the oxygen or nitrogen.[1] It may, however, be anticipated that this latter rather than the derived charge will determine the result, and permit only a condition of electrovalence, when the direction of approach of the anion is such as to expose it to the operation of either. In other words, covalent union with carbon will be dependent on approach from the side of the molecule remote from oxygen or nitrogen, and inversion of configuration must occur. As Kenyon and Phillips[2] have emphasised, inversion in general is associated with reactions of the type now discussed, but it is clear that similar considerations are applicable to a negatively charged atom and a cation, and it is probably only on account of the difficulty of realising these latter conditions in practice that Walden inversions of this type have not been realised.

The relationship of the Beckmann change to the Walden inversion is indicated by the facility of each type of change in the cases of the *p*-toluene sulphonic esters of oximes and alcohols respectively. Since, now, the behaviour of the oximes towards substituting agents is comparable with that of phenol,[3] their isomerisation under the influence of strong acids may be attributed to formation of the system (III.):



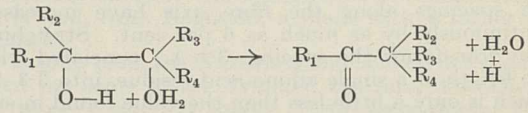
(III.)

The actual Beckmann change then represents an alternative possibility to the occurrence of depolarisation (by reversal of the initial change), which will be facilitated by the presence of a suitable anion to replace the migrating group X in its combination with the carbon atom. X in turn will promote detachment of hydroxyl or other ion from the nitrogen atoms. The analogy of this phase of the reaction to the changes referred to at the outset is obvious, and, accordingly, Meisenheimer's experiments[4] have led him to conclude that inversion occurs, in the sense that it is X rather than Y which migrates. Corroborative evidence in favour of this view is afforded by another reaction, which has long been connected with the Beckmann change, namely, the formation of amines from acid bromoamides and similar derivatives. The reaction is actuated by hydroxyl ions, and may thus reasonably be considered to be analogous in its first stage to the alkaline hydrolysis of esters,[5] involving extrusion of the group X with the pair of electrons requisite to enable it to preserve its configuration[6] and to displace bromide ion from the nitrogen atom:



As thus represented, the reaction is also not dissimilar from the benzilic acid change.

Like these, the pinacone and related changes also exhibit the characteristics requisite for an intramolecular Walden inversion, the negative change requisite for migration of the group R_2 arising from detachment of a proton from the hydroxyl group (or, in certain closely related changes, by attachment of an anion):



In this connexion, Kenyon and Phillips have already surmised that McKenzie's observations[7] on the preservation of optical activity in these types of changes, and in semipinacolinic deamination, are indicative of a Walden inversion.

J. KENNER.

College of Technology,
Manchester,
July 29.

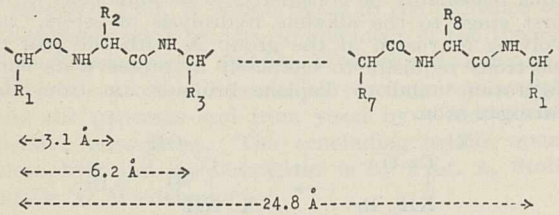
[1] Compare NATURE, **128**, 1000, Dec. 12, 1931.
[2] Compare *J.C.S.*, 415; 1930: 382; 1931: *Trans. Faraday Soc.*, **26**, 451; 1930.
[3] Charlton, Earl, Kenner, and Luciano, *J.C.S.*, 30; 1932.
[4] *Ber.*, **54** B, 3206; 1921.
[5] Compare Houben Weyl, "Methoden der organischen Chemie", 2nd ed., vol. 4, 339.
[6] Jones and Wallis, *J. Amer. Chem. Soc.*, **48**, 169; 1926.
[7] Compare, *inter alia*, *Ber.*, **62**, 272, 284; 1929.

X-Ray Interpretation of the Molecular Structure of Feather Keratin

SOME two years ago it was shown in this laboratory that the quill of a feather gives rise to a complex but well-defined X-ray fibre photograph[1] which is quite different from that of animal hairs.[2] It was afterwards shown that a similar photograph is given also by tortoise shell, and the conclusion was formed that it is characteristic of the keratin of feathers and reptilian scales as opposed to that of mammalian hairs, nails, horns, spines, etc.[3] In the light of knowledge gained from the X-ray analysis of other protein fibres, it is now possible to interpret the feather photograph and fit it into the general scheme which such investigations, with increasing clearness, are beginning to unfold.

The details of the photograph need not be gone into here, and indeed have not yet been worked out completely, but it is clear now that it is only a rather bewildering elaboration of the type of photograph which is obtained from natural silk (fibroin)[4] and the stretched form of hair (β-keratin),[5] both of which have been referred to a polypeptide chain in a more or less fully extended state. The side spacings are similar, but there are indications of some ten hyperbolæ in the feather photograph. By the application of the principle of 'layer line enhancement',[6] these may be separated into sets grouped round a chief

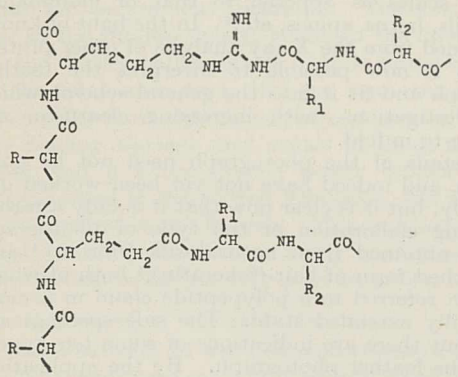
periodicity of (at least) 24·8 A., and secondary periodicities of 6·2 A. and 3·1 A., corresponding to the chain :



The last-mentioned spacing recalls the 3·5 A. found in fibroin and the 3·4 A. in β-keratin : we have shown that the difference is due to a slight folding of the peptide chain, analogous to that discovered in the unstretched form of hair (α-keratin),[2, 5] which must be due to a further inter- or intra-chain linkage of a resistant but non-rigid nature. We base this deduction on the striking observation that when the quill is stretched, its fibres are not ruptured until the spacings along the fibre axis have increased continuously by as much as 6 per cent. Stretching thus transforms the spacing, 3·1 A., associated with the length of a single amino-acid residue, into 3·3 A., which is only a little less than the value found in silk and stretched hair.

Interesting as is the molecular interpretation of feather keratin on its own account, its importance as a contribution to protein analysis in general is even greater, because of the powerful support it brings to the concept of the extensible protein chain. In view of the results here reported, any doubts as to the essential correctness of the conclusions to be drawn from the X-ray analysis of silk and animal hairs [4, 5] may now be set aside. The protein chain, as a long backbone of primary valencies decked out with numerous side-chains the interactions and cross-linkages of which can produce foldings of the main chain of widely varying amounts, may now be thought of as a definite stereochemical entity grown visible, like the cellulose chain and many other simpler molecules, in the light of the X-rays.

It is scarcely necessary to point out how many fascinating questions are involved in the comparative X-ray study of the molecular structure of hair and feathers, and in the significance of the sequence of eight side-chains in the longitudinal pattern of the latter. May it not be that the growth of feathers finds its origin in the development of further keratin chains by the formation of *lateral* peptide linkages ? From the side-chains of arginine and glutamic acid, for example, such outgrowths as the following are possible :



These investigations are being continued and will be described in detail in due course. A complete chemical analysis of the type of feather under examination is also being undertaken in the Textile Chemical Laboratory.

W. T. ASTBURY.
THORA C. MARWICK.

Textile Physics Laboratory,
The University, Leeds, July 12.

[1] See, for example, W. T. Astbury, "The Structure of Fibres", Annual Reports of the Chemical Society for 1931.
[2] W. T. Astbury and A. Street, *Phil. Trans. Roy. Soc.*, A, **230**, 75; 1931.
[3] T. C. Marwick, *J. Text. Sci.*, **4**, 31; 1931.
[4] R. Brill, *Annalen*, **434**, 204; 1923. K. H. Meyer and H. Mark, *Ber.*, **61**, 1932; 1928. O. Kratky, *Z. physik. Chem.*, B, **5**, 297; 1929: **11**, 363; 1931.
[5] W. T. Astbury and H. J. Woods, NATURE, **126**, 913; 1930. *J. Text. Inst.*, **23**, T17; 1932.
[6] W. T. Astbury, *Proc. Roy. Soc.*, A, **112**, 457; 1926. W. H. Bragg, NATURE, **121**, 327; 1928. A. L. Patterson, *Z. Krist.*, **76**, 182; 1930.

J. W. Gregory

"DROWNED by the capsizing of his canoe on the Urubamba." Thus has passed Prof. J. W. Gregory, at the age of sixty-eight years, continuing to the last his brilliant career of tireless exploration. British geology has lost one of its most intrepid leaders, and his fellow scientific workers the world over will miss his stimulating thought.

It is not my privilege to review the varied aspects of his life as administrator, teacher, explorer, and man of science. Although known to me through his observations in Africa, Australia, and Chinese Tibet, he remained an impersonal thinker among my colleagues until we had both passed three score and more. I first met him in his home at Glasgow when on my way to Africa to study the rift valleys, his own special subject.

We were then mutually aware of pronounced differences of opinion on theoretical questions, but the frank, cordial reception accorded me disarmed for all time any instinct of intellectual antagonism and quickly established happy relations. In long and earnest discussions, I found him a well-informed and aggressive opponent, strongly convinced of the essential soundness of the geological philosophy of Eduard Suess. His convictions were natural. In the fluid medium of speculation, where free-swimming facts may group themselves at will, ideas take forms determined by bent of mind and circumstance. The agreement between thinkers so unlike as Suess and Gregory illustrates the effect.

In Gregory's youth, Suess was already the master philosopher of European geology. Certain racial characteristics distinguished the younger from the older man, but there was between them an intellectual link in that both used their great powers of imagination creatively.

Suess was the embodiment of German *Gemütlichkeit*. He loved his home above all else. He had voluntarily become sessile, early in life. His scientific thought was contemplative. He read, absorbed, and moulded the observations of others to create the *Antlitz* of the world of his imagining. Gregory, by contrast, was intensely active. His habit of observation was objective. He travelled far and wide to accumulate facts. But he also possessed a creative imagination that was strong of wing.

While still a daring, enthusiastic youth (in fact he was never any other, where danger was concerned) Gregory explored the Great Rift Valley of East Africa and found it to be a tension rift. Suess, on the evidence of more casual descriptions, had conceived it to be part of a great rent, 4000 miles long, torn through Africa and Arabia by the subsidence of that part of the suppositional Gondwana continent which occupied the site of the Indian Ocean. Here was an agreement

of observation on the part of Gregory with the inference on the part of Suess, which could not but be convincing. The grandeur of the concepts appealed to Gregory's poetic thought, and he became for life an advocate of Suess's ideas of the development of the Indian Ocean basin by the foundering of Gondwanaland.

It is well known that weighty arguments in support of the general theory of lost continents may be adduced from palæontology, from the geological histories of Africa, Asia, and the Americas, as also from climatic changes throughout geological time. Gregory was master of them all. The scope of his knowledge was all-embracing. An eager student, a bold investigator, a rapid thinker, endowed with a capacious memory for facts and constructive capacity for synthesis, he became, as the result of his far-flung explorations, an outstanding authority on the world as a whole.

Gregory was, however, far from being a dogmatic theorist. Though tenacious and formidable in argument, he recognised the incompleteness of geological evidence and appreciated the obligation to consider advances in knowledge. In 1915 he wrote in " Geology of To-day " :

" In order to free geology from hopeless attempts to solve problems which could not be solved with the knowledge then available, and to get rid of the incubus of unscientific and premature hypotheses, a group of English geologists founded the Geological Society of London."

To that purpose he was loyal. In the words of Lyell, he conceived the ideal of the founders to have been " to multiply and record observations ", and to that end he dared every risk and devoted his life unsparingly.

Gregory passed, as he would have wished, in active service. He leaves a most eminent name in the roster of great British geologists, but it cannot fill the emptiness in the hearts of his friends.

BAILEY WILLIS.

Stanford University,
California.

Appearance of a Rusty-Red Pigmentation in the Coats of Albino Rats in the Tropics

SOME details of the appearance of a reddish pigmentation in the coats of certain rats after importation into Trinidad from London may be of interest to geneticists.

The colony lies between ten and eleven degrees north of the equator. The shade temperature during the day ranges from 85° to 95°. The night temperature is somewhat lower, especially in the dry season from December to March or April, when the lowest temperature is about 70°. The health of the rats was good. They arrived at the laboratory in November and December 1928. Forty-five were pink-eyed albinos, seven males and thirty-eight females ; four were black-and-white, two males and two females, with the Dutch-rabbit distribution of pigment : these were all black-eyed. They were placed in roomy cages, four females to each male. No attempt was made to isolate the albinos from the black-and-white in the matings, as genetic experiments were no part of my programme. No alien blood of any kind was introduced. The only selection made was that animals varying in weight more than ten per cent above or below the average of their litter mates were discarded as unsuited for dietetic experiments.

The following notes were recorded :

January 1929 ; the albino offspring ($F1$) of the imported animals were of a creamy-yellow tint.

April 1929 ; second generation ($F2$) born. Some of the ratlings were reddish-yellow.

September 1929 ; the yellow colour became so marked in many of the rats that a profound change in metabolism seemed to have occurred. Paler yellows persisted, and some of the others with pink eyes showed the Dutch marking in pale yellow on a white ground. Black-and-whites still appeared, though in a decreased proportion.

December 1929 ; some of the rats were now of a rusty-red tint, like an English hare.

August and September 1931 ; the figures for the coloration of the animals employed during these two months were :

All rusty-red, of various shades, or all yellow	56	= 72
Rusty-red-(or yellow)-and-white .	16	
Black-and-white (Dutch-marked) .	4	
Black with white belly . . .	4	
Total	80 rats.	

A reddish strain of fancy rats similar to those described above and, like them, possessing pink eyes, is known to animal fanciers. These originated in Japan, coming, it is said, from Nagasaki, a place with a rather hot climate.

In May 1932, Dr. Wise, Surgeon-General of Trinidad, sent me some of the Trinidad red rats, descendants of those I had left there. These seem darker than those I saw last September. The eyes remain pink, and their bellies, though reddish, are lighter than the rest of the body. Four of this contingent are in a tropical house at Kew for breeding experiments.

On March 3, 1932, a male and two female albino Wistar rats from the Medical Research Council were sent to the same house to ascertain whether results similar to those found in Trinidad would be obtained. The conditions as to temperature and humidity are almost identical with those of Trinidad, the chief difference being the lesser amount of sunlight.

In a few weeks these rats showed a slight creaminess of tint, which was especially marked on the back of the neck.

Litters ($F1$) were born in March. These were all cream-coloured, in varying degrees of intensity. One male and two females of these were retained at Kew for breeding, the remainder being taken to the animal house at the London School of Hygiene and Tropical Medicine. In June, litters ($F2$) were born, these being distinctly darker than their parents. The Kew-bred rats grew darker in colour both when retained in the tropical house and when brought to the School, but this latter result may be partly due to the fact that the end of June and the beginning of July were hot.

In addition to these facts, and possibly standing in some causal relationship with them, is the occurrence of extensive gastro-intestinal hæmorrhage in rats living in Trinidad or in a tropical house at Kew, when given for a few days a diet of water only. A few animals on this diet in the temperate climate showed traces of bleeding, but not more than traces, whereas in the tropical climate the appearance of the intestines resembles red-currant jelly.

ALFRED CLARK.

London School of Hygiene and
Tropical Medicine,
Keppel Street, London, W.C.1, Aug. 2.

Cytoplasmic Inclusions of *Opalina* and *Nyctotherus*

A VERY interesting paper has recently appeared by Richardson and Horning,[1] on the cytoplasmic structure of *Protopalina* and *Nyctotherus cordiformis*. In the opalinids these authors distinguish three classes of inclusions : first, darkly staining rod-like structures, the mitochondria, often in close connexion with the

second class of body, the vegetative granules, which are lightly staining and irregular in form; and thirdly, the Golgi bodies, only seen in preparations by the silver methods of Da Fano and Cajal — fairly large polymorphic bodies, often twisted and snake-like, and scattered irregularly in the cytoplasm.

In *Nyctotherus* the mitochondria [2] are numerous small rod-like or spherical structures, often showing a well-marked orientation; while the Golgi bodies are larger and irregularly scattered, and vary from rod-like structures to twisted filaments.

Since last January I have been working on *Opalina ranarum* and *Nyctotherus cordiformis*, both by means of fixed preparations and *intra vitam* staining. In some of my silver preparations I find fairly large blackened bodies, more or less round in shape, near the ectoplasm but never in the central regions, and twisted, snake-like in shape. These seem to be the same bodies as identified by Richardson and Horning as Golgi bodies; but I am not convinced that these bodies seen in my formalin silver material are the homologues of the Golgi bodies of Metazoa, both because of their dissimilarity to known types of Golgi apparatus and from failure to show them after many attempts with post-osmication methods (Lassanov, etc.). They may indeed be artefacts.

In chrome-osmium material I find both the rods and irregular bodies, but this also holds after many fixatives, even alcoholic ones; and also all gradations are found between these rods and irregular forms. Hence I have arrived at the conclusion that these are but two aspects of the same structure; they are not mitochondria, but are probably connected with the storage of food. The true mitochondria are small spherical granules, which stain *intra vitam* with Janus green, as well as being seen in chrome-osmium material.

In *Nyctotherus*, I have observed the same two categories of bodies as shown by Richardson and Horning; the larger (their Golgi elements), I have fixed with many methods (absolute alcohol, corrosive acetic, Flemming-without-acetic) as well as by silver techniques—slides, so made, were stained by Gram's method, and these bodies were proved to be Gram-positive bacteria, exactly like certain bacteria in the rectal contents. For this determination my thanks are due to Prof. Bigger of the Bacteriology Department, Trinity College, who carefully examined my slides. The smaller bodies, mitochondria of Richardson and Horning, were shown by similar fixatives and gave a Gram-positive reaction. It may be that they are mitochondria in which the protein base is particularly well developed, and hence they are not dissolved out by absolute alcohol.

It is hoped shortly to publish a full account of these observations.

RUTH PATTEN.
Department of Zoology,
Trinity College,
Dublin, July 13.

[1] *Amer. J. Morph. and Physiol.*, Sept. 1931.
[2] See also earlier papers of Horning.

Colonisation of the Sea by Insects

THOUGH insects are represented in almost every possible niche in terrestrial and fresh-water environment, very few indeed have colonised the sea. Besides *Halobates*, which is pelagic, only some chironomid larvæ and a trichopteron are known to be permanent inhabitants of the sea.[1] Many insects, however, can live in waters having a salinity equal to and even much higher than that of sea water.[2] This indicates that salinity is not a barrier to their migration, neither do the ocean currents and tides appear to be, since many insects live in torrential hill-streams which run with almost an equal, if not greater, force and velocity. Furthermore, many insects live on the sea shore [3] where the physical effects of tides are most pronounced.

In the autumn of 1930 and the spring of 1931, I made extensive collections in several salt waters of the Salt Range, Punjab. I obtained numerous specimens of insects from waters of a salinity 2-5 times as great as that of the sea. These insects included may-fly larvæ (*Cloeon* sp.) and several hydrophilid beetles. The occurrence of may-fly larvæ in such highly saline waters is, I believe, recorded here for the first time.

A careful comparison of the detailed chemical analyses of waters from the Salt Range area with those of sea-water samples taken by the *Challenger* from different oceans of the world shows that the most important difference between the two is the comparatively low calcium content (1·16-1·20 per cent) of the sea water. In the salt waters investigated by me the percentage of calcium varied from 1·77 to 31·67, except in the San Sakesar Lake, where it was 0·11 per cent and in which no insect life was found. This definitely suggests that it is the low calcium content of sea water which has stood in the way of insects inhabiting the sea, and that it is the large amount of this ion in the waters of the Salt Range which helps insects in keeping their body fluids in equilibrium with the highly saline waters which they inhabit. This suggestion seems to be strongly supported by the work of Pantin,[4] Weil and Pantin,[5] and Pantin,[6] who in the case of estuarine animals showed that calcium has a profound influence on their permeability to water and salts. McCutcheon and Lucke [7] found similar factors operating in the case of *Arbacia*.

I am testing this hypothesis by means of experiments, and the results will be published in due course. My detailed studies on the fauna of some of the salt waters of the Salt Range, Punjab, will be published elsewhere.

HEM SINGH PRUTHI.
Zoological Survey of India,
Indian Museum,
Calcutta, July 20.

[1] Buxton, P. A., *Proc. Zool. Soc. Lond.*, 807; 1926.
[2] Balfour, A., *Bull. Ent. Res.*, **12**, 29; 1921.
[3] Flattely, F. W., and Walton, C. L., "The Biology of the Sea Shore", London, 1922.
[4] Pantin, C. F. A., *Brit. J. Exp. Biol.*, **8**, 63; 1931.
[5] Weil, E., and Pantin, C. F. A., *ibid.*, 73; 1931.
[6] Pantin, C. F. A., *ibid.*, 82; 1931.
[7] McCutcheon, M., and Lucke, B., *J. Gen. Physiol.*, **12**, 129; 1928.

Leaf-Curl in Cotton and Other Plants

IN a recent communication [1] Mr. Mathur gives an account of his observations on the leaf-curl in garden zinnias, caused by *Bemisia gossypiperda* Misra and Lamba, at Dehra Dun. The title of the letter suggests that the virus causing leaf-crinkle in cottons in the Sudan is the same that causes leaf-crinkle in zinnias at Dehra Dun. This certainly has not been established so far.

Leaf-crinkle or leaf-curl is not uncommon in cultivated plants. There are in the Punjab, occurring quite commonly, leaf-curls of potatoes, tomatoes, chillies, cucurbits, etc. In the Punjab, however, so far, no leaf-crinkle on cotton has been found associated with *B. gossypiperda*. Just now there is scarcely a cotton leaf which is free from white-fly infestation, yet leaf-crinkle is completely absent.

Leaf-crinkle in cotton should not be confused with leaf-crinkle in other plants without obtaining definite evidence that the same virus is responsible for the disease.

M. AFZAL HUSAIN.
Locust Research Laboratory,
Lyallpur, Punjab, July 16.

[1] NATURE, **129**, 797, May 28, 1932.

Some Characteristics of Ultimate Lines

1. *Classification and Exciting Potentials.*—The ultimate lines are classified as primary, secondary, or tertiary as suggested by Russell, modifying the nomenclature in the form proposed by Catalan and by us.[1]

The following table gives the number of ultimate lines for the different classes and the minimum and maximum values of their exciting potentials. Those computational data are based on the table of the author published in Twyman and Smith's book.[2] A complete list of the exciting potentials and other data for each element will be published shortly in the "Contribución al Estudio de las Ciencias, Serie Mat.-Fisica" (La Plata).

Classification.	Number of Lines.	Exciting Potentials.
Arc lines Primary .	277	0·0 to 1·32
,, Secondary .	206	0·28 to 5·45
,, Tertiary .	53	0·92 to 9·15
Spark lines Primary .	170	0·0 to 0·56
,, Secondary	109	0·14 to 11·90
,, Tertiary .	60	0·32 to 17·94
Not classified . .	204	?
Total number .	1079	

Fifty per cent of the ultimate arc lines correspond to the primary lines class, and the same proportion is maintained in the spark lines. According to Meggers, Kiess, and Walters, jr.,[3] all the ultimate lines of the spark, with no exception whatsoever, are originated in the fundamental levels; this conclusion is also maintained by Catalan.[4] Our computations do not support that assertion, which is only found true regarding very few elements of the iron group.

2. *Absorption.*—Supplementing our observations regarding the ultimate lines [5] we have established, as the extreme limit for the appearance of the ultimate lines in absorption, the value $N_1/N = 1/14{,}500$, that—according to the equation $N_1/N = e^{-\frac{E}{RT}}$, where N_1 is the number of the excited atoms and N the total number of atoms—corresponds to a value of $E = 1{\cdot}03$ volts for $T = 1250°$ and to a value of $E = 2{\cdot}06$ for $T = 2500°$.

The value $N_1/N = 1/14{,}500$, adopted by us, corresponds to an extreme limit because, according to our experimental data,[6] faint absorption lines only are observed for $N_1/N \geqslant 1/1600$ and lines of medium intensity for $N_1/N \geqslant 1/210$; for the value adopted, only lines of absorption of a very faint intensity and few in number are observed. In accordance with the preceding considerations, and not taking into account other factors in the obtaining of the absorption spectra—the most important of which is the vapour tension of the element considered—it is possible to observe, in an absorption at a temperature of 1250°, those lines the original levels of which are the fundamental ones that are separated from it by not more than 1·03 volts; that is to say, 330 lines out of 536, and, at a temperature of 2500°, 414 lines out of 536. The quantities given are maxima, because if we consider the possible number of lines of absorption of medium intensity, the value N_1/N should be 1/210, corresponding to a value of 1·13 volts at 2500°, which shows that—excluding the lines originated at the fundamental levels—only a small number of those corresponding to other levels may be observed in absorption.

3. *Multiplets.*—In the case of multiplets, the ultimate lines fulfil the conditions $\Delta l = 1$ for $\Delta j = 1$ and 0, and $\Delta l = 0$ for $\Delta j = -1$ and 0. The only exceptions to this rule are the multiplets *SP* (Mn, Cr, etc.). This conclusion is identical with the one we established [7] regarding the lines that appear in absorption and that fulfil the same conditions in the variation of the quantum numbers.

ADOLFO T. WILLIAMS.
Instituto de Fisica de la
Universidad de La Plata (E. Argentina),
June 19.

[1] Twyman and Smith, "Wavelength Tables for Spectrum Analysis", p. 137.
[2] Op. cit., p. 135.
[3] *J.O.S.A.*, **9**, 355; 1924.
[4] *An. Soc. Esp. Fis. y Quim.*, **28**, 92; 1930.
[5] *Cont. Est. Ciencias*, Serie Mat.-Fis., **5**, 512; 1931; and *Comp. rendus*, **193**, 358; 1931.
[6] *Cont.*, etc., **5**, 504; 1931; and *Phys. Zeit.*, **33**, 154; 1932.
[7] *Cont.*, etc., **5**, 511; 1931; and *Phys. Zeit.*, **33**, 157; 1932.

Magnetic Analysis of Molecular Orientations in Crystals

BY correlating the magnetic constants of a diamagnetic crystal with those of the individual molecules constituting it, calculated from measurements on the magnetic double refraction of the substance in the liquid state, or from other considerations, it is possible to obtain direct information regarding the orientations of the molecules in the crystal. In a paper which is in course of publication, the results of some magnetic measurements by Mr. S. Banerjee and me on a number of organic crystals are discussed from this point of view.

It is found that in favourable crystals it is possible by the above method to locate the precise molecular orientations. The cases of biphenyl and dibenzyl may be quoted here as examples. Both of them crystallise in the monoclinic prismatic class, in the space group C^5_{2h}. There are two molecules in their unit cells. Their orientations determined from the magnetic measurements are as follows. Let us for brevity define the directions of the lines joining the carbon atoms 4 and 1 in the molecule (in the usual notation), or the atoms 1′ and 4′, as the length of the molecule, and the plane of the benzene rings as the molecular plane. We then find that the lengths of both the molecules in the unit cell lie in the (010) plane in the obtuse angle β, their inclination to the *c* axis being 20·1° in biphenyl and 83·9° in dibenzyl. As regards the molecular planes, in either crystal, one half of the molecules have their planes inclined at $+59°$ to the (010) plane and the other half at $-59°$ to it.

In the case of dibenzyl, sufficient X-ray data are not available to enable us to test the above conclusions. Our results for biphenyl, however, are fully confirmed by the recent X-ray measurements of Dhar,[1] whose values for the above angular parameters are 20° and 58° respectively, which are almost the same as our values.

K. S. KRISHNAN.
Physics Laboratory,
University of Dacca, July 6.

[1] *Ind. J. Phys.*, **7**, 43; 1932.

Formaldehyde in Rain Water

SINCE 1864, when Baeyer stated his formaldehyde hypothesis, numerous attempts have been made to obtain formaldehyde *in vitro* from carbon dioxide and water on exposure to light. Usher and Priestley,[1] Baly, Heilbron and Barker,[2] Dhar and co-workers,[3] Mezzadroli and collaborators,[4] and others, obtained evidence of formaldehyde formation from carbonic acid or bicarbonates in presence or absence of catalysts when exposed to light. On the other hand, Spoehr,[5] Baur and Rebman,[6] Potter and Ramsperger,[7] Bell,[8] Emerson,[9] Zschiele,[10] and Mackinney [11] obtained negative results, although the last-named worker made the following statement: "The status of this problem is extraordinarily involved, though it can hardly be

doubted that some workers have succeeded in obtaining formaldehyde in *vitro*". Recently, Baly and co-workers [12] seem to contradict their earlier results.

It appears that the formation of formaldehyde is not only favoured by radiations of short wave-lengths, but also a high light intensity is absolutely essential, and some workers in this field could not obtain formaldehyde because of the low light intensity used. In a recent communication, Dhar and Atma Ram [13] have been able to obtain larger yields of formaldehyde by the photo-reduction of carbonic acid and bicarbonates by metals like magnesium, cerium, etc.

It is well known that carbonic acid and water vapour exist in the atmosphere, and under the influence of ultra-violet light from the sun, they should combine and form formaldehyde and oxygen. Hence it seems probable that formaldehyde should be present in the atmosphere.

If appreciable amounts of formaldehyde were present in the atmosphere, it should be partially washed down with rain water. In the last few months, in order to test whether formaldehyde occurs in rain water, we have analysed numerous samples of freshly collected rain water obtained at Allahabad, Barlowganj (Mussorie)—altitude 5500 ft.—and at a village about three hundred miles from Allahabad. In all cases, we have got immediate and definite evidence of the existence of formaldehyde in both distilled and undistilled rain water, as tested by Schiff's reagent, Schryver's reagent, and by the reduction of ammoniacal silver nitrate.

From our experiments, we are of opinion that formaldehyde is actually present in rain water collected in these parts, and it is washed down from the atmosphere. In view of the fact that it is always present in rain water collected in a city, a village, and at a place of high altitude and far from human habitation, it appears that the formaldehyde present in the atmosphere is obtained from the combination of carbon dioxide and water vapour in the presence of the solar ultra-violet light, and not from the decomposition of substances of vegetable origin on exposure to light.[14] It will be interesting to note here that, several years ago, Henriet [15] reported the presence of formaldehyde in air but was not supported by Gautier.

Moreover, in a recent communication,[16] it has been shown from spectroscopic evidence that formaldehyde, like cyanogen, may be present in the absorbing atmosphere of the sun. It will be highly interesting if workers in other countries can also detect formaldehyde in rain water, and I would direct their attention to this matter. Formaldehyde present in the atmosphere and rain water even in small quantities serves as a ready-made plant food and stimulant,[17] and as an antiseptic which can purify the air and act as a disinfectant for the soil.

N. R. DHAR.
ATMA RAM.

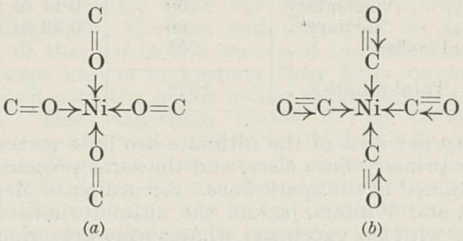
Chemical Laboratory,
University of Allahabad,
Allahabad, June 30.

[1] *Proc. Roy. Soc.*, B, **84**, 101; 1911.
[2] *J.C.S.*, **119**, 1025; 1921.
[3] *J. Phys. Chem.*, **29**, 926; 1925: **35**, 1418; 1931: **36**, 567; 1932.
[4] *Atti Accad. Lincei*, **6**, 160; 1927: *Gazetta*, **59**, 305; 1929.
[5] *J. Amer. Chem. Soc.*, **45**, 1184; 1923.
[6] *Helv. Chim. Acta*, **5**, 928; 1922.
[7] *J. Amer. Chem. Soc.*, **47**, 79; 1925.
[8] *Trans. Faraday Soc.*, **27**, 771; 1931.
[9] *J. Gen. Physiol.*, **13**, 163; 1929.
[10] *J. Amer. Chem. Soc.*, **54**, 973; 1932.
[11] *Ibid.*, **54**, 1688; 1932.
[12] *Proc. Roy. Soc.*, A, **116**, 212; 1927.
[13] NATURE, **129**, 205; 1932.
[14] Compare Spoehr, *Biochem. Z.*, **57**, 95; 1913: Moore and Webster, *Proc. Roy. Soc.*, **90**, 168; 1918.
[15] *C.R.*, **138**, 203, 1272: **139**, 67; 1904.
[16] Dhar, *Z. anorg. u. allg. Chem.*, 1932.
[17] Compare Sir J. C. Bose, "Physiology of Photosynthesis", Longmans, 1924, p. 71.

Electric Dipole Moment of Nickel Carbonyl

WE have recently determined the total and the electron polarisations (the latter as the molecular refractivity for the mercury green line 5461) of nickel carbonyl in carbon tetrachloride solution at 0° C., and found values of 39·5 c.c. and 37·3 c.c. respectively. The latter value is somewhat higher than that of 35·5 c.c. calculated from the data of Mond and Nasini,[1] who used the pure substance, for the thallium line 5351, but it is probably not in error by more than ±0·1 c.c., and the difference may be attributed to the difference of concentration. The apparent orientation polarisation of 2·2 c.c. would give the maximum possible value of the electric dipole moment as $0{\cdot}3 \times 10^{-18}$ e.s.u., but since it is of the order which would be expected for the atom polarisation of such a molecule, the moment may be taken to be zero with a high degree of probability.

This result shows that the structure must be symmetrical, and therefore cannot be cyclic, as suggested by Sugden,[2] nor can the structure be as shown in formula (*a*), in which co-ordinate links are formed



(*a*) (*b*)

between doubly bound oxygen atoms and the central nickel atom, for in this the co-ordinate link and the double bond on each oxygen atom would, on the tetrahedral atomic model, not be collinear, so that by partial rotation about the former links the molecule would become unsymmetrical and, like the methyl and ethyl orthocarbonic esters (electric dipole moments 0·8 and 1·1 respectively),[3] would have a finite moment.

The only structure which could be symmetrical is that shown in formula (*b*), or a similar one with the co-ordinate links between oxygen and nickel. This, which is derived from the co-ordinate triple link structure for carbon monoxide suggested by Langmuir and discussed by Hammick, New, Sidgwick, and Sutton,[4] would be symmetrical if the co-ordinate links, which must be collinear with the triple bonds, were directed either along the axes of a regular tetrahedron or to the corners of a square. It is more likely that the co-ordinate links to the nickel atoms would be formed by the acceptor carbon atoms than by the donor oxygen atoms, and so the former of the structural isomers here possible is the more probable. In either, the third quantum group of the nickel atom is completely filled with unshared electrons, and the valency group is a fully shared octet: such a structure is in complete accord with the diamagnetic nature of the substance.[5] Since no *d* electrons are utilised in attaching the CO radicals, it follows from Pauling's theory [6] that the tetrahedral arrangement is far more probable than the planar one.

The classical hypothesis that a triple bond and a single one on the same atom are collinear has been attacked by Bergmann,[7] who cites electric dipole moment evidence against it, but his arguments are not convincing. It has been given theoretical support by Pauling,[6] and has been proved correct experimentally for the cases of acetylene and hydrogen cyanide, [8, 9] by examination of the spectra, which show that the molecules are rectilinear.

This result is further support for the co-ordinate triple link structure ascribed to the other divalent carbon compounds, the *iso*-cyanides.

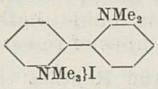
L. E. SUTTON.
J. BREEZE BENTLEY.

Dyson Perrins Laboratory,
Oxford, Aug. 1.

[1] Mond and Nasini, *Z. Phys. Chem.*, **8**, 150; 1891.
[2] Sugden, "The Parachor and Valency", London, 1930, p. 189.
[3] Ebert, Eisenschitz, and v. Hartel, *Z. Phys. Chem.*, B, **1**, 94; 1928.
[4] Hammick, New, Sidgwick, and Sutton, *J.C.S.*, 1876; 1930.
[5] "International Critical Tables", vol. 6, p. 358.
[6] Pauling, *J. Amer. Chem. Soc.*, **53**, 1367; 1931.
[7] Bergmann and Tschudnowsky, *Z. Phys. Chem.*, B, **17**, 116; 1932.
[8] Hedfeld and Mecke, *Z. Physik*, **64**, 151; 1930. Mecke, *ibid.*, 173; 1930.
[9] Badger and Binder, *Phys. Rev.*, **37**, 800; 1931.

Stereochemistry of Diphenyl

THE stereochemistry of diphenyl, as was shown in the "Research Items" in NATURE for April 2, p. 512, in reference to a paper by Prof. R. Kuhn, continues to produce problems of great interest. At a meeting of the Chemical Society held on May 5, a new 'dynamic' effect of groups in the 2:2′ positions was described.[1] We have now effected the optical resolution of the monomethiodide of 2:2′-bisdimethylaminodiphenyl:



The *d*- and *l*-methiodides have $[\alpha]_{5791}^{20^\circ} \pm 48^\circ$ in aqueous solution, in which ionisation is complete, and cold solutions retain their activity for indefinite periods. In aqueous solution at 100°, half-racemisation occurs in just over two hours.

The dissymmetry of the methiodide molecule can only be due to the dynamic effect of the three methyl radicals attached to the nitrogen atom, which, it should be noted, is the smallest atom possessing a tetrahedral configuration. The various implications of our results are being investigated.

F. R. SHAW.
E. E. TURNER.

Department of Organic Chemistry,
Bedford College for Women,
University of London,
Aug. 5.

[1] Lesslie and Turner, *J.C.S.*, 2021; 1932.

The Ring System of Sterols and Bile Acids

THE constitutional formula tentatively suggested by Butenandt[1] for the hydrocarbon $C_{18}H_{14}$ obtained by him from ketohydroxy-œstrin (follicular hormone) is closely related to the new constitutional formula of sterols and bile acids previously advanced by Rosenheim and King.[2] The applicability of this formula to the basic ring system of ketohydroxy-œstrin and pregnandiol (see Bernal[3]) was, indeed, expressed in our preliminary note, and the work of Marrian and Haslewood[4] and that of Butenandt (see above) supplies welcome experimental evidence in its favour.

It may be recalled that the essential principle of the formula proposed by ourselves consists in the grouping of three six-membered rings (I., II., and III.) as in phenanthrene, an arrangement which at once permits of a straightforward formulation of those experimental facts, for which the hitherto accepted formula (Windaus-Wieland) afforded no adequate explanation. Chrysene formation from such a ring system can obviously take place whether the attached ring IV. is six- or five-membered (in the latter case by means of the adjoining CH_3 group).

In the circumstances it is surely unnecessary for Dr. Butenandt to refer, for "similarities" to the proposed ring system, to papers by Wieland and Windaus which are still "in the press". It may be that these authors will be found to prefer the modification of our formula with a five-membered ring IV., but in the latest available publication from Windaus's laboratory[5] our formula with a six-membered ring IV. is adopted.

O. ROSENHEIM.
H. KING.

National Institute for Medical Research,
London, N.W.3, Aug. 15.

[1] NATURE, **130**, 238, Aug. 13, 1932.
[2] *Chem. and Ind.*, **51**, 464; 1932.
[3] *Chem. and Ind.*, **51**, 466; 1932.
[4] *Lancet*, II., 282; 1932.
[5] *Lieb. Ann.*, **497**, 130; 1932.

Hall Effect in Beryllium

I HAVE recently carried out work on the Hall effect in beryllium, by using a plate measuring 1·5 cm. × 1·5 cm. × 0·045 cm., which was prepared, for this purpose, by Siemens and Halske of Berlin, from a sample of pure beryllium (99·5 per cent). I made use of Hall's classical experimental arrangement, and measured the e.m.f. by means of a potentiometric method with the use of a very sensitive Siemens and Halske's "Pancergalvanometer".

A large Weiss-type water-cooled magnet (made by Max Hohl of Chemnitz) capable of producing field strengths up to 27,500 gauss in a 4 mm. gap, the pole faces being 15 mm. in diameter, was used.

Many measurements were taken by varying the intensity of the current, and that of the magnetic field up to a maximum of 500 milliamperes and 27,500 gauss respectively.

The effect was very small and positive; the value of the Hall coefficient was found to be $+0{\cdot}0024 \pm 0{\cdot}0001$.

A detailed account of the experiments will be published shortly.

A. CICCONE.

Physical Institute of the University,
Pisa, Italy, July 23.

Absorption of Boron Neutrons by Lead

WHILE examining the absorption of neutrons emitted from boron bombarded by α-rays from an ampoule of radium emanation, we have been able to establish a phenomenon which seems worthy of attention.

The absorption of beryllium neutrons by lead is greater than by an equal thickness of copper or paraffin. Boron neutrons appear to possess less energy than beryllium neutrons, and are more absorbed by copper and paraffin wax than by lead. To the neutrons from boron, lead is very transparent, a screen 5 cm. thick showing scarcely any appreciable absorption, as shown by the number of recoil nuclei.

During a discussion at the International Electrical Congress recently held at Paris, Prof. Fermi put forward the suggestion that this phenomenon can be approached along the lines of the Ramsauer effect, the wave-length, h/mv, of the neutrons possibly being of the same order as that of the effective radius of a nucleus.

M. DE BROGLIE.
L. LEPRINCE-RINGUET.

Aug. 13.

Research Items

Palæolithic Sites of Bourdeilles (Dordogne).—Excavations in rock-shelters and caves in the neighbourhood of Bourdeilles, a village on the banks of the Dronne, 25 km. north-west of Périgueux, have been described by M. D. Peyrony (*Mém.* 10, *Arch. Inst. Paléontologie humaine*). The Grotte des Bernous yielded late Mousterian, followed immediately by Middle Aurignacian, Lower Aurignacian being absent. The close juxtaposition, and in some instances intermingling, of Mousterian and Aurignacian suggests that here the Mousterian survived while Lower Aurignacian flourished elsewhere, and was driven out by Middle Aurignacian tribes. The Fourneau du Diable furnished a stratification of Aurignacian, Solutrean, and Hallstat, while on the terraces lying above there were three horizons of Solutrean. Many objects found were unique, such, for example, as a haft of reindeer horn socketed to take a stone implement, and a collection of coloured pebbles arranged in a quadrilateral figure. The latter, it is suggested, may have been fastened to some material, such as wood or leather, which has perished, and have been used as a dance rattle. The cultures of Bourdeilles throw new light on a number of questions. The development of the flint industry of the Solutrean can here be followed in detail and the first appearance observed of the implements, such as daggers and the *feuille de saule*, which were the forerunners of the weapons of neolithic times. From the evidence at Bourdeilles it is concluded that for a long time different peoples lived side by side and finally coalesced to adopt a single culture. This view is borne out by the occurrence, in what is virtually the same cultural horizon, of Chancelade man with his Eskimo characters and the man of Laugerie Basse, a Nordic type.

Moieties of the North-Western Mono, California.—In a study of the north-western Mono in the vicinity of Northfork, an affluent of the San Joaquin River (*Univ. Cal. Pub. Amer. Arch. Eth.*, vol. 31, No. 2), Mr. E. W. Gifford records that these people are divided into two moieties, which function in feasts, ceremonies, and games in reciprocity and in rivalry. Thus, at ceremonies or feasts, each moiety prepared food for the opposite moiety; but the moieties never ate together. At these feasts the children ate with the father; but the wife did not eat with her husband if she belonged to the other moiety. One moiety prepared and burned the dead of the other moiety, a service for which they received payment. At the mourning ceremony, which took place two years afterwards, they sang for and washed the mourners, fed them, and paid them. After the ceremony the mourners reciprocated with payment and a feast. The totemic animals, birds, were connected with the moieties, and not with the four divisions, of which two were assigned to each moiety. An individual, however, might consider all totems of his moiety as his own; but the golden eagle, although it was a totem of one of the moieties, was reverenced by everyone as the creator as well as the chief of the birds. If a man wished to kill his totem for its feathers, he explained matters to it, pointing out that it would not die, as he would take care of its feathers. If an eagle was killed by one of the vulture moiety, he brought the feathers to the eagle chief and paid for them. Each moiety had shamans. A vulture shaman who killed an eagle man by magic was killed by the eagle chief unless he had previously paid the eagle chief for the privilege.

Vocational Tests of Dexterity.—Vocational tests of dexterity are classified and psychologically estimated by Miss Amalie E. Weiss Long and Prof. T. H. Pear in Report No. 64 of the Industrial Health Research Board. English, American, French, and German publications are mentioned, and special prominence is given to the less familiar work of foreign countries, illustrations of test methods being drawn from them. The report opens with a discussion of 'skill' and the definition of it as "the integration of well-adjusted muscular performances". Thus understood, it needs a complex system of testing. Vocational research should concentrate on the specific psychological requirements of an occupation, and on determining the most appropriate tests for discovering whether, and in what degree, given individuals possess them. Hence, claims made for single tests in different countries cannot be substantiated. In selecting for an occupation demanding a fairly complex performance, it is of importance to use series of tests involving complex activities. The individual tests should be as numerous and diverse as possible, and the time allowed to do them should be fully adequate. It is not important that the single functions called into play should be identical with those required industrially. This comprehensive survey shows that less has been indisputably established than the vocational guidance promoters would like to think: but it also affords an excellent guide both to the available material and future lines of research.

Adaptation of Sand Reptiles to Environment.—In the Sahara and on the sandy plains of California, Walter Mosaner has been struck by the remarkable resemblances between the sand-inhabiting reptiles (*Copeia*, p. 72, 1932). These are not adaptations to desert conditions, which tend rather to affect behaviour, but structural changes due to the mechanical characteristics of the sand and the texture of the substratum. The changes are twofold: some are modifications facilitating locomotion on or in the sand, others serve for the protection of the sense organs and body openings. As some sand-dwelling mammals have adopted occasional bipedal locomotion, so many lizards assume a bipedal position when at top speed. The tracks in the sand show how different is the work accomplished by fore and hind feet, and with increasing speed the difference is accentuated until the fore-feet, and the tail also, are held clear of the ground. A curious locomotor adaptation common to Saharan and Californian snakes is the habit of 'side-winding', and many structural features, such as the stream-lined body, shovel-like snout, countersunk lower jaw and degenerate limbs, are associated with the habit of burrowing in the sand. Although perhaps less markedly, the protection of the eyes by fringe-like scales, of the tympanic membrane by overlapping scales, and of the slit-like nostril (in *Phyllorhynchus*) by the projecting edges of the nasal scales, all seem to be associated with the burrowing habit.

Copepods of Chesapeake Bay.—The peculiar conditions of Chesapeake Bay offer excellent opportunities for a detailed study of copepods, since in many cases they have a wide distribution and accommodate themselves to great and fairly rapid changes in salinity. Dr. C. B. Wilson shows ("The Copepod Crustaceans of Chesapeake Bay", by Charles Branch Wilson; No. 2915, *Proc. U.S. Nat. Mus.*, vol 80, Art. 15, 1932) that *Acartia clausi* is the most frequently occurring copepod in the Bay, next to it coming *A. longiremis*. These two species are largely eaten by the shad, and are of much greater economic importance than was previously realised. In March, when copepods are at their maximum, the largest hauls are made up almost

entirely of these two species, which breed twice a year, in winter and in summer. The March maximum is the product of the winter breeding, the young copepods having exceptionally good opportunities for growth, as there is then a relative scarcity of fishes and other animals which prey upon them. Later on, the numbers diminish rapidly, probably owing to the coming of the shad. The author finds four breeding seasons in Chesapeake Bay, in winter, spring, summer, and autumn, each characterised by several copepods bearing eggs. In the months following, nauplii and young are caught in numbers. Each copepod has one or two breeding seasons. The records indicate that water of higher salinity is more favourable to the breeding than the low salinity water at the inner end of the Bay.

Fauna of the Tay Estuary.—A study of the inhabitants of the Tay Estuary, made by W. B. Alexander for comparison with the corresponding fauna of the River Tees, reveals the different capacities of marine animals to penetrate upstream into the region of brackish and even fresh water (*Trans. Perthshire Soc. Nat. Hist.*, vol. 9, 1932, p. 35). The real marine fauna, characterised by the presence of limpets and common star-fishes and red sea-anemones, may be said to end near the Tayside Lighthouses. Two miles farther up the estuary, at the Tay Bridge, these have dropped out, and here periwinkles, the amphipod *Orchestia littorea*, three species of the sea-worm, *Nereis*, and a few others reach their limit. Beyond this, for ten miles farther, the shore-crab and some smaller crustaceans, the polyzoon, *Membranipora*, *Nereis diversicolor*, and the seaweeds, *Ulva* and the common bladder-wrack, penetrate. But here ends the conquest of marine forms over the influence of fresh water, and only two species of crustaceans, *Neomysis vulgaris* and *Corophium longicorne*, are found five miles farther on, at Newburgh, although adventurous flounders live in association with a fresh-water fauna twenty miles beyond the limit of the real marine fauna.

Hosts of Rust Fungi.—"Inoculation Experiments with some Heterœcious Species of the Melampsoraceæ in Japan", by N. Hiratsuka (*Jap. J. Bot.*, vol. 6, No. 1, pp. 11-34; 1932), gives the results of very extensive inoculation experiments with the teleutospores and æcidia of heterœcious Melampsoraceæ. The interest is mostly local, but a well-defined specificity of the fungus *Melampsora larici-epitea* claims more general notice. Teleutospores from *Salix viminalis* v. *yezoensis*, *S. rorida*, and *S. sachalinensis* will all infect *Larix Kaemferi* and produce æcidia thereon, but æcidia from the three different sources will not inter-infect the three species of *Salix*.

Petrogenesis of the Dartmoor Granites.—Many intensive studies of reaction between granite and country rock have been made during recent years by British geologists, but by far the most exhaustive is that carried out with brilliant success by Dr. A. Brammall in collaboration with Dr. H. F. Harwood on the Dartmoor granites (*Quart. J. Geol. Soc.*, **88**, pp. 171-237; 1932). The long-awaited record of this model of petrogenetic research, including, as it does, more than eighty detailed analyses of carefully selected series of rocks and minerals, constitutes an unrivalled storehouse of petrological and geochemical data and embodies a convincing discussion of the bearing of these data on many problems, hitherto elusive, of rock genesis. It is demonstrated beyond any possibility of doubt that the observed variation of rock-types cannot be the result of differentiation alone. The study of inclusions and contact-facies shows that an initial acid magma was basified and enriched in biotite and certain other minerals by reaction with the shales, diabases, and spilites of the invaded country rocks. Reciprocally, the granitisation of xenoliths is proved, the observed hybrids ranging between types such as hornblende-diorite and biotite-granite. It is concluded that the whole assemblage of rock-types can be reasonably accounted for by the operation of a bi-generic process of assimilation and differentiation proceeding concomitantly during the emplacement of the invading magma. It is impossible in a brief paragraph to do more than direct attention to the quality and significance of this outstanding investigation. Both are of the highest order, and the authors are to be congratulated on their great achievement.

Coral Reefs and Raised Beaches of Japan.—It does not appear to be generally known that reef-building corals flourish in some parts of the Japanese seas. H. Yabe and T. Sugiyama (*Sci. Rep. Tôhoku Imp. Univ.*, Sendai, ser. 2, vol. 15, No. 2, 1932, p. 143) state that the more southerly islands (Riukiu, Ogasawara, and Taiwan) have well-developed fringing reefs and bank barriers, with a breadth varying from 150 metres to 4000 metres. 202 species and varieties of corals have been recognised, a larger number than is found in either the Philippine or the Hawaiian Islands. Around the more northerly islands (Kiushû, Shikoku, and Honshû), owing to the influence of the warm current, reef corals thrive so far north as lat. 35° N. but do not form well-developed reefs. A living representative of *Stylocœnia*, a genus hitherto known only in the fossil state, has been found. Farther north, in the Kwantô region, raised beaches have been found at levels ranging from 4 metres to 20 metres above sea-level. S. Nomura (*ibid.*, p. 65) gives a list of 470 species of Mollusca found in these beaches. The majority of the species still live along the coasts of central Japan, but some only in western Japan or farther south. The raised beaches are regarded as of Neolithic and later date.

Upper Atmospheric Ionisation.—When the frequency of wireless waves incident on the Kennelly-Heaviside layer is being increased, a stage is reached when reflection is replaced by transmission, and the waves pass to the Appleton layer before return; with further increase in frequency, the same occurs there, but the waves are now completely lost. From the critical frequency for transmission in each case the maximum density of the ions or electrons present can be calculated. The results of some routine measurements of this nature have been described by Prof. E. V. Appleton and Mr. Naismith (*Proc. Roy. Soc.*, July), principally for the lower layer. The ionisation has both annual and diurnal variations, as well as more irregular fluctuations, some at least of which are associated with magnetic storms. During the day, the ionisation is high, with a flat maximum near noon, and it is low at night, again with little change; the ionisation is heavier in summer than in winter. The full interpretation of the results depends on whether molecular and atomic ions or electrons are responsible for the reflection and transmission. If the negative particles are massive, their maximum concentration in the lower layer is about 10^{10} per c.c. in summer, but if they are electrons, the concentrations are only of the order of 10^5 per c.c. A better idea of the significance of the densities may perhaps be obtained from the fact that the number of electrons per c.c. in an Osglim lamp is of the order of 10^{10}, whereas 10^5 per c.c. corresponds more nearly to the state of a gas ionised by X-rays; the analogy is not, however, complete, because the negative carriers in the Osglim lamp are mainly electrons, and not molecular or atomic ions. Actually it is known from other lines of reasoning that the negative particles in the upper layer are

chiefly electrons, and in the lower layer at least partly electrons.

Experiments with High-Velocity Positive Ions.—The work of Dr. J. D. Cockcroft and Dr. E. T. S. Walton on artificial disintegration by protons is described in the July issue of the *Proceedings of the Royal Society*. Disintegration takes place most readily with lithium, but boron and fluorine also give more than 10 per cent of the number of particles from lithium at 300 kilovolts, uranium, aluminium, and carbon between 1 and 2 per cent, and beryllium, calcium, cobalt, nickel, copper, and silver between 0·4 and 0·8 per cent. Oxygen, sodium, potassium, iron, and lead give very small numbers, and in some cases it is not yet certain that the effect is not due to the disintegration of impurities. The disintegration of uranium is of particular interest, in view of its natural activity, but the artificially produced particles appear to have a longer range than the natural ones. Several elements, including beryllium, give two types of particles, presumably with different energies. The majority of the experiments on the properties of the emitted particles have been done with those from lithium. With this element, there can be very little doubt that α-particles are formed, and that they are almost homogeneous in speed, and produced in pairs. From their range, it is calculated that 17 million electron volts of energy are released, in agreement with the 14 ± 3 million electron volts required from the mass defects of the various nuclei involved, but the number of disintegrations taking place is smaller than would be expected from the quantum theory of the effect. In view of the very small chance of protons of 500 kilovolts penetrating the potential barrier of a heavy nucleus in any way other than by resonance, it would appear probable that this is the process coming into operation. It is noteworthy that the three elements—lithium, boron, and fluorine—which give the largest emission of particles also show a similar change in emission with increase in the speed of the incident protons. These elements are all of the $4n+3$ nuclear type, with nuclei presumably made up of α-particles with the addition of three protons and two electrons, so that it is reasonable to suppose that capture of a proton may lead to the formation of a new α-particle inside the nucleus.

Neon Isotopes.—By the aid of a new diffusion process, Prof. G. Hertz has now effected a practically complete separation of the lighter isotope of neon (*Naturwiss.*, June 24). The process is an elaboration of the principle of differential diffusion through porous tubes, and is carried out in a train of twenty-four interconnected elements, controlled by mercury vapour pumps. A single run of eight hours, starting from ordinary neon with a 10 : 1 isotope ratio, gave either a mixture with a 10 : 8 ratio or one with only about one per cent of the heavy isotope. The experiments were controlled by a mass-spectrograph, and by study of the fine structure of the neon spectrum with an interferometer. Evidence was obtained by the former method that there is a fourth isotope of neon with mass 23, in addition to the common pair with masses 20 and 22, and the rarer isotope of mass 21.

Astronomical Topics

Astronomical Notes for September.—Mercury is in elongation as a morning star on Sept. 3 ; 18° from the sun. Venus is in elongation as a morning star on Sept. 8 ; 46° from the sun. Being north of the sun, it is well placed for observation.

There is an almost total eclipse of the moon (magnitude 0·982) on the evening of Sept. 14. The moon enters the umbra at $7^h\ 18^m$, and leaves it at $10^h\ 43^m$, the maximum eclipse being at $9^h\ 0^m$. The sun sets in London at $6^h\ 18^m$. Study should be made of the brightness and colour of the eclipsed region.

There is only one occultation visible in London at a convenient hour ; 27 Capricorni disappears at $6^h\ 44^m$ on the evening of Sept. 11.

Saturn passed opposition in July, but is still observable, though low down. Uranus is observable in Pisces ; it reaches opposition in mid-October. A map of its track among the stars is given in the B.A.A. Handbook for 1932.

The comet Peltier-Whipple was visible with an opera-glass in August, and should still be an easy telescopic object in September. The following ephemeris for 0^h is from the Whipple-Cunningham orbit :

	R.A.	N. Decl.
Sept. 2	$9^h\ 57^m\ 36^s$	79° 47′
6	11 44 44	76 22
10	12 35 45	72 12
14	13 3 14	68 16
18	13 20 12	64 48
22	13 31 56	61 46
26	13 40 32	59 7
30	13 47 16	56 46
Oct. 4	13 52 48	54 45
8	13 57 28	52 56
12	14 1 40	51 22

The comets Newman and Borrelly need more powerful instruments ; an ephemeris for Newman is given in the *Observatory* for August and September ; for Borrelly, use the B.A.A. Handbook, applying the correction given there for perihelion one day later than the assumed value. The Handbook also gives a search ephemeris for Tempel's comet, 1866 I ; all astronomers who have suitable means are asked to join in the search for this comet. Its detection would enable the past history of both the comet and the Leonid meteors to be placed on a firmer footing.

The sun crosses the equator and autumn begins at $6^h\ 24^m$ on the morning of Sept. 23.

Add 1^h to all times given, to reduce to Summer Time.

The Welsh Meteor of April 14, 1931.—Loud explosive sounds were heard over North Wales on the morning of April 14, 1931. Some of the daily papers described it as an earthquake ; Mr. B. M. Peek, who was on the mountain Moel Siabod, sent an article to the British Astronomical Association, in which he made the conjecture that the sounds were due to the passage of a large meteor which probably fell in the Irish Sea. The *B.A.A. Journal* for June 1932 has another article about it, by Mr. A. King. His researches have placed the meteoric character of the object beyond doubt ; two observers, in Ripon and Leeds, actually saw the meteor ; many people in Yorkshire heard the sounds, which some took for thunder ; moreover a fragment of the meteor was seen to fall at Coch-y Bug Farm, a few miles south of Carnarvon. Dr. Spencer has seen this fragment, and pronounces it to be a genuine meteorite, " apparently of an unusual type ". Mr. King has investigated the real path of the meteor ; the calculated earth-point is some eighteen miles west of the farm where the fragment fell ; the visible path appears to have begun over Bakewell and ended over Mold. The velocity was not much less than parabolic, the radiant being 177° from the apex, so that the meteor was overtaking the earth. It is satisfactory that it has been possible to determine so much about this interesting meteor. From the loudness of the sounds it is conjectured that by far the largest portion of the meteor fell in the sea.

The Total Solar Eclipse of Aug. 31

AN account of the work which is being undertaken in connexion with the total solar eclipse of Aug. 31 by the three British expeditions in Canada under the auspices of the Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society appeared in NATURE of July 23, p. 116.

The Imperial College expedition to Montreal will be located on the roof of the Molson Hall of the Arts Building of McGill University, where Prof. Ira Mackay has kindly placed every facility at the disposal of the observers. The site will afford a good view of the sun, the intervening ground being occupied mainly by a reservoir and the wooded slopes of Mount Royal, so that a very steady image of the sun should be obtained. An excellent dark room and source of electric current are convenient of access. The observations are in charge of Prof. H. Dingle, who will be assisted by members of the McGill University staff and students. Through the kindness of Prof. A. S. Eve, the resources of the Macdonald Physics Laboratory and workshops have been made available to the observers, and if the weather is favourable there is every prospect that the expedition will be as successful as the nature of the programme allows.

Two problems are to be attacked. First, the photography, with large dispersion (about 0·7 A. per mm.) of the bright-line spectrum at the cusp of the partially eclipsed sun, which was observed visually by Prof. A. Fowler at South Kensington in 1912. Owing to the extremely short length of slit which will be illuminated (a small portion of a millimetre up to a few minutes before totality with the 2-inch solar image which is to be used), the possibility of success in this part of the programme is somewhat speculative. Provision, however, has been made for both rotatory and translational motions of the sun's image in immediate obedience to the desires of an observer watching the slit through a small telescope, and strong hopes are entertained of a successful issue. The second problem is the photography, with the same dispersion, of the Fraunhofer spectrum at the limb of the sun just before and after totality, in order to obtain precise wave-lengths of the limb-light free from atmospherically diffused disc-light, which is unavoidable during full sunshine.

The intense interest which the eclipse is arousing in America is evidenced by an extensive series of bulletins issued by Science Service, of Washington, D.C. They are divided into two parts: first, information on the nature of eclipses in general, their history, and methods of predicting them; secondly, the arrangements on the present occasion, the locations and plans of the various parties. Thus we note that this will be the ninth totality observed by Dr. S. A. Mitchell, of Leander McCormick Observatory, who will use at Magog the large concave gratings that he used at Tin Can Island in 1930 to study the height of different gases in the solar atmosphere. The Franklin Institute will photograph the corona with a camera 85 feet long, recalling the long refracting telescopes of pre-achromatic days. The Georgetown party, under Dr. P. A. McNally, *S.J.*, will take photographs to measure the Einstein shift of stars; the star-field is not, however, very suitable, and totality is rather short for the purpose; the party will also investigate the infra-red spectrum of the corona. The astronomical artist, Mr. H. R. Butler, has made long journeys to paint total eclipses, but on this occasion he will enjoy 93 seconds of totality at his own home. Mount Washington, which is 6288 feet high and the highest point in the path of totality, will be occupied by a Science Service party, who will endeavour to take photographs of the approach and recession of the moon's shadow on the ground, in addition to eclipse photographs. Astronomical motion-pictures have been a special feature of the Observatory at Lake Angelus, Michigan; a party from it will expose motion films during totality.

The U.S. Naval Observatory will broadcast special time signals from 1.55 to 2.0 P.M. and from 3.55 to 4.0 P.M. Eastern Standard Time on Aug. 31, and the progress of the eclipse will be described by wireless to those outside the track.

The effect of the eclipse on radio observations is to be investigated. The distinction between the optical eclipse and the eclipse of the corpuscular stream was discussed by Profs. S. Chapman and E. V. Appleton in a letter in NATURE of May 21, p. 757. The French and Dutch Polar Year parties will be near the centre line of the optical eclipse, and will make special observations on layer heights. The British party at Tromsö will be near the sunset limit, as will stations in south-east England. The Tromsö workers will, however, measure the densities of ionisation at the time of the eclipse, with control observations on adjacent days, and corresponding measurements will be made at King's College, London, the Radio Research Station, Slough, and at the Cavendish Laboratory, Cambridge. Special observations on trans-Atlantic signals will be made at Slough and at Post Office stations, with special regard to the fact that the particle eclipse may be total over nearly the whole width of the Atlantic at once.

Parties from the U.S. Bureau of Standards, Washington, under the direction of Dr. J. H. Dellinger, will record eclipse effects on the field strengths of radio waves and on the heights of the ionised layers.

Through the Associate Committee on Radio Research of the National Research Council of Canada, three Canadian parties will also undertake radio observations. An effort is to be made to investigate the variations of the Heaviside layers during the passage of the shadow, and to test the theory advanced by Prof. S. Chapman, that the Appleton layer is ionised by ultra-violet light and the Kennelly-Heaviside layer by a stream of corpuscles or of neutral particles.

One party, under the direction of Lieut.-Col. Steel and Dr. Rose, of the National Research Laboratories, Ottawa, is to investigate the upper layer from a point in Kingston, Ontario. Another party, under the direction of Prof. A. S. Eve, of McGill University, and consisting of Messrs. Ross and Stadler, is proceeding to Corner Brook, Newfoundland, to study the 'corpuscular eclipse', which it is calculated will take place to the east of the optical shadow band. A third party, under the same direction and consisting of Messrs. Henderson and Smythe, is proceeding to Vankleek Hill, south-west of the Ottawa River and below the city of Ottawa, to take observations on the Kennelly-Heaviside layer, with the object of determining the ultra-violet light effect. Both Vankleek Hill and Kingston are to the west of the optical shadow band on the surface of the earth.

The Canadian Marconi Company and Northern Electric Company are co-operating with the National Research Council in these investigations. The former will take continuous field strength measurements in the short-wave band, while the latter will take similar measurements at broadcast frequencies. The results of their measurements will check the information obtained by the other parties.

During the eclipse, Messrs. Laurence and Howlett of the National Research Laboratories hope to investigate the origin and appearance of shadow bands.

The Deterioration of Paper on Ageing

THE problem of the permanence of paper is one which is of particular interest to scientific workers. The rapid increase in the volume of scientific publications is causing grave concern to all learned societies, and these are exerting their financial resources to the utmost in order to keep in pace with it. It is unfortunate that in many cases the printing quality and the appearance and feel of a paper have been the principal factors which have influenced those choosing it, but as these qualities do not necessarily go hand in hand with permanence, future generations of members may find that the efforts of their predecessors have been wasted.

The problem is one of recent origin, for it is only since 1860, 1870, and 1880 respectively that esparto grass, mechanical wood pulp, and chemical wood pulp have been used in paper-making. Prior to 1860, rags (that is, cotton, flax, and hemp) were the usual raw materials, and although excessive loading, bleaching, or alum may shorten the life of rag papers, they are generally recognised as being the most permanent. This fact was, indeed, recognised so far back as 1898 in a Report to the Royal Society of Arts, in which it was stated that esparto and straw papers are more permanent than mechanical pulp papers, but less permanent than chemical pulp papers. It was therefore specified that permanent book papers should contain less than ten per cent of loading and not less than seventy per cent of rag.

Subsequent work in the United States and in Germany has modified the inferences drawn from this Report, since it has been shown that the method of manufacture of the paper and the conditions of storage are equal in importance to the nature of the fibre in determining how long the paper will last. Bulletin No. 2795 (1912) of the American Newspaper Publishers' Association, for example, points out that excessive dryness (resulting from the artificial heating of libraries) and excessive dampness may alter the normal moisture content of the paper, and so stimulate its deterioration. Cases are on record in which a badly-made rag paper had undergone rapid deterioration, whilst at the other extreme hand-made mechanical wood-pulp has been stored under proper conditions for a hundred years and still shows no sign of ageing.

A Committee of the League of Nations also pronounced in favour of unbleached rag papers in 1928, and quite recently the investigation has been taken up by the Bureau of Standards in the United States (*Miscellaneous Publication* No. 128, *Research Papers* Nos. 349 and 352). Not only have opinions been expressed as to storage conditions, but in addition, what appears at first sight to be a revolutionary recommendation is made, namely, that the paper may be prepared from any fibres except those of unbleached or mechanical wood-pulps. The great difficulty in arriving at trustworthy results is due, of course, to the impossibility of carrying out tests under the conditions of practice. Not only would this take too long, but it must also be remembered that the earliest commercial papers made from wood or esparto are not more than seventy-five years old, and, moreover, that the extensive improvements in manufacturing methods in the meantime have resulted in a corresponding improvement in the paper of to-day. The Bureau of Standards and others have therefore had to resort to accelerated ageing tests, the actual technique of which varies from one investigator to another and may involve heating for seventy-two hours at 40° to 100° C., with or without exposure to sunlight or ultra-violet rays.

B. L. Wehmhoff, who as technical director of the Government Printing Office at Washington must be regarded as an authority on such matters, has recently devoted some attention to them in a paper before the Technical Section of the Pulp and Paper Industry (*Proceedings*, **94**, 57; 1932). The paper is of value not so much as an account of original work, but because the author has collected the personal opinions of a number of paper experts all over the world on the value of accelerated ageing tests.

The opinions differ widely, but there seems to be general agreement that a temperature of 100° C. corresponds with rather drastic treatment, and, moreover, that the type of deterioration produced by heat and light is not necessarily the same as that which occurs on storage. Opinions also differ as to the value of chemical tests as a means of determining the permanence of paper. This applies particularly to the α-cellulose value, for all agree that the copper number, rosin content, and acidity (or *p*H value) should be as low as possible. The effects of traces of impurities also require investigation; for example, there is reason to believe that ferrous iron accelerates the deteriorating influence of rosin.

It is not surprising that specifications for the same type of paper proposed by different bodies are by no means identical. A Report on the subject to H.M. Stationery Office is a cautious and balanced statement of the available facts, and few responsible for the purchase of paper will disagree with the opinions expressed. The Report states that there is no evidence that papers made from esparto or chemical wood deteriorate if stored under proper conditions. At the same time, new, clean, white or unbleached rags are preferable for the best papers, and whenever it is a question of choosing between esparto and chemical wood, the former should be rejected. J. G.

Early Man in Algeria

IN the course of a recent note on dental mutilation (see NATURE, Aug. 20, p. 268) reference was made to its occurrence in fossil human remains from Afalou-bou-Rhummel. A communication presented to the first International Congress of Prehistoric and Protohistoric Sciences by MM. Marcellin Boule and Henri Vallois, on "The Fossil Men of Afalou-bou-Rhummel (Algeria)", was welcomed as an authoritative statement on "a new type of fossil man" from North Africa. Prehistoric human skeletal remains have been discovered in North Africa on several occasions, but unfortunately most of them—from the shell-heaps of Tunisia and near Constantine as well from certain Algerian caves—cannot be dated with certainty. The type of Afalou agrees with the type already discovered in Algeria, but the deposits in which previous discoveries have been made are usually regarded as of neolithic age.

The human remains studied in the communication by MM. Boule and Vallois belong to at least fifty individuals; and although they were scattered, nine skeletons have been reconstructed. The cave in which they were found is known by the name of Afalou-bou-Rhummel, and is situated on the Algerian littoral in the commune of Oued Marsa. The cave was excavated in 1928 and 1929 by M. Arambourg with the financial assistance of the Institut de Paléontologie humaine. Both stratigraphical and archæo-

logical evidence point to the dating of the remains as definitely Pleistocene and their cultural horizon as Upper Palæolithic.

The remains are homogeneous in character. The skull is pentagonal, about equal numbers being mesaticephalic or dolichocephalic, and a small number brachycephalic. It is moderately high. Sometimes the occiput tends to be chignon-shaped. The forehead is receding and the supra-orbital arches are united in a well-developed prominence at the glabella. Almost all the skulls have a brutal aspect. The face is short and broad; the nose platyrrhine or, at times, mesorrhine. The orbits are low. There is no prognathism. The bones of the skeleton as a whole are very robust, the muscular attachments strongly marked. Stature is below the mean. Sometimes the upper incisors had been knocked out early in life.

Similar skulls have been obtained from the shell-heap of Mechta el-Arbi near Constantine, notably by MM. Debruge and Florance in 1913, and others have been discovered since that date in excavations by M. Debruge.*

The type of Afalou is new. It bears no resemblance to Neanderthal man or to the Mediterranean or negro types of modern times. It differs from Cro-Magnon and, markedly, from Asselar man (see NATURE, Aug. 20, p. 280) notwithstanding the common cultural feature it shares with the latter in the practice of evulsion of the upper incisors. It is, therefore, proposed that the type should be known as the Mechta race, from the site on which it was first found; and it is to be regarded as associated with the Capsian culture.

* Sir Arthur Keith refers to four skeletons excavated from the kitchen-midden at Mechta el-Arbi by Mr. Alonzo W. Pond in 1927 and described by Dr. Fay-Cooper Cole. Sir Arthur accepts the attribution of the site to the Capsian culture. *See* "New Discoveries relating to the Antiquity of Man", London, 1931, pp. 213-214.

University and Educational Intelligence

LONDON.—The following degrees have been conferred: D.Sc. in anatomy on Solly Zuckerman (University College) for a thesis entitled "The Menstrual Cycle of the Primates"; D.Sc. in biochemistry on Margaret A. C. Fixsen (Lister Institute of Preventive Medicine) for a thesis entitled "The Effect of Desiccation on the Nutritive Properties of Egg-white"; D.Sc. in zoology on Norman J. Berrill (University College) for a thesis entitled "Studies in Tunicate Development, Part II. Abbreviation of Development in the Molgulidæ" (*Phil. Trans.*, B, vol. 219); D.Sc. (Engineering) on Charles Edward Larard (Northampton Polytechnic Institute) for published papers on experimental and mathematical investigation dealing with the viscous and elastic straining of ductile material, together with their original work; D.Sc. in metallurgical chemistry on Frank Adcock (private study) for thirteen independent published works, together with two subsidiary contributions; D.Sc. (Engineering) on George A. Tomlinson (private study) for fifteen published papers on (1) atomic forces and cohesion, (2) applications of metrology to engineering problems, together with three subsidiary contributions.

The London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, has issued a pamphlet detailing the post-graduate courses of instruction in preventive medicine given at the School. These comprise courses of study for the diplomas in public health and in tropical medicine and hygiene, and an advanced course of study for the diploma in bacteriology. A brief synopsis of the course is included in each case.

READING.—The Board of the National Institute for Research in Dairying, University of Reading, has appointed Prof. H. D. Kay to be director of the Institute in succession to the late Dr. R. Stenhouse Williams. Prof. Kay, who is at present professor of biochemistry in the University of Toronto, was born in 1893 and educated at Manchester Grammar School and the University of Manchester. He had a varied experience in the conduct and direction of research work in Great Britain before proceeding to Toronto in 1929. The majority of Prof. Kay's many publications deal with oxidation in the animal body, chemistry of bacterial activity, enzymes, chemistry of milk, chemistry of phosphorus compounds in their relationship to living processes, vitamin D, egg proteins, and the biological significance of phosphorus. Prof. Kay hopes to take up his duties at the Institute towards the end of the present year.

Calendar of Geographical Exploration

Aug. 31, 1873.—Franz Josef Land

Julius Payer discovered this arctic archipelago. An Austrian polar expedition had been prepared by Count Wilczek, and Payer and Weyprecht in the *Tegetthof* set out in 1872. While the ship was beset by ice, high land was seen to the north-west and later in the season Payer led expeditions to Hochstetter and Wilczek Islands. After a second winter in the ice-bound ship, a difficult journey northwards to Cape Fligely, 82° 5′ N. (Rudolf Land), was made. This remained the highest northern latitude reached until 1859. Mountain ranges indicating land beyond the eighty-third parallel were seen. B. Leigh Smith in 1881–82 explored the whole southern coast from 42° to 54° E., discovering many islands and sounds. In 1894, Alfred Harmsworth fitted out an expedition in the *Windward* under F. G. Jackson, with the object of establishing a base in Franz Josef Land for an attempt on the north pole. In 1896 the Harmsworth-Jackson expedition reached Cape Richthofen and saw a great sea to the north. Nansen, on his southward journey, approached Franz Josef Land from the north-east, finally proving the existence of a deep sea basin to the north. Nansen wintered near Cape Jackson, Flora Island, a few miles from the point which Jackson had reached in 1895. On June 17, 1896, Nansen and Jackson met and the *Windward* brought Nansen home. The archipelago was further explored and used as a base for expeditions to the pole between 1897 and 1913.

Sept. 1, 1513.—Discovery of the Pacific

Vasco Nuñez de Balboa set out with a hundred Spaniards, among whom was Pizarro, and a thousand natives to cross the Isthmus of Panama. While in the town of Santa Maria de la Antigua del Darien, which he and Enciso had founded, he heard, from a native, accounts of the ocean beyond the mountains and of the gold of Peru. On Sept. 25 or 26, he reached the summit of the mountains and viewed the Pacific. Pizarro and two others had gone on in front, and one, Alonzo Martin, was the first European to embark on the newly found ocean, in St. Michael's Bay. On Sept. 29, Balboa reached the shore and took possession of the 'Great South Sea' for the Spanish monarch. He visited the Pearl Islands, once more heard of the gold of Peru, and returned in triumph to Darien in January 1514. He is said to have revisited the Pacific many times. He captured the Pearl Islands and prepared to conquer Peru, but through the jealousy of another official he was executed in 1517.

Sept. 1, 1736.—Westward from the Lena Delta

A Russian, Lieut. Prontschischev, reached 77° 29′ N. in the neighbourhood of Cape Chelyushkin. The Russian Government had sent an expedition under his command, which started from Yakutsk, 900 miles from the mouth of the Lena, in 1735. After sailing down the Lena and round its delta, he reached the mouth of the Olonek River and wintered in some fur-hunters' tents. The ice broke up in Olonek Bay on Aug. 15, 1736, and Prontschischev proceeded north-west, almost reaching the most northerly point on the coast. He was driven back by ice, but died of scurvy before the vessel reached the mouth of the Olonek River on Sept. 15; his young wife, who had accompanied him, also died of scurvy.

Sept. 3, 1835.—The Russian Polar Seas

Pachtussov reached Archangel after his second polar voyage, and shortly afterwards died from fatigue. His two expeditions were remarkable for the prudence and forethought which he displayed, the care which he showed for the health of his men, and notably for the wealth of astronomical, geodetical, meteorological, and tidal observations which he made. On his first journey, when wintering in southern Novaya Zemlya, in lat. 70° 36′ N., long. 59° 32′ E., meteorological observations were taken every second hour. Pachtussov was sent out in 1832 by citizens of Archangel to re-establish the sea-route to the Yenisei, to survey the east coast of Novaya Zemlya, and to hunt walrus in the latter place. On his first voyage he surveyed the east coast of Novaya Zemlya, and on his second Matotschkin Sound and the east coast of North Island, though his attempt to circumnavigate the latter failed. His second winter was spent on the south side of Matotschkin Sound, at the mouth of the River Tschirakina. Here he found the wreck of the vessel which Rossmuislov had been obliged to leave there in 1769 when he was on a voyage of exploration in Novaya Zemlya. The timber from the vessel was used by Pachtussov for building his winter house.

Societies and Academies

EDINBURGH

Royal Society, July 4.—**Eustace Barton-Wright** and **Alan McBain**: Studies in the physiology of the virus diseases of the potato. A comparison between the carbohydrate metabolism of normal and leaf-roll potatoes. An investigation into the formation of carbohydrates in healthy and leaf-roll potatoes at different times in the growing season. The nature of the translocatory sugars in healthy and diseased plants is also described and discussed.—**J. M. Robson**: Adrenaline and the œstrous cycle in the mouse. The subcutaneous injection of adrenaline hydrochloride into mature female mice inhibits the occurrence of œstrus; adrenaline also inhibits the development of sexual maturity when administered to immature female animals for prolonged periods. Vaginal cornification does not occur, and the growth of the vagina, uterus, and ovaries is less than in control animals. Evidence is presented suggesting that the action of the drug is not toxic in nature. Adrenaline does not interfere with the action of the α-hormone (œstrin) on the uterus and vagina. It does, however, interfere with the reactivity of the ovary to gonadotropic hormones (prepared from pregnancy urine).—**George Trapp**: The foliar endodermis of the Plantaginaceæ. The foliar endodermis is characteristic of the Plantaginaceæ. The Caspary strip is impervious to acid and basic dyes and probably also to water. The coincidence of mesophyll staining with endodermal absence or incompleteness in leaves of *P. arborescens* establishes this for acid dyes, while differential staining of Caspary strip region points to impermeability for basic dyes. Such a property is of value in the elaboration of root pressure. The aerial environment of the shoot reverses the direction of flow of solutes and renders functional interpretation impossible. The foliar endodermis is a feature of evolutionary inertia rather than of physiological necessity.—**A. G. Walker**: Relative co-ordinates. The elementary treatment of moving axes is extended to a general Riemannian space, a system of reference being defined at each point of a given curve. The elementary formulæ are generalised, and it is shown how the relative co-ordinates can be applied to a consideration of the geometry of the space in the neighbourhood of any given curve. As an example of application, the co-ordinates are used to discuss the kinematics of a rigid body in general relativity, the world line of one of the particles of the body being taken as the curve of reference. They also provide the formulæ used by Thomsen in his work on rigid dynamics.—**John E. Mackenzie** and **Harry W. Melville**: The diffusion coefficients of bromine-hydrogen, bromine-nitrogen, bromine-oxygen, and bromine-carbon dioxide. The diffusion coefficients were measured by visual observation of the progress of diffusion of the highly coloured bromine vapour into a colourless gas contained in a long glass tube. The results obtained agree closely with those calculated from the theory of diffusion.

PARIS

Academy of Sciences, July 11 (vol. 195, pp. 85-192).—**Emmanuel Leclainche**: Notice on Bernhard Bang, *correspondant* for the Section of Rural Economy.—**Henri Lebesgue**: Notice on René Louis Baire, *correspondant* for the Section of Geometry.—**Maurice de Broglie** and **Louis Leprince-Ringuet**: The neutrons of boron excited by radium emanation. Whilst the rays from boron are absorbed at least as much by lead as by other bodies of equal thickness, the neutrons from boron pass much more easily through lead than through paraffin, the effect of 5 cm. of lead being scarcely perceptible.—**Léon Guillet**, **Marcel Ballay**, and **A. Le Thomas**: The influence of silicon on copper-nickel alloys containing small proportions of tin. Studies of a series of alloys with a fixed proportion of tin and increasing percentages of silicon, with special reference to the effect on the hardness at high temperatures.—**C. de La Vallée Poussin**: The properties of harmonic functions of two variables in an open area limited by particular lines.—**P. Vayssière**: Experimental observations on *Schistocerca gregaria*.—**Georges Giraud**: Certain operations on partial differentials of the parabolic type.—**A. Witt**: The stability of quasi-periodic movements.—**A. Lokchine**: The stability of a tube with curved axis.—**René Marty**: The calculation of helical springs loaded transversely.—**Emile Merlin**: The attraction between an ellipsoid and an external point.—**Sylvain Arend**: The normal anomaly and its rôle in two common astronomical applications.—**Y. Rocard**: The absorption of sound in tubes and acoustic mouthpieces. The nature of the wall of a tube through which sound is being propagated may cause loss through absorption. A modification of the classical equation (Lord Rayleigh, Webster) is suggested.—**Eligio Perucca**: The electrometer with semicircular sectors. This type of instrument is generally credited to Blondlot and Curie: it is pointed out that Morelli gave a complete theory of this instrument and described its practical realisation almost simultaneously with Blondlot and Curie.—**M. Pauthenier** and **R. Guillien**: The direct electrometric study of the limit charge of a conducting sphere in an ionised electrical field.—

Henri Abraham: The phenomena of synchronisation. A discussion of the conditions necessary for a wireless receiving apparatus to be in exact tune with the waves received.—**Pierre Girard** and **P. Abadie**: Experimental researches on the dispersion of polar liquids in the Hertzian field.—**P. Biquard** and **R. Lucas**: New optical properties of solids and liquids submitted to the action of ultra-sound waves.—**I. I. Agarbiceanu**: The intensities in the fluorescence spectrum of I_2.—**Joseph Giuntini**: α-Methoxy-β-hydroxysuccinic acid, its complex compounds with copper and their circular dichroism.—**B. Bogitch**: The separation of lead from zinc by the electrothermal method. For certain iron ores rich in lead and zinc the flotation method fails. Experiments with an electric furnace have given promising results.—**M. Bourguel, Mlle. B. Grédy**, and **L. Piaux**: Study of the *cis-trans* isomerism in the case of ethylene hydrocarbons of the formula $CH_3-CH=CH-R$. The eight hydrocarbons prepared have been studied from the point of view of the Raman spectrum.—**M. Haïssinsky**: The complex nature of the polonium ions.—**A. Lalande**: The turbidity surface of the system water-alcohol-ether at a low temperature.—**Georges Arditti**: The autoxidation of paraffin oil. A study of the amounts of fatty acids produced at a fixed temperature (130° C.) in the presence of various catalysts (Cu, Ni, CuO, NiO, Fe_2O_3).—**A. Travers** and **J. Aubert**: The variations of potential of electrolytic iron with the *p*H of the medium.—**Jean Cournot** and **Jean Challansonnet**: The action of molybdenum on the mechanical properties of grey cast iron. The mechanical properties of cast iron can be improved by the addition of molybdenum.—**Henri Fournier**: Attempts at stamping by the method of Siebel and Pomp.—**Francois Reymond** and **Tcheng Da-Tchang**: The reaction of precipitation by ammonia of the hydrofluoric acid solution of protactinium and of tantalum.—**A. Machebœuf, H. Cheftel**, and **J. Blass**: The colorimetric estimation of small quantities of lead introduced into food. The method outlined is suitable for determining quantities of lead between 0·15 mgm. and 0·25 mgm. to about 0·01 mgm.—**Jean Calvet**: The separation and determination of copper in the presence of aluminium by 8-hydroxyquinoline. Application to aluminium alloys.—**J. Guéron**: The slow hydrolysis of zinc acetate.—**Emilio Damour** and **Alexandre Nadel**: The diminution of the amount of iron in glass decolorised by selenium. In the decoloration of glass by selenium in presence of sodium chloride there is a partial volatilisation of the iron.—**R. Quelet**: The preparation of a chlormethyl derivative of *p*-bromanisol.—**Georges Corroy**: The Rhetian and the Hettangian in the east of the Paris basin.—**Fernand Daguin**: Stratigraphical observations on the region of Tissa (western Morocco).—**Edmond Saurin**: The Angaras to the east of southern Indo-China.—**J. Lombard** and **D. Schneegans**: The presence of the marine Eocene at Fouta (French Equatorial Africa).—**Paul Becquerel**: The dehiscence of the anther of the white lily.—**Antoine de Cugnac**: A new argument in favour of the hypothesis of a hybrid origin for *Bromus Gussonii*.—**André Dauphiné**: The properties of imbibition of collenchyma.—**Taboury**: The accidental presence of selenium in certain plants. It was shown in 1909 that selenium was present in the mineral springs at La Roche-Posay: selenium has now been found in *Sium latifolium* and in *Scrofularia aquatica* growing in the neighbourhood of these springs.—**Emile André** and **Kiawo Hou**: The lipoxydases of the seeds of *Glycine soja* and of *Phaseolus vulgaris*.—**Marc de Larambergue**: The absence of copulating apparatus in certain individuals of *Bullinus contortus*.—**Y. Le Grand**: The acuteness of the sense for variations of convergence.—**Neda Marinesco**: The influence of an artificial electric atmosphere on the ascent of the sap. An experimental proof of the effect of an electric field on the flow of sap in the stem of a plant.—**R. Sutra**: Study of the celluloses of *Acetobacter xylinum* and of the Tunicata. These celluloses appear to be identical with cotton cellulose: chitin cannot be considered as forming part of the membrane.—**E. Aubel** and **W. S. Reich**: The synthetic preparation of the phosphoryl derivatives of the amino-acids.—**A. Oudin**: The considerable variations shown by different trees of the maritime pine, *Pinus pinaster*, in the rotatory power of the turpentine, and the relative stability of the rotatory power of the turpentine from a given tree.—**Constantino Gorini**: The coagulation of milk by *B. typhosus* and by other bacteria considered as inactive towards milk.—**Pierre Lépine**: The sensibility of the spermophile to exanthematic typhus.

CRACOW

Polish Academy of Science and Letters, April 11.—**K. Borsuk**: The isomorphism of functional spaces.—**W. J. Webber**: Certain properties of trigonometrical series presenting lacunæ. Note concerning a memoir of S. Banach.—**A. Jagielski**: The specific inductive capacity of liquid iodine. The S.I.C. of liquid iodine at 118° C. is 11·08, and increases with the temperature to 13 at 168° C.—**Wlad. Gorczyński**: A simple spectrograph and measurements of the absorption bands in the infra-red made in northern Africa in 1926–27.—**Wlad. Gorczyński** and **Ed. Stenz**: Atmospheric transmission in the ρ and Φ absorption bands of water vapour according to the spectrographic records of the solar spectrum made in Tunis in 1926–27.—**Ed. Stenz**: The absorption of water vapour in the solar infra-red, from spectrographic measurements made on the coast of the Mediterranean in 1931–32.—**Z. Kamecki**: Observations on the behaviour of the larvæ of Chrysopidæ and their faculty of finding their way by means of the senses.—**St. Skowron** and **T. Pawlas**: Observations concerning the action exerted by gonacrine on eggs and on the embryos of the rabbit.

VIENNA

Academy of Sciences, March 3.—**Gerhard Kirsch** and **Fritz Rieder**: Resonance of the beryllium nucleus. It has been recently shown by Curie and Joliot that the highly penetrating secondary radiation liberated from beryllium and boron by α-rays is able to set free, in substances containing hydrogen, a tertiary (H) radiation. The results of investigations on the tertiary radiation from various elements and of a consideration of the energy balance have led Chadwick to the conclusion that the penetrating secondary radiation is probably composed of neutrons of mass 1 and is not an electromagnetic wave radiation, as assumed by Curie and Joliot. Results are now given of experiments on the excitation of the secondary radiation in beryllium in relation to the energy of the exciting α-radiation, the tertiary H-radiation from hydrogen serving as indicator. These results appear to indicate the existence of resonance positions of the beryllium corresponding with residual ranges of the α-particles of 37 mm., 27 mm., and 15 mm. The assumption that the secondary radiation from beryllium comprises several components of varying hardness would furnish an explanation of the disagreement between absorption coefficient and maximum range of the tertiary protons noted by Curie and Joliot. The number of tertiary protons is extraordinarily high; if uniform distribution in space of the beryllium secondary radiation is assumed, the product of the efficiencies of the secondary and tertiary excitation process becomes about 3×10^{-8} for the resonance position corresponding to the 27 mm. range.

Forthcoming Events

Congresses

AUG. 30–Sept. 23

INSTITUT INTERNATIONAL DE DOCUMENTATION (Eleventh Conference). To be held at Frankfort-on-Main.

AUG. 31–Sept. 7

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (YORK MEETING).

Wednesday, Aug. 31.

At 8.30 P.M. (at the Exhibition Hall).—Sir Alfred Ewing: "An Engineer's Outlook" (Presidential Address in the Exhibition Hall).

Thursday, Sept. 1.

At 10 A.M.—Dr. W. H. Mills: "Some Aspects of Stereochemistry" (Presidential Address to Section B).

The Right Hon. Lord Rothschild: "The Pioneer Work of the Systematist" (Presidential Address to Section D).

Prof. H. J. Fleure: "The Geographical Study of Society and World Problems" (Presidential Address to Section E).

Mr. T. B. Ponsonby: "A System of Forestry for the British Isles" (Chairman's Address to the Department of Forestry (K*) of Section K).

Prof. R. G. White: "Sheep Farming, a Distinctive Feature of British Agriculture" (Presidential Address to Section M).

At 2 P.M.—Lieut.-Col. Sir David Prain: "The Conservation of Wild Life" (Presidential Address to the Conference of Delegates of Corresponding Societies).

Friday, Sept. 2.

At 10 A.M.—Prof. A. O. Rankine: "Some Aspects of Applied Geophysics" (Presidential Address to Section A).

Prof. R. B. Forrester: "Britain's Access to Overseas Markets" (Presidential Address to Section F).

Prof. Miles Walker: "The Call to the Engineer and Scientist" (Presidential Address to Section G).

Dr. D. Randall-MacIver: "The Place of Archæology as a Science, and some Practical Problems in its Development" (Presidential Address to Section H).

Mr. W. M. Heller: "The Advancement of Science in Schools: its Magnitude, Direction and Sense" (Presidential Address to Section L).

At 8 P.M.—Sir Arthur W. Hill: "Plant Products of the Empire in Relation to Human Needs" (Evening Discourse in the Co-operative Hall).

Monday, Sept. 5.

At 10 A.M.—Prof. P. G. H. Boswell: "The Contacts of Geology: the Ice Age and Early Man in Britain" (Presidential Address to Section C).

Prof. Beatrice Edgell: "Current Constructive Theories in Psychology" (Presidential Address to Section J).

Prof. J. H. Priestley: "The Growing Tree" (Presidential Address to Section K).

At 5.30 P.M.—Mr. H. E. Wimperis: "Speed in Flight" (Public Lecture in the Co-operative Hall).

At 8 P.M.—Sir Richard Gregory, Sir Harold B. Hartley, Mr. Donald Gray, Dr. W. W. Vaughan, Prof. W. W. Watts, Mr. W. M. Heller: Discussion on "The Place of Science in the Education of Boys and Girls up to Sixteen Years of Age".

Tuesday, Sept. 6.

At 8 P.M.—Mr. C. C. Paterson: "Uses of the Photo-electric Cell" (Evening Discourse in the Co-operative Hall).

Official Publications Received

BRITISH

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1377 (T. 3025): Applica on of Goldstein's Airscrew Theory to Design. By C. N. H. Lock. Pp. 24+4 plates. (London: H.M. Stationery Office.) 1s. 3d. net.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1931 May 19—1932 May 18. Pp. 4. (Cambridge.)

Publications of the Dominion Observatory, Ottawa. Vol. 10: Bibliography of Seismology. No. 13: January, February, March 1932. By Ernest A. Hodgson. Pp. 211-224. (Ottawa: F. A. Acland.) 25 cents.

The Journal of the Institute of Metals. Vol. 48. Edited by G. Shaw Scott. Pp. xi+350+33 plates. (London: Institute of Metals.) 31s. 6d. net.

Indian Journal of Physics, Vol. 7, Part 2, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 16, Part 2. Conducted by Sir C. V. Raman. Pp. 107-164. (Calcutta.) 1.8 rupees; 2s.

Mysore Geological Department. Bulletin No. 12: Mineral Survey of the Sulphide Zone near Chitaldrug. By B. Rama Rao. Pp. iv+40+8 plates. (Bangalore: Government Press.) 1 rupee.

India: Meteorological Department. Meteorological Organisation in India for the Supply of Weather Information to Aviators. Pp. iii+27. 12 annas; 1s. 3d. Scientific Notes, Vol. 4, No. 41: The Sea-Breeze at Karachi. By Dr. L. A. Ramdas. Pp. ii+115-124+10 plates. 1.8 rupees; 2s. 6d. (Calcutta: Government of India Central Publication Branch.)

Proceedings of the South London Entomological and Natural History Society, 1931-1932. Pp. xx+116+11 plates. (London.) 12s. 6d.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1931. Pp. 23. (Hong Kong.)

Annual Report of the Auckland Institute and Museum for 1931-32, adopted at the Annual General Meeting held on 25th May 1932. Pp. 51. (Auckland, N.Z.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 5 (New Series), No. 6, June. Abstracts Nos. 984-1178. Pp. 177-214. (London: H.M. Stationery Office.) 1s. net.

Annals of the Solar Physics Observatory, Cambridge. Vol. 2, Part 2: Stellar Hydrogen Line Contours and their Variation with Temperature and Surface Gravity. By E. G. Williams, under the direction of F. J. M. Stratton. Pp. 19-47+plate 4. (Cambridge: At the University Press.)

Royal Agricultural College Students' Gazette. New Series, Vol. 19, Part 1. Pp. 134. (Cirencester.) 1s.

Proceedings of the Society for Psychical Research. Part 126, Vol. 41, July. Pp. 59. (London: Society for Psychical Research.) 4s.

The Sir John Cass Technical Institute. Report of the Governing Body for the Session 1930-1931. Pp. 31. (London.)

Proceedings of the Cambridge Philosophical Society. Vol. 28, Part 3, 30 July. Pp. 257-402. (Cambridge: At the University Press.) 7s. 6d. net.

London School of Hygiene and Tropical Medicine (University of London). Post-Graduate Instruction in Preventive Medicine. Pp. 32. (London.)

University of Birmingham: Executive Board of Mining Research. Report on the Work of the Mining Research Laboratory during the Year 1931. Pp. 20. (Birmingham.)

FOREIGN

Smithsonian Institution: Bureau of American Ethnology. Bulletin 94: Tobacco among the Karuk Indians of California. By John P. Harrington. Pp. xxxvi+284+36 plates. 80 cents. Bulletin 102: Menominee Music. By Frances Densmore. Pp. xxii+230+27 plates. 80 cents. Bulletin 104: A Survey of Prehistoric Sites in the Region of Flagstaff, Arizona. By Harold S. Cotton. Pp. vii+69+10 plates. 30 cents. (Washington, D.C.: Government Printing Office.)

Instituto Geográfico, Catastral y de Estadística. Anuario del Observatorio Astronómico de Madrid para 1932. Pp. 540. (Madrid.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 370-372: X-Ray Diffractions by Volcanic Glasses and Ashes, by Morisô Hirata; Hyperfine Structure of Lead Spectrum, II, by Kiyoshi Murakawa; Photoelectric Effect of L_{II}- and L_{III}-Electrons for γ-Rays, by Toshinosuke Muto. Pp. 237-298. (Tôkyô: Iwanami Shoten.) 65 sen.

Annuario della Reale Accademia d' Italia. III, 1930-1931, Anno 9. Pp. 364. (Roma.)

National Research Council. Transactions of the American Geophysical Union, Thirteenth Annual Meeting, April 28 and 29, 1932, Washington, D.C. Pp. 401. (Washington, D.C.: National Academy of Sciences.)

Société des Nations: League of Nations. Index translationum: Répertoire International des Traductions: International Bibliography of Translations. No. 1, Juillet. Pp. 58. (Paris: Institut International de Coopération Intellectuelle.) 7.50 francs.

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 28, Part 2: The American Species of Thibaudieae. By Albert C. Smith. Pp. vii+311-547+ix-xiii+19 plates. (Washington, D.C.: Government Printing Office.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 6, June, Research Papers Nos. 446-452. Pp. 669-811. (Washington, D.C.: Government Printing Office.)

Proceedings of the American Philosophical Society. Vol. 71, No. 4. Pp. 135-223. (Philadelphia.)

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 11, No. 4, June 30th. Pp. 359-439. (Tokyo: Maruzen Co., Ltd.) 1.20 yen.

Tanganyika Territory: Geological Survey Department. Bulletin No. 3: Lupa Goldfield. By Dr. D. R. Grantham. Pp. ii+34. (Dar es Salaam: Government Printer.) 5s.

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