NATURE

SATURDAY, JULY 24, 1926.

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Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

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

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

NO. 2960, VOL. 118]

Truth and Tradition.

A CURIOUS change is apparent in contemporary thought. The scientific revolution, with its subversive principle of relativity and its paradoxical quantum theory, invaded the calm and secluded groves of philosophy and caused a strange disturbance. The positivity of science, at least in the form which it had assumed in the nineteenth century, seeme to disappear; accepted principles and methods suddenly became suspect; old controversies lost their meaning; new worlds were being discovered. The reception of the new mathematical relativity by philosophers was at first decidedly hostile. An attitude of incredulity was followed by amazement and dismay. When the results of the eclipse observations of May 1919 were made known, and the principle of relativity, which had been formulated fourteen years before by Einstein, was found to be actually verified and confirmed, the interest was no longer confined to academic circles; popular expositions in journals and scientific manuals flooded the book market and every one was eager to be informed. A few mathematicians and many philosophers thought the whole excitement would prove to be a nine days' wonder and hoped, somewhat impatiently, that all would be explained away and that physics would again free itself from metaphysics. The principle of relativity has not been explained away; on the contrary, in an almost incredibly rapid time, it has established itself as orthodoxy. A revolution in ideas which a few centuries ago would have occupied generations now seems to take place between night and morning and while we sleep. At the beginning of the sixteenth century it was discovered by intrepid navigators that our earth is a sphere. It was not until past the middle of that century that a daring thinker suggested that the earth moves, and it was not until a century later than that, and after bitter persecution, that the revolution of ideas which it implied was accomplished.

The extraordinary thing in the present world of ideas is not the scientific revolution, but the fact that it is accepted and that no one expects it to be upset. This does not mean that the spirit of scientific inquiry has ceased its quest and is resting satisfied with its discovery. It does mean that whatever new revolutions are in the future, there is no return to the old ideas. It is the recognition of this fact which is eloquently and forcibly expressed in the two lectures before us—The Fison Memorial Lecture at Guy's Hospital delivered by Dean Inge on March 25,[1] and

[1] Science and Ultimate Truth: Fison Memorial Lecture, 1926, delivered at Guy's Hospital Medical School, March 25, 1926. By the Very Rev. W. R. Inge. Pp. 32. (London: Longmans, Green and Co., Ltd., 1926.) Paper, 1s. net; cloth, 2s. net.

the Herbert Spencer Lecture given at Oxford by Prof. Sorley on May 19.[2]

Dr. Inge points out that there are only three periods of history when knowledge has advanced by leaps and bounds—the time of the ancient Greeks, the Renaissance, and our own age—and of these the greatest accession of positive knowledge has come in our own time. He passes the brilliant pageant in review, and very impressive it is. Yet the philosopher's interest is in the conception of value, and he asks himself, what is the relation of values as they enter as factors into ethical, religious, and æsthetic experience to scientific truth, and especially to the reality which is the ultimate goal of scientific research? The profounder consciousness of contemporary science is not content to detach or dismiss these universal aspects of human experience, the ideals of beauty, truth, and goodness, as epiphenomenal existences, imparting an apparitional glow to cold mechanical order and to which our epiphenomenal minds respond with an emotional thrill. If the real nature of things is to be found in the atom of the physicists, then, as Dr. Inge points out to us, a microbe is nearer to reality than a man. We are, however, still far from the complete philosophy which would show how the different valuations which physics, history, and religion apply to experience supplement each other. This ideal consummation is yet to be attained. The formulation of such an ideal, however, shows that we are on a higher plane of thought. The reproach which has been and still is levelled at religion, that it is ever retreating from one position to another before the victorious advance of science, and that it is now preparing to die in its last ditch, is not undeserved, nor is it entirely untrue. It is the materialism of religion which has constituted its weakness. It is the "garish promises and terrifying threats" which have failed.

Prof. Sorley also is impressed with the consciousness of its own strength which is the outcome of the triumph of the new ideas in physics and biology. The same kind of confidence which Bacon and the leaders of the scientific renaissance expressed when they represented the modern inquirer, not as the patient interpreter of the old learning, but rising on the shoulders of the past, belonging not to the infancy but to the adult stage of our race. He sees to-day a revival of the same spirit which led the young Descartes to choose a military career, not influenced by desire for glory and for worldly success, or by chivalry, but by the opportunity it offered of gaining first-hand knowledge of man and Nature. All the great periods in which there has been a notable advance in science and a revolution in ideas have witnessed a break with tradition, an emancipation from authority. We are going through such a period to-day, and no more profitable subject of self-reflection can be suggested than to take stock of our traditions, their significance, their value, and the nature of the authority they impose. Is tradition a dead hand throttling the living effort? Prof. Sorley shows us the sense in which it is a vital force necessary for the carrying on of original work. "Unless the solitary thinker emerge from his solitude and sow his seed in good soil, his ideas will not fructify." "It is seldom that a second chance comes to the innovator, as it did to Mendel when his work was rediscovered and became the inspiration of a school of biologists."

The two lectures suggest important reflections on the relation of human science to human nature and individual experience. A strange phenomenon is the apparition of man! When we view him as a form of material organisation, the outcome of a biological evolution, and then compare his activity with that of other forms in the hierarchical series, there is presented a phenomenon paradoxical and unique. The unique thing in the human attainment is the power which has come to man alone (it may be by virtue of the erect position, the visual convergence, and the co-ordination of the sense of hearing with the muscles of articulation) of superposing an artificial life on his natural life. There is nothing resembling it or approaching it in the other forms of living activity. Man by reason of his emancipation from environmental conditions has undergone and is undergoing a cultural as well as a natural evolution. The conditions of this cultural evolution are very strange—opposed to, rather than in line with, the conditions of biological evolution. The mind of the ape is moulded on the environment and responds to it as it were automatically. The mind of the man is educable. The culture which a man acquires by education does not modify his nature: it is super-added to it. Man's wisdom is not the wisdom of the bee or the ant. It is artificial. We may grow daily in grace and wisdom, transforming our natural cravings into social virtues, but we do not change the natural man. We cannot transmit our culture as a heritage to the succeeding generation. If we have the gift of expression and leave behind the works which follow us, all we leave is records which set a task for those who will enter into communion with us. Every individual must tread again painfully the path we have had to tread. The flattering notion that an Oliver Twist, born in a workhouse and brought up among thieves, can retain the gentle nature which cultured parents have bestowed on him is a romantic fiction.

It is this which constitutes the real problem of the genesis, the nature, and the authority of tradition. The new generations must start their education not where

[2] Tradition: the Herbert Spencer Lecture delivered at Oxford, May 19, 1926. By Prof. W. R. Sorley. Pp. 24. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 2s. net.

the old left off, but where the old started. Our generations overlap. It might have been otherwise. Evolution might have produced forms of activity which can retain and preserve individual attainments across a complete breach of continuity. This is the normal case in the insects, but the reverse is the rule in the vertebrates, and in the human form we meet with the formation and growth of an ideal environment, cultural and adventitious. The musician cannot bequeath his acquired skill, the painter cannot impart his acquired technique, the student his erudition. Each individual starts *de novo*, and yet he can only develop under the guidance and influence of the overlapping generation. Hence there grows up around him a tradition and an authority which appear external and seem to restrain him, but which in truth he is himself creating in the very activity of the life which bursts his bondage.

H. WILDON CARR.

Ice-Domes and the Atmosphere.

The Glacial Anticyclones: the Poles of the Atmospheric Circulation. By William Herbert Hobbs. (University of Michigan Studies, Scientific Series, Vol. 4.) Pp. xxiv + 198 + 3 plates. (New York: The Macmillan Co., 1926.) 2.75 dollars.

IN his study of the great ice masses which form the continental glaciers of Greenland and the Antarctic, Prof. Hobbs was impressed with the dome-like shape of their ice-covered surfaces. He also noticed that the predominating wind direction along their coasts had a marked outward component as though the air were sliding off the domes. It was not difficult to find a reason why air should slide off the domes in this way, for meteorologists had long been familiar with the flow of cold air down hill-sides and valleys which occurs when the surface layers of air become abnormally cold owing to intense outward radiation. Sir Napier Shaw has given the name katabatic wind to the winds formed in this way.

Starting, then, with the idea that the air is flowing off the domes outwards in all directions, Prof. Hobbs naturally concludes that it must be replaced by air which is 'pulled down' over the central parts of the dome. But this is the sort of circulation which is described in the old text-books of meteorology as anticyclonic, so Prof. Hobbs assumes that there must be an anticyclone over every dome-shaped ice-covered land. He gives the name glacial anticyclone to such anticyclones; but he categorically states "the domed ice-surface, not the snow-covered land, is the direct cause of the anticyclone" (p. 126).

The outward flow of air, however, is not steady, but takes place in what Prof. Hobbs calls "strophs." Each stroph commences with a calm, then the air starts to move outwards, slowly at first, but acquiring velocity "to accord with the law of acceleration of gravity"; when the velocity has reached full blizzard proportions the motion is suddenly arrested because of adiabatic heating, and the stroph is at an end. Thus the whole regime of the air circulations over the Antarctic Continent and Greenland with their calms, blizzards, föhns and high winds is brought under the dominion of the glacial anticyclones.

The difficulty with all such theories is that the author never knows when to stop, so Prof. Hobbs extends his theory still further. As is well known, the Bjerknes theory of cyclones and the polar front is based on the interaction between polar air and equatorial air. But Prof. Hobbs says that the air in the north polar regions is not suited for such a purpose; in fact, Bjerknes' polar air "is quite different from that encountered by explorers within the north polar region of frozen sea"; what Bjerknes' cyclones want is a dose of air from a glacial anticyclone, so Prof. Hobbs concludes that "the cold air which rejuvenates the dying cyclones on their approach to the coast of Europe from the west, instead of having polar origin, issues from the Greenland Continent during a stroph of the anticyclone" (p. 155). Prof. Hobbs also casts longing eyes on Bjerknes' families of cyclones, but it is not clear whether he claims them entirely as the product of the anticyclone; he does say, however, "when a new stroph is inaugurated a new family of cyclones is generated" (p. 153).

Not content with bringing the cyclones of the northern and southern hemispheres under the dominion of the strophs of his glacial anticyclones, Prof. Hobbs goes still further and claims that the terrestrial climatic zones owe their existence to the glacial anticyclones, and that if there were no iced domes in Greenland and the Antarctic, the world would enjoy the uniform climate which certain geologists consider existed in previous ages. Finally, it is claimed that "these northern and southern glacial anticyclones fixed in position, function as the loci of drainage from the upper wind currents and are therefore the reversing position within the general cycle of air movement—they and not the geographic poles are the wind poles of our planet" (p. 155).

Thus, by a series of plausible steps, Prof. Hobbs has brought practically the whole of the meteorological conditions of the globe and the general circulation of the atmosphere under the dominion of two relatively small ice-domes. We have not the space to criticise this elaborate theory in detail, so a few remarks must suffice. It is now generally agreed that true anticyclones exist over the Antarctic and Greenland, but

these are due to the effect of the snow surface on radiation, and would be there whether the surface were domed or not. In the clear calm air of these anticyclones katabatic winds are often highly developed, and as their direction is practically constant, being always down slope, they produce well marked sastrugi, which can frequently be seen cutting across the sastrugi caused by the blizzards. Katabatic winds, however, need very special meteorological conditions for their existence, the chief of which is that radiation from the surface layers must exceed the radiation received. This is not the case when the sun is high or when the sky is cloudy, as it generally is before and during blizzards. It is possible that the high winds in Adelie Land described by Mawson may be katabatic winds, but until the meteorological data of this expedition are published it is impossible to be certain. We can at least say that the blizzards of the Ross Sea area are not katabatic winds.

That some air from Greenland is drawn into cyclones which pass near to the Greenland coast is clear from the familiar föhn effect which is definitely associated with passing cyclones, but that the cyclonic regime over the North Atlantic would be materially modified if Greenland were reduced to sea-level we cannot accept. The old idea of ascending currents at the equator and descending currents at the poles, in the crude way in which it was formerly stated, has now completely gone. Air cannot be 'pulled down' anywhere; the thermal structure of the atmosphere entirely prevents such motion, and this is as true in Greenland and the Antarctic as it is anywhere else. G. C. SIMPSON.

Infinite Series.

(1) *The Theory of Functions of a Real Variable and the Theory of Fourier's Series.* By Prof. E. W. Hobson. Second edition, revised throughout and enlarged. Vol. 2. Pp. x+780. (Cambridge: At the University Press, 1926.) 50*s*. net.

(2) *An Introduction to the Theory of Infinite Series.* By Dr. T. J. I'a. Bromwich. Second edition, revised with the assistance of Dr. T. M. MacRobert. Pp. xv+535. (London: Macmillan and Co., Ltd., 1926.) 30*s*. net.

(1) THE second volume of Prof. Hobson's book completes a great contribution to the literature of mathematics. The second edition is double the size of the first, and is really a new book. Less than half of the present volume is devoted to Fourier series. The rest of it contains an exhaustive account of sequences and series in general.

Of the first part of the book, Chap. vii. is worthy of special remark. In it Prof. Hobson expounds a theorem of his own which states properties common to a very wide class of representations of functions—including Fourier series as a particular case. (We regret that in this chapter and elsewhere the author has continued to use the word *summable* as meaning integrable in the sense of Lebesgue and—a still more trifling criticism—that he has not adopted the arrow notation for passage to a limit.)

It may be held that among all its branches pure mathematics appears at its best in the theory of Fourier series. There is a peculiar sharpness which has been attained in many propositions (and remains to be attained in others), and there is a peculiar cleanness in the arguments which prove these propositions. To take an example at random, let the reader refer to the ten pages of Prof. Hobson's book in which he expounds the theory of Fourier transforms developed in the last three years by Titchmarsh.

This may explain the feeling one has that if there is any part of the book better than another, it is the part dealing with Fourier series. There is a unity in this chapter (scarcely possible in the earlier, more encyclopædic part of the book) which can only have been attained by great pains in fitting the work of many writers into the author's development of the subject. One source of this unification has already been mentioned in Prof. Hobson's convergence theorem.

One wishes that the author could have woven into his general scheme some of the work published since the chapter was written, which could only be referred to, such as the solution by Hardy and Littlewood of the Cesàro summability problem and the beautiful theorems of M. Riesz on the allied series. But, after all, an account of a rapidly growing subject can only be complete—as Prof. Hobson's is—at the time of writing.

The modern theory of trigonometrical series is largely due to Englishmen—one need only mention Prof. Hobson himself, Young, Hardy, Littlewood, and lately Titchmarsh. It is particularly fitting that one of them has written this book.

(2) We welcome very heartily the reappearance of Dr. Bromwich's book, the first edition of which has been out-of-print for many years, to the great loss of the post-War generation of students. Much excellent new matter has been introduced into the second edition. The most substantial additions deal with the solutions of linear differential equations of the second order, elliptic functions, asymptotic expansions, and trigonometrical series.

To make room, the section in the first edition on summability has been omitted. We cannot help feeling that in a book on infinite series *something* should be included about summability, whatever else may have

to go. It would be ungracious to urge that a discussion of Cesàro's method is more germane to the theory of infinite series than an account of Napier's invention of logarithms or of constructions for trisecting an angle, for much that is valuable and delightful in the way of miscellaneous matter has been included. It would indeed have been impossible to give an extended treatment of summability—for that one must go to Prof. Hobson's book—but we wish that the *idea* had been explained. In twenty pages one could prove theorems which show the importance of conventional methods of summation—say, in dealing with Fourier series—and we think that such a sketch would have enhanced the value of the book.

In making this comment on the choice of matter, we had in mind the advanced student: concern for the beginner now suggests a remark. We fear that the early use of the notation $a_n \to b_n + l$ for $a_n - b_n \to l$ may leave him with free and easy notions of what a limit is. Most of the advantages of the new notation seem to be covered by the symbol $\sim$, which is less dangerous.

Prominence is given to those limit-problems which present themselves naturally and at every turn in analysis. Not only to the mathematician is the book indispensable; it is also the best possible guide to any one who encounters mathematical analysis in his work. The second edition will increase the very high reputation gained by the first. J. C. B.

The Chemistry of Drugs and Perfumes.

(1) *A Text-Book of Pharmaceutical Chemistry*. By Arthur Owen Bentley and John Edmund Driver. Pp. xi+456. (London: Oxford University Press, 1925.) 18*s*. net.

(2) *The Chemistry of Drugs*. By Norman Evers. Pp. 247. (London: Ernest Benn, Ltd., 1926.) 32*s*. 6*d*. net.

(3) *Perfumes, Cosmetics and Soaps, with Especial Reference to Synthetics*. By William A. Poucher. Vol. 1: Being a Dictionary of Raw Materials. Second edition. Pp. ix+304+21 plates. 16*s*. net. Vol. 2: Being a Treatise on Practical Perfumery. Second edition. Pp. xvi+406+42 plates. 21*s*. net. (London: Chapman and Hall, Ltd., 1926.)

THE issue of elementary text-books for particular groups of chemical students is usually a proceeding to be deprecated, but there is something to be said for it in the case of students intending to qualify as pharmacists, for they need special information regarding chemicals used in medicine, and they must know something about such substances as alkaloids and glucosides and the methods by which they are estimated; subjects which are outside the scope of ordinary text-books. Messrs. Bentley and Driver's book (1) meets these and other needs of pharmaceutical students, and the authors wisely point out that it must be regarded as supplementary to a general course in elementary chemistry. For use in this way the book can be cordially recommended. The few errors noted are of minor importance, such as the representation of prulaurasin as a diglucoside on p. 4 and as a monoglucoside on p. 383. It is curious that there is no reference to the digitalis glucosides or to the alkaloid emetine, both drugs of great importance in modern medicine with which pharmacists ought to be familiar.

Any one who has used such a book as Fränkel's "Arzneimittel Synthese," or skimmed through one of those formidable 'Dispensatories' published in the United States, must be appalled at the number and variety of substances which exhibit physiological action and are potential drugs. Mr. Evers's book (2) serves the purpose of picking out the valuable drugs from this mass of material, and is at least usefully suggestive as regards the lines on which progress in chemotherapy is being made. The chapters on such familiar subjects as hypnotics, antipyretics, anæsthetics, and antiseptics are well done, being neither overloaded with unimportant materials nor neglectful of essential points.

It is interesting to find that out of 218 pages of text, synthetic drugs occupy only 66 pages, the rest being required for the discussion of natural drugs containing alkaloids, glucosides, etc. It is sometimes forgotten, especially by chemists, that medicine still depends so largely as this on drugs of natural origin. The work of compilation has been carefully done, and the only points noticed as requiring attention are of minor importance, such as the implication that chenopodium oil is produced in the West Indies and Central America, whereas it is only distilled in the United States. The statement that "though numerous derivatives of such drugs as atropine, cocaine, quinine, adrenalin, and emetine have been prepared and tested, not one of the derivatives has surpassed the natural drug in maximum effect" is true only in a Chestertonian sense, for the author himself mentions quinine derivatives which surpass the parent alkaloid in activity as anæsthetics and antiseptics. Appendix I., in which this statement occurs, is a too brief summary of current information on the relationship of chemical constitution to physiological action, a subject of great importance, which merits much more elaborate treatment than it receives.

It is typical of the difficulty of keeping books like this up-to-date that Kendall's views on the properties and constitution of thyroxine, which are given in considerable detail, have been superseded by the results of the recent admirable work of Harington. Interest in

the chemistry of drugs is steadily increasing, and Mr. Evers has performed a useful service in providing students with this survey of present knowledge on this subject.

(3) A mere chemist is interested to learn from Mr. Poucher's two volumes that so many chemicals have properties which enable them to be applied to the preparation of toilet requisites, but the reader must be more than a chemist to appreciate at its full value such information as the following. "Alloxan, or mesoxalylurea, is used in the preparation of 'blush' creams on account of the fact that it will impart to the skin a delicate pink tint, if used in a very dilute form." "If too high a percentage of alloxan is employed a purple colour is produced, which may be removed by treatment with dilute nitric acid." Clearly, the modern woman may yet be driven into taking a course in chemistry in the interests of her complexion. The author is naturally not always at this high level, and the bulk of the two volumes is occupied with more prosaic information regarding the sources, production, and uses of the immense variety of materials now used in the manufacture of perfumes, cosmetics, and soap, and the recipes beloved of the practical man are abundant. The book no doubt thoroughly deserves the popularity it has obviously secured from those for whose instruction it was written. T. A. H.

Our Bookshelf.

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. (1) Dritter Band: *Tardigrada, Pentastomida, Myzostomida, Arthropoda: Allgemeines, Crustacea, Arachnoidea.* Erste Lieferung. Pp. 128. 12 gold marks. Zweite Lieferung. Pp. 129-272. 15 gold marks. (2) Fünfter Band: *Solenogastres, Mollusca, Echinodermata.* Erste Lieferung. Pp. 96. 10 gold marks. Zweite Lieferung. Pp. 97-176. 8·40 gold marks. (Berlin und Leipzig: Walter de Gruyter und Co., 1925–1926.)

(1) THE section on the Tardigrada, which was finished by the late Prof. F. Richters in 1914, has been revised by the editor. It is an altogether admirable account in 61 pages of the structure, biology (including the remarkable powers of recovery after drying), development, distribution, affinities and systematics of the order, and is illustrated by 68 excellent figures, many of which are original. The editor has appended a list of about 130 memoirs on tardigrades. The Pentastomida are described in about 60 pages by Prof. R. Heymons, and this account also is praiseworthy for the adequate and well-balanced treatment of the subject. The author would place the Pentastomida between the Annelida and the Arthropoda, and near the other short-footed arthropod-like forms such as Tardigrada and Onychophora. In the section on the Myzostomida (about 80 pp.), by Prof. von Stummer-Traunfels, we find again adequate consideration of structure, biology and life-history, together with excellent figures, for the most part from recent memoirs. The effects of the presence of Myzostoma upon the respective crinoid hosts are clearly set forth. We can thoroughly recommend these three sections to the attention of teachers of advanced zoology. The remainder of the second part is occupied by a general introduction to the morphology and phylogeny of the Arthropoda, written by Dr. Anton Handlirsch.

(2) Prof. Johannes Thiele, the author of these two parts, prefers to regard the Solenogastres as separate from the Mollusca. In the account of the order (14 pp.) more might have been given on the development, and figures to illustrate the more important stages should have been provided. The part on the Mollusca contains a brief general introduction, and accounts of the classes Loricata (Chiton, etc.), Gastropoda, Scaphopoda and Bivalvia, this last to be concluded in the third part. The best of these accounts is that of the Loricata, but here again the author does not provide figures of the developmental stages or of the excretory organs.

While we admit that it is difficult to give adequate consideration to the several systems of organs of the Prosobranchia, we cannot help feeling some disappointment in looking over the account of the sense organs and nervous system (which together receive the same space as the radula), and surely it would have been more helpful to have figures of egg capsules of known origin rather than those of unknown parentage which are given on p. 67. The classification of the Prosobranchia is well done, but some of the subdivisions, *e.g.* Heteropoda, deserve fuller treatment on account of their special interest. Certain aspects of molluscan morphology, *e.g.* torsion, have not received adequate consideration. The account of the Scaphopoda occupies less than 5 pp., and the only illustrations represent the shell, the animal removed from the shell, and three of the radular teeth; there are no figures of the internal anatomy or of the developmental stages.

The systematic part of this work is satisfactory, but the descriptions of structure and development leave much to be desired. As compared with the third volume, the present volume is far less adequate in both text and illustrations.

Volatile Solvents and Thinners used in the Paint and Varnish Industries. By Noël Heaton. (Oil and Colour Chemistry Monographs.) Pp. 158. (London: Ernest Benn, Ltd., 1925.) 15*s.* net.

IN less than 140 pages of text the author has attempted the task of compiling "for reference and comparison detailed information as to the nature, preparation and properties of every solvent of industrial importance in the paint and allied industries." His sixty-odd substances are broadly classified under the heading of petroleum and coal-tar hydrocarbons, hydrocarbon chlorides, terpenes, alcohols, ketones, ethers, esters, and in addition, carbon disulphide. His claim that his list of individual solvents includes every one of the type indicated is scarcely correct, especially in the United States, where the lacquer trade has made enormous strides in recent years. There is a final short chapter on the general significance of the tests for solvents, with some theoretical considerations involved in their use.

A large proportion of the material in this book can be found in many theoretical organic chemistry books, and in view of the comparatively high price of the volume it might be advisable to have restricted such matter and to have dealt more with the technical application of the solvents. Some typographical errors and a fair number of obscure or slightly inaccurate statements occur, but in spite of these and the author's disclaimer to literary style in dealing with technical data, the book is exceptionally well written. It collects together a large amount of useful information on a special type of organic substances, and it should be of great use not only to the technical man but also to the organic chemist generally. J. REILLY.

Castles. By Sir Charles Oman. Pp. xii + 232 + 100 plates. (London: Great Western Railway, Paddington, 1926.) 5*s*. net.

To the two delightful volumes, "Cathedrals" and "Abbeys," the Great Western Railway has now added a third dealing with the castles on or accessible from its system. Eighty castles in the south and south-west of England and in Wales are here described in full and illustrated by many photographic plates of great beauty and a number of equally pleasing sketches in the text. All the castles with the exception of six have been carefully inspected by the author, while his son was responsible for about half the illustrations. In addition to the description of each building and the notes on its history, Sir Charles Oman has provided an introduction in which he gives the history of the castle, royal and baronial, in England, and sketches its development as well as the development in methods of attack which took place *pari passu*—a subject on which so distinguished an authority on military history is peculiarly competent to speak. Sir Charles discusses at some length what constitutes a castle, and finally defines it as a military structure used for residential purposes which is a unit as itself. It is interesting to note that the author attributes the fact that castle building virtually ceased in the fourteenth century, not so much to the development of artillery, though that was no doubt a contributory cause, as to the realisation by that time that war in the open had come to be the only form of decisive action, and it was consequently more effective to spend money on the maintenance of men-at-arms rather than in buildings.

The Chemical Analysis of Foods: a Practical Treatise on the Examination of Foodstuffs and the Detection of Adulterants. By Dr. H. E. Cox. Pp. vii + 323. (London: J. and A. Churchill, 1925.) 18*s*. net.

THE aim of the author has been to write a text-book of food analysis for the general requirements of chemists who have no special experience in the analysis of foods. On the whole he has produced a compact and readable volume which contains a large amount of useful information. In eleven chapters the subjects dealt with include carbohydrates, baking-powder, fruits, tea, coffee, cocoa, mustard, pepper, wines and other alcoholic liquors, flesh foods, milk and related products, and various oils. In an appendix the Public Health (Preservatives, etc.) Regulations of 1925 are given.

Methods are often too briefly described to be of real value to the inexperienced, and the details given are not always strictly accurate. In some cases definite alterations in standard existing procedure is indicated without comment or reference to original sources. The expert analyst is certain to be disappointed in many sections of the book, for in several instances where information is required, even on common controversial problems, little help is given. There is possibly some justification for this, as the author indicates that he is not writing for the specialist, and has endeavoured only to present the elements of the subject. The book is therefore more useful in initial training than as an aid in discussing special isolated points. In a second edition with a fair amount of revision and correction a very useful text-book should result.

Economic Geography of South America. By Prof. R. H. Whitbeck. Pp. vii + 430. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 17*s*. 6*d*. net.

THERE has long been need for a text-book on South American economic geography, since much that has been written on this subject is not free from bias and is far from trustworthy. In this volume, Prof. Whitbeck, who has the necessary qualification of personal experience of South America and a wide outlook, has largely supplied the want. The physical background is merely sketched and there is little explanation of climatic processes. These are the weak sides of the book. But the economic problems are ably handled, and the human element, which is of great significance, is kept well in the foreground. States are selected as geographical entities, but within the larger States natural regions are recognised. National boundaries, traditions, and even prejudice, play too important a part in the economic life of any State to be neglected, as must happen if natural or geographical regions are chosen as the larger units for treatment. The Falkland Islands may be of small importance, but they merit more than one casual reference, at least if the book is to be used in Great Britain. There are admirable illustrations and sketch-maps and copious bibliographies, while the text shows a pleasing absence of New World phraseology.

The Human Body. By Dr. Marie Carmichael Stopes. Pp. v + 224 + 7 plates. (London: The Gill Publishing Co., Ltd., 1926.) 6*s*. 6*d*. net.

FEW will venture to deny that some elementary knowledge of the structure and working of the human body should be included in the education of every child. To further that object, Dr. Marie Stopes offers this book to adolescents and to all who missed this knowledge when they were young. In general, it is eminently suitable for the purpose; it is simple in expression, clear and accurate in detail, and easily readable by any youth of average intelligence. There are, however, certain features of anatomy and physiology which cannot adequately be explained in print; they are best left to the tact and common sense of the parent or guardian, and their omission from this book would certainly have increased its sphere of use, to those, at least, who are passing from childhood to youth. The only other criticism we have to offer is that technical terms, such as 'omos,' 'lumbus' and 'natis,' are unnecessary even in the diagrams of a book intended for lay readers.

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.*]

The Secondary Hydrogen Spectrum.

THE further examination of the secondary spectrum of hydrogen has led to a number of interesting discoveries since my last publication (*Roy. Soc. Proc.* A, vol. 111, p. 714, 1926). It appears that the green and red bands have the same electron jump but correspond to different sets of vibrational transitions, those for the green bands being $0\rightarrow0$, $1\rightarrow1$, $2\rightarrow2$, $3\rightarrow3$, and $4\rightarrow4$, and those for the red bands $1\rightarrow0$, $2\rightarrow1$, $3\rightarrow2$, $4\rightarrow3$, $5\rightarrow3$, and $6\rightarrow5$. In addition, there are five other less well developed sets of bands with the same electron jump, two in the infra-red with vibrational transitions $2\rightarrow0$, $3\rightarrow1$, $4\rightarrow2$ and $3\rightarrow0$, $4\rightarrow1$ respectively, and three on the violet side of the green with the respective sets of vibrational transitions $0\rightarrow1$, $1\rightarrow2$, $2\rightarrow3$, $3\rightarrow4$ and $0\rightarrow2$, $1\rightarrow3$ and $0\rightarrow3$. There is an intercombination between the lines of all the above bands and indications of a further combination in the members of the $P\,R$ branches, which, however, are less well developed than the Q branches. The second differences of the Q branches form a square array with a common vertical difference $= 2{\cdot}4$ and a common horizontal difference $= 2{\cdot}8$ wave number.

The blue bands have a different electron jump from the foregoing. It appears that there are less well developed bands on the violet side of these, which are connected with them and with the red bands by means of a Rydberg formula. Thus if the first element on the violet side of each band is indicated as usual by the letter A, the frequencies of the successive lines AQ (1) are given by the formula

$$\nu = 109678{\cdot}3 \times \left\{ \frac{1}{(2-\mu_1)^2} - \frac{1}{(m-\mu_2)^2} \right\}.$$

The value of μ_1 is approximately 0·067 and μ_2 falls steadily from about 0·063 to 0·058 as m increases from 3 to 7. Evidence of the bands can be found for each of the values $m = 3, 4, 5, 6, 7$. When $m = 3$ we get one of Fulcher's red S_3 lines, the one, in fact, nearest the violet end, and when $m = 4$ we get the first line at the violet end of Dieke's blue bands. There is also evidence of the existence of a similar lot of bands connected by a Rydberg formula with the green bands. There can be little doubt, in view of the above equation, that this system constitutes the band analogue of Balmer's series.

O. W. RICHARDSON.
King's College, University of London,
July 11.

Imperfect Crystallisation of Common Camphor.

QUITE recently (NATURE, May 22, p. 721) A. Müller described the imperfect crystallisation of behenolic acid. The crystals of this substance proved to be built up of small crystal elements which have one direction in common and a random orientation perpendicular to this direction. This seems to be the case with many long-chain compounds.

As another example of such an imperfect crystallisation where, however, the imperfection is still greater, I should like to mention common *d*-camphor (Japan camphor). This substance, which, according to Traube, crystallises in the trigonal-trapezohedral class, was studied in the course of an investigation of the space-groups of some optically active crystals. The rotatory dispersion of camphor crystals is practically the same as the rotatory dispersion of the substance in the melted, gaseous and dissolved states (L. Longchambon, Thèse, Paris, 1923; *C.R.*, 182 (1926), 769). It was therefore supposed that the crystals might prove to possess no trigonal screw-axes, and thus owe little or none of their rotatory power to the molecular arrangement within them.

Assuming that the crystals are truly trigonal or hexagonal, their tabular form is in favour of this hypothesis. Indeed, the best developed planes in any crystal (here $\{0001\}$) are generally those which are the most closely packed with molecules. The presence of a threefold screw-axis would reduce the molecular density of the basal plane to one-third of the value which would hold in the case of a threefold rotation axis.

The crystals used were found in a bottle in which they had been produced by slow sublimation, apparently over a number of years, at room temperature. They consisted of thin hexagonal plates. The X-ray investigation showed, however, that the external form of the crystals is deceiving.

With the Bragg spectrometer never more than three reflections were observed, corresponding to the planes which occur on the crystals. From them the following spacings were deduced: $d_{0001} = 5{\cdot}80$ Å.U., $d_{10\bar{1}1} = 5{\cdot}42$ Å.U., $d_{10\bar{1}0} = 6{\cdot}06$ Å.U. (indices according to Traube). Actually, d_{0001} must be multiplied by 2 to make these spacings consistent. They give for the axial ratio 1·656 (Traube, 1·685). The hexagonal unit calculated from them contains two chemical molecules (1·95). Strange to say, a reflection from $\{11\bar{2}0\}$ was never observed on the spectrometer. Many rotation- and oscillation-photographs were taken with different settings of the crystals (with regard to the outer form). None of these photographs showed the typical hyperbolæ of spots that would be expected. All of them showed only a relatively small number of spots, more or less distributed in a circle round the centre. Although the spots corresponding to the three planes mentioned above were generally found in positions where they would be expected, still no spot that could be definitely identified with $\{11\bar{2}0\}$ was ever found. On the other hand, there were always spots in positions which bore no definite relations to the setting of the crystal. As a consequence it was practically impossible to deduce trustworthy conclusions from the *positions* of the spots on the plates. Clearly, what are apparently good crystals are in reality no more than conglomerations. Laue photographs seem to confirm this view. Several of them were taken in a direction perpendicular to the basal plane, but a hexagonal or trigonal distribution of spots was never obtained. There were a number of broad spots which appeared to correspond to a more correctly orientated larger part; but mostly the spots were drawn out into lines and located in circles round the centre. It should be noted that no definite indication of a larger constituent could be deduced from the rotation- and oscillation-photographs. The sharp spots must correspond to small crystals having a random orientation.

A small number of spacings were obtained from the oscillation-photographs. Attempts were made to increase this number by taking powder photographs, but a real powder could not be obtained. Rubbing camphor in a mortar effects an orientation of the crystal elements with the basal planes more or less parallel to the surface of the pressed substance. An oscillation photograph of this surface gave a strong reflection corresponding to the spacing of the basal plane. Subliming quickly on a cold surface produced crystals which were too big to be considered as a powder.

The spacings obtained are not sufficient to determine definitely the crystal unit. When a hexagonal or trigonal unit was assumed, it was only possible to account for the spacings by taking a much larger unit than would follow from the spectrometer measurements and assuming a number of accidental halvings, etc. In the course of the investigation there were also indications which seemed to point to the possibility that the crystals are not truly hexagonal but intergrowths of biaxial lamellæ. For example, on several photographs double spots were present, and once a very fine stratification of lines making angles of 60° with each other was observed on a thin layer of camphor which crystallised on the surface of a solution of camphor in aqueous methyl-alcohol. If the crystals are really biaxial, an artificial spiral of lamellæ must be present to account for the uniaxial nature of the composite crystals.

The imperfection of the crystals is probably due to the changes in temperature during the long time which is necessary for their growth. With rising temperature crystal elements resublime, whereas at lower temperatures new crystal elements are deposited. It is possible that the orientations of these latter are variable.

It is hoped that crystals will be grown from a solution later, and that better results will be obtained with them.

W. G. BURGERS,
Ramsay Memorial Fellow.
Davy Faraday Research Laboratory,
Royal Institution, W.1.

Influence of Temperature on Biological Processes.

THE study of Van 't Hoff's law in biology has led to the following main conclusions:

1. Biological reactions showing a $Q_{10} = \pm 1$ are of a photochemical nature.

2. Biological reactions with a negative Q_{10} are based upon surface forces.

3. In the remaining cases the Q_{10} lies between 1·3 and 6·0, but usually this value depends much less on the nature of the reaction involved than on the temperature itself, the Q_{10} of one and the same reaction being higher at low than at high temperatures. Thus in these cases the Q_{10} is not a true constant, and Van 't Hoff's formula does not fully hold. It might be noted here that even in many chemical reactions the Q_{10} is not absolutely constant but that it varies slightly with the temperature. In the overwhelming majority of biological processes, however, this variation is much more considerable.

For that reason some investigators have introduced the Arrhenius formula $\left(\frac{v_2}{v_1} = e^{\mu\left(\frac{1}{T_1} - \frac{1}{T_2}\right)}\right)$ into biology. Ch. Snyder[1] was the first to do so, and has been followed, in recent years, chiefly by W. J. Crozier.[2] The latter author, however, finds that the coefficient μ of the above-mentioned formula of Arrhenius is not always uniform for one and the same reaction, but that it has in many cases at least two, and according to Cole[3] even three, different values for different ranges of temperature. Thus the Arrhenius formula should not be generally used in biology (see Heilbrunn's criticism[4]).

Many biological observations unfortunately are not sufficiently accurate to serve as the basis for a quantitative law. However, after trying various mathematical formulæ for a large number of cases recorded in the literature, I have found that the following equation usually represents the relation

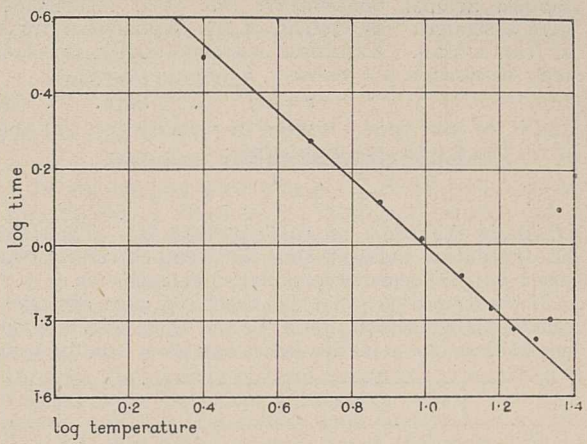

FIG. 1.—Effect of temperature on the locomotion of marine amœbæ (Pantin's experimental data).

between the temperature (x) and the time (y) necessary to accomplish a given reaction:

$$y = \frac{a}{x^b}, \quad . \quad . \quad . \quad . \quad . \quad (1)$$

a and b being constants. In logarithmic form the formula becomes:

$$\log y = \log a - b \log x, \quad . \quad . \quad . \quad (2)$$

which means that the logarithm of time plotted against the logarithm of temperature gives a straight line. The following examples, which give good lines, show that the formula is very general.

Reaction.	Species.	Author.	a.	b.
Pulsation of the vacuole . . .	Paramæcium	Cole [3]	5460·0	1·87
Amœboid movement	Marine amœbæ	Pantin [5]	7·76	0·90
Growth . . .	*Scirpus Kisoor*	Bose [6]	$346 \cdot 10^{12}$	9·50
Oxygen consumption	*Tenebrio molitor* chrysalids	Krogh [7]	2819·0	2·10
Vasomotor effect n. ischiadicus . .	Cat	Howell [8]	3802·0	2·02
Regeneration . .	Tubularia	Moore [9]	5012·0	1·70

Figs. 1 and 2 show the curves obtained in two of the above reactions.

The constant a expresses the time at $\pm 1°$, as it may be calculated in putting $x = 1$. It is evident that the value of a varies according to the unit of time used. The value of b is independent of the actual velocity and of the unit of time employed, because b represents an acceleration.

If $b = 1$, the formula becomes

$$y = \frac{a}{x}, \quad . \quad . \quad . \quad . \quad . \quad (3)$$

which is the general equation of a rectangular hyperbola. Some entomologists have put forward the hypothesis that the product of temperature and time in the embryonic development of insects is a constant for one and the same species. This hypothesis may be written mathematically in the form given above (3), and is therefore only a special case of the more general equation (1).

Krogh,[10] Warburg,[11] and others have shown that

[1] Snyder, *Arch. für Anat. und Physiol.*, 1907, p. 113.
[2] Crozier, *Journ. Gen. Physiol.*, **7**, 1924; *Proc. Nat. Acad. Sci.*, **10**, 1924.
[3] Cole, *Journ. Gen. Physiol.*, **7**, 1925.
[4] Heilbrunn, *Science*, **62**, 1925.
[5] Pantin, *Brit. Jour. Exper. Biol.*, **1**, 1924.
[6] Bose, *Trans. Bose Res. Inst. Calcutta*, **1**, 1918.
[7] Cf. Robertson, "Principles of Biochemistry," 1920.
[8] Howell, Budget and Leonard, *Journ. of Physiol.*, **16**, 1894.
[9] Moore, *Roux's Archiv*, **29**, 1910.
[10] Krogh, *Zeitschr. für allg. Physiol.*, **16**, 1914.
[11] Warburg, *Bioch. Zeits.*, **100**, 1919; **103**, 1920. Yabusoe, *ibid.*, **152**, 1924.

some biological reactions are affected by the temperature in such a way that the velocities themselves plotted against temperature (*not* their logarithms) give a straight line instead of the exponential curve of Van 't Hoff. Expressed mathematically, this fact may be written (v = velocity, x = temperature) :

$$v = kx, \quad . \quad . \quad . \quad . \quad (4)$$

and if we take time y instead of velocity ($y = 1/v$) and if we put $k = 1/a$, we may write :

$$y = \frac{a}{x},$$

which is the same as the equation (3). Thus the linear relation between time and temperature is true when b in the general formula (1) becomes = 1.

If we construct a curve based on any arbitrary case of the general formula (1) and then calculate the Q_{10} of that curve in the same way as is usually done

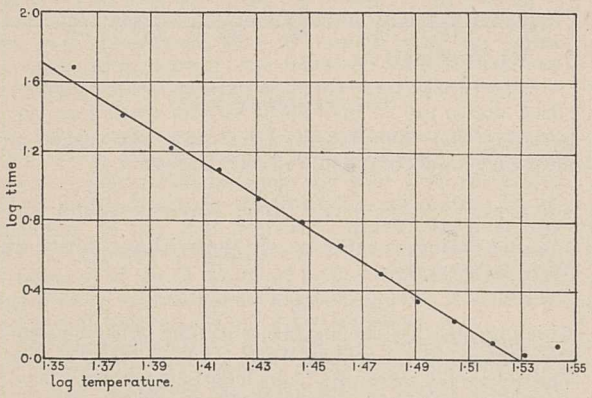

FIG. 2.—Effect of temperature on growth of *Scirpus Kisoor* (Bose's experiments).

in biology, we find that the value of Q_{10} decreases with rise of temperature in the same manner as in the majority of actual biographical reactions, provided always that b is greater than 1.

At high temperatures (near and above the optimum) the formula of course does not hold, because of changes occurring in the protoplasmic equilibrium. Sometimes it may also be observed that at very low temperatures (in the neighbourhood of 0° C.) the calculated and actual values do not correspond ; this is due to the fact that in the previous calculations the possible difference between the physical zero (0° C.) and the biological zero has been neglected. If the biological zero is below 0° C., the calculated points possess somewhat higher values than the points observed, and vice versa. When the temperature is measured from the biological zero (which may be expected to lie not very far from 0° C.), these divergences at low temperatures disappear.

Variations in the constant b in formula (1) appear to have considerable biological significance. I hope to show in a later note that, for the same reaction in one and the same species, b increases with age ; also that it is larger in homothermic than in poikilothermic animals, and in tropical than in temperate plants.

J. BĚLEHRÁDEK.

King's College, London, June 11.

Migrations of Butterflies.

IN NATURE of April 11, 1925, p. 535, I gave an account of certain annual movements of the Painted Lady Butterfly (*Pyrameis cardui*) and ascribed them to a deliberate migratory effort on the part of the insect.

In NATURE, September 5, 1925, p. 365, and again on May 29, 1926, p. 754, Dr. E. P. Felt has suggested that this interpretation of the facts is wrong and that in reality we are dealing only with another form of the more general phenomenon of the involuntary distribution of insects by means of overpowering wind currents along the surface of the earth, or upwards by convection, and then along at high altitudes.

No one will disagree with Dr. Felt as to the frequence of involuntary distribution. On the other hand, the evidence that the seasonal movements of such butterflies as *P. cardui*, *Anosia plexippus* and various species of *Catopsilia*, etc., is an entirely different phenomenon, is too long to give in detail in a short letter. I have prepared a fuller statement of the arguments for and against, which will be published elsewhere.

However, one or two points might be summarised here.

(1) The evidence that enormous unidirectional flights of butterflies takes place at ground level, apparently independent of wind direction, or at least more often against or across the wind than with it, is overwhelming. I have more than five hundred references to flights of more than one hundred species in my bibliography for Lepidoptera alone, and the records are multiplying almost daily. The point in dispute seems to be to what distance such flights extend.

(2) In the Pulney Hills in South India, Mr. Evershed has observed for more than ten years a regular stream of butterflies of four families going to the south in November and December almost every year, and a northerly stream of Pieridæ in the earlier months of the year about March. He is convinced that these flights are independent of wind direction.

(3) In the Argentine, Hayward (*Entomologist*, 1925, pp. 147 and 162) records numerous butterflies 'migrating' to the north and flying near the ground when the wind was against them and high up when it was favourable, *i.e.* making use of the wind when possible but not in any way dependent on it or driven by it.

(4) Dr. Felt suggests that as the north and north-west movement of *P. cardui* between March and June over N. Africa and Europe is against the prevailing ground winds, it must therefore be due to upper air currents. I have collected information about the upper air currents in Egypt and the Mediterranean basin, and find that it is necessary to go up from two to four kilometres to get from the ground winds (prevailing north) to a permanent steady westerly upper current. At no height is there any wind current that would account for the migration. The most favourable conditions for the northerly drift of unresisting objects would be with a southerly wind. When there is such at the surface in Egypt, it has veered to south-west at a height of one kilometre and to the permanent west current between two and three kilometres. It should also be emphasised that it is not when there is a south wind, but when there is a north or north-west wind, that thousands of Painted Ladies pass steadily to the north or north-west through the Cairo district.

(5) Practically the same conditions apply with the southerly migration of the Monarch Butterfly in the eastern U.S.A. in the autumn. Neither at the surface nor at any height above it are there prevailing winds to account for the movement.

(6) If the great spread of these insects is due to involuntary drift at high altitudes, why do they continue to move, over many miles at least, in a set direction, often against the wind, when they come to the surface again ? (or is it before they go up ?). The mad, untiring unidirectional flight of butterflies is a thing apart from their normal flight and cannot

be accounted for except by profound physiological disturbances such as are found in birds during migration.

It is difficult not to add, although it is not argument, that if Dr. Felt had once seen a hundred thousand butterflies going headlong against the wind, or coming out of the bare desert like a thin haze, or flying out to sea without taking any other interest in a steamer than that necessary to avoid it, he would realise the complete lack of identity between this and the willy-nilly drift that carries aphids to Spitsbergen or mosquitoes and house-flies to the Rebecca Shoal Lighthouse.

C. B. WILLIAMS.
Ministry of Agriculture,
Cairo, Egypt, June 10.

Series Spectra of the First Long Period.

THE regular and irregular doublet laws have been applied to some lines which appear in the high-potential spark of scandium, titanium, vanadium, and chromium, and those listed in the table appear to be the first members of the *P* doublets of Sc III to Cr VI. For convenience, those of K I and Ca II have been included from Fowler's "Series in Line Spectra."

Element.	λ.	*I.*	ν.	Δν.
K I .	7664·94	10 *R*	13042·8	57·7
	7699·01	10 *R*	12985·1	
Ca II .	3933·7	10 *R*	25414·4	222·8
	3968·5	10 *R*	25191·6	
Sc III .	2699·9	10	37038·4	474
	2734·9	9	36564·4	
Ti IV .	2067·6	9	48363	821
	2103·4	8	47542	
V V .	1680·4	5	59510	1462
	1722·7	3	58048	
Cr VI .	1446·7	4	69123	2367
	1498·0	2	66756	

The wave-lengths were measured *in vacuo* on a two-metre grating having 30,000 lines per inch, giving an average dispersion of 4·5 Å.U. per mm.

There is no doubt that from scandium onward the intensity of these pairs falls steadily as indicated, but there is no direct comparison intended between these and potassium or calcium. It may be said, however, that calcium and scandium were taken on the same plates in some cases, and the calcium doublet was strongly reversed and apparently very much more intense than that for scandium.

When the intensity ratio of the two lines of each pair is considered, it is found that the shorter line is always the more intense of the two.

The corresponding doublet for Mn VII falls in a region having many strong lines, mostly due to silicon, and so no definite conclusion could be arrived at regarding its existence.

The origin of these pairs seems unexplained, since each of these elements from calcium onward is supposed to have but two electrons in the *N* levels, unless we assume that when these are removed some of the *M* electrons move out to take their places in a manner similar to that discussed by Catalán (*Phil. Trans.*, A, vol. 223, p. 166). Some such assumption seems necessary to explain chemical and magnetic results. It seems possible, also, that there may be some connexion between this and the decreasing intensity of the pairs.

The doublet for Sc III was arrived at independently by Mr. S. Smith, who spent considerable time looking for further series relations for this system, but while several pairs having the same separation are known, no certain results have been found.

R. J. LANG.
University of Alberta,
Edmonton, Canada,
May 25.

Technical and Intellectual Values.

IN the leading article in NATURE of June 12, the Association of Teachers in Technical Institutions is invited to publish the philosophy of that branch of education in which its members are specialists. A series of principles is urgently required, and this the Association has formulated, partly philosophical, partly scientific. Control experiments to check our hypotheses are now in the process of performance through the medium of Lord Emmott's Committee of Inquiry into Technical Education, which was suggested, and the preliminary work undertaken by the A.T.T.I., but which is now under the control of an executive committee representative of industry, local education authorities, learned institutions, and technical teachers, with Mr. J. Wickham Murray as its honorary secretary. The guiding principles which are asked for will soon be in a form suitable for publication, and will then be submitted to the reading public for criticism and suggestion.

The urgent need for their formulation and publication is shown by recent speeches of the president of the Board of Education. In his opinion, secondary education is the preparation for a university education destined to provide the 'governing classes'—to use his words as reported in the press. Such a typically constricted outlook must be widened. The function of a government does not end with the manipulation of Emergency Powers Acts. Industry and commerce must be encouraged and fostered. Whether governmental philosophy be individualist or collectivist, we shall require men with technological training and capable of the application of science to the industrial world. Education must include education for service as well as for government, and this service must be intelligent: not a clumsy translation of good intentions into feeble practice.

A. E. EVANS, President.
Association of Teachers in
Technical Institutions,
29 Gordon Square,
London, W.C.1.

Natural History of the New Hebrides.

IN a few months my brother and I are going to the New Hebrides, in the Pacific Ocean, to explore the interior of the largest island, to collect the fauna, to study animal reproduction in a climate that is almost constant throughout the year, and to undertake other work of a more special nature. Particular interest attaches to a large lake on one of the islands, said to be almost the only lake in Melanesia. We are financed in part by the Trustees of the Percy Sladen Memorial Fund.

If any reader of NATURE who is a specialist in any group of terrestrial or fresh-water animals or their parasites would care to communicate with me, I should be glad to make a particular point of collecting that group and of sending the specimens to him on our return, provided that he will undertake to work out the collection and subject to the approval of the Percy Sladen Trustees.

JOHN R. BAKER.
Department of Zoology and
Comparative Anatomy,
University Museum, Oxford.

The Imperfect Crystallisation of Common Things.[1]

By Sir WILLIAM BRAGG, K.B.E., F.R.S.

MANY things consist of, or contain, agglomerations of small crystals which are plain to the eye or may be made evident by the use of the microscope. Many more are only discovered to be of similar composition when they are examined with the aid of X-rays, as for example, fats, cotton and silk. In some cases the small crystals are in complete disorder. In others there is a partial arrangement; some one direction related similarly to each crystal has a tendency to orient itself more or less in a certain direction related to the body of which the crystals form part. When this happens there must necessarily be a cause for it. The body may have been subjected to strain or mechanical treatment of some sort, as when a metal sheet is hammered or rolled, or when a metal wire is drawn. Or again the body may have been formed under conditions which favour orientation, as when a substance is deposited electrolytically. Yet another case of great interest is that of animal or vegetable structure; the general orientation of the crystallites in cotton, silk, animal scales and spines, teeth and the like, has features which are clearly associated with growth.[2]

It is most probable, in some cases it is already certain, that the presence of the small crystals and their arrangement affects the properties of the body which contains them. We know that the strength of a wire depends on the arrangement of its constituent crystals; the strength of a cotton fibre, or of a bone, is most probably affected in the same way. It is part of Nature's scheme to produce this partial orientation in living things, so that a knowledge of it may be essential to the understanding of the structures which contain it. To this knowledge the X-ray diffraction figures, which are formed on the photographic plate in the customary ways, are able to contribute materially. These figures are of various types. One of them is the original Laue diagram which is obtained when a

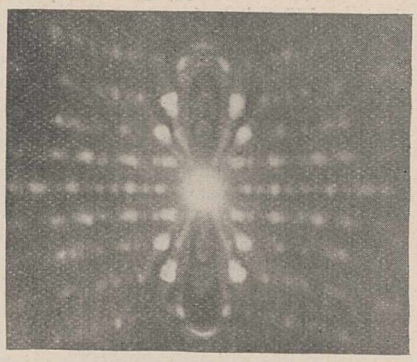

FIG. 1.—Cane sugar. Crystal rotating, homogeneous rays.

beam of heterogeneous X-rays falls on a single crystal. The lattice points in the crystal can be imagined as all lying on sets of parallel and equally spaced planes; there are an infinite number of such sets, but only a moderate number of them are sufficiently widely spaced to reflect X-rays of ordinary wave-lengths. Whenever a reflection takes place the relation $n\lambda = 2d \sin\theta$ must be satisfied, where λ is the wave-length, d the spacing of the set of planes, n is an integer,

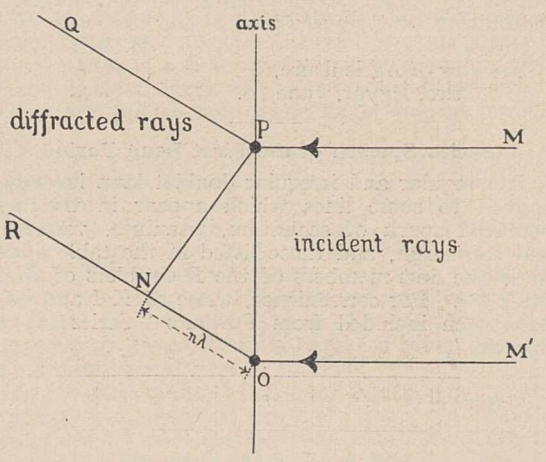

FIG. 2.

and θ the angle between any plane of the set and either the incident or reflected ray. The well-known Laue photograph is formed by the reflections from the various sets of planes, each set reflecting that particular wave-length which it is able to reflect, according to the above equation. The arrangement of the spots on the photographic plate is closely connected with the symmetry of the crystal.

A second well-known type consists of a series of concentric rings; it is formed by reflections of rays of one wave-length—not mixed rays as in the previous case—which are incident on a mass of small similar crystals oriented in all directions. The explanation is that the reflection from a set of planes of given spacing must make a certain angle with the incident rays, but otherwise there is no condition which its direction must satisfy. Each ring is the aggregate of reflections from one such set. These ring photographs were introduced independently by Debye and Scherrer and by Hull, about ten years ago.

There is a third type which has been much used in recent years and is particularly important in view of the researches now under consideration. A small crystal is made to revolve about an axis perpendicular to a pencil of incident rays of one wave-length. The resulting photograph when the plate is also normal to the rays is of the character shown in Fig. 1, which is due to a sugar crystal. Each set of planes has its chance of reflecting during the revolution, provided that its spacing lies within certain limits. The spot which the reflection produces must lie on a certain circle concentric with the spot where the incident rays strike the plate; the same circle as that which was fully represented in the previous case when there was no limitation on the orientation of the crystal. But there is now a further condition; each spot must lie on one of a series of hyperbolas, such as are clearly

[1] Abstract of lectures delivered by the author at the Royal Institution on April 29 and May 6. The lectures were abbreviated on account of the industrial disarrangements of the time. It is proposed to give the lectures in full next November.

[2] The researches in this direction have been principally carried out in the Kaiser Wilhelm-Institut für Faserstoffchemie in Berlin-Dahlem by Herzog, Gonell, Mark, Weissenberg, and other workers. The photographic illustrations of this article are due to Mr. W. T. Astbury.

shown in the sugar photograph. This point is readily explained with the help of Fig. 2, which shows incident rays falling on two lattice points O and P, and diffracted rays passing away from these points. It is to be remembered that OP is extremely small in comparison with the size of the crystal, and this again is small in comparison with the distance from the crystal to the photographic plate. The incident and reflected rays are 'fine pencils,' though they contain an enormous number of such lines as MP, M'O. When there is

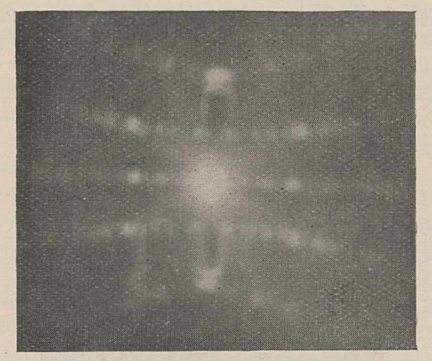

FIG. 3.—Asbestos. Bundle of fibres held steady. Homogeneous rays.

a diffracted or reflected ray from the crystal the contributions from any two such points must be in the same phase. Hence ON must be equal to $n\lambda$ where n is zero or an integer. If O and P lie on the axis of rotation, every diffracted ray must make with OP an angle $\cos^{-1} n\lambda/OP$. Thus all such rays must lie on one or other of a series of cones having OP as axis, and these cones cut the plate in a series of hyperbolas. If O and P are consecutive lattice points along OP, the first hyperbola is given by $\theta = \cos^{-1} \lambda/OP$. If θ is measured, OP can be calculated; and in this way the geometry of the lattice can be found.

A substance containing a number of small crystals having one direction in common, but otherwise oriented in a haphazard manner, gives the same photograph as a single crystal rotated about that direction during the exposure. Such a photograph is, for example, given by asbestos as shown in Fig. 3; the fibres have been set normal to the rays.

It is not often that a substance shows this arrangement in perfection, and gives a photograph like that of a single revolving crystal. Sometimes it is a spot photograph from which a number of spots are missing; it is like that of a single crystal which has not been turned through a full revolution. A bent flake of maleic acid (Müller, NATURE, May 22, p. 721) gives a photograph of this kind; if it could be bent so as to make a cylinder the tale of spots would be complete.

More often the spots are opened out into arcs of the circles on which they lie. A spot cannot move off its circle so long as the wave-length remains the same; but if there is any variability in the common direction of the crystals, the positions and spacings of the set of hyperbolæ are also variable, so that the spot broadens out along the circle on which it lies. The same effect would be obtained from a rotating photograph of a single crystal, if the axis of revolution were given some motion of its own, regular or irregular. The amount of extension of each spot into an arc varies from plane to plane, and much information can be obtained from a study of the photograph as to the possible variation in the orientation of each plane.

If there is complete uncertainty as to the orientation of the small crystals, that is to say, if there is nothing like a common direction, then a spot may lie anywhere on its circle, and we have again the ring photographs which Debye and Scherrer and Hull obtained independently.

Thus the type of photograph obtained by passing monochromatic rays through a substance shows the extent of the crystallisation. A single crystal gives no picture unless rotated. A substance containing many crystals, all having one direction in common, gives a photograph of spots, arranged in a series of hyperbolæ. The picture has symmetry about the projection of the axis on the plate; and if the incident ray is perpendicular to the axis and the plate, there is also symmetry about a line perpendicular to the projection. If there is only an approach to a common direction, the spots are drawn out into arcs of circles. If there is no approach at all, the circles are complete.

A spot never moves off its circle no matter how the crystals are oriented, so long as the rays are monochromatic. But if the rays are heterogeneous, the spot is drawn out to form part of a closed curve of a lemniscate form which crosses the circle. Photographs (Figs. 1 and 3) show traces of these curves, when the rays employed are not quite monochromatic.

The photographs of structures from several sources composed partly, sometimes almost wholly, of cellulose, all show the existence of crystals having the same lattice. Ramie (Fig. 4) gives quite a good spot photograph when the fibres are perpendicular to the rays; from which it can be concluded that one direction of the minute

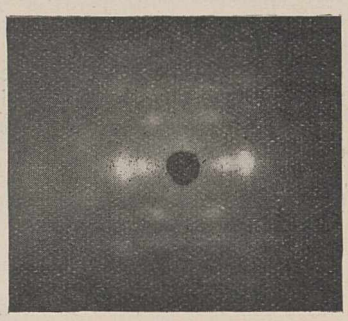

FIG. 4.—Ramie fibre. Homogeneous rays. Bundle of fibres held steady. The original photograph shows some thirty or forty spots, many of which are too faint to appear in the reproduction.

crystals is for all of them very nearly parallel to the fibre axis. It is possible, in fact, to calculate the size and form of the unit cell; the size turns out to be comparable with that of cells of ordinary organic substances. Clearly the unit of pattern does not contain the substance of many molecules, nor does each molecule contain many atoms (Herzog, *Naturwiss.*, 1924, p. 958). Cotton-wool, in the form of a small pad, gives rings, showing that its crystallites are in this case arranged entirely at random; but when a number of fibres are stretched parallel to one another there is some approach to a common axis. That the arrangement is not more complete has been ascribed to the fact that cotton fibres have a spiral structure.

It is of course no new idea that woollen, cotton and other fibres are two-phase systems at least. The elastic properties [3] point directly to such a supposition.

Mercerisation makes changes in the X-ray picture; the spots move perceptibly, but very little, and the relative intensities of some of them alter. It would appear that the general form of the lattice remains much the same, but there is some slight rearrangement of the atoms in the unit cell, perhaps an addition to them. (The cellulose photograph shows, too, that there is more than one crystalline substance present.)

Artificial silks show the structure of cellulose, as might be expected; though there are small differences in the intensities of different spots, depending on the

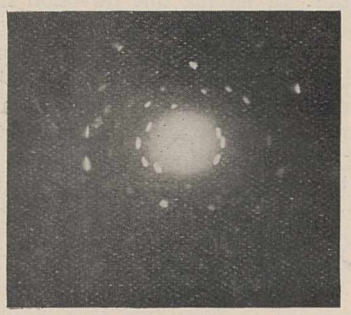

FIG. 5.—Spine of Arbacia. Laue photograph: rays heterogeneous, object held steady.

method of manufacture. Brill has examined a number of natural silks from different sources and found the same structure in all of them.

Herzog has examined chitin from various snails and insects, and found the same structure in them all. A very good spot diagram was obtained from a layer separated from the wing case of the Goliath beetle; the whole case, containing many layers, gave a blurred picture because the crystallites are not oriented the same way in the different layers.

In some cases the X-rays have confirmed previous suppositions, as, for example, that the spines of the sea-urchin consist of single crystals, or at least of aggregates of single crystals all similarly oriented in all respects, not merely in one direction (Fig. 5).

These will serve as examples of the application of the X-ray methods to various substances in the living organism. They are but a beginning, relatively few in number, and imperfectly understood.

In metallurgy the methods have been largely employed in the study of the gradual changes that take place during mechanical treatment. Rolling and drawing tend to give special orientations to the metal crystals. It has been shown by Wever, and by Owen and Preston, that in rolled aluminium foils the crystals finally arrange themselves so that (112) planes lie in the surface, a (111) direction being the direction of rolling (Fig. 6). The cube diagonals of the small cubic crystals lie in the surface; this condition is satisfied

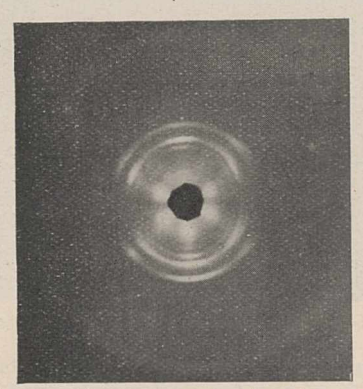

FIG. 6.—Aluminium foil rotated about an axis parallel to the direction of rolling [111]. Homogeneous rays.

by two positions of the cubes, which are images of each other in the surface.

The interesting point is that a certain tendency to orientation is a consequence of treatment which may be due either to mechanical handling or to some process of life. Absolutely irregular orientation cannot be generally consistent with purpose or design. Whenever small crystals exist in organic substances—and they are far more common than we have supposed—their arrangement is connected with growth, and they may be essential to it, or illustrate it, or be connected with it in some way or other which may be important to know. The X-rays show simply and conveniently the amount of any such regularity, and it is for that reason that it is interesting to apply them to a wide study of natural structures of all kinds.

[3] Shorter, *Journal of the Textile Institute*, **15**, 4, p. 207.

The Passing of Finsbury Technical College.

THE closing of Finsbury Technical College—familiarly known as "Finsbury"—on July 26, after an existence of nearly half a century, is an event which will be generally regretted. The College was founded in 1878 by the City and Guilds of London Institute, its object being specifically to train students in the principles of science as applied to industry. In this respect it was a new departure in English education, and great interest in its future was aroused both in academic and industrial circles. The courses of instruction were in applied physics, mechanical engineering (to which civil engineering was added later), and applied chemistry, the first professors being W. E. Ayrton, J. Perry, and H. E. Armstrong. A department of applied art, under the direction of Mr. A. Brophy, was attached, and from the beginning both day and evening classes were held in all subjects. The experiment was immediately successful, and in 1885 the Central Technical College at South Kensington—also founded by the City and Guilds of London Institute—was opened. Profs. Ayrton and Armstrong were transferred to the new establishment, and were succeeded by Silvanus P. Thompson and R. Meldola, both of whom held office for more than thirty years.

Thompson on joining the staff was made principal of the College, and threw all his energy into the work. Under his direction the reputation of the College rapidly grew, and students were attracted not only from different parts of the British Isles, but also from all over the world. The day students attended for two years, and received the College certificate on passing

the prescribed examinations. Special lecture and laboratory courses were arranged for evening students, many of whom made long train journeys to take advantage of the facilities afforded. No outside examinations were held, and within wide limits each member of the staff was permitted to teach what he thought best and most useful, instead of being tied down to an examination syllabus. Under this system Finsbury flourished, and the number of students increased to such an extent that further accommodation became necessary, and a new wing was added to the College in 1904, which included a large engineering laboratory equipped with modern machinery and commodious drawing-offices. It appeared at this date that Finsbury was firmly and permanently established; but in the ensuing years various difficulties arose which threatened this seeming security, and ultimately led to the closing of the College.

The first troubles were financial. The amount available for Finsbury depended mainly upon voluntary subscriptions to the Institute from the City Companies, which were in some cases reduced in order to provide for special activities on the part of the companies concerned. The development of the College was greatly impeded by the absence of much-needed funds at a time when competitive establishments, often financed from public sources, were being organised in London and other parts of England. Temporary relief was afforded by the closing of the Art Department; but Finsbury was unable to keep so far ahead of its rivals as to attract a full complement of students from all quarters, and about 1910 a notable fall in the number of entrants, both day and evening, occurred. A contributory cause, in the case of day students, was the extension of the course to three years in order to conform with new regulations for admission to membership of the professional institutions.

At this stage the College also began to suffer from the increasing importance attached by public bodies, and even commercial companies, to the possession of a university degree, for which no provision could be made without fundamentally changing the character of the instruction. The War, with the greatly increased cost of upkeep which supervened, added further to the financial difficulties, and a great loss was sustained by the deaths of Profs. Meldola and Thompson during the War. In 1920 it was announced that the College was to be closed, and no new students were admitted in that year. As the result of a widespread agitation the London County Council offered financial aid for a period of five years, and in 1921 new students were again enrolled. The numbers joining, however, were not considered sufficient by the County Council to justify a continuation of the grant, and as the necessary sum was not forthcoming from any other source the closing of the College became inevitable.

Such, in brief, is the life-history of Finsbury; but a few words are needed to explain why it became well known all over the world. The two chief causes were an efficient and enthusiastic staff, from the principal down to the laboratory boys, and a true research atmosphere which infected the students and contributed largely to the great success they achieved in all branches of applied science. Amongst members of the staff who attained to the distinction of F.R.S. were the five early professors already named and Profs. Dalby, Coker, Morgan, and Eccles. Many important researches in applied science were carried out at Finsbury, such as the early work of Mrs. Ayrton on the electric arc; of Ayrton and Perry on electrical measuring instruments; Thompson on X-ray targets, cathode rays, and various electrical and optical devices; Meldola on dye-stuffs; Dalby on the balancing of engines; Coker and Scoble on the optical method of investigating stresses in materials and on the temperatures prevailing in the cylinders of internal-combustion engines; and Eccles on various radio devices, including the valve-controlled tuning-fork.

All these researches were fundamental, and will in themselves preserve the name of Finsbury; but a much longer list could be compiled dealing with researches in many branches of physics, engineering, and chemistry conducted by other members of the staff. It will no doubt be possible easily to distribute the students who would have attended Finsbury among other institutions, but it will not be easy to establish everywhere they may go the atmosphere of enthusiastic work and inquiry which characterised the College and brought out the best that was in the students. It has been said that the usual fate of successful reformers is to render themselves superfluous; and Finsbury, which set out to reform technical education and succeeded, has had this fate forced upon it by adverse circumstances. Whilst its demise must be deplored, it will be a satisfaction to all who have been connected with the College in any capacity that it has made for itself a lasting name in the annals of British education. C. R. D.

The Oxford Meeting of the British Association.

OXFORD is in many respects a centre well-suited for meetings of the British Association for the Advancement of Science. It is easy of access from most parts of the country; it is well provided with accommodation for persons with moderate requirements; it is situated in a neighbourhood full of interest both historical and natural; and lastly, in its University lecture-rooms and laboratories it is able to furnish most of the conditions needed for the scientific business of the various sections.

In one particular Oxford is at a disadvantage compared with many of the places which have extended their hospitality to the Association—it is deficient in buildings large enough to collect all the members attending the meeting under one roof. It will not be possible in Oxford for even half of those who wish to do so to see and hear the Prince of Wales deliver his presidential address in his own person. The largest hall in the University—the Sheldonian Theatre—will not accommodate more than about 1500, and of these the large majority will have to submit to the discomfort of seats without backs. Conditions in the Town Hall, which has been put at the disposal of the Association by the civic authorities, are somewhat better adapted for an audience with present-day notions of comfort; though it will accommodate no larger number than the

Theatre where the address will be actually given. It is hoped that the Prince, at the conclusion of the business in the Sheldonian, will be able to visit the Town Hall, to which building his address will have been relayed. A further relay has been arranged to the debating hall of the Union Society, and in this way provision will have been secured for every one to hear the words of the president, and for nearly every one to see him.

The fact of the meeting taking place in Oxford will recall to the minds of many the records that exist of the famous meeting of 1860, which was especially signalised by the caustic reply of T. H. Huxley to the criticism passed by Samuel Wilberforce, then Bishop of Oxford, on the Darwinian theory of evolution—at that time a startling, and to the majority an unpleasant novelty. The scene of this memorable encounter was the northern section of the first-floor room in the front of the University Museum, part of which room is now occupied by the Hope Department of Entomology. To those who, like the present writer, heard the presidential address of the late Marquis of Salisbury at Oxford in 1894, there was something peculiarly impressive in the calm and measured language in which one of the former protagonists, Huxley himself, commented on an address which contained the words, "[Darwin] has, as a matter of fact, disposed of the doctrine of the immutability of species." The stage on which this latter development of the drama was played was the same as that which will witness the address of this year's president, namely, the Sheldonian Theatre. It was here, also, that the Marquis of Salisbury, on the occasion referred to, as Chancellor of the University, imparted a pleasantly light touch to the proceedings by introducing and welcoming himself as president of the British Association.

Oxford has, however, scientific associations of an earlier date. It will doubtless be remembered by many of the visitors that it was the scene in the thirteenth century of the labours and researches of Roger Bacon, the great Franciscan who, as the unflinching advocate of experimental science as against authority, was held by Humboldt to be "the most important phenomenon of the Middle Ages."[1] Perhaps some of the members of the Association will be able to find time to visit the traditional site of Roger's workshop at Folly Bridge, and the memorial tablet lately affixed to the old City Wall in close proximity to the spot where he is known to have been buried.

In Sir Archibald Geikie's happy phrase, "if Oxford was not present at the birth of the Royal Society, it at anyrate rocked the cradle of the infant." In these words he was referring to the account published in 1667 by Dr. Thomas Spratt of the meetings held "in *Dr. Wilkins* his Lodgings, in *Wadham College* (1648–59), which was then the place of Resort for Vertuous, and Learned Men." These meetings, says Spratt, in his History of the Royal Society, "laid the foundation of all this that follow'd." "By this means," he adds, "there was a race of yong Men provided, against the next Age, whose minds receiving from them [*i.e.* the men who met under Wilkins's auspices], their first Impressions of *sober* and *generous Knowledge*, were invincibly arm'd against all the inchantments of *Enthusiasm*."[2]

It need scarcely be said that the last word cited did not bear for the men of that time precisely the same meaning that belongs to it at the present day. Among the "principal and most constant of those who met at Wadham," Spratt enumerates the names of Seth Ward, the astronomer; Willis, the instructor of Lower and Mayow; Hooke, Robert Boyle, Sir William Petty, and "that miracle of a youth," as Evelyn calls him, Christopher Wren. The earliest experiments on transfusion were carried out in Oxford by Lower at the suggestion of Wren; and it is worthy of note that Sydenham, the great physician, and Mayow, the actual discoverer of oxygen and of the chemical and physiological explanation of combustion and bodily heat, were, besides Wren, all members of Wadham College, the institution presided over by the scientifically-minded brother-in-law of the Protector, spoken of by Evelyn as "that most obliging and universally-curious Dr. Wilkins."

The interest in 'natural knowledge' thus set going in the middle of the seventeenth century finds no abatement to-day; and those who will take the opportunity of the forthcoming meeting to make themselves acquainted with the scientific equipment and appliances now to be found in Oxford, will not fail to gain the impression that this ancient seat of learning is fully determined to take her proper part in the scientific progress of the present and future ages.

F. A. D.

[1] NATURE, June 18, 1914, p. 405.

[2] Italics and spelling preserved as in the original text.

The Ross Institute and Hospital.

OPENING BY THE PRINCE OF WALES.

NO ceremony relating to the health and welfare of the British Empire has attracted so wide an interest as the opening of the Ross Institute and Hospital for Tropical Diseases by H.R.H. the Prince of Wales on July 15. It was the outward and visible sign of the initial success of a movement started more than three years ago to found a Ross Institute for Tropical Diseases which should include a Research Hospital. That movement had several objects in view, namely, to do honour to Ross while living for his epoch-making discovery of the method of transmission of malaria to human beings, to commemorate for all time his great achievement, to further the much-needed work of research in the prevention and treatment of tropical and sub-tropical diseases, to create a more general professional and public interest in the prevention and treatment of tropical diseases throughout the vast possessions of Great Britain in the tropics, and to assist medical men to carry out research work.

It has long been the complaint of some of the most promising men in the tropics that there was no institute in London where they could have the facilities when at home for research work on any special subject that had interested them in the tropics, which they desired to pursue further in their leisure time. The Ross Institute will now help them. France has her Pasteur

Institute in memory of her great man of science and to carry on his work. America has her Gorgas Institute at Panama, Japan has her Kitasato Institute, London has now her Ross Institute and Hospital for Tropical Diseases, the president of which is the Duchess of Portland, the chairman, Sir Charles McLeod, Bart., and the vice-chairman, Mr. Walter Shakespeare. There is a strong executive committee and council. The present medical officers are Sir Ronald Ross, director-in-chief, Dr. Castellani, director of tropical medicine and dermatology, and Sir William Simpson, director of tropical hygiene. Sir Ronald is still hale and hearty, and it must have been a source of gratification to him that, twenty-nine years after his famous discovery, and when the application of it is universally acknowledged to have resulted in the saving of an enormous number of lives and made some formerly uninhabitable places habitable, to have this Institute bearing his name opened by the Prince of Wales, who was the first to give a lead to the appeal for the necessary funds which was made in the *Times* of June 23, 1923.

The building, which contains two hospital wards, three laboratories, a library, and nurses' quarters, is not large, but it is on a healthy site facing Putney Heath, and the grounds are sufficiently extensive to allow of great additions in the future.

The Prince on his arrival at the Institute was received by the president, the Duchess of Portland, and the chairman, Sir Charles McLeod. A number of presentations were made to His Royal Highness, who afterwards inspected the wards, laboratories, and library, and then proceeded to the dais reserved for him and facing a pavilion in which more than six hundred guests were assembled. Here the chairman, Sir Charles McLeod, presented an address to the Prince in which he mentioned that His Royal Highness on his visits through different parts of the Empire and in foreign countries had landed on many tropical shores, and that his interest and sympathy cannot but have been aroused by the record of the decimating scourge of diseases incidental to these latitudes. Many of these diseases still hold the field but, thanks to Sir Ronald Ross, in honour of whose discoveries this Institute was founded, one of the greatest of them—malaria—has been or can be practically overcome. Sir Charles described the objects of the Institute, the chief of which is by research into causes of diseases to lessen the burden which weighs so heavily on labour and industry, and still more terribly on human life, in tropical and sub-tropical lands. Great strides in the knowledge of tropical diseases have been made during the last quarter of a century, and there is every hope and encouragement that in the quest and exploration of still unknown regions in medicine it will be possible to add to the stores of that science which aims only at conferring benefits on all human beings. The Prince was then presented by Sir Charles with a golden key, on which was a colour impression of the Ross Institute, and asked to declare the Institute open.

The Prince of Wales in rising to speak was received with great enthusiasm, and said:

"The opening of this Institute, which I am very glad to perform, commemorates a definite achievement in the work which the British Empire has done for civilisation. Not the least important obligation which the development of that Empire has laid on the members of our race is the constant struggle against disease in all the varied forms it can assume in different climates and in different latitudes. The struggle is always fiercest in the tropics, where man, and especially the white man, is the continual prey of diseases from which we in this country are, comparatively speaking, protected by a more temperate climate; and perhaps the saddest page in the whole history of our Empire is that which tells of the terrible toll taken by plague and by fever of those who helped to build it.

"Of all these tropical enemies, malaria has probably been the most deadly and elusive. But now, thanks to the achievement of one man, whose name we are perpetuating in this Ross Institute, its ultimate defeat is certain. Only a few months ago I was able to see in the Sir Alfred Jones Laboratory in Sierra Leone not only the vital need for a campaign against malaria, but also the remarkable progress which has already been made in it. Perhaps I am biassed by many visits to tropical and sub-tropical parts of the world where malaria is rife, and by having talked with so many men and women whose health has been shattered by a life's work in such districts, but I can think of no other single discovery in recent times which will earn the deep gratitude of so many thousands of human beings of all nationalities as the discovery made in India by Major Ronald Ross—as he was then—on August 20, 1897. The story of its subsequent development and of what it has led to is well known to you all. I need only summarise it in the words of a famous writer: 'It is not too much to say that Sir Ronald Ross has made one-third of the world inhabitable.'

"Over a quarter of a century has elapsed since that epoch-making discovery, and this institute and hospital now stands as a memorial to the life-work of Sir Ronald and his colleagues. But it is not merely a passive memorial to work accomplished in the past; it is also, as Sir Charles McLeod has reminded us, a very active centre for work to be done in the future. All who have any experience of the tropics will know that there is still a vast field for scientific medical research, and here, with all the resources that modern science can provide, such research can be effectively carried out, provided adequate funds are forthcoming. From this building may issue results which will bring back health to thousands who have lost it, or safeguard the lives of countless others threatened by unseen dangers in tropical lands. More than that, it may open out for the use and benefit of mankind as a whole, huge districts which are at present denied to civilisation.

"It is not surprising, therefore, that, when the scheme for founding this Institute was first put forward, it immediately received widespread public support. That support happily made its inception possible, and once the first financial obstacle was surmounted, its promoters lost no time in making it a reality. To the president, the Duchess of Portland, to Sir Charles McLeod and Mr. Shakespeare, and to Sir Ronald and his two co-directors, Sir William Simpson and Dr. Castellani, the gratitude of all of us is specially due for the time and energy they have devoted to its execution. They and their fellow-officers of the Institute may well feel proud of the result of their labours and of the knowledge that they have called into being something which cannot fail to be of incalculable benefit to many generations.

"It is with the sincere hope that further public

support for the necessary endowment may be forthcoming, and that the labours of those who will work here may be blessed with every success, that I now declare the Ross Institute and Hospital open."

After the Bishop of Southwark offered a dedicatory prayer, a vote of thanks to the Prince was proposed by the Duchess of Portland, and seconded by Sir Ronald Ross, who expressed his grateful thanks to the Prince for the kind manner in which His Royal Highness had referred to his work. He also thanked all the contributors for the honour they had done him in naming the Institute after him. The Prince replied to the vote of thanks, and after his departure the Institute was opened to the inspection of the guests.

News and Views.

ON July 14, in the House of Lords, the Duke of Northumberland directed attention to the alteration in the status of the engineer officers of the Royal Navy brought about by the Admiralty Fleet Order 3241/25 issued last November. This matter has already been referred to in these columns on several occasions. In his remarks the Duke of Northumberland said that the Order abolished the last vestige of the improved status of the engineer officer under the 1902 scheme for the amalgamation of the engineering branch with the deck officers. Not only did it relegate the engineer officer to the non-executive branch of the Navy, but it also emphasised the distinction between the deck officer and the engineer officer by re-imposing the wearing of the purple stripe. The Duke of Northumberland was supported by Viscount Chelmsford and the Earl of Selborne, the latter remarking that the point of view of the engineer officers had been recapitulated by Engineer Rear-Admiral Sheen in a letter in the *Times* of June 1, and to that he had seen no answer. Moreover, the Order might do great harm and could do no possible good. Viscount Chelmsford said that the question had arisen when he was First Lord and he had left a personal note for his successor, Mr. Bridgeman, to the effect that there had been no acute demand for the change, and that the system as it then stood was working well. The Duke of Montrose also spoke. He seemed to think that because purple had been worn by emperors, engineers should not object to it. The answer to that is, of course, that it is the way it has been imposed and what it signifies that renders it so distasteful. With his suggestions that engineer officers should have executive command of certain establishments ashore and that an engineer officer should be appointed a Sea Lord of the Admiralty a good many will agree.

THE reply for the Admiralty was made by Earl Stanhope, who repeated Mr. Bridgeman's assurance that the Order did not affect the ranks, titles, and powers of engineer officers. That, however, is not correct, for the Order does undoubtedly take away the power of engineer officers to rise to certain high appointments which they could have reached as executive officers. Earl Stanhope said that the Order was designed to sweep away an anomalous position, and divided all officers into categories according to their duties. He did not say, however, why there should be three categories of engineer officers—one for the main machinery, one for the gun machinery, and one for the electrical machinery, while navigating, gunnery, and torpedo officers all remained in one category. Such a reply will give no satisfaction in engineering circles, and does nothing towards removing that sense of injustice from which engineer officers are suffering. In view of the apparent determination of the Admiralty to stand by this Order and to impose the purple stripe, we think the Joint Committee of the Engineering Institutions, of which Sir William Ellis is chairman, would do well to issue a short plain statement of the matter as it now stands. The excellent memorandum issued some months back was too long for general distribution, and in the highest interests of Great Britain this is a matter for the widest publicity.

ON July 22 the centenary occurred of the death of Guiseppe Piazzi, the discoverer of the first of the minor planets. Piazzi was born in the north of Italy in 1746, and came under some of the most distinguished teachers of his day. He then entered the monastic order of the Theatines. A professor first at Genoa and then in Malta, in 1780 he was appointed to a chair of mathematics at Palermo. His efforts to found an observatory there were seconded by the Viceroy of Sicily, Prince Caramanico, and the observatory was opened in 1791. Piazzi meanwhile had studied Lalande's methods in Paris and Maskelyne's at Greenwich, and when he returned to Palermo in 1789 he had among his instruments a 5 ft. vertical circle by Ramsden. He devoted himself to the preparation of star catalogues, and it was while pursuing this work that in January 1, 1801, he discovered Ceres, named thus in allusion to the titular goddess of Sicily. He communicated his discovery in the first place to Oriani, who calculated the elements of its orbit, and then to Bode. Piazzi's star catalogues were published in 1803, 1807 and 1814, the latter containing 7646 stars. He served for some time as president of the Academy of Sciences of Naples, and was elected a foreign member of the Royal Society of London. By his will he bequeathed his library and instruments to the observatory at Palermo, and left an annuity for educating students in astronomical science.

THE news of the impending retirement of Prof. J. A. Fleming from the chair of electrical engineering at University College, London, a position which he has occupied since its foundation in 1885, will be received with regret by the large number of friends and students who have come under his influence. His tenure of office has been practically co-extensive with the growth of modern electrical engineering, a development in which he has taken a great part. So early as 1879 he was the scientific adviser of the original Edison Telephone Company of London, and in 1882 he was appointed to a similar position with

the Edison Electric Light Company of London, taking part in the establishment of the first electric supply stations. In 1890 he acted in the same capacity for the London Electric Supply Corporation, formed to operate the Ferranti system of high voltage electric supply, using single-phase alternating current. In 1899 he was retained by Marconi's Wireless Telegraph Company to advise on the engineering work in connexion with the establishment at Poldhu of the first high power radio station in the world. Prof. Fleming has thus been in intimate touch with the early development in Great Britain of the three important electrical inventions: the telephone, the electric incandescent lamp and radio communication. During the forty-one years of his teaching work at University College, about 2000 students have passed through his department, many of whom have since achieved great distinction, there being among them three who have become presidents of the Institution of Electrical Engineers. His interest in general education has shown itself in the prominent part which he took in the work which led to the foundation of the Morley Memorial College.

PROF. FLEMING'S original contributions to knowledge are comprised in rather more than a hundred papers published in the transactions of various learned societies and covering such matters as the direct reading potentiometer, the investigation in conjunction with the late Sir James Dewar of the electric and magnetic properties of matter at low temperatures, a paper read before the Institution of Electrical Engineers in 1885 on the necessity for a National Electrical Standardising Laboratory, which gave the first impulse to the movement that resulted in the establishment of the National Physical Laboratory, and the invention of the thermionic valve, which in its modernised form is the essential element in radio communication. He is the author of a large number of very widely known text-books on electrical subjects. He was elected a fellow of the Royal Society in 1892 and received the Hughes Medal of the Society in 1910. The Royal Society of Arts awarded him its Albert Medal in 1922, especially for his invention of the thermionic valve. The Institution of Electrical Engineers has awarded him its Institution premium on two occasions, and made him an honorary member in 1923. His membership of other societies includes that of the Society of Engineers of London, the Glasgow Philosophical Society and honorary membership of the Royal Engineers' Institute, Chatham. Prof. Fleming's great gift of clear exposition and successful experimenting has created for him a special place as a public lecturer, as the audiences whose attention he has held on very many occasions at the Royal Institution have testified. He carries with him into his retirement the sincere good wishes of a large circle of friends, colleagues and students.

IN his address to the tenth annual meeting of the Association of British Chemical Manufacturers, held on July 8, Mr. D. Milne Watson, the chairman, dealt with recent activities of the Association and certain topical events, such as the coal strike, from the point of view of the chemical manufacturer. The British chemical industry may be comparatively small, yet it is advancing: during the decade 1911–21 the number of persons engaged in it increased from 0·81 to 1·15 per cent. of the total number of occupied persons in the country. Although rather jaded with fairs and exhibitions, the Association has supported the revived British Industries Fair; the view is held that chemical firms should not, as a rule, exhibit individually or indiscriminately, but unitedly as an industry at selected exhibitions. Whatever views may be held on the policy of protection, there is no doubt that the careful survey of an industry prior to legislating, such as was recently carried out in connexion with the extension of the Safeguarding Act to the fine-chemical industry for a further period of ten years, is very stimulating to the industry; on the other hand, care is needed to prevent a protected industry from becoming lethargic.

REFERENCE was also made in Mr. Watson's address to the harm done in recent years by viewing the dyestuffs industry through magnifying glasses. This industry suffers from fierce competition abroad, and from an excess of plant left over from the War. The contention that it has a secure home market is only a half-truth, for security is only given when a dyestuff is equal in quality to a competing foreign one, and when it is sold at a price which does not place the user in an unduly disadvantageous competitive position. Consolidation of interests, such as has been effected between Scottish Dyes, Ltd. and the British Dyestuffs Corporation, and between British Synthetics, Ltd. and the British Alizarine Co., is advisable and should be extended; and the lines upon which industrial development is proceeding in other countries must be studied with the view of introducing changes in the organisation of British chemical industry. The council of the Association does not see how it can take any effective or direct part in negotiating a settlement of the coal strike, but it is co-operating to that end with other industries under the ægis of the Federation of British Industries. So far, chemical manufacturers have been able to maintain stocks and to meet all demands. The fact that during the general strike only a very few employees in the chemical industry left their work is ascribed to the cordial relations which have always subsisted between masters and men, and to the circumstance that the men are for the most part really interested in their work.

IN the discussion on the chairman's address, Dr. E. F. Armstrong emphasised the need of more effective co-operation among home-producers, and also the undesirability of building up sections of the industry "which are strong because they are members of international groups, in which the British voice varies in loudness." All indications point to foreign competition becoming more fierce. The Right Hon. J. W. Wilson referred to the magnitude of the German Interessengemeinschaft and to the even greater combination in the iron and steel industry; although

the United States will probably follow suit, this line of development is not in accordance with the British temperament. Dr. G. C. Clayton, M.P., has noted the increased attention paid by the House of Commons to chemical matters, while the Government is showing considerable interest in the Department of Scientific and Industrial Research. He regards recent results obtained in the Fuel Department as hopeful, and thinks that before long an economic process for recovering the valuable products from coal and for producing smokeless fuel will see the light of day. The Germans claim that they have overcome most of the difficulties in producing liquid fuel direct from coal; we in Great Britain are not very far behind them, if, indeed, we are not actually in front.

THE annual meeting of the Society of Chemical Industry and Congress of Chemists, in which a number of societies with related interests are co-operating, opened on Monday, July 19, and in the afternoon the Messel Memorial Medal was presented to Lord Balfour by the Duke of York. After the presentation, Lord Balfour delivered the Messel Memorial Lecture, taking as his subject the relation of the State to science and industry. In tracing the association between science and industry, Lord Balfour referred first of all to the men of genius, moved solely by the desire to add to the store of human knowledge, to whom falls the glory of making fundamental discoveries. This work can be stimulated only by education. The next stage is accomplished by men of constructive ability who can see how the achievements of the scientific worker are to be applied. Then comes the time for testing the results on a scale larger than that of the laboratory experiment, and finally there is the full scale trial which, if satisfactory, means that another piece of laboratory work has been applied to the purposes of industry, and the organisation of production and marketing can proceed. A Government department can do little to further fundamental discovery and should not interfere with the last stages of development, namely, production and marketing. Its assistance should be given, Lord Balfour stated, in the middle region, where industry as a whole rather than one special branch is concerned. There has been no falling-off in the achievements of British men of science or in the business capacity of the leaders of industry, but more co-operation is needed between them, coupled with the broad and imaginative outlook which has been the basis of the great industries in other countries of the world.

IN the course of an address delivered by Sir Robert Hadfield on the occasion of the opening of new metallurgical and engineering research laboratories during the twenty-first anniversary celebrations of the University of Sheffield, the speaker reviewed the history of the University and its predecessors, the Firth College and the Technical School, and of the efforts made to establish educational facilities in connexion with the industries of the city. Although Sheffield had been for many centuries an important centre for the manufacture of steel by the old methods, it was not until the invention of crucible steel by Huntsman in 1740 that it began to assume the leading position which it has occupied ever since. It is remarkable how, the manufacture of steels of specially high quality having once been established, the existence of a skilled body of workers, and of manufacturers accustomed to the trade, favoured the introduction of new processes, so that a large number of important inventions, especially concerning alloy steels, have originated in that city. It is also appropriate that the study of metallography, which may be said to have furnished the scientific basis for all modern metallurgy, should owe its origin to a Sheffield scientific man, H. C. Sorby, a pioneer in so many branches of science. The new laboratories are equipped for the investigation of metals, and particularly of steel, by modern physical methods, in view of the remarkable results which have been attained by the application of exact physical measurement and by the study of physical properties in the improvement of metallurgical operations.

SIR ROBERT HADFIELD'S address contains statistics concerning the work of Sheffield firms during the War, when the great armament plants were largely increased and enormous quantities of munitions were produced. Statistics as to present employment show the number of employed persons to be about 184,000, of whom, roughly, 42,000 are engaged in the iron and steel industry and 21,000 in cutlery, to name the two occupations most usually associated with the city. The importance of education and training for these industries is therefore obvious, and the University has set itself to meet the needs of the local population, whilst at the same time becoming a centre of post-graduate study and research. In view of the situation on the South Yorkshire coalfield, the study of coal also assumes great importance, and the Fuel Department of the University has been specially equipped for research on the utilisation of coal. One of the urgent needs of the industry is the greater application of electrical power, and interesting facts bearing on this subject are quoted by the author. Even with the existing comparatively high cost of electric power, its use in the steel industry has assumed vast dimensions.

THE fifth Hurter and Driffield Memorial Lecture was delivered by Prof. Charles Fabry before the Royal Photographic Society on April 20 last, and is published, with illustrations, in the July issue of the Society's journal. Prof. Fabry took as his subject "The Photographic Plate as an Instrument for the Measurement of Visible and Invisible Radiations," and passed in review probably all the useful methods of photographic photometry, indicating their respective advantages, difficulties, and limitations. The use of polarisers for varying the intensity of the incident beam is excellent when the light is not partially polarised, but the layer of Canada balsam present in most polarisers is absolutely opaque to ultra-violet radiations of wave-length less than 3400 Å.U. Beyond this the balsam may be replaced by air, but this gives a small angular field. Prof. Fabry adds, "I have, however, used Glan prisms with success." When

working in the ultra-violet region in conjunction with M. Buisson, it was found that the stripped gelatine film (glass being inadmissible because of its absorption) of a developed plate gave a sudden diminution of its absorptive power, transmitting about twelve times as much light at 3150 Å.U. as at a little distance on either side of this point, due to the transparency of metallic silver for radiations of about this wave-length. This difficulty was overcome by intensifying the plate with mercuric chloride and ammonia before stripping. Schumann plates are not suitable for photometric purposes because of the irregularities following from the difficulties of their manufacture, but the 'oiled plate' introduced by Duclaux et Jeantet is spoken of as perfectly suitable. A thin layer of mineral oil put upon the plate fluoresces in the ultra-violet and the fluorescent light affects the plate. An illustration shows the effect with and without the oil for wave-lengths from about 2816 to 1854 Å.U. Prof. Fabry urges the desirability of founding one's photometry on the energy (or heating power) of radiations, as this is "the only real measure of the intensity of a radiation." "Two rays which appear equal with a certain exposure may seem to be absolutely different if a longer exposure is given."

A SERIES of postcards depicting objects of scientific interest preserved in or connected with the Old Ashmolean Museum has recently been issued by the Oxford University Press. The collection comprises a set of designs representing the Old Ashmolean at different dates, including a reproduction in colour of a print by Rowlandson (1809). Another set, devoted to the Dodo, begins with an excellent coloured copy by Mrs. Gunther of the well-known picture in the Sloane Collection, and is continued by De Bry's representation of the landing at Mauritius in 1598, by the drawings of Clusius and Savery, and by photographs of the head still preserved at Oxford. An interesting series of portraits starts with Richard of Wallingford, Merton College (1292–1336), the first describer in detail of the making of scientific instruments, and ends with John Evelyn, Balliol College (1620–1706). Other notable portraits are those of Robert Recorde, All Soul's College (1510–1548), the inventor of the mathematical signs of multiplication and equality, Robert Boyle, Elias Ashmole, Christopher Wren, and John Wilkins, the last two of Wadham College. In a set representing the history of medicine occurs a drawing by Christopher Wren of the base of the brain, which for exactness of detail could scarcely be bettered at the present day.

SINCE the quantum theory of spectrum emission was started on its career by Bohr in 1913, the stream of contributions by workers in all parts of the world has been almost unparalleled in its volume and variety of character. The, as yet, semi-empirical character of the whole conception gives the widest possible scope to speculation and the formation of arbitrary practical rules, and such rules have for some time been put forward at too rapid a rate for the controlling factor of experiment to separate the false from the true. The subject has consequently become so intricate and so charged with ideas, many of which are incompatible with one another, that the experimenter who has wished to obtain a clear idea of what is being proposed has had no time left for his experiments. In particular, the notations and numerical values assigned to the various 'quantum numbers' now recognised are almost as numerous as the writers on the subject, and the resulting confusion, which is largely unnecessary, has been a serious hindrance to the acquiring of definite ascertained knowledge. The appearance of a new *Bulletin* of the National Research Council of the National Academy of Sciences, Washington, on "Quantum Principles and Line Spectra," by J. H. Van Vleck, assistant professor of physics in the University of Minnesota (Washington, D.C., National Academy of Sciences, 1926, 3 dollars), in which the many-sided activities of theoretical workers are ably summarised and compared with one another, is therefore an event of great importance. Duplication of Sommerfeld's "Atombau und Spektrallinien" has been avoided so far as possible, and particular prominence is given to the methods of approaching the subject which are suggested by Bohr's correspondence principle. The volume has been brought up-to-date during passage through the press by the insertion of numerous footnotes, and may really be said to be invaluable to the large body of workers in spectroscopy. The author is to be commended on the clearness of his exposition. Each sentence has usually only one possible meaning—a characteristic which is far too rare in many of the original papers on the subject.

ROTHAMSTED Experiment Station appears to have made a new departure in the issue, in very attractive form and under the general title of "Rothamsted Conferences, I.," of an account of a recent discussion at Rothamsted upon the growing of lucerne. This little memoir is extremely effective. The case for a further cultivation of lucerne in Great Britain is first presented by Sir John Russell and members of his staff. Experience with lucerne is then given by members of staff from various experiment stations, by private growers, by big seedsmen, etc. Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture and Fisheries, and Lord Clinton, chairman of the Lawes Agricultural Trust Committee, contribute, as also Mr. Dampier Whetham of the Royal Agricultural Society Research Committee. This committee has helped financially Mr. H. G. Thornton's experiments upon inoculation by *Bacillus radicicola*. A summary of points collected at the conference follows upon the discussion and makes a very clear presentation of the main case for lucerne growing. It appears that lucerne has often been a failure because British soils are not infested with the strain of the nodule nitrogen-fixing organisms necessary for its healthy growth. Mr. Thornton's field trials suggest that the difficulties in the way of successful inoculation often met with in the past are now overcome and lucerne then deserves a more extended trial. It will not grow on ill-drained or shallow soil, and probably requires a fair supply of lime; it must be sown on clear land and the weeds

kept down by suitable cultivation. Given these conditions, it is apparently one of the most valuable of arable crops, and adds to the fertility of the soil, permitting a more intense farming. It gives each year after the first year usually two good hay cuts and a green aftermath for cutting or grazing.

THE Council of the Royal Meteorological Society has awarded the Howard Prize for 1926 to Cadet B. W. Harman, of H.M.S. *Worcester*, for the best essay on "The Causes and Distribution of Fog in the North Atlantic."

DR. W. H. GIBSON has been appointed Director of Research for the Linen Industry Research Association in succession to Dr. J. Vargas Eyre. Dr. Gibson was educated at University College, London, under Sir William Ramsay, and afterwards spent twelve years at the Research Department, Royal Arsenal, Woolwich; for his services in connexion with high explosives research during the War he was awarded the M.B.E. in 1918 and the O.B.E. in 1920. For the last seven years he has been in charge of the Research Department of a prominent linen firm in Belfast.

EXCAVATIONS on prehistoric sites in the Crimea are about to be commenced under the auspices of the Russian State Academy for the History of Material Culture by G. A. Boutch-Osonolovsky. The first site to be attacked is the Kik-Koba cave, where it is hoped may be discovered missing parts of an early human skeleton already found. Exploration will then be extended to the hill caves of later palæolithic age in continuation of the investigations which were begun in 1924.

IT is stated in *Science* that, at the annual meeting of the Geological Society held at Peking on May 3-5, the first presentation was made of the Grabau Medal, founded by Mr. C. Y. Wang for "accomplishment in the field of geological research in China, or for original advancement of the science throughout the world." This first award was made to Prof. Amadeus W. Grabau, who has been largely responsible for the training of an active group of young Chinese geologists and has himself contributed to our knowledge of the invertebrate fossils and palæogeography of China and Central Asia.

THE secretary of the Department of Scientific and Industrial Research announces that a licence, under Section 20 of the Companies (Consolidation) Act 1908, has been issued by the Board of Trade to the British Food Manufacturers' Research Association, which has been approved by the Department as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of this Association is Mr. R. M. Leonard, 22 Buckingham Gate, London, S.W.1. The investigations of the Association will be conducted in close co-operation with those of the British Association of Research for the Cocoa, Chocolate, Sugar, Confectionery, and Jam trades.

PROF. H. H. BARTLETT, Director of the Botanical Gardens of the University of Michigan, who has just been appointed honorary collaborator of the Smithsonian Institution, is about to make collections of the flora of Sumatra and Formosa for the Smithsonian Institution and the University of Michigan. The flora of Sumatra, which is exceptionally rich from the scientific point of view as well as economically important, is poorly represented in the United States collections. During a year previously spent in studying the rubber-producing plants of Sumatra, Prof. Bartlett's attention was attracted to the folklore of the poorer Malays, and especially to their custom of writing beliefs, legends, and descriptions of the magical and medicinal properties of plants on the internodes of green bamboos which are afterwards dried and preserved. This folklore has received little attention hitherto. Prof. Bartlett proposes to devote some part of his time to the study of it as well as the language during his stay in the island.

REFERRING to the review entitled "Eugenic Reform" in NATURE of July 10, p. 39, Mrs. C. B. S. Hodson writes stating that her share in Major Leonard Darwin's book "The Need for Eugenic Reform" was confined merely to proof-reading for the detection of printer's errors.

UNDER the title "Instructions to Collectors: No. 7—Blood-sucking Flies, Ticks, etc." (1926: price 6*d*.), the British Museum (Natural History) has issued a fifth edition, revised and enlarged, of a useful illustrated pamphlet. The Museum requires carefully collected and properly labelled material of this kind from practically all parts of the world. Medical men and others who may be willing to help in the collection of specimens will find within its pages full directions for the collecting, mounting, and transmission to England of such material (other than mosquitoes).

MR. E. PICKWORTH FARROW'S book upon the plant life of East Anglian Heaths was recently reviewed in these columns (NATURE, December 19, 1925, p. 896). Based upon the experience of vegetation study recorded in this book, Mr. Farrow communicated a brief article entitled "The Study of Vegetation" to *Discovery*, which is intended to stimulate and, to some extent, to guide the beginner in this fascinating field of inquiry. In an enlarged form this article has now been reprinted as a pamphlet which is published by Messrs. Blackie and Son, Ltd., on behalf of the Coastal Research Laboratory and Bird Sanctuary at Blakeney Point, Norfolk (price 2*s*.). The price of the pamphlet may seem a little high, but all proceeds from its sale go towards the maintenance of this well-known centre of ecological research, now under the National Trust.

THE Fuel Research Board of the Department of Scientific and Industrial Research has just issued a further pamphlet in the series of the Physical and Chemical Survey of the National Coal Resources. This pamphlet, No. 6, is the fourth dealing in detail with one of the seams of the Lancashire Coalfield, the present one being devoted to the King Seam; sections of the coal in various parts of the coalfield are given as it happens to vary a good deal both in thickness and in quality, the latter point being brought out by analyses of the coal from a number of points in the

coalfield. This pamphlet is on precisely similar lines to those previously published, and gives a mass of valuable information concerning the coal seam under discussion.

MESSRS. J. J. Griffin and Sons and Baird and Tatlock have issued a joint catalogue, No. 50, of scientific apparatus mainly for physics. It is well printed and bound and has 735 pages, 14 of which are devoted to the index. In the section on light, an X-ray spectrograph, neon lamps, and a number of new optical benches are described. Under electricity, several new forms of galvanometers, resistance boxes, selenium cells, and electric furnaces are to be found.

THE latest catalogue (New Series, No. 19) of Messrs. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, deals with upwards of 3000 works relating to astronomy, classified as follows: History, biography, bibliography; origin and development of astronomy from Aristarchus to Sir W. Herschel; periodicals, publications of societies and observatories; elementary works, treatises, dictionaries; spherical and theoretical astronomy; celestial mechanics; practical astronomy; spectroscopy, solar and stellar spectra, photometry, photography; astrophysics, cosmogony; the sun, transits, sunspots; eclipses; Mercury, Venus, minor planets; the earth; the moon; Mars; Jupiter; Saturn, Uranus, Neptune; comets and meteors; stellar astronomy; double and multiple stars; variable stars, red stars and nebulæ, clusters, Milky Way.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—Demonstrators in civil and mechanical engineering in the University of Leeds—The Registrar (July 28). An assistant lecturer in philosophy at the University College of Wales, Aberystwyth—The Secretary (August 3). An assistant in the department of physics of University College, London—The Secretary, University College, Gower Street, W.C.1 (August 7). A lecturer in biology and chemistry at the Municipal Technical College, Swansea—The Director of Education, Education Office, Dynevor Place, Swansea (August 9). A chemical pathologist and lecturer on chemical pathology (jointly) at St. Bartholomew's Hospital Medical College—The Dean of the College, E.C.1 (August 16). A professor of music at the University College of Wales, Aberystwyth—The Secretary (August 25). A lecturer in moral philosophy in the Queen's University, Belfast—The Secretary (August 31). An assistant master at the Kingston-upon-Thames Technical Institute, to teach engineering workshop practice—The Principal.

Our Astronomical Column.

KOPFF'S PERIODIC COMET.—This short-period comet was discovered by Kopff in 1906, and was detected again after two revolutions in 1919. It passed perihelion last January, when ephemerides were published in the *B.A.A. Handbook* and elsewhere. However, the comet was then badly placed for observation, being nearly behind the sun; it escaped observation for six months after perihelion. Prof. M. Wolf succeeded in photographing it on July 13 at $1^h\ 5{\cdot}2^m$ U.T. in R.A. $1^h\ 17^m\ 12^s$, N. Decl. 18° 14′, the magnitude being 16. The observation indicates Jan. 27·15 as the date of perihelion. The other elements are taken from the *Handbook*:

ω	19°	43′	29″	log q	0·232113
Ω	263	55	10	e	0·51422
i	8	41	30	Period	6·5842y

The comet is probably only observable with large reflectors; the following ephemeris is for 0^h U.T.:

	R.A.	N. Decl.	log r.	log Δ.
July 26.	$1^h\ 27^m\ 48^s$	19° 55′	0·3680	0·3060
Aug. 3.	1 32 24	20 47	0·3761	0·2949
11.	1 35 33	21 31	0·3839	0·2828
19.	1 36 48	22 3	0·3917	0·2715

THE CONSTITUTION OF THE INTERIOR OF THE EARTH.—Dr. H. Jeffreys read a paper on this subject at the June meeting of the Royal Astronomical Society which is printed in vol. 1, No. 7, of the Geophysical Supplement of the *Monthly Notices, R.A.S.* It has hitherto been supposed that the rigidity near the earth's centre is very great, but since it was discovered that secondary seismic waves are (apparently) not transmitted through this region, Dr. Jeffreys reinvestigated the data for rigidity in the interior, including that based on the tides, and finds that they are quite consistent with the interior being composed of liquid iron, possibly with an admixture of nickel. The depth of the outer boundary of this liquid core is given as 2900 km. or 0·455 of the radius, this being the surface of discontinuity of seismic waves found by Gutenberg. Though mainly geophysical, the paper has also an astronomical bearing.

LARGE SOLAR PROMINENCE.—The recent appearance of a very large prominence has been reported by Mr. Newbegin observing with his solar spectroscope at Sutton. On July 16 at $10^h\ 25^m$, it extended 40° around the sun's west limb—from position angle 276° to 316°—and its height was then 85 seconds of arc. Probably it is the largest prominence observed as yet during the present cycle. Its character was of 'massive' formation and quiescent in type. An amount of fine detail is indicated by Mr. Newbegin's sketch, the prominence appearing to be composed of a number of tree-like structures rising at more or less equal distances from the chromosphere and connected together by branching filaments.

As a class, the large massive prominences last for some time—frequently for several weeks—and although usually found within the sunspot zones they are rarely, if ever, seen above a spot. In the present instance there was no spot in the vicinity, but there were faint patches of faculæ which were the remains of the extensive area connected with the great spot of December and January last. Indeed, the position of the prominence, at least for a portion of it, is almost identical with that of this spot. The mean position of the spot during its two transits in December and January was longitude 32°, latitude 22° N. Allowing for the average polar retardation at latitude 22°, the longitude of the place originally occupied by the spot was 0° on July 16, while the longitude of the sun's western limb on the same day at the time of Mr. Newbegin's observation was 2°.

Spectroheliograms showing disc markings and limb phenomena have doubtless been secured at several observatories equipped with spectroheliographs and should give additional information of great value as to the life-history of this large prominence, which is evidence of a recrudescence of activity in the chromosphere above an extinct sunspot. It may be added that no unusual magnetic disturbance has recently been recorded in this connexion.

Research Items.

EFFECTS OF MENTAL WORK.—A paper of great interest on the changes which take place in the metabolism of the body during severe mental work has been published by Prof. V. Suk of the Masaryk University, Brno, Czechoslovakia (*Bull. internat. de l'Acad. des Sc. de Bohême*, Nov. 20, 1925). Prof. Suk took the following three groups of students: Group 1—29 men undergoing physical training in a teachers' college; group 2—31 members of the highest class in a *gymnasium* working for final examinations; group 3—31 members of another class also working for examinations. He kept these three groups under observation for three months, keeping a record of the amount of hæmoglobin and of sugar in their blood. There was a slight increase on the percentage of hæmoglobin in those undergoing physical training while that in the brain-workers remained stationary. On the other hand, while the blood-sugar remained stationary in those who exercised their bodies, there was a fall of 36-38 per cent. in the sugar content of the blood in the brain-workers. Severe and prolonged mental toil, therefore, does interfere with the carbohydrate metabolism of the body. The exact mechanism by which the nervous system produces this change is not apparent, but it may be through an effect produced in the functions of the liver. It is well known that brain-workers are particularly liable to colds and other infections, and Prof. Suk suspects that this liability may arise from the reduction of their blood-sugar.

THE CHANCELADE SKULL.—In *Annals of Eugenics*, vol. 1, Parts 3 and 4, Mr. G. M. Morant compares, by means of modern statistical methods, the craniometrical features of the skull found in 1888 by Féaux and Hardy near Raymonden, Chancelade, with those of Fürst and Hansen's series of Greenland Eskimos. He concludes, in agreement with the suggestion of Testut, and contrary to Keith's recent verdict (*Man*, 1924), that the Magdalenian skull is not more removed from the mean type of the modern inhabitants of Greenland than many individuals picked at random from that population are likely to be. In accordance with the view that the Chancelade individual was closer to the Eskimo than to the modern English, he sees justification for assuming that, in the Magdalenian period, a race of hunters existed in southern Europe, which migrated northwards following the reindeer, or was pushed to the fringe by other and invading races. Excellent photographs, taken with a telephoto-lens to reduce distortion, accompany the study.

POTTERY FROM CHANCAY, PERU.—A further study of the Uhle Collections of Peruvian pottery in the University Museum appears as vol. 21, No. 7, of the *University of California Publications in American Archæology and Ethnology*. Mr. A. L. Kroeber now describes the pottery from Chancay which was obtained by Dr. Uhle in graves on five sites described in his field notes, part of which form an appendix to the present publication. Five successive styles are represented: black-on-white, a style known as that of Chancay and the latest in date; three-colour geometric, epigonal (three and four colour), white-on-red, and the interlocking style. White-on-red is a hitherto undescribed style which is definitely Central Peruvian. The interlocking type, of which the most common design has the typical outline of complementary animal heads with worm-like bodies having serrated edges, is undoubtedly textile in origin. Certain vessels present affinities with the Proto-Nasca of Ica, and, further, round lumps of adobe characteristic of Proto-Nasca construction were also found with the Chancay burials. Dr. Uhle has demonstrated the relation of Ica in the north and Truxillo in the south. Notwithstanding the wide geographical separation of the two styles, Chancay, lying half-way between the two, appears to bridge the gap by a civilisation of the same general character, and suggests a cultural stage all over Peru at a remote epoch antedating Tiahuanaco. The importance, undoubtedly religious, of this design was indicated by the discovery of a painted wall belonging to a small terrace building on an artificial base. The wall was 23 m. long and 1·6 m. high at its best-preserved part, and was painted in four colours with outlines of the textile design.

THE FOX INDIANS.—The fortieth annual report of the Bureau of American Ethnology (1918–19), which has just been issued, contains, in addition to the report of the chief of the Bureau, five accompanying papers by Dr. Truman Michelson based upon material gathered fourteen years ago and supplemented by later information dealing with the Fox Indians of Iowa. Each paper is a Fox text written out in the current syllabary by one of the Indians and afterwards phonetically restored, accompanied by an English translation and ethnological and linguistic notes by the author. The first paper deals with the mythical origin of the White Buffalo dance, and contains, in addition to the information about Fox ritual, some interesting data bearing upon changes in custom and the social and religious outlook of the Indians. The reverent observance of religious rites still to be found among the older men is no longer characteristic of younger generations, who attend the dance purely for social purposes and to get something to eat. A note on mortuary customs and beliefs is important for its detail and for the light it throws on observances in connexion with behaviour after death of a husband or wife and remarriage. Of the remaining three papers, two deal with Fox religious societies, and the third, an autobiography of a Fox woman, is unique. It begins with her earliest recollections, and from her eighth year gives particulars of her introduction to the various household duties which fall upon the woman in the Indian family. At nine years she helped her mother in the planting; at ten in washing clothes and cooking, and in cutting and gathering wood; at eleven she learned to make bags, and so on. One of the most interesting features of the story is the importance of the mother's brother, which becomes especially marked after marriage, when the father ceases to function in relation to his daughter and his place is more than taken by the uncle. For example, the uncle advises his niece as to her behaviour after divorce, and when her husband dies instructs her in the mourning ceremonies and the observances which secure release from the death ceremonies. Apparently this function of the maternal uncle has nothing to do with matrilinear descent, and cannot be regarded as a survival of that system, though the Foxes are now patrilineal.

THE ALIMENTARY CANAL OF SCORPIONS.—In the current issue of the *Quarterly Journal of Microscopical Science* is a detailed account by Prof. E. N. Pavlovsky and Prof. E. J. Zarin of their studies on the structure and functions of the various parts of the alimentary canal of scorpions. The authors have not been able to investigate the physiological properties of the maxillary glands, which it is believed may produce a proteolytic ferment. The food—the juices and muscles of arthropods and of earthworms—passes

into the stomach of the scorpion, where it is acted upon by pepsin, trypsin, chymosin, and lipase. The mid-gut of scorpions is of insignificant volume as compared with the cavities of the liver tubules, and it is evident that the latter are of the greatest importance. They contain two kinds of cells, secretory cells, producing ferments which act on proteins, fats, and carbohydrates, and absorptive cells. The authors suggest that the liver also plays a part in excretion, the presence of brown granules in its cells being cited as evidence. The intestine appears to play little or no part in the digestive processes.

LUMINOUS FISHES AND CEPHALOPODS OF THE MEDITERRANEAN.—Number 9, vol. 2 (Biology), A. 12, of the report of the Danish Oceanographical Expedition, 1908–10, to the Mediterranean and adjacent seas includes an extremely interesting account of the Mediterranean Sternoptychidæ by P. Jespersen and Å. Vedel Tåning (Copenhagen: Andr. Fred. Høst and Søn, 1926. 35*s*.). In their study of these peculiar luminous fishes, much light is thrown on their breeding, life-histories, and migrations. Many of these fishes tend to move to a greater depth with increasing age, the adults often occurring naturally at a depth of more than 1000 metres, whereas the post-larvæ are found much higher up. The photophores in this group are important as a means of classification, but in many of the genera these do not appear until late in post-larval life or after metamorphosis, and there is often an enormous alteration in general appearance and also a great reduction in length, as, for example, in *Ichthyococcus ovatus*. Dr. Degner's important monograph (C. 1), which is also included in No. 9, vol. 2, of this report, on the cephalopods deals also with a group which in many forms is luminous, but in this case comparatively few are from great depths. The majority occurred between the surface and a depth of 65 metres, and mainly belonged to the Decapoda. A single specimen of an adult Argonauta was obtained in the Mediterranean and one of Spirula just outside, close to Gibraltar. Many young forms of various species were taken and a few new species are described, including *Mastigoteuthis Schmidti* and *Desmoteuthis Thori*, both from waters of 2700 metres depth.

AMPHIPODS AND DIATOMS FROM THE DANISH OCEANOGRAPHICAL EXPEDITION.—In Number 9, vol. 2 (Biology), D. 5, of the report of the Danish Oceanographical Expedition, 1908–10, to the Mediterranean and adjacent seas (Copenhagen: Andr. Fred. Høst and Søn, 1926. 35*s*.), Dr. K. Stephensen finishes his account of the Hyperiidea-Amphipoda, of which Parts 1 and 2 have already appeared. A large portion of the present work is taken up by the valuable synopsis of the Hyperiidea in which the Mediterranean species, eighty in all, are fully discussed. The author finds that there do not seem to be any species endemic to the Mediterranean, nearly all being found also in the Atlantic, and there seem to be scarcely any differences between specimens from the two areas. The Hyperiidea are almost exclusively oceanic, and many are found over great depths, some never rising above a 300-metre level; but of these deep-water forms few enter the Mediterranean. The species found there belong almost exclusively to the surface layers. Prof. Pavillard, in the same volume (J. 4), gives an interesting account of the planktonic diatoms which in these regions are really fairly well known, and his investigations show few new species but much new matter as regards distribution. The absence or great rarity in the Mediterranean of certain species common and well known in the English Channel and outside is striking. Thus *Hyalodiscus stelliger* apparently does not occur, *Paralia sulcata* is very rare, and *Thalassiosira gravida* is replaced by *T. rotula*. The summaries of the larger genera such as Chætoceros, Rhizosolenia, and Coscinodiscus are instructive and helpful, and as an up-to-date guide to pelagic diatoms the whole work is extremely valuable.

MICRO-ORGANISMS IN INDUSTRY.—In his presidential address to the Royal Microscopical Society, Mr. A. C. Chapman gave an account of some of the Fungi imperfecti—torula, mycoderma, ooidia—and their activities (*Journ. R. Micr. Soc.*, vol. 46, Part 1). He referred to a yeast-like organism, isolated by Prof. Lindner of Berlin in 1916 from the sap which had exuded from a birch tree, which was able to grow freely on the surface of carbohydrate solutions containing ammonium salts and to form a thick greasy film. This film when separated and dried was found to contain 18 per cent. of fat, 31 per cent. of crude protein, and 43 per cent. of carbohydrates, so that, given a cheap source of carbohydrate and ammonium salts, it was evident a food product rich in fat and protein could be produced in large quantity. Mr. Chapman isolated a similar organism in 1917, and reports that the product of its activity contained about 50 per cent. of crude protein and up to 10 per cent. of fat, and that when pressed it formed cakes having the odour and flavour of cream cheese. He points out that if an efficient biochemical process were discovered for the conversion of cellulose into sugar, the production of a synthetic food product on a large scale would become practicable perhaps even under peace conditions. He quoted a sentence from a lecture which Hayduck delivered in Berlin in 1916—"when we can convert our evening papers into sugar so rapidly that we are able the following morning to eat the albumen prepared therefrom, then indeed we shall have solved one of the greatest problems of the century." Mr. Chapman advocates the founding of a National Institute of Industrial Microbiology for research on micro-organisms which play an important part in industry, for the training of teachers of microbiology, and for maintaining a collection of pure cultures of micro-organisms for industrial purposes.

AUSTRALIAN RIVER BASINS.—A map of Australia, showing the extent of the drainage areas of the various rivers, has been published by the Bureau of Meteorology of the Commonwealth of Australia. The positions of river gauges and flood report stations are also shown. The map should prove useful in connexion with the flood warning service of the Bureau. In times of heavy rainfall, it will facilitate the issue and distribution of flood warnings to the districts concerned. The map is on the scale of 200 miles to an inch and a half.

THE CLIMATE OF HELWAN.—A discussion on the above by Mr. L. J. Sutton, Director of the Egyptian Meteorological Service, has been issued by the Ministry of Public Works, Egypt, as Physical Department Paper No. 20 (Government Publication Office, Cairo, price P.T. 10). The present report deals with the observations of the years 1906–20, and fifteen years are said to be probably sufficient in a climate like that of Helwan to give a fair representation of a true normal, except perhaps for rainfall. The scheme for the report was commenced by Mr. Knox-Shaw, but, owing to his appointment as Radcliffe Observer at Oxford, the work of preparing the report was handed to Mr. Sutton. The climate of Helwan is essentially of the Saharan desert type. There is a short winter, December to February, when the nights are cold, averaging 9° C., and the days comparatively warm, averaging about 20° C. The temperature never falls to the freezing-point, the lowest ever

recorded being 1·6° C. Nearly 8 hours of sunshine are enjoyed each day, and normally there are only 3 days of rain in each of the winter months, but sometimes thunderstorms occur with heavy rain. Summer commences in June and lasts until the end of September; from June to August there are more than twelve hours of sunshine a day, the temperature reaches 35° C. on the average during the daytime and falls to about 21° C. at night. In the early part of summer, temperatures of 40° C. are not uncommon, and on two occasions a temperature of 46° C. (115° F.) has been recorded. The summer is rainless, and there is scarcely any rain from May to October. Tables and diagrams with detailed accounts are given of all the meteorological elements. The work adds much to our knowledge of weather conditions in this part of the globe.

WEATHER AND AGRICULTURE.—Responsible United States officials engaged in the Weather Bureau, the Bureau of Agricultural Economics, and the Forest Service have co-operated in producing a discussion, No. 918, published by the United States Department of Agriculture (Washington: Government Printing Office, price 20 cents). It is asserted that so early as 3000 years B.C. man was a tiller of the soil and gathered a harvest. Since then the history of agriculture and the weather has been contemporaneous with that of civilisation itself. The development of agricultural education such as the establishment of agricultural colleges and experimental stations is dealt with. The influence of the weather and especially the control of weather by cyclones and anticyclones is referred to and the adjustment of agriculture to climate, soil condition and topography. Maps are given showing the distribution of rainfall over the globe, and the natural vegetation, and also air isotherms over the world for January and July. Referring to the rapidly increased population in recent times, the unoccupied arable land of the world has become gradually occupied until to-day very little remains in regions with healthful climates. It is stated that the United States, with only about 5 per cent. of the world's population, produces one-seventh of the world's cattle, one-fifth of its wheat, and three-fourths of its corn. Rainfall and crop growth is gone into with considerable detail, also the temperature influence on crop distribution. It is asserted that where climate and other conditions permit of mixed farming, the weather hazard is very much reduced. Many matters such as weather and the railroads and details intimately associated with salving the crops are of much interest.

METEOROLOGY AND GEOPHYSICS IN POLAND.—In Communications Nos. 1-18, Institut de Geophysique et de Meteorologie de l'Université de Lwów, Prof. H. Arctowski and eight collaborators publish a series of papers on meteorological, astronomical, and geophysical subjects. Eight papers contain discussions of temperature variations observed during the years 1910–1919 at Arequipa and at a number of widely separated stations. These temperature variations are employed to show the distribution and movement of "thermo-pleions" (areas of positive departure of temperature from the normal) and "anti-pleions" (areas of negative departure) in Egypt, Hawaiian Islands, India (the Deccan), New Zealand, Peru, Philippine Islands, Russia, and Scandinavia. The agreement between the Arequipa or standard type of thermo-pleionian fluctuation and that prevailing in the Deccan is found to be particularly striking during the ten years of observation. Four other papers deal with pyrheliometer observations. During 1924 a number of these observations were made by three different methods at Pozyzewska (altitude 1406 metres) in the eastern Carpathians for the purpose of finding a suitable site for a solar observatory. The remaining contributions relate to (1) The dissimilarity of the variation of the frequency of sunspots observed north and south of the sun's equator, and the desirability of considering sunspot statistics for each hemisphere separately; (2) the anomalies in the measurement of rainfall and the exposure of rain-gauges; (3) the determination of the "geothermic" degree from observation of the temperature gradient existing in certain petroleum wells in Poland; and (4) the occurrence of potassium salts in Poland. The above series of papers have been published in the *Kosmos*, vols. 46-50, 1922–1925.

MAGNETIC VARIATION IN NORTH AFRICA.—The secular magnetic variations at Tunis, Carthage and Malta are considered by Dr. L. Palazzo in the *Memorie della Pont. Accademia delle Scienze Nuovi Lincei*, vol. 8, 1925. Dr. Palazzo himself made observations of all three magnetic elements at Tunis and Malta in 1890, and has recently repeated the observations. In 1890 he also measured the horizontal intensity at Carthage. In this memoir he summarises other observations available for the three stations, and constructs graphs showing the secular variation of declination, dip and horizontal intensity; for Tunis the graphs extend from 1875 to 1925, in which time the declination has decreased by about 5° to its present value of about 7° 20′ E. The Carthage declination and dip graphs extend from 1820 to 1905, and are in general agreement, as regards secular variation, over the period in common with those for Tunis, as would be expected from the proximity of the stations. The Malta data extend from about 1820 to 1925, and show a decrease in E. declination from 17° 20′ to 5° 40′.

VELOCITY OF DETONATION FOR EXPLOSIVES.—The explosives in general use in fiery and dusty mines belong to the class of detonating explosives. It is known that the ignition of inflammable gases in the neighbourhood of the borehole depends in large measure on the velocity of detonation. It is therefore of great importance to find a method of determining this velocity for the practical explosives used in mines. To determine this velocity, very small intervals of time of the order of a millionth of a second have to be measured. A method suitable for doing this is described by E. Jones in the Safety in Mines Research Board, Paper No. 22 (London: H.M. Stationery Office, 1926. Price 9*d*. net). The method is an electrical one. It depends on the partial discharge of a condenser through a known non-inductive resistance. The time of the discharge is the time taken by the detonation wave to travel between two points at which the circuits are broken. The times computed were tested with mechanical arrangements which gave time intervals of the order 10^{-4} sec. to 10^{-6} sec. The results were concordant for long fuses, but unsatisfactory when the trinitrotoluol fuse was only about 10 cm. long. The discrepancies in this case were traced to electrical phenomena due to detonation, and were overcome by removing the break-points of the circuit to a distance from the detonating explosive. Consistent results were now obtained, although the fuse length was reduced to 2 cm. The difference between the results and that given by the Mettegang method for metre lengths of the explosive was rather less than 3 per cent. The latter method, however, only gives the average velocity over the metre. The agreement consequently is satisfactory. Further researches are in progress.

Oxford Meeting of the British Association.

PROVISIONAL PROGRAMMES OF SECTIONS

WE print below short accounts of the proceedings of the various sections of the British Association at the Oxford meeting to be held on August 4-11. For these particulars we are indebted to the recorders of sections. The statements are brief, but it is clear that interesting and stimulating sessions have been arranged which should do much to make the Oxford meeting memorable in the history of the Association.

SECTION A (MATHEMATICS AND PHYSICS).

The coming meetings of Section A (Mathematics and Physics) are likely to be filled with interest. Apart from the attractions of Oxford itself with its own important schools in these subjects, there are two other contributing factors. First, the list of foreign guests is a particularly interesting one, the visitors including Bohr, Born, Carathéodory, Franck, Runge, Siegbahn, Wien and Zeeman, in addition to well-known representatives of the Dominions overseas. Secondly, a full programme has been arranged for a subsection in mathematics, meeting for three mornings. This should attract many mathematicians who may have refrained from attending previously owing to the minor part that this subject has played in the programme of the Section in recent years.

In physics, in addition to full accounts of work being carried out in the laboratories of Prof. Townsend and Prof. Lindemann, papers will be read by Sir Ernest Rutherford, Sir William Bragg, Prof. W. L. Bragg, and others. On Monday, August 9, Prof. A. Fowler's presidential address will be followed by a discussion, in which most of the foreign guests are expected to take part. A joint discussion with Section B (Chemistry) on the mechanism of homogeneous chemical reactions should enable many physicists to learn something about a subject in which few of them have specialised.

In mathematics, in addition to a full morning on integration and trigonometrical series, special lectures from Dr. T. M. Cherry, Mr. F. P. Ramsay, Mr. M. H. A. Newman and Mr. T. W. Chaundy have been arranged, and contributions are expected from Sir George Greenhill and Prof. E. A. Milne. Lastly, a paper by Mr. Stratton on the recent eclipse observations, and by Prof. Turner on the coming total eclipse in England, should make a wide appeal throughout the Section.

SECTION B (CHEMISTRY).

Prof. J. F. Thorpe will deliver the presidential address to Section B (Chemistry) at 10 A.M. on Thursday, August 4, and will take as his subject "The Scope of Organic Chemistry." Two discussions have been arranged—one (a joint discussion with Section A) on the mechanism of homogeneous chemical reactions and the second one on tautomerism. Prof. W. N. Haworth is to submit a paper on modern views on the structure of the disaccharides, and Mr. J. J. Manley is to describe the work he has conducted on the union of mercury and helium. Of the foreign visitors, Prof. J. Backer is reading a paper on separation and racemisation of simple optically active compounds, and Prof. H. ter Meulen is to describe the uses of hydrogenation in organic analysis. A novel feature of the work of the section will be a paper by Mr. A. Chaston Chapman and Dr. H. J. Plenderleith on an examination of King Tutankh-Amen's cosmetic.

SECTION C (GEOLOGY).

The communications promised for Section C have been so numerous that the time available for presentation and discussion may prove inadequate. Although the meetings of the Section have been extended beyond the normal number, selection of papers has been necessary; yet the programme as at present arranged covers a very wide range of interest, and, so far as possible, kindred studies have been grouped. It is invidious to pick out any papers for special mention, but, to take a conventional subdivision of the subject-matter into mineralogy and petrology, palæontology and physical and stratigraphical geology, the following notes may suffice to convey some idea of the scope of the programme.

The atomic structure of silicate minerals has proved difficult up to the present, but a paper on certain of these minerals is promised, while communications on the textures and structures of igneous rocks will also be received. Sedimentary petrology is also represented. In the realm of palæontology the faunas and classification of the faunas of certain epochs in the past will be considered, notably those of Cambrian and Silurian times: the fauna of more recent deposits, local to Oxford, will be represented by an exhibit which may be consulted during the meeting. Physical and stratigraphical geology will naturally figure largely, and here interests range in time from pre-Cambrian to recent, and in space from England to the farthest confines of the British Empire.

Two important discussions will be held: one on problems connected with the Thames gravels and their fossil contents, and the other in conjunction with Sections D (Zoology) and K (Botany) on the "Conception of a Species." In all branches of natural science the definition of units is necessary, and a biological unit is as fundamental as a unit of length or of temperature. Unfortunately the species, as a unit, has not proved capable of rigid definition, and, from time to time, it is obligatory to take stock of the position. The discussion therefore should be of value in stating the present ideas on this fundamental biological concept.

In the interests of those who are beginning research work and desire some knowledge of technique, a series of short descriptions of certain research methods will be given by workers who have taken special interest in the development of such processes. Demonstrations have also been arranged in illustration.

A most important part of the work of the section centres round the excursions. The local secretaries have so arranged their work that this part of the programme has been in the hands of Mr. C. J. Bayzand, who has drafted an excellent series of half-day and whole-day visits to the neighbourhood. Ill-health may prevent him from being present on these trips, but it is hoped that he may be recovered in time to reap the reward of his sowing. On present showing, then, the Oxford meeting, so far as Section C is concerned, promises to be an excellent one from every point of view.

SECTION E (GEOGRAPHY).

Much attention has been directed of late to economic and social problems associated with the awakening of Negro Africa. Their complexity defies unanimity on methods of administration and development. The president of the Section—the Hon. W. Ormsby Gore,

Under Secretary for the Colonies—following his recent investigations in East and West Africa, will speak on "The Economic Development of Africa and its Effect on the Native Population." This will be followed on the afternoon of Thursday, August 5, by an important joint discussion with Section H (Anthropology) on "The Effect on African Native Races of Contacts with European Civilisation." Among those who will take part in the discussion may be mentioned the Rev. Edwin Smith, Sir Frederick Lugard, Capt. G. Pitt-Rivers, Prof. J. W. Gregory, Sir James Currie and the Hon. Hugh Wyndham.

In Britain, of recent years, one of the most striking applications of geographical study has been the attempt consciously to adjust conditions of life and industry to locality, especially in urban areas. Town planning and regional surveys have in a measure reacted on the character of some of the geographical research in the universities. Two papers, one on London and the other on Manchester, illustrate what is being done in the several university schools of geography, and will form the basis of a general discussion on "Regional Work in Geography."

Several papers present historical aspects of geographical science: Elizabethan theodolites and astrolabes, by Dr. R. T. Gunther; the 'Pantometria' of Leonard Digges, by Mr. A. R. Hinks; the British Isles in the nautical charts of the fourteenth and fifteenth centuries, by Mr. M. C. Andrews; roads on English and French maps at the end of the seventeenth century, by Sir George Fordham. The numerous implications which the geographical study of a region involves is well represented by such contributions as Dr. D. G. Hogarth's on "Our Near Eastern Borders," Prof. Lyde's on modern markets for Canadian wheat, and Mr. Dunlop's comparison of Queensland and Jamaica.

Geographical excursions have been arranged to Brill, the Cotswolds, the central Chilterns and the Goring Gap.

Section F (Economics).

In his presidential address to Section F (Economics), Sir Josiah C. Stamp will deal with "Inheritance as an Economic Factor"; it is expected that Prof. Rignano (Italy), Dr. Hugh Dalton, M.P., Prof. Edwin Cannan and others will take part in the discussion.

A distinctive point of view upon "Collective Bargaining" will be presented in a paper by Sir Lynden Macassey, in which he will argue that effective collective bargaining is the basis of industrial stability and that recent events have shown the absence of this condition in Great Britain. Mr. Flux, of the Board of Trade, will deal with the markets of the chief British export industrial centres and will use material which has not previously been available for this purpose.

A discussion of peculiar present-day importance will take place upon currency problems, and it will be opened by Prof. Gregory in a paper dealing with the gold standard.

In addition to such topics of outstanding interest as those mentioned above, the Section is to take part in a discussion on a "Survey of the Limits of Agricultural Expansion," which will form the subject of Sir Daniel Hall's presidential address to Section M (Agriculture).

Section G (Engineering).

The programme of Section G includes discussions on subjects of very varied interest. The president, Sir John Snell, chairman of the Electricity Commission, in his address will deal with the important subject of electric supply, its recent and probable future development. Following the address Mr. Kennedy will read a paper on the distribution of electric energy, and Mr. Borlase Matthews will discuss the use of electricity in agriculture; some phenomena of conduction will be discussed by Prof. Cramp. Refrigeration, particularly in relation to food preservation and transport, is a subject of scientific and practical interest, and two papers by Dr. Ezer Griffiths and Prof. C. F. Jenkin are to be followed by a discussion in which Sir William Hardy and Sir Richard Glazebrook will take part. The papers will describe small plants that have recently been developed and experiments carried out in the laboratory and on four ships. In connexion with this discussion, a number of small plants will be working in the University Engineering Laboratories.

Recent developments in aircraft are to be discussed. Mr. Wimperis will deal with the 'rotating wing' and describe experiments and the attempts that have been made to use the device for sustentation purposes; the possibilities of its use will be discussed. The researches that have been carried out in connexion with the development of a compression ignition engine for aircraft and burning heavy oils will be described by Mr. H. D. Pye. The problem of producing a fuel jet which penetrates the compressed gas sufficiently to give adequate mixing of air and fuel, and at the same time to obtain sufficient pulverisation and combustion in the short time available, will, *inter alia*, be dealt with. It has been found possible to burn 70 per cent. of the oxygen in the cylinder, but to get perfect mixing at high speeds is extremely difficult. The possibility of eliminating all complications and danger incidental to electric ignition makes it worth while to attempt to develop a compression ignition engine sufficiently light for aircraft purposes. The use of light alloys in aircraft is becoming increasingly important, and the paper by Mr. Bengough and Mr. Sutton will describe the anodic oxidation process which has been successfully developed to render these alloys immune from surface corrosion.

Experiments on materials subject to complex stress conditions will be discussed by Prof. F. C. Lea and Mr. S. Timoshenko.

The microscopic and macrographic methods of detecting the sulphur bacterium *Beggiatoa Alba*, and investigations in which its presence indicates sewage pollution, will be described by Prof. Ellis. The cause of the blackening of the river sands below water level in the Clyde Estuary has been investigated, and it has been shown that this is not due to sewage pollution but to the formation of ferrous sulphide by a reaction between the ferruginous constituents of the sand and the hydrogen sulphide liberated by bacteria which consume the animal and vegetable remains on the shore. A paper by Mr. Edgar Morton on the "Composition and Texture of Sandstone and Limestone in relation to Strength and Durability" should prove of interest to geologists, engineers, architects and builders. Papers dealing with the distribution of pressure in turbines and the influence of voltage harmonics on power factor correction are to be given.

Section H (Anthropology).

In Section H (Anthropology) one of the most important features of the programme will be the exhibition of the human skull found in association with Mousterian implements by Miss D. A. E. Garrod near the Devil's Tower, Gibraltar. In view of the conditions of its discovery and its possible relation to the skull of Neanderthal type found at Gibraltar in the middle of the last century, it should give rise to an important discussion. Miss Garrod's discovery will give added interest to Sir W. Boyd Dawkins'

paper on the range of the Neanderthal race on the Pleistocene continent.

The Section will engage in two joint discussions with other sections. The first, with Section E, on the effect on African races of contact with European civilisation, arises directly out of Mr. Ormsby Gore's presidential address to Section E, and will be opened for Section H by the Rev. E. Smith, who will be followed by Sir Frederick Lugard, should his engagements permit. The second joint discussion, with Section D (Zoology) and Section J (Physiology), on mental and physical aspects of heredity, will be opened by Dr. C. S. Myers, to be followed by Profs. Ruggles Gates and Julian Huxley. Sir William Ridgeway will open a sectional discussion on "The Origin of the Scot."

Among a large number of communications making up the remainder of the programme mention can be made of a few only. Sir Arthur Evans on "The Shaft-Graves of Mycenæ and their Contents in relation to the Beehive Tombs" is likely to prove provocative of animated discussion; Mrs. Zelia Nuttall, the distinguished American archæologist, in dealing with the ancient calendar systems of America, will give the Section what is virtually a summary of the results of her life's work. The excavations of the British School at Athens during the past three seasons will be described by Mr. A. M. Woodward, the Director, and Mr. W. A. Heurtley, the latter dealing with his own investigations in Macedonia. Recent excavations in Mesopotamia will be covered by Mr. C. L. Woolley on his recent work at Ur, and Prof. Langdon on work at Kish, skulls from the latter site being described by Mr. L. H. D. Buxton. In Egyptian archæology Miss Gardiner and Miss Caton-Thompson will describe their recent work on the geology and early archæology of the Fayum, and Sir Flinders Petrie will put forward for discussion his views on the prehistoric relations of Egypt and the Caucasus. An important paper by Mr. Gordon Childe will deal with the Terramare and the Hungarian Bronze Age, in which he will carry further his previously published work on the prehistoric archæology of Central Europe.

An interesting series of papers dealing with physical anthropology must be passed over; but in conclusion mention must be made of Miss Alford's communication on 'the ritual dance,' in which she discusses the ritualistic origin of a number of English folk-dances and cites continental parallels. The paper will be illustrated by dances performed by members of the English Folk-Dance Society.

SECTION I (PHYSIOLOGY).

By an unfortunate chance the British Association meetings this year fall at the same time as the (triennial) meetings of the International Congress of Physiology, which will be held at Stockholm on August 3-6. Although the Section may, in consequence, lack a certain number of British and of foreign workers, the sectional programme is quite a full one. The subject of the presidential address is "Function and Design": to this question Prof. Leathes is bringing a fresh outlook, notably from recent work on molecular structure and orientation, with a special consideration of the arrangements at the limiting surfaces and membranes of the organism.

As was suggested in the columns of NATURE of May 29, p. 747, the lecture by Dr. J. S. Haldane on "Acclimatisation to High Altitudes" is of particular interest, in that a reply to Prof. Barcroft's recent publications may confidently be expected, and a consideration of the physiological observations and problems connected with the climbs on Mount Everest. In the joint discussion with Section D (Zoology) on the value of tissue-culture in biology, members will have the first opportunity in England of hearing from Prof. Ch. Champy, of the Sorbonne, an account of his technique and the results he has obtained in this work. The discussion will be opened by Dr. H. M. Carleton, who is in charge of the Department of Histology at Oxford.

A symposium on the 'machinery' whereby a posture is set up or maintained, will allow an exchange of observations and opinions between clinicians and laboratory workers, who have a common interest in this problem, though their paths of approach may be entirely different. Of wide interest, again, is Sir J. C. Bose's lecture on "The Pulse-Beat of Plant and of Animal," while among the more specialised papers are contributions on colour-vision, on biochemistry, and on visceral sensation.

SECTION J (PSYCHOLOGY).

Applied psychology figures prominently in the programme of Section J (Psychology); thus the presidential address by Dr. J. Drever is entitled "Psychological Aspects of our Penal System." A whole session is given to such industrial questions as accidents in industry, restriction of output, and the judgment of value of individual advertisements. There is also a lecture on recent progress in vocational selection. These papers will give an account of some of the activities of the National Institute of Industrial Psychology.

Medical psychology is represented by three papers, namely, personality and value, a method of self-analysis, and heredity and environment in the production of morbid mental reactions. That psychologists are paying attention to heredity is shown by their participating with Sections D and H in a joint discussion on heredity in its physical and mental aspects.

It is gratifying to note that all past presidents of the Section are contributing papers: Prof. C. Lloyd Morgan, "Individual and Person"; Dr. C. S. Myers, "Heredity in its Physical and Mental Aspects"; Prof. Cyril Burt, "Estimations of Temperament and Character"; Prof. W. McDougall, "An Experiment supporting the Lamarckian Hypothesis" and "Intelligence in Rats": Prof. C. Spearman, "The Origin of Error."

Of the more academic papers mention should be made of one by Prof. Rignano of Milan on "La psychologie dans ses Rapports avec la Philosophie et avec la Science," one by Prof. Michotte of Louvain on observation and analysis of mental facts, one by Dr. Aveling on the psychogalvanic phenomenon, and one by Dr. Banister on the localisation of sound. A paper by Dr. Maxwell Garnett on the psychology of patriotism should prove of wide interest; also one by Mr. F. C. Bartlett, Director of the Cambridge Psychological Laboratory, on the social psychology of leadership.

SECTION K (BOTANY).

Owing to the lamentable death of Mr. W. Bateson, Section K (Botany) will meet at Oxford under the presidency of Prof. F. O. Bower. The Section will participate in a discussion on "The Conception of a Species" with the Sections of Geology and Zoology. Within the Section there will be a discussion on sex-determination in plants, which will be opened by Dame Helen Gwynne-Vaughan and contributed to by Dr. Heslop Harrison, Prof. H. Kniep, and Miss Cayley. Prof. J. H. Priestley will initiate another sectional discussion on the scientific principles underlying vegetative propagation, a subject on which a good

deal of light has been thrown recently. The popular lecture will be given by Sir Frederick Keeble on "The Nervous System of Plants."

A large number of papers representative of different branches of botany have been included in the programme, the subject of genetics being particularly well represented this year. A notable feature of the Oxford meeting will be the attendance of a larger number of distinguished foreign botanists than has been the case in recent years. All of them are contributing actively to the programme. As in the last few years, there will be a Sub-section of Forestry, which will be linked with Section K. The Sub-section also has a very full programme, and will be presided over by Lord Clinton.

Section L (Education).

Section L (Education), under the presidency of Sir Thomas Holland, opens its session at Oxford on Thursday, August 5, with several papers dealing with the place of history of science in education. Dr. Charles Singer and Prof. Cecil H. Desch will discuss the subject from the point of view of its value as a humanising element in the teaching of science at university or school. Dr. Gunther will demonstrate the educational value of the Lewis Evans' Collection of historic scientific instruments at the Old Ashmolean Building.

Later in the meeting the more recent advances in educational science will be discussed: the development in the general conception and scope of education during the last twenty-five years by Prof. T. P. Nunn; the education of children under eleven years of age by Miss Margaret Drummond; developments in methods of teaching by Dr. M. W. Keatinge; the organisation of education by Prof. Strong; and educational psychology by Prof. C. Burt. The Section will be invited to discuss scholarships—methods of award and their effect on the present system of education—by Mr. William Hamilton Fyfe. Important results of a recent investigation into the claims of the kinema and of radio to be potent agencies in modern education will be brought before the Section by Dr. C. W. Kimmins, Mr. G. T. Hawkin, and Dr. J. C. Stobart. The public school system is to be reviewed by Mr. Ronald Gurner, Mr. W. W. Vaughan, Mr. M. L. Jacks, Dr. Crichton Miller, and Mr. F. J. R. Hendy. Its relation to national life, its psychological interpretation, its value as a training in community life, together with a critical appreciation of its economic position, are some of the features of the papers to be read.

On Thursday, August 5, a joint session of Section L (Education) and M (Agriculture) will be held in the hall of the Union Society to discuss the educational training of boys and girls in secondary schools for life overseas. Various aspects of this question will be dealt with by Sir A. Daniel Hall, Hon. W. Ormsby-Gore, Sir Halford Mackinder, Miss Gladys Potts, Sir John Russell, Sir Alfred Yarrow, and others. This meeting has been organised for the purpose of directing public attention to the results of an investigation carried out by a special committee, appointed by the Council in 1923. Two reports have already been issued. The Committee hope this year, through this meeting, to emphasise the most important results of their investigation, namely, first, that a growing and widespread demand exists in the Overseas Dominions for boys and girls well educated with an agricultural bias; secondly, that Great Britain has an increasing need of finding healthy and profitable employment within the British Empire for a large number of her sons and daughters; and thirdly, that practical studies of all kinds, especially those related to agriculture, possess a training value far too little realised by parents and by educational authorities.

Section M (Agriculture).

The Section will meet under the presidency of Sir Daniel Hall, whose presidential address on the limits of agricultural expansion will form the basis of a joint discussion with Section F (Economics), at which the speakers will include Lord Bledisloe, Sir Thomas Middleton, and Mr. R. J. Thomson. Sir Daniel Hall will also open a joint meeting with Section L (Education) on training for overseas life, at which several distinguished people have promised to speak, and at which it is hoped that the president of the Association may be present.

In addition to these two joint discussions, much time will be devoted to sectional discussion, so that the number of individual papers which are being presented is smaller than usual. It is proposed at a sectional meeting to review the present position of agricultural education in Great Britain, and to consider the methods adopted to make available to those engaged or about to be engaged in the agricultural industry the results of scientific research. Another session will be devoted to possible improvements in cultivation methods, both hand and machine, which is a subject with very important practical and economic bearings at this time when the position of arable land farmers is so precarious.

Other subjects of more technical interest which will occupy the Section are those of soil classification and the nutrition of dairy cattle, in which connexion a paper by Sir A. Theiler and Drs. Green and Du Toit on the minimum mineral requirements of cattle should be of great interest. This South African work forms an interesting complement to that carried out at Aberdeen, Cambridge, and elsewhere in Great Britain.

Messrs. Sutton of Reading have kindly invited members of the Section to visit their seed establishment, and a visit will also be made to the Agricultural Department of the University of Reading.

Universities of the British Empire.

THE universities of the British Empire are parts of a system dependent for its equilibrium and orderly progress in changing conditions on adjustments of factors making for integration and differentiation. The Congress of Universities of the Empire, which met last week at Cambridge, represents an adjustment on the side of integration. A glance at the lists [1] of subjects discussed at the first and second Congresses, 1912 and 1921, brings out the fact that the subjects of last week's discussions are, like those of 1912, but to an even greater extent, concerned directly with co-operation between universities, whereas the programme of 1921 was of a more open and exploratory character. Of the seven subjects of the plenary sessions, five, of the four subjects of sectional meetings, three, were directly and obviously concerned with the question as to how universities in different parts of the British Empire may most effectively help one another. Congresses are sometimes criticised adversely as "leading to nothing," especially where, as in the present instance, the discussions do not culminate in 'resolutions.' It remains to be seen whether the third Congress of the Univer-

[1] "Universities Yearbook, 1926," pp. 12 and 13.

sities of the Empire will merit this criticism, but definite practical suggestions for immediate action were not lacking.

Lord Balfour opened the proceedings of the first session on Tuesday, July 13, the subject of discussion being "The State and the University." The new problems confronting universities arise, he pointed out, not from the social changes of the time so much as from the growth of modern knowledge and its paradoxical correlative, the growth (due to specialisation) of modern ignorance. The former has brought in its train an enormous increase in the expensiveness of the material plant indispensable for the pursuit of the study of science and urgent pressure on the State, and, through the State, on the universities, to develop the applications of science to the problems of industry. In the absence of other sufficient available means of obtaining the wherewithal to provide and maintain the requisite buildings and equipment, the universities of Great Britain have sought and obtained State subsidies, and, even where these have not been ear-marked for work in applied science, have inevitably aroused a natural and pardonable, but dangerous, instinct on the part of the State to control and supervise. Hitherto that instinct has not found expression in Britain in any serious menace of excessive interference, but the universities must ever be watchful lest they betray their trust to cherish the spirit of disinterested research, a dereliction which would in the long run be fatal to the very industrial interests it might be supposed to serve. The sphere in which the universities can at present most fruitfully study to promote the material interests of the community lies in the middle region between fundamental and practical research.

The idea of the duty of watchfulness against State encroachments or enticements proved to be the keynote of most of the discussion which followed Lord Balfour's address. Prof. E. R. Holme, of the University of Sydney, while proudly asserting that in Australia there has never been a sustained public policy that is contrary to the right British tradition, admitted the existence of dangers in the large "and necessary" dependence upon the State which characterises Australian universities. A specially insidious risk is that of political parties being tempted to make capital out of the pride of the people in their university and the desire to spread its benefits—to make, in American parlance, the campus of the university coterminous with the State.

This same danger was touched upon in a paper by President Klinck, of the University of British Columbia, one of the four State (Provincial) universities of Western Canada—who remarked, however, that while the unwillingness of the universities to pander to the expectations of those primarily interested in utilitarian education has led to their disappointment and disillusionment, it has not yet led to any appreciable diminution in the numbers demanding admittance. He was able to assure the Congress that the governors of a State university in Canada are no more liable to be dictated to by the legislature than the governing board of an endowed institution by private benefactors. The academic freedom of the professorial staff in the State universities is even more jealously guarded and more universally respected than is freedom from political interference in matters affecting the financial administration of the universities. The legislatures are not interested in staff appointments or in the details of academic policies, but leave the universities completely autonomous in these respects.

Prof. Holme referred to a recent political agitation of the question of the Australian universities' duty to country students, and, in this connexion, to the commission now studying the project of a Commonwealth University at Canberra for examinational purposes only. He suggested that the University of London might well offer to undertake for Australia the function of such a Commonwealth University. Either plan would have the advantage that Australian universities would not be driven to establishing (as Queensland has done) departments of "teaching by correspondence." Sir Theodore Morison suggested that the proper safeguard against the exertion of undue influence, whether by the State or by benefactors, is to present a bold front and a frank exposition of the grounds of the university's claim to autonomy. Prof. Payne, of Melbourne, quoted an instance of a government offering a chair coupled with the name of a prospective holder—an offer which the university rightly refused.

Sir Alfred Hopkinson summed up the relationship of State and university under five heads: Initiation, which should not be, and in the past has not been in Great Britain, the business of the State; recognition, which should always be in the hands of the State, to prevent fraudulent degree-granting; support, for which, ideally, the university should not be mainly dependent on the State; control, which should not be exercised by the State except to the extent of seeing that State grants are spent on development and not on fancy fads; service, in which there should be close co-operation. This last aspect of the relationship between State and university was presented with some enthusiasm in a speech by Dean Mackay, of the graduate school of McGill University, where, he said, the prevalent attitude towards the State is one, not of watchfulness against imaginary dangers of interference by the State, but of eagerness to promote its welfare. In one respect this has been prejudicial to the university, for it has led to an excessive withdrawal of the most talented alumni for the service of the State in other spheres.

"Co-operation in Research throughout the Empire" was discussed at the morning session of July 14 under the presidency of Lord Londonderry, Chancellor of the Queen's University of Belfast. This session attracted a maximum attendance—between five and six hundred. Sir Thomas Holland outlined the history of the Department of Scientific and Industrial Research and the various other governmental agencies in different parts of the British Empire for promoting and conducting research—agencies which, originating in the necessities of the War, have demonstrated that they are equally indispensable in time of peace. Two questions in connexion with them were, he suggested, of obvious importance to the Congress: "Does the establishment of Government laboratories tend to supplant university functions?" and "Can the universities take further advantage of the new official machinery for correlation and financial support?" To the first the answer seems, he said, to be favourable so far as Britain is concerned, but such official institutions have a strong natural tendency to extend their activities. This tendency is minimised where, as in England, the scope of their work is strictly limited to well-defined, large-scale investigations beyond the capacity of any university to undertake, and the universities are well represented on controlling committees. As regards the second question, he had found at the Imperial College a ready response to suggestion and a willingness to render the necessary financial assistance to research workers.

Sir John Farmer, professor of botany at the Imperial College, suggested that more might be done towards keeping the universities in touch with scientific workers in the outlying parts of the British Empire. The universities might, for example, give assurances that such workers would be welcomed

should they visit the university laboratories when on leave in England. At present the universities seem, he said, scarcely alive to the importance of the great development that is going on in tropical agriculture, and the opportunities open to their graduates in connexion therewith. Dr. Andrew Balfour, of the London School of Hygiene and Tropical Medicine, complained of the ignorance on the part of men working in his field of what others working in the same field are doing. An organisation is badly needed for laying down lines of research, following up what is done, and deciding what results should be recorded and how. India has its Scientific Advisory Board, which advises on the disposal of the Indian Research Fund Association's money, but it has no link with England. A central co-ordinating body in London, possibly a committee of the Medical Research Council, should be established, and one of its most important functions should be the selection and training of personnel. A recent promising move in this direction is the appointment of a Chief Medical Advisor to the Colonial Office.

The same subject, co-operation in research, came up again for discussion on July 16 under the title "The Actual Working of the Ph.D. Scheme." Questions relating to facilities for the migration of university teachers and students were touched on in this discussion, and were dealt with at other meetings under various aspects: interchange; an Imperial policy in education; mutual recognition of examinations; pension schemes. The sectional meeting devoted to the discussion of "An Imperial Policy in Education," under the presidency of Sir Frederick Lugard, aroused much interest. A paper on the subject was read by Prof. Earle, of the University of Hong-Kong, who advocated the formation of a committee with a constitution designed to secure interest in the assistance of educational effort throughout the British Empire, a function which the Universities' Bureau is not competent to undertake.

University and Educational Intelligence.

BIRMINGHAM.—Applications are invited for the Walter Myers travelling studentship for research in pathology, value 300*l.* for one year. Candidates must be under 30 years of age and graduates in medicine of the University of Birmingham or of some other university in Great Britain or Ireland. In the case of graduates of other universities, candidates must have been students of the Birmingham Medical School for three years immediately preceding their application for the studentship.

Further information may be obtained from the Dean of the Medical Faculty, and applications must be lodged with the Dean not later than September 1 next.

CAMBRIDGE.—The late Captain H. E. Laver has bequeathed to the Museum of Archæology and Ethnology his collection "of Chinese and the Far East Archers' Implements, meaning all [his] collection of Bows and Arrows and all implements connected with the manufacture of the same and all [his] Archers Thumb Rings, consisting of Jade and other hard stones of Ivory, Bone, Porcelain, Glass and Metal." One of the conditions of the bequest is that the specimens shall never at any time be lent for exhibition out of the precincts of the University.

C. R. N. Winn, Trinity College, has been nominated by the Vice-Chancellor to the Choate Memorial Fellowship at Harvard, and N. H. France, St. John's College, to the Princeton Visiting Fellowship. The Harkness Scholarship for geology has been awarded to M. Black, Trinity College, and the Wiltshire Prize to F. W. Shotton, Sidney Sussex College.

The Observatory Syndicate reports the addition of a photo-electric photometer, mainly by Günther and Tezetmeyer, to the equipment of the Observatory. The photometer will be used with the Sheepshanks equatorial.

C. B. Timmis has been elected to the Caldwell Studentship at Corpus Christi College.

MANCHESTER.—The Council has made the following appointments: Mr. H. E. Buckley to be lecturer in crystallography; Miss Margaret S. Willis to be assistant lecturer in geography; Dr. C. E. Brunton to be demonstrator in human physiology; Dr. O. R. Howell, lecturer in applied chemistry in the faculty of technology; Mr. Robert Grindley, demonstrator in chemical technology in the faculty of technology.

THE Air Ministry has announced that five hundred aircraft apprentices, between the ages of 15 and 17 years, are required by the Royal Air Force for entry into the Schools of Technical Training, Halton, Bucks, and Flowerdown, near Winchester. They will be enlisted as the result of an open and a limited competition held by the Civil Service Commissioners and the Air Ministry respectively. Successful candidates will be required to complete a period of twelve years' regular Air Force service from the age of 18 years, in addition to the training period. Full information regarding the aircraft apprentice scheme, which offers a good opportunity to well-educated boys of obtaining a three-years' apprentice course of a high standard and of following an interesting technical career, can be obtained on application to the Secretary, Air Ministry, Kingsway, London, W.C.2.

VACATION courses being held in Germany this summer are described in a 16-page pamphlet published by 'Hochschule und Ausland,' Charlottenburg. Courses for foreigners in the German language and culture are provided by, or in connexion with, the Universities of Berlin, Greifswald, Heidelberg, Jena, Kiel (of special interest to Swedish students), and Marburg. Göttingen (October 4–14) and Munich (September 27–October 9) offer post-graduate medical courses; the Nordic Association of Lübeck is giving (August 2–20) a course of lectures for foreigners entitled "German Light on European Problems." Greifswald has an attractive programme including not only literary, artistic, and philosophical subjects but also astronomical, botanical, chemical, geographical, geological, physical, and psychological. The Jena courses are grouped in ten divisions including philosophy, pedagogy, University extension problems, natural science, domestic science, political and economic science, and German for foreigners.

THE Board of Education announces that the Institution of Naval Architects and the Worshipful Company of Shipwrights have consented to co-operate with the Board in arrangements for the award of national certificates in naval architecture to students in technical schools and colleges in England and Wales. Under the agreement which has been reached, 'Ordinary Certificates' and 'Higher Certificates' will be issued jointly by the Institution and the Company and the Board on the successful completion of approved courses. The scheme will provide only for part-time students. Should the authorities of any school in England or Wales desire further information, their inquiries should be addressed to the clerk to the Worshipful Company of Shipwrights, 4 New London Street, London, E.C.3, in the case of ordinary certificates, and to the secretary of the National Certificates Committee, Institution of Naval Architects, 5 Adelphi Terrace, London, W.C.2, in the case of higher certificates.

Contemporary Birthdays.

July 25, 1848. The Earl of Balfour, K.G., O.M., F.R.S.
July 26, 1872. Prof. Joseph Barcroft, C.B.E., F.R.S.
July 27, 1857. Sir E. Wallis Budge, D.Litt. (Oxon.).
July 27, 1857. Dr. John William Evans, F.R.S.
July 28, 1843. Sir W. T. Thiselton-Dyer, K.C.M.G.
July 28, 1844. Sir Howard Grubb, F.R.S.

The EARL OF BALFOUR, Chancellor of the University of Cambridge, and also of the University of Edinburgh, was born in Scotland. He was educated at Eton and Trinity College, Cambridge. Always deeply interested in the advancement of science, he is a past-president of the British Association, and has, at two separate periods, served on the council of the Royal Society.

Prof. JOSEPH BARCROFT was educated at Bootham School, York, and King's College, Cambridge. He succeeded the late Prof. J. N. Langley as professor of physiology in the University of Cambridge, and is also Fullerian professor of physiology in the Royal Institution. His researches on the respiratory function of the blood and its relation to the activity of the tissues form but one department of many physiological inquiries. He has explored the conditions of life at high altitudes with persistency and acumen, undertaking the leadership of two expeditions for that purpose, one to Monte Rosa, and another to the High Andes. Prof. Barcroft was awarded a Royal medal by the Royal Society in 1922.

Sir WALLIS BUDGE, Oriental scholar, formerly keeper of Egyptian and Assyrian antiquities in the British Museum, is a graduate of Christ's College, Cambridge. He has conducted excavations at Assuan, Nineveh, in the Sudan, and elsewhere.

Dr. JOHN W. EVANS, lately president of the Geological Society of London, was educated at University College School. He has rendered much service to geological science by initiating, extending, and guiding the conduct of geological investigations in the colonies and dependencies of the British Empire. In western and southern India and in South America he has led official exploring expeditions. The Geological Society recognised the high value of his work by awarding him, in 1922, its Murchison medal. Dr. Evans is the author of a useful pamphlet of 20 pp. issued by the Colonial Office in 1914, on "Directions for the Collection of Geological Specimens."

Sir W. T. THISELTON-DYER, who was born at Westminster, attended King's College School, graduating afterwards at Christ Church, Oxford. In 1875 he became assistant director of the Royal Botanic Gardens, Kew, and he was director from 1885 until 1905. The "Flora Capensis," recently completed, and the "Flora of Tropical Africa," which will run to eleven or twelve volumes, will always be associated with his many years at Kew, where he also started the *Kew Bulletin*. He has contributed notably to the economic and systematic botany of the British Empire.

Sir HOWARD GRUBB, to whom our hearty congratulations are extended on the occasion of his eighty-second birthday, was educated privately and at Trinity College, Dublin. The practical outcome of his skill and labours in the production of objectives and instruments of precision is known wherever there are observatories. Early this year Sir Howard was the recipient of a congratulatory address signed by the leading astronomers and astrophysicists of Great Britain, referring to his resourcefulness and ingenuity in the development of the instrumental equipment of astronomers through more than sixty years.

Societies and Academies.

LONDON.

Optical Society, June 24.—M. von **Rohr**: Joseph Fraunhofer and the development of optical instruments. The position of high-grade optical work at the beginning of the nineteenth century was discussed. The chief cause of the transference from England to Germany of supremacy in telescope construction at that time was the appreciation in the latter country of the importance of fundamental research to the industry. The developments which took place in Munich and later at Benediktbeurn due to Fraunhofer's activities were detailed and some of the more important instruments produced under his direction were described.—T. **Smith**: (1) Reflection as a special case of refraction. Some difficulties which arise in applying the formulæ for refraction to reflection, and particularly the sign conventions which should be adopted for reflection, were discussed. (2) On the light transmitted and reflected by a pile of plates. The properties of a series of media or of a pile of plates which absorb and scatter light, and the interfaces of which may also absorb and scatter as well as transmit and reflect light, were investigated. In general, the ratio of the transmissive factors of a pile of plates in the two directions is independent of all reflective properties of the surfaces, and the factors are equal if the individual transmissive and absorptive factors are the same for the two beams. The ratios of the light transmitted without reflection to the total light transmitted are equal in both directions. The reflective properties of the pile depend upon all the factors of the system, and the ratio of the two reflective factors is not independent of the order in which the plates are placed. In non-absorbing systems, the sum of the intensities of the reflected and transmitted beams is equal to the intensity of the incident beam, and the ratio of the intensity of the reflected to that of the transmitted beam is equal to the sum of the corresponding ratios for the component plates or surfaces of the pile. Such a pile forms an exception to the rule that the reflective coefficients depend on the order in which the plates are arranged.—D. S. **Perfect**: Note on the immutability of transmissive factors with reversal of light. Direct experimental evidence has been obtained that the transmissive factor of the surface separating two media is unaltered if the direction in which the light travels is reversed.

DUBLIN.

Royal Dublin Society, June 22.—P. A. **Murphy**: The downy mildew of onions (*Peronospora Schleideni*), with particular reference to the hibernation of the parasite.—W. R. G. **Atkins** and H. H. **Poole**: Photo-electric measurements of illumination in relation to plant distribution (Part 1). Measurements of the illumination in shaded and open sites have been made by means of two photo-electric photometers and an apparatus already described, the readings being nearly simultaneous. The ratio of the illumination at a shaded site to the illumination due to diffused light in the open forms a useful index for comparing different sites. This ratio is conveniently expressed as a percentage which is called the daylight factor. It is usually found with both the photometers horizontal (so as to measure the vertical illumination), but a useful value near the edge of a wood is that found by tilting the photometer so as to receive the maximum illumination. There is a marked correlation between the flora and the daylight factors of the sites examined.—J. **Reilly** and G. T. **Pyne**: Studies in peat (Part 1). The thermal decomposition of peat under reduced pressure. Distillations of dried peat

were carried out under atmospheric and reduced pressures, and at both low and moderately high temperatures. The vacuum distillations gave larger yields of tar, of the heavier acidic substances, and of paraffin, while those at atmospheric pressure gave larger yields of simpler products such as ammonia, methyl alcohol, acetic acid, and gases. This points to a type of decomposition under low pressure favouring the formation of the more complex intermediate products.—J. **Reilly** and Miss H. E. **Bastible**: The velocity of formation of 3-5-dimethylpyrazole-4-diazonium chloride. The rate of reaction between nitrous acid and the amine was retarded by working in $N/100{,}000$ solutions. Owing to the great stability of 3-5-dimethylpyrazole-diazonium salts, measurements were possible up to comparatively high temperatures. The reaction is bimolecular, and at 0° C., $K=0{\cdot}022$, the value increasing regularly with rise of temperature. At 72° C., $K=5{\cdot}8$, more than 90 per cent. of the nitrous acid being destroyed in two minutes. In a control experiment without the base, less than 1 per cent. of the acid was destroyed in two minutes at 100° C.

PARIS.

Academy of Sciences, June 14.—E. **Goursat**: A problem of the theory of surfaces.—Marcel **Brillouin**: The centre of gravity and moments of inertia of the oceans. The mean action of the earth on the ocean.—Charles **Moureu**, Charles **Dufraisse**, and Paul Marshall **Dean**: A coloured hydrocarbon: rubrene. The substituted phenylacetylene, $(C_6H_5)_2CCl.C:C.C_6H_5$, has been proved to be very unstable, owing to the mobility of the atom of chlorine. If this compound is heated alone in a vacuum, hydrogen chloride is evolved, and from the residue a new hydrocarbon (rubrene) can be extracted, distinguished by its fine orange red colour, high melting point (331° C.), and sparing solubility in ordinary solvents. It combines with four atoms of bromine giving derivatives remarkable for their stability at high temperatures, one melting at 460° C. and another at 500° C., both without decomposition.—A. **Blondel** and A. **Dargenton**: Apparent brilliance of the face of exit of an optical system with any number of thick lenses.—Léon **Guillet**: The cementation of copper and its alloys by aluminium. As cementing agent an aluminium copper alloy (aluminium 20 per cent.) was used, the powdered alloy being mixed with 5 per cent. of ammonium chloride. Details of the results of experiments with various alloys are given, including the depth of penetration, hardness of the surface, and microscopic structure of the surface.—Charles **Nicolle** and Charles **Anderson**: Recurrent fever transmitted both by Ornithodorus and by lice. Sadi de Buen has recently announced the existence in Spain of a special type of recurrent fever, not transmitted by lice, but by *Ornithodorus marocanus*. These experiments were made on rats, but the author now proves that if monkeys are substituted for rats, the Spanish recurrent fever can be transmitted both by lice and by Ornithodorus.—N. E. **Nörlund** was elected corresponding member for the Section of Geometry in succession to the late Cl. Guichard.—Bertrand **Gambier**: Voss-Guichard surfaces.—Gaston **Julia**: Correction to the note on the polynomials of Tchebichef. Admitting priority to D. Jackson and G. Polya.—E. **Lainé**: Equations of the form $s=f(x, y, z, p, q)$ which are of the first class.—Jacques **Risler**: The formation of luminescent helium tubes. Details of the methods of purifying the helium and cleaning the tubes from foreign gases.—D. K. **Yovanovitch** and Mlle. A. **Dorabialska**: A new method for measuring the absorption of the β- and γ-radiation of radioactive bodies. The usual method consists in measuring the ionisation produced by the energy remaining in the rays after traversing several layers of material: the method now proposed is to measure calorimetrically the energy retained by the material itself in the form of heat.—**Frilley**: Absorption of the penetrating radiation of actinium in equilibrium with its derivatives.—René **Dubrisay**: Researches on surface actions. Solutions of various dyes (methylene blue, congo red, methyl orange, etc.) were shaken with absorbent materials (sand, kieselguhr, asbestos, cotton) and the quantity of dye adsorbed measured colorimetrically. The addition of an electrolyte, sodium chloride, increased the amount adsorbed in every case.—P. **Mondain-Monval**: The thermal properties of the various varieties of selenium. The heat of transformation of vitreous selenium into metallic selenium at 130° C. was found to be 13·5 cal. per gm., and that of red crystallised selenium at 150° C. into metallic selenium, 2·2 cal. per gm.—A. **Kirrmann** and H. **Volkringer**: The absorption in the ultra-violet of two isomers. The substances compared were the two bromoheptenes, $C_5H_{11}-CH=CHBr$ and $C_5H_{11}-CBr=CH_2$.—L. **Barthe** and E. **Dufilho**: The estimation of sodium: applications. A modification of the method of Blanchetière suitable for material containing organic matter or phosphates. The sodium is precipitated as the triple acetate of uranium, magnesium, and sodium.—B. **Bogitch**: The removal of iron from copper and nickel matte.—Charles **Prévost**: The two stereoisomeric α-ethylene-γ-glycols.—P. **Russo**: The presence of three transported beds in the southern Rif.—Pierre **Termier**: Remarks on the preceding communication.—**Pouget** and **Chouchak**: The radioactivity and chemical composition of the mineral waters of Hammam des Ouled Ali.—Ignace **Puig**: The large electromagnetic disturbances of the four first months of 1926 according to the records of the Observatory of Ebro, Tortosa, Spain.—André **Dauphiné**: New experiments on the vascular relations between the leaf and the root.—B. P. G. **Hochreutiner**: A new genus, intermediate between the Malvaceæ, the Bombacaceæ and the Sterculiaceæ.—L. **Blaringhem**: The production of double flowers as a result of complex crossings between divergent species of Geums (Rosaceæ).—G. **Mouriquand**, M. **Bernheim**, and Mlle. **Theobalt**: The antirachitic power of Wood's light. The radiations corresponding to Wood's light possess a protective action against the development of experimental rickets.—R. **Legendre**: The presence of two sea birds in the stomach of *Lophius piscatorius*.—R. **Courrier**: The quantitative action of the follicular hormone.—Em. **Perrot** and Al. **Rouhier**: *Yocco*, a new drug containing caffeine. The bark of the stem of a plant known as Yocco grown in Colombia, especially in the Putumayo and Caqueta regions, is used as a stimulant by the natives. The bark contains about 2·7 per cent. of a crystalline substance presenting all the characters and reactions of caffeine.

ROME.

Royal Academy of the Lincei, May 16.—O. M. **Corbino**: Perot and Fabry fringes obtained with a half-silvered doubly refracting plate.—Federico **Sacco**: The tunnel at Drink (Valle d' Aosta). A representation is given of the stratigraphic metamorphic crystalline series traversed by the tunnel at Drink.—Angelo **Tonolo**: Equations for the conformable representability of a three-dimensional variety of Euclidean space.—Alessandro **Terracini**: The geometrical signification of the projective normal.—G. **Horn-D' Arturo**: The theory of flying shadows. The recent suggestions of Armellini and Ronchi with regard to the origin of flying shadows during solar eclipse are refuted, the author re-asserting his view that the light

intervals of these shadows represent real images of the solar crescent.—Giorgio **Abetti**: The structure of the *Hα* line of the chromosphere.—Filippo **Burzio**: Some new properties of ballistic precession.—E. **Persico**: Magnetic rotatory polarisation in an alternating field.—Ubaldo **Barbieri**: Astronomical determination of latitude and azimuth made at Cape Noli in 1911.—Ramiro **Fabiani**: First results of new investigations in the Permian outcrops in the Sosio basin (Palermo).—Enoch **Peserico**: The manner in which the electrical conductivity of the submaxillary gland is modified during its functional activity (ii.).—Giulio **Savastano**: Non-productivity of the pistachio in Sicily. Faulty fertilisation due to lack of pollen, rather than adverse climatic conditions or ovular abortion, is the principal cause of non-productivity.—P. **Pasquini**: Ineffective closing of the blastopore and subsequent development of the segmented ovum of *Rana esculenta* subjected to rapid centrifugation.—Constantino **Gorino**: The microflora of the Italian silo.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 12, No. 5, May).—L. H. **Adams** and R. E. **Gibson**: The compressibilities of dunite and of basalt glass and their bearing on the composition of the earth. Direct measurements were made of the cubic compressibilities in the pressure range 2000 to 12,000 megabars (1 megabar = 1·0197 kgm./cm.^{2} = 0·987 atmos.). Assuming change of compressibility with pressure is a function of the compressibility, the compressibilities of dunite are $0{\cdot}84 \times 10^{-6}$ and $0{\cdot}79 \times 10^{-6}$ reciprocal megabars at 2000 and 10,000 megabars pressure respectively. The velocities of longitudinal waves at these pressures would be 7·9 km./sec. and 8·2 km./sec. Seismological data indicate that the velocity for longitudinal waves at 60 km. depth increases suddenly from 5·9 km./sec. to about 8 km./sec. The average compressibility of basalt glass was $1{\cdot}45 \times 10^{-6}$ for the above pressure range, giving a velocity for longitudinal waves of $6{\cdot}45$ km./sec. The results suggest the existence below 60 km. of ultra-basic rock.—Edwin B. **Frost**, Storrs B. **Barrett** and Otto **Struve**. Radial velocities of 368 helium stars. Of these stars, 158 are spectroscopic binaries the periods of revolution of which are mostly only a few days. Using 350 stars, those brighter than mag. 2 have an average residual velocity of 6 km./sec., while for those fainter than mag. 5·3 it is 12 km./sec. The remainder have intermediate velocities.—George E. **Hale**: Visual observations of the solar atmosphere. The spectrohelioscope is of value for detecting exceptional phenomena quickly, while observations can readily be made with light of different wave-lengths. The chromosphere, prominences, spots, and faculæ can be investigated, and the instrument affords a means of searching for solar magnetic and electric phenomena. In the laboratory it should prove of service in the study of arcs, sparks, and other light sources with lines of various types.—William C. **Bray** and Hal D. **Draper**: Capillary condensation and adsorption. Sorption isotherms have been found for water vapour on partially hydrated oxides of copper and manganese, and mixtures of them in the form of porous granules. There is a rapid increase of sorption at higher pressures due to condensation of liquid in the capillaries. This occurs only when the surface, covered with a monomolecular layer by adsorption, is sufficiently curved.—Cecil D. **Murray**: The physiological principle of minimum work. (ii.) Oxygen exchange in the capillaries. The principle of minimum work can be applied to the circulation in the arterial system and in the capillaries. The general conclusion is that a minimum principle holds in physiology; the internal environment is in a state of mobile equilibrium, its components settling down to a new equilibrium with new constraints.—Cesar **Uribe**: Nuclear division in the trophozoites of *Endamœba histolytica*. Stained preparations were made of the intestine of a cat experimentally infected. A consecutive series of stages of nuclear division in trophozoites is described. Cloudy material forming two polar masses and an "axial band" in which the spindle is embedded appear to arise from the karyosome. The polar masses are surmounted by two clear cones with a centriole at the apex of each. The number of daughter chromosomes is estimated as six.—D. L. **Hopkins**: The effect of hydrogen-ion concentration on locomotion and other life-processes in *Amœba proteus*. Optimum conditions for growth and reproduction of Amœbæ from both acid and alkaline solutions occur at about *p*H 6·7 and *p*H 7·6. Locomotion, measured by sketching a pseudopodium with a camera lucida at minute intervals, shows similar optimum points. A neutral solution seems to cause a marked change in permeability, leading to decreased movement and vitality.—A. F. **Blakeslee** and J. L. **Cartledge**: Pollen abortion in chromosomal types of Datura. The size and condition of the pollen is an indication of the chromosomal group to which a plant belongs.—Edward **Condon**: Remarks on penetrating radiation. (*a*) Assuming that an electron is a sphere of negative electricity of uniform density and that a proton is a point charge, it is calculated that the 'neutron' can execute simple harmonic motion with a frequency of the same order as that of Millikan's penetrating radiation. (*b*) Using a corrected absorption law to accord with the geometrical conditions of Millikan's experiment, the results suggest that the radiation observed is truly homogeneous. There are difficulties in accepting the 'neutron' postulated.—Edwin H. **Hall**: New evidence in favour of a dual theory of metallic conduction. This theory gives an explanation of the Peltier development of heat observed by Bridgman, where an electric current changes direction within a metal crystal.—R. de L. **Kronig**: (1) The magnetic moment of the electron. (See NATURE, April 17, p. 550.) (2) A theorem of space quantisation.—E. O. **Salant**: On the heat capacity of non-polar solid compounds. Taking Born's theory of the heat capacities of crystalline solids and assuming a mean vibration in all directions for the molecule, terms are obtained expressing the contributions to heat capacity by (*a*) molecular vibrations, (*b*) bond frequencies (determined by characteristic bond frequencies in the infra-red), and (*c*) vibrations of the atoms across their bonds.—Robert S. **Mulliken**: Systematic relations between electronic structure and band-spectrum structure in diatomic molecules (iii.). Molecule formation and molecular structure.—Richard C. **Tolman** and Sinclair **Smith**: On the nature of light. G. N. Lewis has suggested that an atom never emits a quantum of radiation except to another atom, the possibility of transmission being determined by the laws of interference. His crucial experiment of arranging a mirror on a pivot in order to detect the effect of reflexion of quanta from one half only, those from the other half being forbidden by interference laws, is considered inadequate. The suggestion is made that a radiation field contains both waves and light quanta, the latter carrying energy and the former providing a signalling system. When and where both wave and quantum theory permit, the action of light occurs.—Einar **Hille**: On Laguerre's series (iii.).—Tracy Yerkes **Thomas**: On conformal geometry.—R. L. **Moore**: Concerning indecomposable continua and continua which contain no subsets that separate the plane.

Official Publications Received.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 543: Surface Water Supply of the United States, 1922. Part 3: Ohio River Basin. Pp. vi+262+2 plates. 25 cents. Water-Supply Paper 563: Surface Water Supply of the United States, 1923. Part 3: Ohio River Basin. Pp. vi+258+3 plates. 25 cents. Water-Supply Paper 567: Surface Water Supply of the United States, 1923. Part 7: Lower Mississippi River Basin. Pp. iv+122+3 plates. 15 cents. Water-Supply Paper 572: Surface Water Supply of the United States, 1923. Part 12: North Pacific Slope Drainage Basins. A: Pacific Basins in Washington and Upper Columbia River Basin. Pp. v+193+li+3 plates. 25 cents. Bulletin 780D: Antimony and Quicksilver Deposits in the Yellow Pine District, Idaho. By Frank C. Schrader and Clyde P. Ross. (Contributions to Economic Geology, 1925, Part 1.) Pp. iv+137–167 +plates 18-19. Bulletin 785A: Recent Developments in the Aspen District, Colorado. By Adolph Knopf. (Contributions to Economic Geology, 1926, Part 1.) Pp. ii+28+1 plate. Professional Paper 146: Mississippian Formations of San Saba County, Texas. By P. V. Roundy, George H. Girty and Marcus I. Goldman. Pp. iv+63+33 plates. 35 cents. (Washington, D.C.: Government Printing Office.)

Bird Sanctuaries Committee (England). Report for 1925. Pp. 15. (London: H.M. Office of Works.)

Proceedings of the United States National Museum. Vol. 68, Art. 9: North American Species of Two-winged Flies belonging to the Tribe Miltogrammini. By Harry W. Allen. (No. 2610.) Pp. 106+5 plates. Vol. 68, Art. 10: Field Notes on Gall-Inhabiting Cynipid Wasps, with Descriptions of New Species. By Lewis H. Weld. (No. 2611.) Pp. 131+8 Plates. Vol. 68, Art. 20: A new Genus and Species of Borborid Flies from South America. By Mario Bezzi. (No. 2621.) Pp. 6. Vol. 68, Art. 21: New Genera and Species of Acalyptrate Flies in the United States National Museum. By J. R. Malloch. (No. 2622.) Pp. 35+2 plates. Vol. 68, Art. 23: North American Two-winged Flies of the Genus Cylindromyia Meigen (Ocyptera of Authors). By J. M. Aldrich. (No. 2624.) Pp. 27+1 plate. Vol. 69, Art. 2: The Optical Properties and Chemical Composition of Glauconite. By Clarence S. Ross. (No. 2628.) Pp. 15. (Washington, D.C.: Government Printing Office.)

Year Book of the Academy of Natural Sciences of Philadelphia for the Year ending December 31, 1925. Pp. 100 +8 plates. (Philadelphia, Pa.)

Research Publications of the University of Minnesota. Bibliographical Series, No. 3: Research in Progress at the University of Minnesota, July 1924—July 1925. Compiled by Dr. Clarence M. Jackson. Pp. vi+306. (Minneapolis, Minn.) 1.25 dollars.

Department of the Interior: Bureau of Education. Bulletin, 1925, No. 45: Statistics of Universities, Colleges and Professional Schools, 1923–24. Pp. 161. (Washington, D.C.: Government Printing Office.) 25 cents.

Astronomical and Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the Year 1924. Under the Direction of Sir Frank Dyson. Pp. 8+Axxiii+A55+iv+B22+C7+Dix+D85 +5+Exxii+E76+21. (London: H.M. Stationery Office.) 37*s.* 6*d.* net.

Researches of the Department of Terrestrial Magnetism, Vol. 5. Ocean Magnetic and Electric Observations, 1915-1921. Magnetic Results, by J. P. Ault; Atmospheric-Electric Results, by J. P. Ault and S. J. Mauchly. Special Reports: The Hudson Bay Expedition, 1914, by W. J. Peters; Navigation of Aircraft by Astronomical Methods, by J. P. Ault: The Compass-Variometer, by Louis A. Bauer, W. J. Peters and J. A. Fleming; Sunspot and Annual Variations of Atmospheric Electricity, with Special Reference to the *Carnegie* Observations, 1915–1921, by Louis A. Bauer; Studies in Atmospheric Electricity based on Observations made on the *Carnegie*, 1915–1921, by S. J. Mauchly. (Publication No. 175.) Pp. vii+430+15 plates. (Washington, D.C.: Carnegie Institution.) 7.25 dollars.

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 23: Some Marine Bottom Samples from Pago Pago Harbor, Samoa, by M. N. Bramlette; Proportions of Detrital Organic Calcareous Constituents and their Chemical Alteration in a Reef Sand from the Bahamas, by Marcus I. Goldman; Report on a Bacteriological Examination of 'Chalky Mud' and Sea-Water from the Bahama Banks, by N. R. Smith; Recent Foraminifera from Porto Rico, by J. A. Cushman; Fossils from Quarries near Suva, Viti Levu, Fiji Islands, and from Vavao, Tonga Islands, with Annotated Bibliography of the Geology of the Fiji Islands, by Wendell C. Mansfield; Miocene Corals from Trinidad, by T. W. Vaughan and J. E. Hoffmeister. (Publication No. 344.) Pp. ii+134+15 plates. (Washington, D.C.: Carnegie Institution.) 2.50 dollars.

Papers from the Department of Marine Biology of the Carnegie Institution of Washington. Vol. 24: Taxonomy of the Amebas, with Descriptions of Thirty-nine new Marine and Freshwater Species. By Prof. Asa Arthur Schaeffer. (Publication No. 345.) Pp. iii+116+12 plates. (Washington, D.C.: Carnegie Institution.) n.p.

Human Metabolism with Enemata of Alcohol, Dextrose and Levulose. By Thorne M. Carpenter. (Publication No. 369.) Pp. ix+197. (Washington, D.C.: Carnegie Institution.) 2.25 dollars.

Contributions to Embryology. Vol. 17, Nos. 85 to 89. No. 85: Development of the Human Embryo during the period of Somite Formation, including Embryos with 2 to 16 pairs of Somites, by George W. Bartelmez and H. M. Evans; No. 86: Origin and Development of the Rete Ovarii and the Rete Testis in the Human Embryo, by Karl M. Wilson; No. 87: Physiological Study of Cortical Motor Areas in Young Kittens and Adult Cats, by Lewis H. Weed and Orthello R. Langworthy; No. 88: Lymphatics and Blood-Vessels of the Ovary of the Sow, by Dorothy H. Anderson; No. 89: Relation of Onset of Decerebrate Rigidity to the Time of Myelinization of Tracts in the Brain-Stem and Spinal Cord of Young Animals, by Orthello R. Langworthy. (Publication No. 362.) Pp. iii+140+27 plates. (Washington, D.C.: Carnegie Institution.) n.p.

Proceedings of the Board of Agriculture in India held at Pusa on the 7th December 1925, and following days; with Appendices. Pp. iv+154. (Calcutta: Government of India Central Publication Branch.) 1.14 rupees; 3*s.* 3*d.*

Patents for Inventions: including some Useful Information on Trade Marks, Designs and Copyright. By Benj. T. King. Pp. 16. (London: King's Patent Agency, Ltd., 146a Queen Victoria Street, E.C.4.) Free.

Observatoire de Zi-ka-wei. 1122 étoiles doubles de J. Herschel: étudiées d'après les catalogues photographiques et les cartes-du-ciel. Par le Rev. P. Gauchet. (Annales de l'Observatoire de Zô-sè, Tome 14, Fascicule 3.) Pp. B72. (Zi-ka-wei, Chang-hai.)

Canada. Department of Mines: Geological Survey. Memoir 144, No. 128 Geological Series: Mount Albert Map-area, Quebec. By F. J. Alcock. (No. 2083.) Pp. ii+75+6 plates. 20 cents. Memoir 147, No. 127 Geological Series: Michipicoten Iron Ranges. By W. H. Collins, T. T. Quirke and Ellis Thomson. (No. 2079.) Pp. iii+175+9 plates. 30 cents. Economic Geology Series, No. 1: Geology and Economic Minerals of Canada. By G. A. Young. (No. 2065.) Pp. iv+187+57. 50 cents. (Ottawa: F. A. Acland.)

Leeds Tercentenary Celebrations. Report of the Tercentenary 'Clean Air' Committee, July 1926. Pp. 52. (Leeds: Walter Gardham.) 3*d.*

A Bibliography on Research: Selected Articles from the Technical Press, 1923, 1924, 1925. Pp. 46. (New York: National Research Council.)

The Royal Society for the Protection of Birds. Thirty-fifth Annual Report, January 1st to December 31st 1925: with Proceedings of Annual Meeting, 1926. Pp. 108. (London: 82 Victoria Street, S.W.1.) 1*s.*

Proceedings of the Imperial Academy. Vol. 2, No. 4, April. Pp. vii-xi+149-191. (Ueno Park, Tokyo.)

Annalen van de Sterrewacht te Leiden. Deel 12, Stuk 3: New Mathematical Theory of Jupiter's Satellites. 1 and 2: The Intermediary Orbit and the Variations. By Prof. W. de Sitter. Pp. ii+83. Deel 14, Stuk 3: Measures of Double Stars made with the 10½-inch Clark-Repsold Refractor in the Years 1920–1925. By W. H. van den Bos. Pp. 88. (Haarlem: Joh. Enschedé en Zonen.)

Diary of Societies.

MONDAY, JULY 26.

CAMBRIDGE PHILOSOPHICAL SOCIETY (in Cavendish Laboratory), at 4.30.—Dr. P. A. M. Dirac: On Quantum Algebra.—Miss B. Swirles: The Polarisabilities of Atomic Cores.—J. R. Oppenheimer: On the Quantum Theory of the Problem of the Two Bodies. (Preliminary Communication.) *Communicated by title only:* M. H. A. Newman: Integral Invariants of the Affine Field.—Dr. A. Young and Prof. H. W. Turnbull: The Linear Invariants of Ten Quaternary Quadrics.—G. S. Mahajani: A Contribution to the Theory of Ferromagnetism.—E. B. Moullin: On some Resistance Properties of a Certain Network containing Inductances and Capacities, and their Analogies in a Mechanical System.—J. C. Burkill: On Mellin's Inversion Formula.—Major P. A. MacMahon: The Elliptic Products of Jacobi and the Theory of Linear Congruences.—R. Hargreaves: Geodetic and Dynamical Principles, a Comparison and Connexion.—J. R. Oppenheimer: On the Quantum Theory of Vibration-Rotation Bands.—P. A. Taylor: An Approximation to the Motion of Two Rotating Electrical Doublets in a Plane.—D. R. Hartree: Some Relations between the Optical Spectra of Different Atoms of the same Electronic Structure: II. Aluminium-like and Copper-like Atoms.—J. P. Gabbatt: Note on the Extension to Higher Space of a Theorem of Wallace.—J. B. S. Haldane: A Mathematical Theory of Natural and Artificial Selection. Part III.

CONFERENCES.

JULY 26 TO 31.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Lyons).

AUGUST 3 TO 6.

INTERNATIONAL PHYSIOLOGICAL CONGRESS (at Stockholm).

AUGUST 16 TO 23.

INTERNATIONAL BOTANICAL CONGRESS (at Cornell University).

AUGUST 23 TO 28.

AUSTRALASIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Perth, Western Australia).—Prof. E. H. Rennie: The Chemical Exploitation, Past, Present and Future, of Australian Plants (Presidential Address).—The Presidents of Sections and the Titles of their Addresses are as follow: *A* (*Astronomy, Mathematics and Physics*), Prof. K. Grant, Atomic Transformation; *B* (*Chemistry*), Prof. J. Kenner, Some Aspects of the Problem of Molecular Structure; *B* 2 (*Pharmacy*), A. T. S. Sissons, The Indebtedness of Pharmacy to Organic Chemistry; *C* (*Geology and Mineralogy*), Sir Douglas Mawson, The Igneous Rocks of South Australia—a brief Survey of Present Knowledge relating thereto; *D* (*Zoology*), Prof. L. Harrison, The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis; *E* (*Geography and History*), Prof. E. Scott, The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux; *F* (*Ethnology and Anthropology*), Prof. F. Wood Jones, The Claims of the Australian Aboriginal; *G* (*Social and Statistical Science*), Major L. F. Giblin, Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth; *H* (*Engineering and Architecture*), Sir John Sulman, Town Planning; *I* (*Sanitary Science and Hygiene*), F. S. Hone; *J* (*Mental Science and Education*), P. Board, Social and Economic Values in Education; *K* (*Agriculture and Forestry*), C. E. Lane Poole, Forestry and Land Settlement; *L* (*Veterinary Science*), Prof. J. D. Stewart, The Relationship of Veterinary Science to the Prosperity of the State; *M* (*Botany*), Prof. A. J. Ewart, Past and Future Development of Botanical Science; *N* (*Physiology and Experimental Biology*), Prof. W. A. Osborne, The Study of the Reflex.

AUGUST 26.

MEDICAL WOMEN'S INTERNATIONAL ASSOCIATION (at Prague): Discussions on Tuberculosis and Pregnancy; Women Police-surgeons.