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## Science for Citizenship

ALL who are concerned about the gathering economic distresses of our time will welcome the growing conviction of the world of science, as evinced at the Leicester meeting of the British Association, that scientific men have a social mission over and above the disinterested investigation of Nature, and that it is impossible completely to detach the process which we call science from the uses to which its discoveries are put in the life of our race.

If this world were simply a technical problem, something far more radical than the advisory activities now proposed to be taken up by the Association would be possible. Those aspects of government which depend simply on exact knowledge could undoubtedly be better handled by technicians and men of science than by politicians. But the problem is not merely technical. What has to be organised is not the interaction of cams and cogs and levers, nor even the more complex dynamics of chemical and biological systems. The salvation of our world from the chaos which threatens it is a problem of the co-operation of human beings. That co-operation must admittedly be based on exact knowledge and informed with the spirit and temper of science ; but it must also, if it is to be happy and fruitful, awaken the sympathy and understanding of the lay public whose daily lives it will involve.

It follows that the scientific world must conduct, *pari passu* with its expert discussion of social problems, a campaign of publicity and education more ambitious than it has ever attempted before. It must seek to popularise, not principally its concrete proposals for the scientific control of civilisation, but the knowledge and method from which those proposals derive their force. Many scientific workers will look askance on such a project, rightly perceiving that the delicacy and precision of their intellectual technique is ill-adapted to the rough handling of the marketplace. But while it is true that science cannot be put on the hoardings like the catchwords of a political party, or conveyed in an atmosphere of emotionalism like the tenets of a popular religion, it does not pass the wit of man to invent modes of presentation whereby a broad understanding of scientific knowledge can be imparted to the man in the street. Moreover, since it is becoming painfully clear that the scientific man lives in the social world and is himself



peculiarly vulnerable to its misfortunes, the sort of professional pride which will not explain itself to ordinary folk is a pride which goes deservedly before a fall.

It is therefore very appropriate that the Educational Science Section of the British Association should have received at Leicester a report from its Committee on the position of "Science Teaching in Adult Education Classes"\*. The world of science is to-day increasingly able to obtain, and should deliberately seek, the most varied forms of publicity, including isolated popular lectures, newspaper articles, 'feature' films for general exhibition, radio talks and attractively written popular books. The serious study of science by non-professional adult students, continued over a series of meetings under the guidance of a tutor or lecturer of adequate knowledge and ability, must play an increasingly important part in the formation of the public mind. Men and women trained in such classes, though they be necessarily a tiny minority, can become by their vivid consciousness of the relevance of scientific knowledge to the happenings of the economic world the catalysts of that scientific revolution the need for which grows ever more pressing.

The presentation of science to non-professional adult students necessarily differs in its angle of approach from the instruction of students destined for some branch of the scientific profession. Its aim is to fit men for life in a civilisation founded on science, rather than to make original investigators or technical specialists. There will therefore be less insistence on the minutiae of logical and experimental technique, and more on the manifold contacts of science with life. People, as the Committee's report suggests, are more interested in conclusions and their social and philosophical bearings than in the more recondite details of specialised research; and in the event that the scientific purist should urge that such a study is not science at all but something else, the reply is open that, science or not, it is a popular interest of the greatest importance to the scientific profession.

The traditional way of relating science to life is that generically represented by the caption, 'science and common things'. The worker in metal can be interested in the new knowledge of crystal structure as it relates to alloys or the heat

treatment of metals. The worker in the chemical industry can be approached through the transformations which he sees going on in the works. The motorist or the wireless enthusiast can be led to science through the gateway of his very technical hobby. The agricultural labourer or farmer can find scientific interest in his daily experience of plant and animal life, of fertilisers and dressings. Even the housewife, practitioner of the most primitive of modern callings, can learn to discover unsuspected scientific truths in the washtub, the oven or the child's top.

There is, however, another and still more important avenue, which is suited both to the present temper of the scientific world and to the enduring common interest shared by most intelligent working people. Few who have not direct contact with working-class movements can realise how large a part 'politics'—in the broadest sense—plays in the intellectual development of the worker. The intelligent workman naturally gravitates to the activity of his trade union, his co-operative society or his political association; and his whole vocabulary and outlook bear the impress of this dominant interest. It plays in his life an analogous rôle to that of the university in more fortunate social strata. It is his avenue to the mastery of life. It follows that the most appropriate way of presenting science to that vast majority of our population which makes up the working-class is from the angle of its effects on social life and the hopes and dangers for common folk which scientific discovery brings in its train.

This predilection of intelligent working-people affords a striking opportunity to the missionaries of science at the present time. The technique of presentation which those missionaries must employ offers, however, a problem of its own. The Report to which reference has been made emphasises the apparent lack of good tutors and lecturers able to present science acceptably to working-folk. That task demands, not only a wide and sound knowledge of science combined with the power of lucid exposition and happy illustration which the great masters of popularisation have possessed, but also a living appreciation of the social interests of the student. It demands also the rather unusual ability to relate social aspiration, not merely to scientific results, but also to that objective temper of thought whereby those results have been so abundantly achieved.

Men possessed of the aptitudes of knowledge and temperament for such work are comparatively

\* Report of Committee appointed to consider the position of Science Teaching in Adult Education Classes, and to suggest possible means of promoting through them closer contact between Scientific Achievement and Social Development. (British Association, Burlington House, London, W.1.)



rare; nevertheless they are probably available in larger numbers than the Report suggests. The problem is to attract them from pursuits which at present seem to offer greater prospect of advancement. The young scientific man who has a bent for adult teaching finds at present that though he may make or supplement a living by such work, yet it is through research that his way to professional success lies. Adult education, however fascinating, does not yet offer the man of science a career. If, therefore, the scientific world wishes to make effective the educational aspect of its increasing social project, it must create a new branch of the profession of science to concern itself principally, and not merely incidentally, with such work. There must be a career open to men of talent in the interpretation of science as well as to those whose bent is original investigation.

There is a type of science student who would rather talk about research than pursue it. It is a type which has been rather neglected in the past, since the scientific man feels with good reason that the life of investigation is pre-eminently worthy of respect. Probably, however, at the present time, the interpreter can do for science something which is even more vitally necessary than the creative work of original inquiry. It would perhaps be well if scientific workers made in the near future an unprecedented attempt to organise the propagandist and interpretative side of science, and to see their problem of publicity as a whole in which the adult educational class has its essential place.

If a deliberate effort were made to link up the teaching of science to adults with the whole business of scientific journalism and writing, scientific broadcasting and the making of scientific films, and the organisation of adequate publicity for science, it should be possible to offer to the young science student with a gift for writing and talking a career which would be well worthy of his consideration.

The House of Saloman was conceived as an organisation of *savants*; but it was the dream of a man greater himself as an interpreter than as an original investigator. Those who inherit his great tradition could not more fitly honour his memory than by the creation of a body of professional missionaries and teachers who would make straight the pathway of the scientific State in a world threatened with dissolution and chaos.

L. A. F.

## History of Elementary Mathematics

*Geschichte der Elementar-Mathematik in systematischer Darstellung: mit besonderer Berücksichtigung der Fachwörter.* Von Dr. Johannes Tropfke. Band 2: *Allgemeine Arithmetik*. Dritte verbesserte und vermehrte Auflage. Pp. iv+266. (Berlin und Leipzig: Walter de Gruyter und Co., 1933.) 12 gold marks.

THE first volume of this third edition of Tropfke's history of elementary mathematics appeared towards the end of 1930; the second, now under notice, follows at an interval of two and a half years. At this rate of progress, it will be a long time before we have the seventh volume which is to contain the new and complete indexes to the whole work. The absence of the indexes in the meantime will be a serious inconvenience; for those, however, who possess the second edition this will be mitigated by the fact that, so far as the matter in that edition is concerned, the old indexes will serve, because the editor gives at the end of each volume tables showing the correspondence of pages in the two editions and of the relative footnotes.

The number of pages in vol. 2 has increased in this edition from 222 to 266 and the number of footnotes from 1,157 to 1,461! Many of the new references are to works and papers so recent as 1932, so that the two and a half years which have elapsed since the issue of vol. 1 have yielded much that was worth waiting for. The book cannot be too strongly recommended as a really up-to-date encyclopædia of the history of elementary mathematics. The editor had the assistance of Heinrich Wieleitner, the well-known historian of mathematics, until his death in 1931, and his young co-workers, Kurt Vogel and J. E. Hofmann, gave further assistance while the book was in the press.

In accordance with the original plan, vol. 2 is entitled "Allgemeine Arithmetik" and deals with (a) algebraic notations and their gradual development, (b) the name 'Algebra', (c) the development of the notion of number (including irrational, negative, and complex numbers), (d) algebraical operations, (e) the history of logarithms, which itself covers nearly sixty pages.

Specially noteworthy are the additions made in the domain of ancient mathematics. Account is taken (1) of a number of Greek papyri recently investigated and published (see the long note on page 5), (2) of the latest researches into Babylonian



and Egyptian mathematics. Under the latter head reference is made, as regards Egypt, to the Moscow Papyrus at length published by W. W. Struve in 1930, and as regards Babylon to the translations and interpretations of a quantity of cuneiform texts published within the last few years by O. Neugebauer and others. It is now known that the Babylonians solved quadratic equations arithmetically, using precisely the same formula for the roots as we use in our solutions, though never stating the formula in general terms. It is as if the solver carried in his memory an imprint, as it were, of the formula and proceeded in each case, as it were automatically, to square the half of one of the given coefficients, multiply two others, add or subtract the product, find the square root of the result, and so on; this was as early as 2000 or 1800 B.C.

The Babylonian also made attempts at approximations to square roots of non-square numbers corresponding to the use of the formula  $\sqrt{a^2 \pm b} = a \pm b/2a$  nearly. This implies a knowledge of the Pythagorean theorem, which is further attested by Babylonian calculations of the lengths of chords in a circle from their abscissæ and vice versa. Cuneiform inscriptions now being deciphered make it clear also that the Babylonian was fully aware that the quadratic equation has two roots, and found both, at least in the case where both are positive.

T. L. H.

### Plant Analysis

*Handbuch der Pflanzenanalyse.* Herausgegeben von G. Klein. Band 3: *Spezielle Analyse.* Teil 2: *Organische Stoffe II.* Erste Hälfte. Pp. xiii+806. Zweite Hälfte. Pp. vi+807-1613. (Wien und Berlin: Julius Springer, 1932.) 168 gold marks.

THE subject of plant analysis, in the sense of knowing chemically all about every constituent of each plant, is obviously a big one, though few will have realised that it had ever grown to the extent portrayed in this series of compendia. The organic section of the so-called handbook in three massive volumes has already reached 34 sections with more to come; 43 different authors have taken part in its production. The last book in English on the glycosides, a very specialist subject, was written by but two authors; here the same subject is divided into ten sections requiring nine separate authors and occupies 415 pages. Such figures give a measure of the extent to which both knowledge and specialisation are

growing, and yet it can be said that we are only on the threshold of the knowledge of plant analysis.

Many rare and interesting substances remain to be discovered, like for example ascorbic acid, as the methods of detection and isolation are refined and the plant families are searched through one by one. It is useful, therefore, to have a work of reference which is comprehensive and yet not too much like a dictionary, so that future workers may be spared at least some of the labour of searching the original literature.

The sections strive to give a summary of the individual substances, suitably classified with a note of their methods of detection and isolation. At the end of each group of compounds, there is given a systematic list of their distribution and occurrence in individual plants. Contrary to the usual practice, references to the original literature are scanty, but their insertion would have occupied much space and have been of little additional value. They can be obtained elsewhere.

The best criterion of such a book is the standing of the authors: they comprise all the leaders in the respective fields, writers who may reasonably be expected to have direct practical knowledge of their subject. The two volumes before us deal with the 'membrane stuffs', as the German calls them, of which chemists are just beginning to achieve some understanding and expect with confidence to make much of during the next decade. Further, the tannins, ethereal oils, rubber and resins, are also fields in which the foundation stones for important future progress have been laid.

In the second volume, the glycosides, divided as stated into many sections, and the plant colouring matters are reviewed. These latter include the carotinoids now in the forefront of interest, chlorophyll, and the strange colouring matters of algæ, fungi and bacteria.

Of the whole range of plant products considered, only the ethereal oils and glycosides have been worked out with any completeness in regard to structure; the rest of the compounds are mostly of a molecular complexity greater than the chemist has yet been able to unravel, though he is more than ever confident of being able to do so. At one end of the scale physicists are searching for units ever smaller; at the other, astronomers seek stars and study phenomena which are ever farther away in point of distance; on a third front, the chemist is extending his attack to find out the structure of the largest molecules of actual living matter.

E. F. A.



### Archæology and the Greek Heroic Legends

- (1) *The Horse and the Sword*. By Harold Peake and Herbert John Fleure. (The Corridors of Time, 8.) Pp. viii+152. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 5s. net.
- (2) *Homer and Mycenæ*. By Prof. Martin P. Nilsson. (Methuen's Handbooks of Archæology.) Pp. xii+283+24 plates. (London: Methuen and Co., Ltd., 1933.) 21s. net.
- (3) *The Annual of the British School at Athens*. No. 31: Session 1930-1931. Pp. viii+234+28 plates. (London: Macmillan and Co., Ltd., 1933.) 50s. net.
- (4) *A Handbook to the Palace of Minos at Knossos with its Dependencies*. By J. D. S. Pendlebury. Pp. 63+24 plates. (London: Macmillan and Co., Ltd., 1933.) 4s. net.

(1) IN "The Horse and the Sword" the authors of "The Corridors of Time" have now reached the period of four hundred years following the fall of Knossos in 1400 B.C. It is, as they point out, a period which falls into two parts. In the first, great empires—Hittite, Cassite, Egyptian—fall or become enfeebled; in the second, other powers rise to take their place, following the appearance of peoples associated with the horse and armed with the sword, such as the Achæans and Dorians in the eastern Mediterranean and the Aryan-speaking peoples who irrupted into India.

The central point of interest for any study of this period must be the fall of Troy and the problems to which it gives rise. It will be found that the authors have treated this difficult question, or group of questions, with admirable clarity and detachment, giving due consideration to the discussion of the various views which are held. On the problem of the Achæan and Dorian migrations, free use is made of Greek heroic legends, which, as 'folk-memory', are taken as throwing the light of tradition on the historical problem—a problem to the solution of which, as is shown here, archæology and the study of Greek dialects are contributing their share.

(2) Prof. Nilsson reconstructs the Homeric age and discusses the Homeric question in the light of the results of archæological research. On the Homeric question, it would be difficult to say whether he is to be classified as a 'separatist' or a 'unitarian'; but one thing is evident, and that is his firm conviction of the genius and originality

of the poet who added the psychological interest to the Homer of tradition. So far he is to be regarded as a 'unionist'. He does not, however, hold that the Iliad is the product of one man or of one period. He agrees with the view that some parts of the poem are late; but on the other hand he maintains that much, not necessarily the oldest parts of the poem, represents a real tradition from the days of pre-Dorian Greece and goes back to Mycenæan times. He supports this view by an analysis of the Homeric environment, material culture, social organisation and so forth, comparing it with the Mycenæan civilisation.

In arriving at his solution of the Homeric problem, Prof. Nilsson ranges the whole field of this intricate period and brings his wide knowledge as an archæologist to bear upon its vexed questions. His book may be read with much profit side by side with "The Horse and the Sword", in so far as the latter covers the same ground, as a stimulating exercise in weighing evidence.

(3) In the annual report of the British School of Archæology at Athens, 1930-31, which is published in vol. 31 of the School's "Annual", attention is directed to the increased activity of the School as shown both in the number of students and the extent of its work in archæological excavation and observation. The excavations at Perachora, Armenochori (Macedonia), Mitylene, Haliartos, Knossos (by Sir Arthur Evans) and Ithaca during the year are briefly described. The papers published in this volume include an analysis by Messrs. W. Heurtley and T. C. Skeat of the material from the tholos tombs at Marmariene in Thessaly, which were excavated by the late Dr. Leonardos in 1890 and two years later by Prof. Tsountas. The conclusions at which the present authors arrive do not support the view on which the tombs were associated with the passage of the Dorians, but assign them to a later date. Miss Lamb gives a brief account of her further excavations in Mitylene.

(4) In writing this guide to the Palace of Knossos, Mr. Pendlebury, to use a trite but appropriate phrase, has met a long-felt want. The complexity of the site and the elaborated chronological classification of its cultures demand a detailed knowledge for the appreciation of the buildings and their interrelation, which is not at the command of any but the few, while for all the limitations of time must be a consideration. Mr. Pendlebury has provided in a compass convenient for the traveller an outline of Minoan chronology, a



route which will enable the palace and neighbouring buildings to be visited with a minimum of waste of time and energy, followed by a description of the remains in the order in which they will be seen in following this route. This descriptive matter, while sufficiently detailed, does not go beyond the needs of the average visitor.

It may not be out of place to refer here to the stratigraphical collection which, begun by Sir Arthur Evans in 1905 and continued by Dr. Duncan Mackenzie, is now in the hands of Mr. Pendlebury. This valuable instrument of research will now be more widely available through the catalogue which has been compiled recently. Those who use the catalogue will realise the need for the extended corpus of Egyptian pottery of which the initiation has been announced.

### Determinations of Gravity at Sea

*Gravity Expeditions at Sea, 1923-1930.* Vol. 1: *The Expeditions, the Computations and the Results.* By F. A. Vening Meinesz. (Publication of the Netherlands Geodetic Commission.) Pp. iv+109+2 plates. (Delft: J. Waltman, Jr., 1932.)

GOOD observations of gravity at sea are of recent date, and first became possible through the improved pendulum apparatus designed by Vening Meinesz in 1923. Since that date he has made many sea voyages (including one round the globe) on which the value of gravity has been measured at more than four hundred stations. Vening Meinesz himself, and his country Holland, have just grounds for satisfaction at this outstanding contribution of one man of science, and one national State, to our knowledge of the distribution of the attraction of gravity over the surface of the globe.

It is right and necessary to couple the man and his country in writing of this achievement. The apparatus, the skill in its use, and the planning of the programme of observation, were due to the one; the opportunities to apply them were afforded by the other. The man himself may be considered fortunate in his nationality, for Holland, though not unique among the smaller countries of Europe in its high level of intellectual culture, and in its extensive support of scientific research, combines with these the possession of far-distant colonial territories, for the protection of which it maintains a navy the ships and submarines of

which necessarily make long voyages to and from Europe, across the equator. On six separate submarine voyages, remarkable facilities were placed at the disposal of Vening Meinesz by the authorities of the Netherlands Navy. On one of these voyages the journey from Holland to Java was specially extended, for the sake of the gravity observations, across the Atlantic to Panama and thence across the Pacific to Java, visiting California and the Sandwich Islands on the way. The captain, officers and crews of the submarines, following the lead of the naval authorities at home, co-operated heartily in assisting the scientific work, which itself was supported and financed by the Netherlands Geodetic Commission.

It is interesting to recall that the design of the apparatus for use at sea grew out of difficulties experienced in taking gravity measurements *on land*, in the swampy parts of Holland. The gravity pendulums, when swung in the ordinary way, set their supports in motion, owing to the impossibility of embedding a fixed base in the mobile soil. The difficulty was overcome, and the troublesome horizontal accelerations of the apparatus were removed, by swinging two pendulums simultaneously, in opposite senses, in the same vertical plane. Based on this simple idea, a very accurate apparatus has gradually been developed which will give satisfactory measurements even at sea, provided the orientation of the apparatus is maintained constant within certain narrow limits. Using suitable suspensions, constancy within these limits can be achieved if the apparatus is housed in a submarine submerged to a depth of 20 metres, during ordinary wave movement, or about 30 metres in the presence of long sea waves.

Short accounts of the six gravity-voyages and their results have appeared, and also a book on the "Theory and Practice of Pendulum Observations at Sea". The Netherlands Geodetic Commission is issuing the complete report of the work in two volumes by Vening Meinesz. Of these the first is now published; it deals with the voyages, the measurements, their errors, and their reduction to sea-level, but not with their interpretation or the isostatic reductions, which will form the subject of the second volume. The present volume is handsomely produced, well bound and printed, written in clear concise English, and has several photographic plates and two maps. The results of all the expeditions are given in a final table; this contains the value of gravity reduced to sea-level, its mean error, and the anomaly from the 'normal'



gravity as internationally defined, for 425 stations, which in a number of cases represent combinations of more than one station separated by not more than a few miles.

The author sums up the principal outcome of his investigations in a few words. All areas where there is tectonic activity show great gravity anomalies, which are not closely related to the

topography of the earth's solid surface; they are, on the other hand, narrowly related to the seismic and volcanic activity. "This points to the supposition that the principal tectonic phenomena take place in the deeper layers of the crust, and that they have a more simple character than the surface deformations, which are responsible for the surface topography of the crust". S. C.

### Short Reviews

*Hydrogen Ion Concentration and its Practical Application.* By Frank L. LaMotte, William R. Kenny, Allen B. Reed. Pp. vii+262. (London: Baillière, Tindall and Cox, 1932.) 20s.

LOGARITHMIC scales are becoming increasingly popular nowadays, and justly so inasmuch as they afford a ready means of exhibiting the variation of a property over a very wide range, without necessitating the use of numbers intolerably large or small. The pH scale—pH being the symbol for the logarithm of the reciprocal of the hydrogen ion concentration—may seem at first a little topsy turvy, inasmuch as the variable studied—the hydrogen ion concentration—goes up as the number representing it goes down, but custom, which 'does often reason over-rule', soon makes its use mechanical, and there is no doubt of its ultimate convenience.

The authors of this work are more concerned with applications than with any detailed development of theory, and their brief, but quite sufficiently detailed introduction might be made a little more clear if due attention were paid to the fundamental rule of never introducing a new term without first defining it clearly and unambiguously.

Compare, for example, the chapter on buffer action, where the term *buffer* and derived words and phrases are used before they are formally defined. In this section of the book the technique of measurement and sources of error are very fully discussed.

In the second and larger section the authors have collected and presented in careful order an immense mass of data which shows the importance of the study of hydrogen ion concentration in the most diverse types of industrial work. Would you know something of the importance of 'swells' and 'springers' in the canning industry, of the advantage of pH determinations in the examination of doubtful oysters, of the soil preferences of the hairy phlox or the he-huckleberry, of the standard pH value of ginger ale, the shrimp, or sour pickles, of the important pH zones in the processing of sugar, gelatin and glue, pulp and paper, leather and textiles? All this, and much else of importance, is to be found in this second section, wherein the authors have discussed the application of a knowledge of hydrogen ion concentration to problems of water purification, corrosion, sewage

and waste disposal, in the milk, baking and laundry industries and in various bacteriological and pathological problems.

The book should prove very useful to workers in any of those industries, more numerous than one would at first imagine, in which a knowledge of pH technique is necessary or desirable.

A. F.

*Origins of Sacrifice: a Study in Comparative Religion.* By E. O. James. Pp. xvi+314. (London: John Murray, 1933.) 10s. 6d. net.

DR. JAMES has written a comprehensive study of the rite of sacrifice from the earliest times down to the doctrine and ritual of the Christian church of to-day. It is a task for which a wide range of reading and a broad outlook are essential. Dr. James finds the earliest evidence for the rite in the representations of animals in the palæolithic caves of France and Spain, and the palæolithic female figures carved in ivory. Of these, the first, he holds, depends for its efficacy on the blood offering, which renews life; the second is connected with the bloodless oblation, also a renewal of life and surviving in the 'corn-dolly', but perhaps not always bloodless, as the theories of Sir James Frazer have taught us. The two opposing systems are symbolised in the story of Cain and Abel. Dr. James follows up this conception of sacrifice as the renewal of strength in the central figure or objects of a cult through its various manifestations and modifications in the religions of antiquity to the doctrines of the Christian church both in its early and latest days. Particularly to be noted is, on his view, the spiritualisation of the theory of sacrifice consequent on the divorce of Jewish religious practice from the holy places during the captivity.

It will be found that Dr. James's interpretation of sacrifice at certain stages differs fundamentally from such theories as, for example, that of Robertson Smith. It may seem that his analysis throughout tends to an over-simplification in an attempt to reduce varying conceptions of the rite to a formula. Even in the palæolithic paintings it may well be that the aim of the magic art varied from time to time. It would be rash to say that the purpose of representation in a painting of an animal with its heart transfixed by a dart was



identical with that of the painting of the sorcerer of Trois Frères and his attendants.

Notwithstanding these points—suggestions for consideration rather than criticisms—Dr. James's theories cannot be lightly dismissed. He is to be congratulated on a bold attack on an intricate subject.

*Photoelectric Cell Applications: a Practical Book describing the Uses of Photoelectric Cells in Television, Talking Pictures, Electrical Alarms, Counting Devices, etc.* By R. C. Walker and T. M. C. Lance. Pp. viii+193. (London: Sir Isaac Pitman and Sons, Ltd., 1933.) 8s. 6d. net.

VERY few physicists who can recall experimental work on photoelectricity a quarter of a century ago could have anticipated the remarkable developments and practical applications which have since occurred. In this book, the authors, who are connected with the Research Laboratories of the General Electric Company, have described some typical examples of the applications of the photoelectric cell. Thus their work may be regarded as the complement of "Photoelectric Cells" by Campbell and Ritchie (Pitman). They have dealt exclusively with the alkali metal cells with which they have most acquaintance, and emphasise the distinction between the older type 'mass' layer cathode and the more modern 'thin film' cathode. They state that, so far, the caesium on silver oxide cathode has proved to be the most efficient for general purposes.

The wide range of the applications of such cells may be indicated by mentioning some of the chapter headings:—counting and timing gear, alarms, advertising, talking films, photo-telegraphy, television, and scientific instruments. "The photo-cell partnered by the thermionic valve or the grid glow tube will undoubtedly play a great part in future industrial development."

The book may be recommended to all who are interested in the technical applications of scientific principles.

H. S. ALLEN.

Union Académique Internationale. *Catalogue des manuscrits alchimiques grecs. 4: Manuscrits d'Allemagne, d'Autriche, de Danemark, de Hollande et de Suisse.* Décrits par le Dr. G. Goldschmidt. Pp. xxvi+447. (Bruxelles: Union Académique Internationale, 1932.) 30 belgas.

WITH the present volume, the publication of which has been much delayed, the seven volumes of the catalogue proper stand complete. Besides the catalogues indicated in the title, the volume contains a reprint of the famous account by Reinesius of the inferior Gotha MS., published in Latin by Fabricius ("Bibliotheca Græca", Hamburg, 12, 748; 1724) but now presented again in the original rather rugged German; also a continuation of the polemic of Lagercrantz with Reitzenstein, carried over from vol. 2.

Since the full texts of nearly all the treatises entered in the catalogue, from better MSS. than

any of those described, have long been available in the edition of Berthelot and Ruelle, which gives variant readings, the present work is mainly of bibliographical interest. Dr. Goldschmidt has added an interesting preface (in German) which gives information as to the origin of some of the manuscripts. The volume is one which possessors of the parts of the Catalogue previously published will wish to add to the series.

*Primitive Arts and Crafts: an Introduction to the Study of Material Culture.* By R. U. Sayce. Pp. xiii+291. (Cambridge: At the University Press, 1933.) 8s. 6d. net.

MR. SAYCE'S book is not, as its title may suggest, a descriptive account of the technology of primitive peoples; but it deals with the principles of the study of that subject. It is written primarily to meet the needs of the student, a purpose which it serves admirably, but at the same time it has a broader appeal in its bearing on the outlook generally of ethnological studies. Thus Mr. Sayce points out how technology cannot be considered effectively merely as a question of processes and products, but must take into account environment, both geographical and cultural, including social organisation and religious belief and practice. Not unnaturally, questions of contact and borrowing, as well as 'diffusion', occupy a considerable place in the treatment of the subject matter. On such points as these, Mr. Sayce will be found to be eminently sane and well-balanced.

*Organic Chemistry.* By Dr. F. Sherwood Taylor. Pp. xii+587. (London: William Heinemann, Ltd., 1933.) 10s. 6d.

THE author has written a sound account of organic chemistry, arranged on familiar lines, and has taken pains to make it accurate and up-to-date. He states that "the requirements of the medical student have been given the first place in deciding upon the matter to be treated". The treatment is, however, much more comprehensive than this aim would imply. The book contains a great deal of material suitable for students reading for an honours degree in chemistry, and is in some respects to be assessed as an advanced rather than an elementary textbook of the subject.

*Enchanted Ways.* By John Prioleau. Pp. xiv+288. (London and Toronto: J. M. Dent and Sons, Ltd., 1933.) 5s. net.

"ENCHANTED WAYS" is a happily chosen title to express the author's attitude towards the country he traverses in this series of motor runs, planned to cover the most beautiful and characteristic features in the countryside of England and Scotland, to the charm of which he is keenly sensitive in all seasons, winter and summer, autumn and spring. Most of the book will be familiar to, and have been enjoyed by, readers of the *Observer*; but its appearance in permanent form deserves to be noted.



## The 74-inch Reflecting Telescope for the University of Toronto

SINCE November 1930, a 74-in. reflecting telescope—the largest in the British Empire and the second largest in the world—has been under construction for the University of Toronto at the works of Sir Howard Grubb, Parsons and Co., Newcastle-upon-Tyne, a subsidiary company of Messrs. C. A. Parsons and Co., Ltd. The observatory will be situated in a park of 177 acres on Richmond Hill, eight hundred feet above sea-level, a few miles to the north of Toronto, and, in addition to the 74-in. reflector and its dome, will comprise a block of administration buildings on which three smaller domes will be mounted. It is being built as a memorial to the late David A. Dunlap, the funds being provided by his widow and son, and, on completion, will be presented to the University of Toronto and administered by the Department of Astronomy.

The telescope is of the reflecting type with a clear aperture of 74 in. and is arranged so that it can be used either as a Cassegrain or Newtonian (Fig. 1). The mounting is of the modified 'English' or 'Composite' type, in which the tube is placed on one side of the polar axis and the counterpoise on the opposite side.

## THE MOUNTING

The polar axis is 22 ft. long, built up of two tapered tubular steel castings with forged steel pivots shrunk into the ends and bolted to a central cubical steel box. It runs in self-aligning radial ball bearings with ball thrust bearing at the lower end housed in a cast iron base casting. The weight of the axis is nine tons. The bearing housing at the upper, or North, end is fitted with adjustments for the true alignment of the axis.

The driving circle, or wormwheel, is mounted free on ball bearings on the lower pivot of the axis and can be clamped rigidly to the quick motion gear wheel, which is keyed to the axis, by a motor operated clamping gear. The circle is a steel casting and the bronze rim, in which the teeth are cut, is slightly shrunk on and fixed with a number of delta metal screws. The pitch diameter is 8 ft., cut into 960 teeth of 8 mm. circular pitch. The wheel was copied from a 4 ft. diameter master circle graduated on silver.

The sidereal circle is 8 ft. diameter and is strung

on the boss of the driving circle. It can easily be rotated by any one of six handwheels attached to it and fitted with pinions gearing into a toothed ring attached to the driving circle. It is constructed of fabricated steel with a delta metal rim 3 in. wide graduated on both edges to 1 minute of time divisions. The lower set of divisions

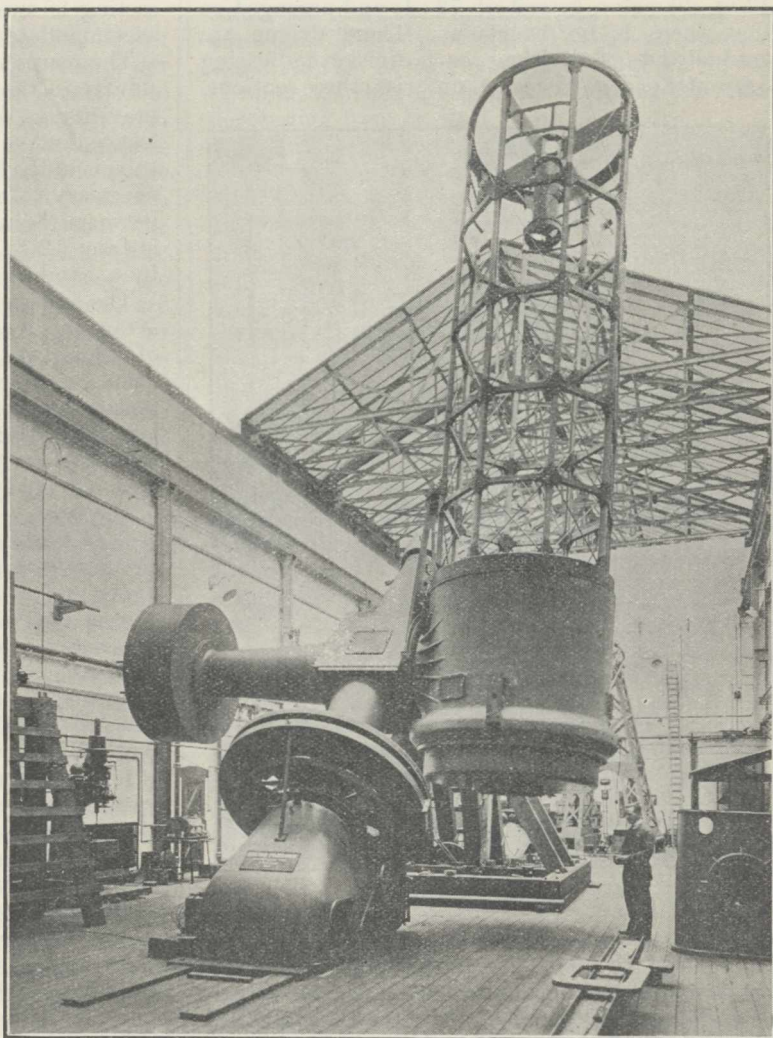


FIG. 1. The Toronto 74-in. reflector. View from south-east.

read against indexes fixed to the guard of the driving circle and mark sidereal time, while the upper set of divisions read against indexes attached to the polar axis and mark right ascension.

An hour angle circle is fixed to the quick motion gear wheel. The declination axis passes through the cubical centre section of the polar axis at right angles, supported at the outer end in a tubular tapered steel casting attached to the cubical portion of the polar axis.

The declination axis itself is of forged steel 13 ft. long, weighing  $3\frac{1}{2}$  tons and formed with a flange



at the inner end 3 ft. 5 in. diameter, to which the tube is attached. It is mounted in ball radial bearings, with a double thrust bearing at the small, or outer, end, to which is keyed the quick motion gear wheel and also the declination circle 6 ft. 3 in. diameter, graduated to  $1^\circ$  of arc. The gear wheel and circle are housed inside a drum-shaped casting attached to the end of the tubular support carrying the axis, this casting forming the counterpoise for the tube. The declination circle drives two drums 12 in. diameter, geared up 72 : 1, and arranged so that there is no backlash. These drums are graduated to 60 divisions, each division indicating 5 minutes of arc. The tube comprises three sections,

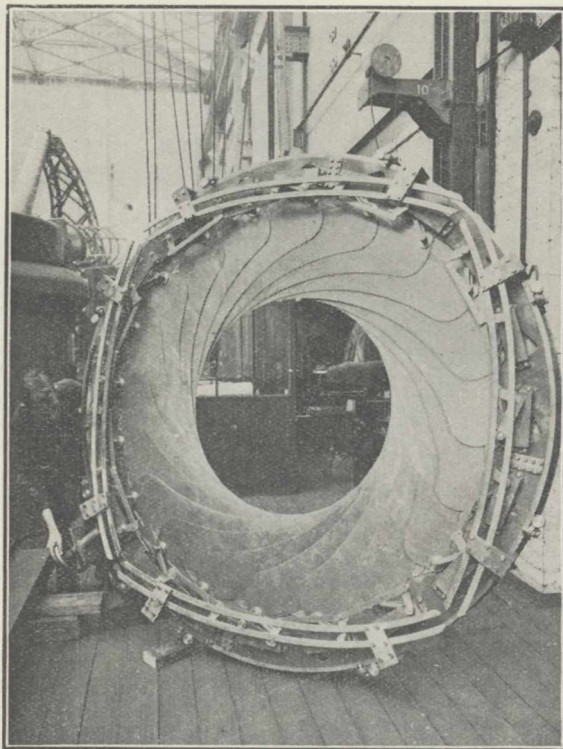


FIG. 2. The iris diaphragm. Half-aperture.

the lower portion a cell in which the main mirror is mounted, the central section which is bolted to the flange of the declination axis, and the upper, or skeleton, section for carrying the Cassegrain or Newtonian mirrors and the photographic breech-piece.

The main mirror cell is a ribbed steel casting fitted with nine circular pads for the back support of the mirror. The pads are mounted in groups of three on spherical seatings on three triangles, which are themselves mounted on ball-ended screws, by which the mirror can be 'squared'. The nine pads are so disposed that each bears its proper proportion of the load.

For the lateral support of the mirror, 18 weighted levers are disposed round the inside of the cell mounted on universal joints, the short end of the levers engaging in holes in brackets riveted to a flexible band loosely clamped round the mirror.

This band has blocks fixed at intervals on its inner edge, loosely fitting into a groove in the edge of the mirror to keep it central. A large wormwheel is fitted to the back of the cell for carrying the spectrograph.

The centre section of the tube is a steel casting 7 ft. diameter weighing  $5\frac{1}{2}$  tons, and formed with a large boss on one side for attachment to the flange of the declination axis. Just above the lower flange, to which the cell is attached, the casting is swelled out to 8 ft. 7 in. diameter to accommodate an iris diaphragm (Fig. 2).

The construction of this diaphragm is generally similar to those used in cameras, but in order to prevent sag, due to the considerable weight of the leaves, and to keep the aperture central when the tube is in the horizontal position, it has been found necessary to guide the moving ends of the leaves between radius bars. The range of the diaphragm is from 12 to 74 inches aperture and is operated by a handwheel.

The upper, or skeleton, portion of the tube is octagonal in section, the main and cross members of which are constructed of 3-in. duralumin I beams, connected by steel gusset plates. Diagonal tension rods of duralumin, screwed with right and left hand threads, are fitted in each bay and tightened up to a predetermined tension, so that they are always in tension, whatever the position of the tube.

A fabricated steel box of square section, with circular flanges, is suspended in the centre of the upper end of the tube on four spring steel strips placed edgewise, to which the mountings for either the Cassegrain or Newtonian mirrors can be attached. Gear is supplied for handling these mountings and interchanging them conveniently and safely. The Newtonian mirror is arranged so that the reflected beam can be directed to any one of four positions round the sides of the tube, where frames are fixed to which the photographic breech-piece can be attached. This breech-piece comprises a focusing gear and plate holder with two guiding microscopes mounted on cross slides operated by micrometer screws. It is fitted also with a rotary motion to correct for rotation of the field. The plate holders take plates  $3\frac{1}{4}$  in.  $\times$   $4\frac{1}{4}$  in. and are interchangeable with a knife-edge focusing plate and with adapters for oculars.

The driving clock comprises a heavy crossed arm governor driven indirectly by a  $\frac{1}{2}$  horse power direct-current motor through a differential gear box. A weight suspended from a chain passing over a pulley and attached to the outside of the differential gear box gives a constant driving force to the governor. The gear box carries an arm with a contact at its outer end passing over a number of studs arranged concentrically and connected to resistances in the field circuit of the motor. When the motor is running at a correct speed, the weight is kept floating, but if its speed alters, the gear box rotates together with the contact arm, which immediately corrects the speed of the motor by altering the field resistance. The governor runs at



80 r.p.m. and is directly coupled to a worm gearing into a wormwheel on a jack shaft making one revolution in 24 seconds. The jack shaft is mounted parallel to the shaft on which the driving worm is cut and geared to it by a pair of accurately cut spur gears. Thus there are only one pair of spur gears and one worm wheel between the clock governor and the driving screw.

A 'Grubb' type of electrical control operated by one of the observatory clocks, is incorporated on the jack shaft.

The right ascension and declination quick motions are operated by  $1\frac{1}{2}$  and  $\frac{3}{4}$  horse-power reversible motors respectively and are arranged to rotate the axes at the rate of one revolution in eight minutes. The drives are taken through dog clutches operated by solenoids in parallel with the motor circuits, so that the motors and reduction gears are automatically disconnected from the telescope when not in use. A friction clutch is also incorporated and the switch gear controlling the motors so arranged that when the motors are switched off the dog clutches remain engaged for a few seconds, allowing the friction clutches to slip and bring the telescope to rest.

The declination clamp is placed between the tube and the polar axis, and consists of a fabricated steel arm about 7 ft. long mounted on a 'V' ring 4-ft. diameter attached to the side of the polar axis. This arm can be rigidly clamped to the 'V' ring by a toggle gear operated by a small electric motor. The outer end of the arm carries a nut mounted on a link motion and engages with a screw mounted in bearings attached to a bracket which is firmly clamped to the side of the tube. A motor operated two speed gear is connected to this screw for giving the setting and guiding motion in declination. This motor is controlled by two separate reversing switches. For the setting motion a dog clutch operated by a solenoid in parallel with the motor connects the gear to the slow motion screw and moves the tube in declination through 15 minutes of arc in one minute of time. For the guiding motion an electromagnet in parallel with the motor brings a differential gear into action, giving a rate of motion of 30 seconds of arc in one minute of time. Similar rates of motion are provided for setting and guiding in right ascension.

Three finders are provided, one of  $4\frac{1}{2}$  in. aperture with eyepiece mounted on cross slides, at the lower end of the tube, one of  $2\frac{3}{4}$  in., and one of 2 in. aperture at the upper end.

#### OPTICAL PARTS

The main parabolic mirror, of pyrex glass, will have a focal length of 30 ft. The Cassegrain and Newtonian mirrors, of hard crown, are of 19 and 20 in. diameter respectively, the former being designed to give an equivalent focal length of 111 ft. ( $F/18$ ).

The total weight of the telescope is about 50 tons.

The stellar spectrograph is being constructed by Messrs. Adam Hilger, Ltd. It is of the single

prism type with  $2\frac{3}{4}$  in. collimator and two cameras of  $12\frac{1}{2}$  in. and 25 in. focus respectively.

#### THE DOME

The steel dome is 61 ft. outside diameter, with parallel opening 15 ft. wide extending from the horizontal to 7 ft. beyond the zenith. Two parallel moving shutters running on rails at the top and bottom of the dome close the opening and are operated simultaneously by means of wire ropes connected to a motor operated gear. An emergency hand gear is also provided. Two motor operated wind screens of sail cloth are mounted in the opening, one rising from the bottom, the other descending from the top.

The dome, which weighs about 80 tons, is carried on 24 canted rollers of 27 in. diameter mounted in self-aligning ball bearings and running on a flat bottomed rail. Sixteen pairs of lateral roller bearings on the inner and outer edge of the rail keep the dome in position. Two segmental platforms, the lower one at the base of the opening, the upper one at the back at a 16-ft. higher level, are fixed inside the dome. Rails are mounted on the parallel straight edges of these platforms on which runs a bridge in the form of a semi arc. This bridge is 5 ft. 6 in. wide, and divided into two portions, the right hand side forming a stairway, the left being a track on which a truck carrying the Newtonian observing platform runs. The upper portion of the truck is automatically kept horizontal as it travels up the curve of the arch, by means of a lever, the outer end of which travels on a contoured rail. The truck is operated by means of a motor driven winding drum fixed at the top of the bridge, where is also fixed the gear for giving it the cross traverse motion. The rail on which the dome runs is mounted on a strong annular girder on the top of 24 steel pillars, 21 ft. high. The pillars form a circular building, sheathed inside and out with steel sheeting.

The entrance is in the south side through a steel porch with two pairs of doors. The observing floor is 13 ft. above ground level with doorway leading on to the top of the porch. From each side of the porch a stairway gives access to a gallery running right round the building 23 ft. above the ground. A similar gallery on the inside of the building gives access to the lower segmental platform in the dome and so on to the Newtonian observing platform.

A lift is provided inside the circular building for removing the cell and main mirror when it requires to be resilvered. The  $7\frac{1}{2}$  horse-power motor and gear for rotating the dome will be fixed at ground level in the building.

Rotation is effected by means of an endless steel rope passing almost round an annular channel ring carried on brackets fixed to the base of the dome, over two tangent pulleys and down to the turning gear, a tension pulley being provided for keeping the rope tight.

The dome and building was dispatched in June and the telescope has recently been shipped.



## Insect Transmission of Spike-Disease

THE cause of the spike-disease of sandal, which has seriously affected forest revenues in southern India for more than thirty years, has eluded prolonged investigation. The work of Coleman<sup>1</sup> in 1917 indicated that the causal organism was a filterable virus which was transmitted by insects, but the entomological investigations undertaken at the time were not productive. During the past five years, studies by the Mysore Agricultural Department, the Indian Institute of Science, the Madras Forest Department, and the Forest Research Institute at Dehra Dun have confirmed and extended Coleman's conclusions and established the insect-borne nature of the disease.

Entomological work was commenced in 1930, as part of the programme of the Forest Research Institute, under the direction of Dr. C. F. C. Beeson, forest entomologist. Dr. Beeson felt that a careful quantitative survey of the insect fauna of sandal and associated plants would save much fruitless experimental endeavour, as an analysis of the morphological, ecological and numerical data so obtained would permit the selection of a small group of probable vectors when considered in relation to the peculiar characteristics of the disease and the factors affecting it. He also recognised the fact that such a survey would provide a unique contribution to Indian entomology, as it would represent the first extensive study of the fauna of a single species of forest tree in the East.

The survey has been productive in both these respects. With the co-operation of numerous specialists, a large number of systematic papers, incorporating descriptions of new species and data on distribution, host-plants and seasonal and relative abundance, is in course of publication in the *Indian Forest Records*, while several papers on the morphology and bionomics of important sandal insects by Mr. N. C. Chatterjee (the officer in charge of most of the field work) are also in the press. Transmission studies were guided at an early stage of the inquiry by the selection of a small group of probable vectors, and a critical discussion of the various hypotheses affecting the problem, a preliminary account being published by Mr. Cedric Dover<sup>2</sup> early in 1932. This paper began the series of reports on the entomological aspects of the problem of spike-disease and, with an introductory note by Dr. C. F. C. Beeson<sup>3</sup>, provides a more detailed description of the history, objects and general results of the inquiry than is possible here.

Among the insects suggested as probable vectors of the disease was an inconspicuous jassid known as *Moonia albimaculata*, Distant, which Mr. Dover regarded, for reasons stated in his paper, as the most likely vector. Attention was also directed to the importance of aphids as likely carriers. Some argument attended the selection, but trans-

mission studies have now supported it. A paper on insect transmission of spike-disease by Messrs. M. Appanna and C. Dover (which will be published shortly in the *Indian Forest Records*) shows that a large number of transmission experiments with a variety of suctorial and mandibulate insects was unproductive, whereas experiments with *Moonia albimaculata* yielded three positive results and produced symptoms in other cases which are regarded as likely to develop into those of typical spike. The three plants in which the symptoms of spike-disease have been produced by exposure to *Moonia albimaculata* are inseparable from typically spiked plants on symptomatic grounds, and samples from one of them have also answered important biochemical and cytological tests for the disease. The nitrogen content (which was tested by Mr. Y. V. S. Rao, of the Indian Institute of Science) and the starch content were both much higher in the samples, as is generally the case in spiked plants, and the intracellular inclusions characteristic of spike and other virus diseases were also found in leaf-sections by Mr. M. J. Narasimhan, of the Mysore Agricultural Department. The transmission by grafting of the symptoms produced by *Moonia* remain to be established, as grafting tests were only recently commenced. There appears to be little doubt, however, that the three infected plants are genuinely spiked.

When the transmissibility of the disease produced by *Moonia* is established, it will bring to a close an important phase of the inquiry on spike-disease, as with the discovery of the insect transmitting it we shall be able to proceed to a critical study of the way in which it can be controlled. The incrimination of *Moonia* as the vector of spike is of more academic interest, as spike-disease and peach yellows were, until very recently, regarded<sup>4</sup> as exceptions in the 'yellows' group of viruses, the members of which are transmitted by grafting and suctorial insects, chiefly jassids. Dr. L. O. Kunkel has recently established the fact that peach yellows is transmitted by the jassid, *Macropsis trimaculata*<sup>5</sup>, and the present result therefore removes the last exception and makes the 'yellows' diseases a compact group limited by well-defined characteristics. It is of interest to note here that Dr. Quanjer's paper and the work of Drs. K. M. Smith, L. O. Kunkel, and H. H. Storey indirectly but strongly influenced Mr. Dover's selection of probable vectors, and that the experimental programme owes much to their publications and support.

In so far as aphids are concerned, only seven experiments were possible, one of which has yielded a result which is suspected to be positive. Unfortunately, this experiment was complicated by the presence of thrips, but it is believed that these insects did not prejudice it as they lived only for a short time and the plant was not in flower. The result is being tested and further experiments



are in progress, but it is believed that even if aphids are incriminated as vectors, they can only be regarded as of secondary importance in the spread of spike, as they are very rare on sandal. Moreover, aphids appear to be peculiarly fitted for the transmission of virus diseases under experimental conditions<sup>6</sup>.

These satisfactory results are the outcome of collaboration between several research organisations with the financial support of their respective

governments. They have now to be translated into practical silviculture, and it is hoped that the forest departments interested will be able to allot the additional funds required for this purpose.

<sup>1</sup> *Mycol. Ser., Dept. Agric., Mysore, Bull. 3*; 1917.

<sup>2</sup> *Indian Forest Rec.*, 17, pt. i; 1932.

<sup>3</sup> *ibid.*, 17, pt. ix.

<sup>4</sup> Quanjer, *Phytopathology*, 21; 1931.

<sup>5</sup> *Bull., Boyce Thompson Institute*, 5, pt. i; 1933.

<sup>6</sup> Smith, *Biol. Rev.*, 6; 1931.

### X-Ray Analysis of Fibres

"PRESENT methods can still go far, but I am convinced that progress . . . is about to gain a great impetus from the application of those new methods of research which chemistry is inheriting from physics: X-ray analysis . . ."<sup>\*</sup> So spake in general terms the president of the British Association in his address on the evening of September 6: on the following morning, Sections A (Mathematical and Physical Sciences) and K (Botany) foregathered to demonstrate the point in somewhat more detail. That physicists should hobnob with botanists—and not simply for the purpose of drinking tea—and on the following Monday† even be invited into the stronghold of vitalistically-minded zoologists is a very definite cause for congratulation, in spite of the dark mutterings of some that it is all very well to talk about the structure of molecules and adopt such an attitude of pitiable optimism in the face of 'life' and all the tremendous tale of the activities of living organisms!

In opening the joint discussion of Sections A and K, Mr. W. T. Astbury outlined some developments in the X-ray interpretation of the properties of hair, feathers and other protein structures. Recent progress in our knowledge of the molecular structure of natural fibres arises largely out of the recognition by X-ray means that the solid state of fibres is a crystalline state, generally imperfect, it is true, yet nevertheless sufficiently organised to give valuable information about the form and properties of the giant molecules which orthodox chemistry suggests as their basis. The crystallites are sub-microscopic, but it can be seen at once from X-ray photographs that they are always *effectively* long and thin and lie with their long axes either roughly parallel to the fibre axis, as in silk and hair, or arranged spirally round it, as in ramie and cotton.

In the light of a mass of experimental evidence of one sort and another—and it must be emphasised that the study of the fine structure of biological subjects has advanced and will continue to advance only through a close alliance between all the various methods of attack—the conclusion seems irresistible that these crystallites, or organised aggregates, which make up the body of the fibre

substance and which we must now identify with Nägeli's micelles, are simply bundles of long chain-molecules, bundles of varying size and degree of perfection of organisation, and probably without any particularly sharp demarcation one from another. In the case of fibres of cellulose and natural silk, when the X-ray data are submitted to detailed analysis and compared with the results of tensile experiments and the findings of organic chemistry, this concept leads further to the decision that the chain-molecules are stereochemically fully extended; but we immediately encounter difficulties when we try to apply these ideas to the study of protein structures other than silk, such as hair, collagen, muscle, etc. The main obstacle, however, is removed by the discovery and interpretation of the X-ray photograph of *stretched* hair, a photograph which shows that the molecule or complex of hair keratin, when pulled, undergoes a reversible intra-molecular transformation into an elongated stereo-isomer in which the polypeptide chains are analogous in form to those of silk fibroin, that is to say, are fully extended and correspond to the normal polypeptide chains of the chemist. It follows, therefore, that the chains in unstretched hair are in equilibrium in a folded state, so that the mechanism of its extraordinary long-range elasticity is inherent in the keratin molecule itself: by the application of tension in the presence of water the keratin molecule can be stretched to roughly twice its equilibrium length, to which it returns exactly when the tension is removed.

More recent work on this problem indicates now that the 'unit' of the keratin complex is actually a polypeptide sheet or 'grid' in which the main-chains are linked side-to-side by a long series of roughly co-planar cross-linkages formed by the side-chains of the various amino-acid residues incorporated in the structure. The folds in the main-chains of unstretched hair referred to above lie apparently in planes transverse to the side-chains, as one would perhaps rather expect: each grid simply flattens out when pulled in the direction of the main-chains, thereby giving rise to a complex system of stresses and strains which must be the basis of the observed long-range elasticity. From this point of view the elastic properties of keratin are in no way different in principle from those of

<sup>\*</sup> "Some Chemical Aspects of Life" (see NATURE, Sept. 9, p. 389).

† Discussion on the structure of protoplasm, Section D, Sept. 11.



the simpler molecules; the latter, too, are susceptible of distortion within the limits imposed by inter-bond angles, electrostatic attractions, rotation about bonds, and so on, but in keratin the possibilities are so enormously enhanced by the length and mobility of both main-chains and side-chains that at first sight we appear to be dealing with a new phenomenon.

The most beautiful example of this line of reasoning is afforded by feather keratin, which gives an X-ray photograph at the moment unique in crystal analysis. Besides revealing quantitatively and for the first time the truly heroic proportions of a protein molecule, this photograph shows also that the molecule or complex of feather keratin can be stretched continuously and reversibly up to as much as 7 per cent of its equilibrium length! It seems clear, too, that we are again operating with a net- or grid-like system, a molecular device which we may feel sure is common in biological structures, and of which the elastic properties are of fundamental importance for our knowledge of the mechanism of both growth and movement.

The paper presented by Dr. J. B. Speakman on the co-ordination of chemistry and X-ray analysis in fibre research followed admirably on the above account, emphasising as it did once more the extreme fruitfulness of a union of branches which, alone in fields of such bewildering complexity, might well prove barren. There is a pronounced difference in the lateral swelling of wool or hair in weak and strong acids, the former being far more effective. Considerations based on the Donnan equilibrium indicate why this should be so, and the argument is given stereochemical form, so to speak, by the corresponding X-ray photographs, which show how, in hydrochloric acid, for example, the main outlines of the keratin complex are scarcely disturbed, though in quite a dilute solution of chloracetic acid the diffraction pattern is obliterated completely, only to return in all perfection when the acid is removed by washing and drying. It was pointed out by Speakman how this observation offers a possible means of estimating the size of the grid-like units of keratin suggested by X-ray analysis; for we should be able, from a study of heats of reaction and swelling, to measure the total inter-grid cohesion in the extended form ( $\beta$ -keratin) as compared with that in the single-chain protein of silk, to which X-rays have shown the main chains of  $\beta$ -keratin to be analogous (see above). Experiments to this end are in progress.

The study of the effects of de-aminating animal hairs provides a still more instructive example of the value of X-ray and chemical collaboration. Stretched hair, as is well known, can be 'set' in the elongated form by exposure to steam, and X-rays show that this is due to a re-distribution of cross-linkages in the keratin grid, whereby a new equilibrium configuration is taken up with the main-chains in the extended state. The reversibility of the intra-molecular transformation is thus

destroyed by prolonged steaming, and the photograph of  $\beta$ -keratin persists. The remarkable thing now is that it is found that de-aminated hair has lost this power of 'permanent set', and to an extent depending on the degree of de-amination. The change can be followed throughout by means of X-rays, which show at once whether the  $\beta$ -photograph is 'set' after a given amount of de-amination and steaming of the fibre in the stretched state.

The experiments are a most valuable contribution to our knowledge of the chemistry of keratin, and therefore of all proteins, for we may now feel confident not only that the process of 'setting' wool and hair involves the  $-\text{NH}_2$  groups of the basic side-chains, but also that the contractile power of keratin is by no means destroyed—rather is its range extended—on their removal. In view of the theory of K. H. Meyer that the contractile power of muscle arises from attractions between basic and acidic side-chains of one and the same main-chain, it is clear that this discovery may have far-reaching implications.

The botanists were offered an elegant piece of structure analysis by Dr. R. D. Preston who, continuing the work of Astbury, Marwick and Bernal which brought to light that the cell-wall of the alga, *Valonia ventricosa*, is constructed of two sets of cellulose chains crossing according to some regular plan at an angle near a right angle, described the present state of an X-ray exploration of the whole of the wall of a single complete cell. Since a normal photograph taken at any point of the wall gives the two cellulose directions at that point, the method adopted is to follow up one of the directions exactly as one follows lines of force with a small compass needle, the results being afterwards plotted both on the cell-wall itself and on a large-scale model made from a bladder.

The investigation is necessarily a prolonged one with the modest apparatus available, but already the findings are of a highly intriguing character. They show to date that the molecular structure of this cellulose *balloon* is built up in spiral fashion, exactly as are the cellulose *fibres* ramie, cotton, etc. The completion of the investigation will no doubt be eagerly awaited, for there is a widespread interest in the structure and metabolism of *Valonia*. The single cells of this alga are the first to be explored in detail by X-ray methods, and the discovery that it shares with the fibres a spiral architecture must be of deep significance for the problem of the mechanism of growth.

The mechanism of growth was also indirectly the subject of a fascinating contribution by Mr. J. Thewlis, who showed how X-rays have revealed the arrangement of the apatite crystals which constitute the enamel of teeth. Tooth enamel, like so many other biological structures, is of a fibrous nature, the hexagonal axis of the apatite crystals being the fibre axis. In human enamel there are two sets of fibres, one with the fibre axis inclined at about  $20^\circ$  to the normal to the tooth surface and on the same side as the tip, the other at about  $10^\circ$  and on the opposite side to the



tip. In dog's enamel the fibre axis is at right angles to the surface of the tooth. Variations in the perfection of fibre orientation are observed, and three kinds of enamel can be distinguished. In human teeth it is found that one kind is associated with clinically immune teeth, and the other two with clinically susceptible teeth. Here again the verdict of X-ray analysis must ultimately prove of fundamental importance in the study of living things, and it is to be hoped that this most promising field of investigation will soon be extended so as to take in the effects of the action of vitamins.

The biological implications of recent advances in the X-ray analysis of protein fibres were again dealt with by Mr. W. T. Astbury at the discussion on the structure of protoplasm. No doubt some of the zoologists present were not a little shocked at such heresy, but nevertheless the message of X-rays seems clear enough. The proteins are infinitely variable and adjustable molecular patterns, exquisitely sensitive to changes in physical and chemical environment, and capable of functioning not only as enzymes but also as the material embodiment of the genes. Surely they are no other than the very patterns of life! W.T.A.

## News and Views

### Honorary Fellows of the Physical Society

THE list of honorary fellows of the Physical Society was lengthened on October 6 by the addition of the names of Profs. F. Paschen, A. Sommerfeld and R. W. Wood. Friedrich Paschen, director of the Reichsanstalt until last year, was born in 1865, and has crowded an immense amount of fundamental work into the intervening years. 'Paschen's law', governing the sparking potential between electrodes, is as familiar as the Paschen series in the line spectrum of hydrogen, whilst the Paschen galvanometer (now nearly forty years old) is still probably the most sensitive yet constructed. These three examples remind us of his versatility, but it has to be remembered that he also measured the heat evolution of radium, investigated the Doppler effect in canal rays, measured a great number of wave-lengths in the ultra-violet and infra-red and, above all, was one of those who established experimentally the form of the spectral distribution curve for a black body.

ARNOLD SOMMERFELD, best known by that encyclopaedic summary of the old quantum mechanics, 'Atombau und Spektrallinien', is three years the junior of Paschen. He occupies a chair at the University of Munich, and his contributions to knowledge are all mathematical. He has contributed to subjects so diverse as the calculation of the A.C. resistance of coils, and the theory of optical dispersion. In the early days of wireless, he, like most of the mathematical physicists of the time, took part in the discussion on how the waves managed to follow the curvature of the earth. More familiar to students is his mathematical formulation of the intensity due to a wave, regarded as a summation of the effects due to Huygens' wavelets, though his fame rests chiefly on the refinements which he applied to Bohr's theory of the atom, such as the taking into account of elliptical orbits, and the application of a relativity correction to the equations of motion of an electron, thus correctly accounting for the fine structure of the hydrogen lines.

THE third of this distinguished trio, Prof. R. W. Wood, was born in the same year as Sommerfeld, and is, like him, a foreign member of the Royal Society. Professor at the John Hopkins University, scene of

the 'Baltimore Lectures', it is fitting that his interests should have centred around wave theory, first in optics and more recently in supersonics. His experimental genius is universally acknowledged, and his textbook on "Physical Optics"—as it must be with such an author—is not only full of facts in all branches of its subject, but also contains a wealth of practical advice. Light filters, the construction of zone plates, the making of a prism with an angle of a few minutes (or was it seconds?) of arc, all received the same careful attention. Perhaps his greatest single discovery was that of resonance radiation. Great as it was in itself, it came at the right time to help the theoretical physicists to work out the conception of energy levels and quantum transitions in the atom.

### Guthrie and the Physical Society

ON October 15 occurs the centenary of the birth of Frederick Guthrie, through whose initiative the Physical Society of London was founded. Born in Bayswater, London, Guthrie was the son of a Bond Street tailor, and as a boy had as tutor the chemist Henry Watts (1815–1884), to whom no doubt he owed his early devotion to science. He was sent to University College School, and afterwards entered University College, where Watts was an assistant professor, and studied chemistry under Graham and Williamson, and mathematics under De Morgan. From London, at the age of twenty-one, he went to Germany, working under Bunsen at Heidelberg and under Kolbe at Marburg. On his return to England he was successively assistant to Frankland at Owens College and to Lyon Playfair at Edinburgh. In 1861 he was appointed professor of chemistry and physics at the Royal College, Mauritius, where he had as his colleague Walter Besant, the novelist. In 1869 he became professor of physics at the Normal College of Science, South Kensington, and this post he held until his death.

GUTHRIE'S early published papers related to chemistry, but in Mauritius he turned to the study of physical problems and afterwards published memoirs and textbooks on heat, magnetism and



electricity and other subjects. Widely known as a gifted and versatile man, it was in 1873 that he issued to his friends a characteristically worded circular which resulted in the formation, early in 1874, of the Physical Society, of which J. H. Gladstone became the first president. The Society soon met with success and in a few years included most of the leading physicists of Great Britain. Guthrie himself became demonstrator to the Society, but in 1884 was elected to the office of president. Two years later he was unfortunately attacked by cancer of the throat and died on October 21, 1886, at the early age of fifty-three years. He had been four times married and after his death a memorial fund was raised for his widow and children; his widow was also granted a Civil List pension. Guthrie was buried in Kensal Green Cemetery. His work for the Physical Society was of the greatest importance and a year or two ago the Guthrie memorial lecture was founded in his honour.

### The Science Museum

WE have on several occasions referred to the remarkable developments in recent years of the Science Museum at South Kensington, and the instructive character and arrangements of the collections there. Sixty years ago, a report of the Royal Commission on Scientific Instruction and the Advancement of Science, of which Sir Norman Lockyer was secretary, directed attention to the wide sphere of usefulness that was open to well-devised science collections; and a loan collection of scientific apparatus formed by Lockyer at South Kensington in 1876 was the beginning of the then contemplated "National Collection of the Instruments used in the investigation of mechanical, chemical, or physical laws". For thirty years after, the valuable collections of machines and apparatus were housed in temporary buildings, but the scheme was then revived and in 1909 the President of the Board of Education received a large deputation which urged that it should be put into action. The result was the appointment of a Departmental Committee of which Sir Hugh Bell was chairman, and the adoption of the report of this Committee as the basis for the development of the Museum. The new building was opened by the King and Queen in 1928, and every year sees an increase in the number of visitors and in its sphere of influence. Sir Henry Lyons joined the Museum in 1912 and became director eight years later, and it is through his untiring work and wise guidance that the Museum has become not only a great treasure house of apparatus and machines of historic importance, but also a living record of notable achievements in science and engineering.

### Presentation to Sir Henry Lyons, F.R.S.

It was appropriate, therefore, that at the Museum on October 11, Lord Irwin, President of the Board of Education, should present, on behalf of the Advisory Council, to Sir Henry Lyons, who retired from the office of director on October 9, a writing table and the following address:—"We, your friends, members of

the Advisory Council of the Science Museum, wish to express to you, on the occasion of your retirement after holding for thirteen years the position of Director of the Museum, our great regret at the termination of your services and our warm appreciation and admiration of the work which you have done. In 1920 when you were appointed, the Museum was a small Institution known only to a few. The Eastern Block, planned in pre-War days by Sir Hugh Bell's Committee, was incomplete. The Collections, scattered throughout various unsuitable buildings, were without order and arrangement. You had the vision to realize the position the Museum might take and the value it might be to Science and to Industry. By your tact, energy and ability you have made it what it now is and is known to be—a treasure-house of past achievements and an inspiring guide to future progress. One single fact suffices to indicate the magnitude and success of your work: the number of visitors has increased from about four hundred thousand in 1921 to nearly one and a quarter millions in 1932. We claim for the Museum a foremost place among Institutions of its kind, and recognise that it is to you that this is due. You lay down that work with every good wish from all of us for your future happiness and prosperity." The address was read by Sir Richard Glazebrook, chairman of the Advisory Council, and the hope was expressed by several speakers that the promised Central Block of the Museum would soon be available.

### Tercentenary of the Observatory of the University of Leyden

THE Observatory of the University of Leyden was founded in 1633 and celebrates its tercentenary this year. Prof. W. de Sitter has written a commemorative brochure which is illustrated by many photographs and reproductions of old prints, and describes the history of the Observatory from its foundation down to the present day (Haarlem: Joh. Enschedé en Zonen). Leyden is not quite the oldest active observatory. The Vatican Observatory was founded by Pope Gregory XIII, the reformer of the calendar, in the sixteenth century. But Leyden is the oldest of the seventeenth century observatories, the others, in order of foundation, being Utrecht, Copenhagen, Paris and Greenwich. Amongst the early scientific workers mentioned by de Sitter is Jacobus Golius, the founder, who was led by the corrupt state of the Greek texts to study the ancient mathematicians in the Arabic; he possessed a very fine Arabic edition of Apollonius, but could not be prevailed upon to publish a Latin translation of it. Actually, the first Latin translation of Apollonius was published by Halley in 1710. Few observations were made at Golius's observatory. For more than a century the observatory was located on the roof of the University, and was maintained as much for instructional as for scientific purposes. As the public had the right to look through the telescopes at any time, the observers were often hindered in their work.

THE Observatory became at times very nearly defunct; Lalande says: "En 1774 je n'y vis ni Astronome ni instrumens que l'on puisse citer."



One is reminded of the observatory which once existed on top of the great gate of Trinity at Cambridge. Many plans were made for the reorganisation of the observatory during the first half of the nineteenth century, but nothing was accomplished until Kaiser prevailed upon Parliament to grant money for a new observatory, which was built in 1860. Kaiser combined his chair of astronomy with the office of 'verificator of nautical instruments', and devoted the observatory to meridian work, so that, as reorganised, it resembled Greenwich. Recently, an astrophysical department has been added. The present staff of the Observatory of Leyden is very strong, and includes de Sitter, Hertzsprung, Woltjer and Oort. The tercentenary brochure enumerates the many instruments now to be found in the Observatory, and we may echo Prof. de Sitter's concluding remark that the Observatory of Leyden is well equipped to enter upon its fourth century.

#### Meteor Shower of October 9

A FINE display of shooting stars was observed at many places in western Europe on the night of Monday, October 9, between the hours of 6.30 p.m. and 10 p.m. The spectacle caused great alarm in many country districts of Portugal, people taking refuge in the churches. A similar display occurred on October 9, 1926, and it is associated with Giacobini's comet, which has a period of about  $6\frac{1}{2}$  years. In 1900, when the comet was discovered, the nearest approach of the two orbits was about  $5\frac{1}{2}$  million miles, but perturbations sufficiently disturbed the orbit of the comet to make it intersect that of the earth in 1926, though the point of intersection was about two months in front of the comet, and the comet itself was therefore about 77 million miles from it on October 9 of that year. This year the comet is estimated to have been only about one million miles distant from the earth, and a brilliant shower of shooting stars was the result.

#### Integral Right-Angled Triangles

THE solutions of the equation  $a^2 + b^2 = c^2$  in integral numbers given in Sir Flinders Petrie's letter in NATURE of September 9, are all contained in the formula

$$\{2n(n+p)\}^2 + \{(n+p)^2 - n^2\}^2 = \{(n+p)^2 + n^2\}^2$$

for  $n = 1, 2, 3, 4, 5$ , horizontally and  $p = 1, 2, 3, 4$ , down the page. The most general solution of the equation  $a^2 + b^2 = c^2$  in integral numbers is given by

$$a = 2\lambda fg, b = \lambda(f^2 - g^2), c = \lambda(f^2 + g^2)$$

for integral values of  $f, g, \lambda$ . Sir Maurice Amos, and several other correspondents, have addressed letters to the Editor pointing out that Sir Flinders Petrie's statements are incomplete. In the first place, solutions certainly exist not contained in the table; for example,

$$a = 12, b = 9, c = 15.$$

Again, Mr. J. H. Awbery, of Teddington, points out correctly that, when the table is extended to include all solutions of one and two digits, their number is

30, of which 16 are sets without common factor, and not 19 as stated by the author. Mr. A. F. Dufton, of Garston, points out that there are fifty solutions of  $a^2 + b^2 = c^2$  for which  $c$  contains fewer than three figures; but some of these, of course, are not included in Sir Flinders Petrie's table. Further, Mr. H. J. Woodall, of Stockport, points out that a large range of integral solutions of the equation  $a^2 + b^2 = c^2$  was tabulated by the late Lt.-Col. A. J. C. Cunningham. This table, however, only mentions the cases where  $c$  is a prime number, whereas Sir Flinders Petrie's table includes many solutions where  $c$  is composite.

#### Sites of Scientific Interest in East Africa

REPRESENTATIONS supported by the leading scientific societies of Great Britain, including the British Association, the Royal Society, and the Royal Anthropological Institute, have been made to the Government of Kenya, asking for the protection of the area in which are the fossil beds of Kanam and Kanjera. The area in question is situated at the north-east corner of Victoria Nyanza. The fossil beds include those on Rusinga Island at the mouth of Kavirondo Bay, which constitute one, and the richest, of the three deposits of Miocene age in Kenya. It was in the Kanam and Kanjera Pleistocene deposits that Dr. L. S. B. Leakey discovered the fossil human remains, which were examined at a conference of leading palaeontologists, geologists, anatomists and archaeologists at Cambridge in March last (see NATURE, 131, 427 and 477; 1932). It is now announced that the Government of Kenya has taken steps to exclude the site from the area for which exclusive prospecting licences have been invited, and to preserve it as a protected area under the Ancient Monuments Preservation Ordinance, 1927. Earlier in the year, in response to similar representations addressed to the Government of Tanganyika Territory, an order was issued under the Preservation of Archaeological Objects Ordinance, 1929, declaring the area containing the fossil beds in which were found the remains of Oldoway man a protected area. Dr. Leakey, who has been chiefly responsible for bringing the matter to the notice of the respective Governments, is to be congratulated on a result assuring the preservation of these areas, which are of the greatest importance for future research in the archaeology and palaeontology of East Africa and for the history of the development of man.

AN exhibition of specimens, including human remains, found by Dr. Leakey at Kanam and Kanjera is on view at the British Museum (Natural History) until October 30. Since the conference at Cambridge, to which reference is made above, accepted the human remains as presenting no characters incompatible with their inclusion in the type *Homo sapiens*, and their assignment to Lower and Middle Pleistocene age respectively, Dr. Leakey has been engaged in further comparative study of the specimens. His conclusions, it is now understood, confirm his previous views. The Kanjera skulls, he holds, belong to *Homo sapiens*, and as being of Middle Pleistocene



age, far antedate any of the previously known examples of *Homo sapiens*, to which dates not earlier than the end of the Ice Age have been assigned. On the other hand, he holds that the Kanam fragment of mandible, being of early Pleistocene age, is of the same high order of antiquity as Java, Peking and Piltdown man. Dr. Leakey will submit his conclusions to the Royal Anthropological Institute in a lecture on "The Status of the Kanjera Skulls and the Kanam Mandible" to be delivered on October 20 at 5.30 p.m., when Prof. Elliot Smith will take the chair.

#### Romano-British Pottery at Colchester

FURTHER details of the interesting finds of Roman potters' kilns at Colchester are given in an article in the *Times* of October 10 which marks the close of the Colchester Excavation Committee's work for the season. Since comparatively little is known about the detail of the manufacture of 'Samian' pottery in Britain, the find is of considerable importance. A series of eight kilns was discovered. Four of the kilns, widely spaced, had been used for jugs, mortaria and other vessels in coarse buff ware. The second four kilns were concentrated in a narrow area surrounded by a retaining wall and buried 5-8 ft. deep beneath a mass of material in which the numerous fragments of 'Samian' moulds and ware made it evident beyond question that this was the place of manufacture of the 'Samian' ware. The material in the largest kiln, 14 ft. long, had been fused by over-firing. Not only were the two types, the old-style British and the 'Samian', mass production articles, found where they had been made, side by side, but also the stamps of the 'Samian' ware bore well-known names of potters whose factories are known in eastern Gaul and Germany. These are repeated on the colour-coated 'Castor' ware, decorated with applied hunting scenes, which was also made at Colchester. These stamps and the similarities of form and moulds linking them up with examples of known date from the Continent, afford sure criteria for fixing a date, which is corroborated by the find of a coin of Marcus Aurelius, at about A.D. 180 to 200.

#### Significance of Anthropological Studies in Modern Civilisation

A COURSE of eleven public lectures on "The Study of Man" will be delivered at University College in the University of London during the coming session. The lectures will have a topical interest in a somewhat unusual sense. Their aim will be to present aspects of the subject-matter of the science of anthropology as a study of the methods by which man in the past and also backward peoples have approached the problems of life; but more especially they will suggest the practical bearing of the principles governing human actions and reactions, revealed by anthropological studies, in the solution of like problems which arise in modern civilisation. The opening lecture, on "The Practical Value of Human Studies", will be delivered by Mr. F. J. Richards, honorary lecturer in Indian archæology.

Prof. Charles Singer will follow on "The Development of the Study of Man". The remaining lecturers will be: Prof. C. B. Fawcett, on "Geographical Factors in the Study of Man"; Dr. R. E. M. Wheeler, on "Early Civilisation and Economics"; Dr. Margaret Murray, on "Religion and Ritual in the Study of Man"; Prof. B. Ashmole, on "The Place of Art in the Study of Man"; Mr. S. R. K. Glanville, on "The Eastern Origin of Western Civilisation"; Dr. R. E. M. Wheeler, on "Race and History in Ancient Europe"; Dr. L. W. G. Malcolm, on "Africa, Past and Present"; Mr. A. M. Hocart, on "The South Seas, the Organisation of Peoples"; and Mr. K. de B. Codrington, on "India, the Village as a Social Unit". The lectures will be delivered at University College, Gower Street, W.C., on each Monday in term at 5.30 p.m., beginning on Monday next, October 16. The chair at the first lecture will be taken by the Provost, Dr. Allen Mawer.

#### Chemistry, Philosophy and Food Values

IT is evidence of vigour of both mind and body when a man who can say that he saw the *Great Eastern* upon the stocks, before she sailed west to lay the first Atlantic cable, is able to deliver an address of an hour's duration which will hold an audience largely composed of students. Prof. Henry E. Armstrong is, however, known in the world of chemistry as one whom the years pass lightly by. His mind is as intellectually alert, critical and unrepentant to-day as at any time during his long career. The address which he gave at the opening of the College of the Pharmaceutical Society on October 4 contains passages of caustic comment mixed with others of no less delightful charm, which illustrate as much his philosophy of life as his outlook upon his own profession. It makes stimulating reading. Although some may smile as here and there they detect echoes of opinions which the author has made peculiarly his own, yet the address emphasised a truth that can never be overstated: that it is essential that philosophical theorising shall proceed side by side with the practical experiments of the laboratory, without which there can be no sure progress.

SOME flowers from Prof. Armstrong's collection may be preserved. His first chemical appointment he chronicles in the words:—"I mounted the professional dunghill in the autumn of 1870 at the London Institution, Finsbury Circus". Of Bentley, whose services to botany were mainly in the realm of classification, he says:—"He was certainly a character, but he knew his plants, an accusation that can be brought against few botanists to-day", and upon the trend of modern chemical thought towards mathematics and away from the laboratory, his comment is:—"Of late years the clerical mind has again ruled us; chemistry has suffered a neophilogistic outburst. Oxygen has gone out of fashion, its place taken by a beautiful myth, as elusive as phlogiston, the hydrogen ion, a creation of Leipzig journalism, never born of science, but only guess-work". He is critical of the fads of the researcher



into food values, who would have us believe that "Correct nutrition cannot be left to instinct, or to the use of natural unspoilt foods, or to a varied diet", and he adduces as evidence to support his condemnation, a personal experience above criticism: "I have raised a family of seven. . . . Archbishops and Royalty are showing interest in clearing slums. The Bishops need to take their crooks in hand and first lead their flocks to proper food".

#### Value of the Motion Camera for Testing Purposes

THE cinema camera and similar recording cameras are now usefully employed in connexion with the testing of moving apparatus. In a paper by W. Wilson on the testing of electrical equipment read to Section G (Engineering) of the British Association and published in full in *Engineering* for October 6, many illustrations are shown proving practical utility. In tests of electrical circuit-breakers, fuses, lightning arresters, etc., the significant part of the test lasts only 20-140 milli-seconds. A complete record can therefore be supplied by only a few feet of the film. An example is shown of twelve pictures taken from a short circuit to earth at a 'Grid' substation. The arc was struck between a pair of 'horns' of an arrester by bridging them with a fuse wire prior to the closing of the main switch. The successive shapes assumed by the arc as it rapidly extends are shown, as well as the relative intensity of the various stages of the phenomenon and their duration. A blizzard was blowing when the photograph was taken but the arc attained a length of about twenty feet. Experiments with exactly similar fuse wires show that when they 'blow' with direct current, the arc lasts a third of a second, but with alternating current it is over in one sixteenth of a second. The common theory that an arc snaps at one point like a stretched thread is erroneous. The photographs show that the arc persists until there is not sufficient electrical output to maintain its temperature and consequent ionisation. It then fades away uniformly over its whole length. The motion camera method was usefully employed in testing the 19,000-ton electrically propelled liner *Queen of Bermuda*. By photographing an assembly of 17 different instruments, most useful results were obtained as the ship was put through a specified series of manoeuvres.

#### Electrification of the Polish Railways

WE learn from the *English Electric Journal* for September that Poland has decided to electrify the main Warsaw junction railways. For this purpose a contract involving the sum of two million pounds has been signed with the English Electric Co. Warsaw is the largest city in Poland and has a population of 1,100,000. For some time the present layout of the railway tracks has caused great inconvenience arising from the loss of time in moving trains from one side of the city to the other owing to the congestion of the traffic. At present there are four principal stations in Warsaw connecting the city with Vienna, Danzig, Moscow, etc. These stations are all connected by a loop line and the increased traffic has slowed down train movements. The

Government has decided that the best solution is to construct a new line across the city, part of which will be through a tunnel and part over a bridge and viaduct. This permits the closing of two stations, and all passenger traffic will be concentrated at the new central station. Over the Vistula, a new bridge, which is about 550 yards in length, has just been completed. In order to operate trains through the tunnel, which is nearly completed, it has been decided to electrify three of the most important lines radiating from Warsaw. For the local passenger services motor-coaches will be used, but electric locomotives will be used to haul international and through expresses on the new junction line. The commission appointed by the Government recommended the use of direct current at 3,000 volts. Each motor-coach will be equipped with four 200 horse power 1,500 volt motors, two motors being connected in permanent series to operate off the 3,000 volt trolley system.

#### History and Uses of Maps

DR. F. J. NORTH has written a useful little pamphlet on this subject (*Maps: their History and Uses*, with Special Reference to Wales. (A Handbook to a Temporary Exhibition, July to October 1933.) By Dr. F. J. North. Pp. 45. (Cardiff: National Museum of Wales, 1933.) 6d.) It is primarily intended as a handbook to a temporary exhibition of maps held in the Museum during the past summer, but it has a wider value in being a summary of the development of maps with more special reference to Wales and to Great Britain in general. A final section of the pamphlet gives a sketch of the development of the geological map. Though the work, in view of its object, is written in a popular style, it contains much of interest concerning early maps and the history of early cartographers and some account of their methods. There is also some discussion of methods of cartography and there are references to larger works.

#### British Association Seismological Committee

THE report of the Committee for the year 1932-33 contains a notice of the death of a valued member, Dr. J. E. Crombie, who has left a legacy of £1,000 after the death of his wife for the work of the Committee. It also refers to work by several members of the Committee, on recent Scottish earthquakes, on high-focus earthquakes and microseisms, and Messrs. Jeffreys and Bullen's revision of the standard seismological tables. Interesting memorials of the earliest earthquake station in England have recently been obtained by the Science Museum, South Kensington; Miss Morey, of Newport, I. of W., presented the original lamp-post on which Milne erected his first seismograph at Shide. The drum and recording mechanism have been purchased by the Museum, and an effort will be made to reconstruct the instrument as accurately as possible.

#### International Union of Geodesy and Geophysics

THE Fifth Assembly of the International Union of Geodesy and Geophysics was held at Lisbon on



September 17-24. It was the last to be held under the presidency of C. Lallemand, who resigned and will be succeeded by W. Bowie (United States). Owing to the present economic depression, the subscriptions for the coming three years were reduced by one quarter, and provision was made for further reductions in exceptional cases. This will affect the budgets of the several associations that are combined in the Union, and it is uncertain, for example, whether the additional funds required for the continuance of the publication, from Oxford, of the *International Seismological Summary* will be available from the Association of Seismology. Another Association with large needs at the present time is that of Terrestrial Magnetism and Electricity, which desires to further, as much as possible, the reduction and discussion of the data obtained during the International Polar Year, 1932-33. The next meeting of the Union is to be held at Edinburgh in 1936.

#### National Central Library

It is hoped that His Majesty the King, accompanied by the Queen, will open the new building of the National Central Library in Malet Place, London, W.C., on November 7, at 3.15 p.m. The National Central Library, founded in 1916 as the Central Library for Students, was reconstituted in 1930, and in addition to supplying books to adult education classes it is now used as a reserve and clearing-house for all public, county, and university libraries of Great Britain. The new building has been provided and equipped by the Carnegie United Kingdom Trust at a cost of about £50,000.

#### England to Australia Flight

ON Wednesday, October 4, Air-Commodore Sir Charles Kingsford-Smith started on a flight from England to Australia. He flew a Percival 'Gull' cabin monoplane, fitted with a Gipsy Major engine. As we go to press (October 11), it is announced that he has reached Wyndham, on the north coast of Western Australia. The record for the England to Australia flight was held by Mr. C. W. A. Scott, who in 1932 took 8 days 20 hours 44 minutes. Kingsford-Smith followed roughly the same course as Mr. Scott, except that he chose a shorter crossing of the Timor Sea, from Sourabaya to Wyndham (about 1,250 miles) instead of to Port Darwin (nearly 1,400 miles).

#### Announcements

THE Christmas lectures this year at the Royal Institution, which will be the one hundred and eighth course of six lectures "adapted to a Juvenile Auditory", will be delivered by Sir James Jeans, commencing on Thursday, December 28.

MR. W. E. FREEMAN has been appointed tobacco breeding officer, Mauritius (Colonial Agricultural Service).

PROF. R. A. PETERS, Whitley professor of biochemistry in the University of Oxford, will deliver the twenty-third Bedson lecture of the Bedson Club

at Armstrong College, Newcastle-upon-Tyne, on November 3, at 6.30 p.m. The title of Prof. Peters's lecture, which is open to the public, will be "Some Recent Aspects of the Vitamin B Complex".

PROF. A. F. C. POLLARD, professor of technical optics in the Imperial College of Science and Technology, will deliver the Thomas Hawksley lecture before the Institution of Mechanical Engineers on November 3 at 6 p.m. The title of Prof. Pollard's lecture will be "Kinematic Design in Engineering".

WE have received a copy of the first number of the *Independent*, a weekly journal published by Sir Ernest Benn, price 6d. The journal is of general interest, dealing with economics and politics, art, everyday topics, books, drama, music, etc., but no attention is given in this first issue to scientific subjects other than economics.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A technical assistant for clinical laboratory work—General Superintendent and Secretary, Manchester Royal Infirmary (Oct. 19). A mechanical and electrical engineer for the Royal Aircraft Establishment—A. 567, Chief Superintendent, R.A.E., South Farnborough, Hants (Oct. 20). A pathologist—Secretary, Queen Mary's Hospital for the East End, E.15 (Oct. 20, marked "Pathologist" in left hand top corner). A head of the Pharmacy Department at the Central Technical College, Birmingham—Particulars (stamped addressed foolscap envelope) from Principal, Central Technical College, Birmingham 1 (Oct. 21). A chief veterinary officer for the Essex County Council—Clerk, Essex County Council, Shire Hall, Chelmsford (Oct. 23). A lecturer in horticulture at the University of Leeds—Registrar (Oct. 23). An instructor in poultry husbandry in the Department of Agriculture, University of Leeds—Registrar (Oct. 25). Probationary inspectors (male) in the Engineering Department of the Post Office—Secretary, Civil Service Commission, London, W.1 (Oct. 26). An instructress in rural domestic economy in the Department of Agriculture, University of Leeds—Registrar (Nov. 6). An American international fellowship, offered by the American Association of University Women for 1934-35—"Research Applications", British Federation of University Women, London, S.W.3 (Nov. 18). Four Henry fellowships, available for British graduates and tenable for one year at Yale or Harvard—Secretary, Henry Fund, c/o University Chest Office, Oxford (Jan. 1, 1934). An International residential scholarship at Crosby Hall, offered by the British Federation of University Women for 1934-35, and an International (American Fellowship Crusade) fellowship offered by the American Association of University Women for 1934-35—"Research Applications", British Federation of University Women, London, S.W.3 (Jan. 13, 1934). Grocers Company research scholarship for original investigations in sanitary science—Clerk to the Grocers Company, Grocers Hall, London, E.C.2 (April 29, 1934).



## 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.]

## Remarkable Optical Properties of the Alkali Metals

RECENTLY Wood<sup>1</sup> has published a full account of some beautiful experiments on the optical behaviour of the alkali metals, of which a preliminary report appeared in these columns<sup>2</sup>. His main results are:

1. The alkali metals, which have a large coefficient of extinction in the visible part of the spectrum, become more or less transparent sufficiently far in the ultra-violet. As a consequence, they have in this spectral region a Brewsterian angle at which ordinary light upon reflection becomes plane polarised.

2. The limit of the transparent region on the side of long wave-lengths shifts toward the red with increasing atomic number, lying at about 2050 Å. for Li, 2100 Å. for Na, 3150 Å. for K, 3600 Å. for Rb, 4400 Å. for Cs, while no limit was observed on the side of short wave-lengths as far as the experiments permitted to penetrate (about 1860 Å.).

3. The index of refraction in the transparent region is less than unity, so that the phenomenon of total reflection occurs.

It is the purpose of this note to point out that all the interesting phenomena mentioned above can be fully accounted for by means of the quantum theory of metallic dispersion developed by the present writer<sup>3</sup>, in which the electrons of the metal are considered as moving in a periodic field of potential. In such a field the stationary states of the electrons are grouped together in zones, the energy of the stationary states within one and the same zone being a continuous function of the variables distinguishing these states, while in passing from one zone to another it shows a discontinuity. This discontinuity and a selection rule derived by me have the result that the absorption spectrum of the metal consists of a number of continuous bands bounded both on the low and on the high frequency side, each band being due to the transitions from a zone occupied by electrons to an unoccupied zone. While very far in the ultra-violet, as well as in the X-ray region, these bands will partially overlap, it is to be expected that in some cases the band lying farthest toward the red and corresponding to transitions from the highest occupied zone to the lowest unoccupied zone will be separated from the other bands by a finite frequency interval in which no absorption can take place. This is evidently the case for the alkali metals. The optical data for silver and gold, discussed by me in my first paper, make it probable that here too a transparent region will be found when going farther to the ultra-violet than has been done hitherto.

The shift of the first absorption band toward longer wave-lengths with increasing atomic number of the alkali can also be understood. The theory shows that, for electrons not too firmly bound, the energy differences between the zones, and hence the transition frequencies, vary roughly as  $1/a^2$  for similar lattices,  $a$  being the lattice constant, so that the absorption bands shift towards the red with increasing  $a$ . Now for the alkali metals  $a$  does indeed become greater with increasing atomic number, having the

following values: Li 3.46 Å., Na 4.24 Å., K 5.25 Å., Rb 5.62 Å., Cs 6.05 Å.<sup>4</sup>

Finally, as regards the index of refraction in the transparent region, this is just what one would expect. For one is here immediately on the violet side of a band of strong absorption, so that the contribution to the electric polarisation from this band, which due to its proximity outweighs by far the influence of the other bands, is  $180^\circ$  out of phase with the electric vector of the light wave, causing a diminution of the index of refraction below unity.

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Sept. 24.

<sup>1</sup> R. W. Wood, *Phys. Rev.*, **44**, 353; 1933.

<sup>2</sup> R. W. Wood, *NATURE*, **131**, 582; 1933.

<sup>3</sup> R. de L. Kronig, *Proc. Roy. Soc., A*, **121**, 409; 1929. *A*, **133**, 255; 1931. See also Y. Fujioka, *Z. Phys.*, **76**, 537; 1932. H. Fröhlich, *ibid.*, **81**, 297; 1933.

<sup>4</sup> F. Simon and E. Vohsen, *Z. phys. Chem.*, **133**, 165; 1928.

## Solar Activity and Cosmic Rays

THE intensity of the cosmic radiation on the summit of the Hafelekar (2,300 metres above sea-level) near Innsbruck (Austria) has been recorded almost continuously for two years by means of a Steinke-Standard apparatus (steel ionisation chamber of 22.6 litres, filled with carbon dioxide at 9.5 atm.). The room temperature in the observatory was kept constant within  $\pm 0.1^\circ$  at  $15^\circ\text{C}$ . during the whole period by an automatic regulator. All ionisation values were reduced to the same barometric pressure and outdoor temperature. A detailed account of the results has been given elsewhere<sup>1</sup>, so far as the diurnal, seasonal and irregular variations of the cosmic radiation are concerned.

It may be mentioned that no regular diurnal variation according to sidereal time was detected. The existence of a small diurnal variation according to local time was, however, proved again beyond doubt: the midday intensity is higher by about 0.012  $J$  than the intensity at night. The maximum intensity occurs not exactly at noon, but at 2 p.m., indicating some indirect rather than a direct influence of the sun. Our results agree with the observations of G. Hoffmann, Lindholm, Steinke and A. H. Compton.

The large number of observations accumulated at the Hafelekar Observatory makes it possible now to investigate whether solar activity (sunspots, earth-magnetic storms) has any influence on the intensity of cosmic radiation.

Quite recently O. Freytag<sup>2</sup>, by an analysis of Lindholm's observations at Muottas Muraigl in 1930, concluded that the diurnal variation of the more penetrating components of the cosmic radiation is more marked in periods with large sunspot numbers.

We analysed our observations extending over nineteen months and could not find any relation with the relative sunspot numbers observed at the same time. It might be suggested that this result was not very decisive, since our observations were made in years of minimum sunspot numbers.

We therefore selected from the heliographic maps of the Astronomical Observatory in Zurich only such days when a large sunspot or group of spots was near the centre of the sun and analysed the intensities of the cosmic radiation observed at the same time and also on the following days. Again no certain influence could be detected. A slight



increase noticeable between ten and fifteen days after the passage of large spots through the central meridian of the sun is still uncertain and may be purely incidental.

Another point of interest was the investigation of magnetic storms. Some time ago A. Corlin<sup>3</sup> found, that in Abisko (northern Sweden) the cosmic ray intensity increases after the beginning of a magnetic storm, especially if this is accompanied by a so-called magnetic 'impetus'.

From September 1931 to March 1933 twenty-four magnetic storms were observed; the magnetic data were taken from the records of the Geomagnetic Station at Vienna (Auhof). With the apparatus screened with 10 cm. lead on all sides, we obtained an average cosmic ray ionisation of 2.751 *J* in the ten hours preceding the storm and 2.743 *J* in the ten hours after the beginning of each magnetic storm. With no lead screen on top of the apparatus the ten-hour means were 4.547 *J* before and 4.536 *J* after the beginning of the magnetic storm.

Thus our observations indicate that a slight decrease of the cosmic ray ionisation (by 0.008 *J* with lead screen all around and 0.011 *J* with no lead on top of the apparatus) occurs after the beginning of the magnetic disturbance. This is in apparent contradiction to Dr. Corlin's results in northern Sweden. On the other hand, the effect in our latitudes is, of course, by no means comparable with that in lat. 68° N. It seems quite possible that an increase of the cosmic ray intensity in the far north is accompanied by a decrease in Central Europe. Dr. Corlin agrees with us on this point. It can be expected that the simultaneous observations carried out by Dr. Corlin in Abisko and by us on the Hafelekar will clear up this point.

It can be said that our results are an additional argument for the corpuscular theory of the cosmic radiation, or at least of a part of it. The strongest proof so far is, of course, the so-called latitude effect, discovered by J. Clay on his journeys from Holland to Java and back (1927-1929). Lemaitre and Valarta<sup>4</sup> erroneously ascribed the discovery of the latitude effect to A. H. Compton. The great merit of Compton's world-wide survey of the intensity distribution of cosmic radiation is by no means lessened by stating that not he, but Clay, found first that the intensity of cosmic rays decreases towards the equator.

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<sup>1</sup> V. F. Hess, *Terr. Mag.*, **137**, 399; 1932. V. F. Hess and R. Steinmaurer, *Sitz. Berichte Berlin, Akad. d. Wiss.*, **15**, 521; 1933.

<sup>2</sup> O. Freytag, *Gerlands Beitr. z. Geophys.*, **33**, Nr. 1; 1933.

<sup>3</sup> A. Corlin, *Lund Observatory Bulletin*, Nr. 1; 1931.

<sup>4</sup> *Phys. Rev.*, **43**, 87; 1933.

### Production of High Magnetic Fields at Low Temperatures

THE use of a supra-conductor (therefore completely free from Joule heating) has been more than once suggested for the production of magnetic fields at low temperatures. The magnetic field obtainable by this means is limited by the magnetic threshold value at which supra-conductivity ceases. Still, considerable fields can be obtained by the use of alloys (investigated in Leyden<sup>1</sup>) the threshold value of which is

22,000 gauss at 2° K., a strength which is sufficient for many experiments.

The chief remaining difficulty lies in the heat conductivity of the leads to the supra-conducting coil. This problem of heat conduction through the leads can be eliminated by transferring the necessary energy for the magnetic field by induction. The suggested arrangement is similar in principle to a transformer, the primary circuit of which is normally conducting and the secondary circuit of which is supra-conducting. The primary circuit consists of a D.C. source and the primary of the transformer; the supra-conducting secondary circuit consists of a secondary with a few turns of large radius and a solenoid with many narrow turns for producing the high field. On closing the primary circuit the magnetic energy transferred to the secondary is shared with the solenoid. With this arrangement, one produces, to some extent, condensation of the lines of force. Calculation shows that for given geometrical dimensions there is an optimum ratio for the number of turns in the secondary coil to that in the solenoid. In this way, within the limits of the usual dimensions of an apparatus, it is easily possible with a primary field of about 1,000 gauss to obtain a field of 22,000 gauss in the space of a few cubic centimetres.

The method should be specially suitable whenever it is desired to produce fairly high magnetic fields at low temperatures in not too large a volume, as, for example, in the production of extremely low temperatures by the adiabatic demagnetisation of paramagnetic substances<sup>2</sup>. According to the experiments of Kürti and Simon<sup>3</sup>, Giaque and MacDougall<sup>4</sup> and de Haas and his co-workers<sup>5</sup>, it should be possible, with the above arrangement, to obtain temperatures below 0.1° K. from a starting point of 1° K. Since heat conductivity along the current leads is eliminated, and since heat capacities at helium temperatures are so minute, a few cubic centimetres of liquid helium should suffice to cool the whole arrangement.

Experiments with an apparatus embodying the above methods are being made in this laboratory.

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Sept. 28.

<sup>1</sup> W. J. de Haas and J. Voogd, *Comm. Leiden*, No. 214b; 1931.

<sup>2</sup> P. Debye, *Ann. Phys.* (4) **81**, 1154; 1926. W. F. Giaque, *J. Amer. Chem. Soc.*, **49**, 1864; 1927.

<sup>3</sup> N. Kürti and F. Simon, *Naturwiss.*, **21**, 178; 1933.

<sup>4</sup> W. F. Giaque, D. P. MacDougall, *Phys. Rev.*, **44**, 235; 1933.

<sup>5</sup> W. J. de Haas, *NATURE*, **132**, 372, Sept. 9, 1933.

### Structure of Emulsoid Sol Particles and their Hydration Film

THE powder-photographs of cellulose, starch and similar substances have been interpreted as originating from the crystal structure of those substances. In the course of an investigation with X-rays into the structure of the hydration film of emulsoid sol particles, we arrived at provisional results which indicate that this interpretation is liable to be erroneous.

It seems to us at present highly probable that at least the greater part—perhaps almost all—of the powder lines of some of the said substances is due to crystal structure, not of the substance itself, but of the hydration film surrounding its particles (that film has been called 'concrete' before).

A kind of regularity in the marshalling of the



water molecules in the film was to be expected as a consequence of the electric field of the sol particles. It was, indeed, not at all impossible that this regularity could take the character of a crystal structure. In that case, part of the lines of the powder-photograph ought to correspond more or less narrowly to those of a powder-photograph of an ice modification. The correspondence could not be expected to approach perfection; for the strong forces of the electric field at the inner side of the film, as well as the gradual transition to the diffuse layer at the outer side of it, must influence the apparent spacings in the crystal structure. In order to test this hypothesis, we took powder-photographs of starch and ice with the same camera, using the same radiation. Tabulating the line distances from film centre, measured in mm. on a photograph of starch, and comparing these with the distances on a photograph of ordinary ice, we see that, of the first 18 ice lines, 15 correspond to starch lines within a few tenths of a mm. (the line distances for ice ranging from 10.9 to 39.1 mm.); mean of absolute values of differences 0.2 mm. The remaining three ice lines have small weight in the comparison as they are situated near the end of the film and are very faint.

On the starch photograph, only six lines cannot be connected with ice lines; so probably these are due to starch proper. Experiments in course of completion have corroborated our conviction, that *the water film has the structure—more or less deformed—of ordinary ice*. Our investigations on this point will be continued.

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#### Relation between Van der Waals' and Activated Adsorption on Chromium Oxide Gel

IN the absence of definite evidence to the contrary, it has always been assumed that Van der Waals' and activated adsorption take place independently of each other and are additive. Such, however, is not the case, for activated adsorption on a surface has been found to diminish Van der Waals' adsorption to a marked degree.

A technique has been evolved by which a low temperature Van der Waals' isotherm can be determined for a surface on which a known amount of high temperature activated adsorption of hydrogen has taken place. This was done for hydrogen at  $-78.5^{\circ}$  and for nitrogen at  $0^{\circ}$  C. on chromium oxide gel.

If in the wide portion of a Smekal crack, adsorption can take place very rapidly at low temperatures as far as a given point, then at high temperatures further activated diffusion or solution will take place down the narrower portions of the crack. The presence of hydrogen here could not prevent the access of hydrogen at low temperatures to the wider portions of the fissure originally accessible; yet experimentally one finds that high temperature adsorption diminishes the low temperature adsorption continuously up to the saturation limit of the former.

This can only be explained by the gradual alteration of the surface from chromium oxide to one of hydrogen chemically absorbed on chromium oxide, or to the mechanical closing of the pores by activated

adsorption of hydrogen on the walls. In either case, there must be two fundamentally distinct types of adsorption which can take place on a surface, one of which impedes the other. Ward's attempt<sup>1</sup> to attribute slow adsorption to solution or to a process of activated diffusion along cracks inaccessible to straightforward adsorption is, in this instance, untenable.

These experiments provide the first conclusive proof that the slow adsorption which is often described by the names chemical, secondary, or activated, is a true surface phenomenon. A more detailed report containing the experimental details will be published later.

Hydrogen can scarcely be regarded as a poison against its own adsorption, unless that adsorption takes place in two ways, so Burrage's explanation<sup>2</sup> that slow adsorption is due to the presence of impurities, falls to the ground. The speed with which equilibrium was reached in the nitrogen isotherms was independent of the amount of hydrogen on the surface, while the hydrogen equilibria were absolutely reproducible, being unaffected by the number of previous 'flushings out'.

The diminution of Van der Waals' by activated adsorption also explains Emmett and Harkness' result<sup>3</sup> that the low temperature ortho - para hydrogen conversion is retarded by activated adsorption. I am indebted to Prof. H. S. Taylor for his helpful criticism.

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<sup>1</sup> *Trans. Far. Soc.*, 28, 399; 1932.

<sup>2</sup> *Trans. Far. Soc.*, 29, 677; 1933.

<sup>3</sup> Paper read at the 85th meeting of the American Chemical Society on March 29 at Washington.

#### Photo-activity of Bichromated Colloids

THE hardening of bichromated colloids, forming as it does the basis of nearly all photo-engraving processes, is of great importance in the printing industry. In the photogravure process the colloid used is gelatine which is coated on paper to form 'carbon tissue'. This is activated by immersion in a solution of potassium bichromate, which in practice is frequently rendered alkaline by the addition of ammonia. We are at present studying the effect of pH of the gelatine and of the bichromate solution on the photographic qualities of the tissue.

One of the methods employed is to expose tissue sensitised in solutions of different pH under a step-wedge and to measure the density of the resulting image. We have come to the conclusion that the addition of an alkali to the bichromate bath increases the contrast of the image; that is, while the denser tones show little or no change, the weaker tones have a lower density value; in other words, the density gradient has become steeper.

We are of the opinion that the hardening of the tissue is due to oxidation, and we therefore draw a parallel with the photo-chemical oxidation of the alcohols, studied by E. J. Bowen at Oxford<sup>1</sup>. Dilute solutions of potassium dichromate contain the ions  $\text{HCrO}_4^-$  and  $\text{CrO}_4^{2-}$  and he has shown that the former only is photo-active. Dilution or the addition of an alkali favours a change of equilibrium towards



$\text{CrO}_4^{=}$ . In bichromated gelatine films both ions absorb light of short wave-length, the absorption of  $\text{HCrO}_4^-$  being greater than that of  $\text{CrO}_4^{=}$  over a range of 400–560 m $\mu$ , coming to a maximum at approximately 440m $\mu$ . The brown product of the oxidation, generally assumed to be  $\text{CrO}_2$ , also absorbs actinic light.

It is possible to explain the increase in contrast in view of the above facts. Gelatine films sensitised in a solution of high hydrogen ion concentration will be more sensitive to light than those sensitised in solutions containing ammonia, and will therefore attain a relatively higher density with short exposures. They do not, however, give relatively higher density values with long exposure on account of the screening effect of the  $\text{CrO}_2$ , which forms, as it were, a filter between the light and the unexposed portions of the film, the formation of  $\text{CrO}_2$  being more rapid when the concentration of  $\text{HCrO}_4^-$  is high.

It is hoped that this work, which is proceeding, will further elucidate the theory of the photo-activity of bichromated colloids, and that it will have some bearing on workshop practice. We should be interested to hear from anyone who may be following investigations on similar lines.

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<sup>1</sup> *J. Chem. Soc.*, 2031; 1932.

#### Decomposition of Specific Bacterial Polysaccharides by a Species of *Myxobacterium*

DURING the course of work carried out to determine the nature of the carbohydrate groupings that are associated with immunological specificity in bacterial antigens, the action of certain micro-organisms on the purified specific polysaccharide of *B. dysenteriae*, Shiga, was investigated.

We have isolated a micro-organism from a specimen of decayed vegetable debris which rapidly decomposes the specific polysaccharide<sup>1</sup>,  $[\alpha]_{5461}^{18} + 110^\circ$ , of Shiga's bacillus. The isolation was effected by the use of a synthetic mineral medium described by Dubos and Avery<sup>2</sup>, in which the only source of carbon is the specific polysaccharide. In this medium the organism grows poorly, but we have found that the addition of a small amount of an aqueous extract of rabbit faeces or the presence of culture-filtrates of certain other micro-organisms increases both the rate and the density of growth.

The morphology of the organism when studied on the special mineral medium to which agar has been added, appears to be that of a typical *Myxococcus*, Thaxter<sup>3</sup>, but as the most suitable conditions for growth have not so far been ascertained, it is not possible to state whether typical cyst formation occurs.

The action of the organism on the specific polysaccharide of other bacterial species has also been examined. The accompanying table summarises the results obtained when 0.10 c.c. of an actively growing culture of the *Myxobacterium* was implanted in 3 c.c. of the synthetic mineral medium to which a bacterial polysaccharide had been added to make a final concentration of 0.005 per cent. The cultures, after incubation for 2 or 7 days at 37°C., were tested with the homologous immune-serum. The

specific polysaccharides of *B. dysenteriae*, Shiga. *B. dysenteriae*, Flexner Y, *Pneumococcus* (Type II)<sup>4</sup> and the tubercle bacillus<sup>5,6</sup> were attacked and their power to form a specific precipitate when mixed with the homologous immune-serum was destroyed.

Specific polysaccharide isolated from	Precipitation with the homologous immune-serum		
	Control (uninoculated medium.)	After 2 days' growth	After 7 days' growth
<i>B. dysenteriae</i> , Shiga	<i>h</i>	<i>n</i>	<i>n</i>
<i>B. dysenteriae</i> , Flexner Y	<i>m</i>	<i>n</i>	<i>n</i>
<i>Pneumococcus</i> (Type I)	<i>h</i>	<i>h</i>	<i>h</i>
<i>Pneumococcus</i> (Type II)	<i>h</i>	<i>n</i>	<i>n</i>
<i>Tubercle bacillus</i> (Human)	<i>h</i>	<i>s</i>	<i>s</i>
<i>B. proteus</i> X19.'O' variant <sup>7</sup>	<i>m</i>	<i>m</i>	<i>m</i>

*h* heavy precipitate. *m* medium precipitate. *s* slight precipitate.  
*n* no precipitate.

So far as we are aware, this is the first reported instance of a micro-organism which is able to attack and to destroy the immunological properties of several specific bacterial polysaccharides.

Experiments are in progress to investigate the action of the *Myxobacterium* on other specific bacterial polysaccharides and to isolate from cultures of it an active enzyme preparation.

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<sup>1</sup> Morgan, *Brit. J. Exp. Path.*, **12**, 62; 1931.

<sup>2</sup> Dubos and Avery, *J. Exp. Med.*, **54**, 51; 1931.

<sup>3</sup> Thaxter, *Bot. Gaz.*, **17**, 389; 1892.

<sup>4</sup> Heidelberger and Avery, *J. Exp. Med.*, **33**, 73; 1923.

<sup>5</sup> Laidlaw and Dudley, *Brit. J. Exp. Path.*, **6**, 197; 1925.

<sup>6</sup> Gough, *Biochem. J.*, **23**, 248; 1932.

<sup>7</sup> Furth and Landsteiner, *J. Exp. Med.*, **49**, 727; 1929.

#### Method for the Separation of Enzymes from their Mixtures

ENZYMES usually occur in mixtures and often associated with other inert impurities. Their purification and separation into their individual components have been accomplished largely through methods of selective adsorption and elution developed by Willstätter and his pupils.

The method to be described takes advantage of the difference in the molecular weights of enzymes, which are therefore expected to vary in their rates of diffusion and sedimentation in a centrifugal field. The experimental procedure consists in freezing about 20 c.c. of the clear enzyme extract in a centrifuge tube in a mixture of ice and salt, and centrifuging the frozen mass at about 6,000 r.p.m. for about fifteen minutes. The centrifuge tube when afterwards taken out is found to consist usually of three distinct layers which can be carefully pipetted off. The topmost layer consists of practically pure ice-cold water, containing the more easily diffusible enzyme fractions, the bottom layer represents the most concentrated fraction and mainly consists of enzymes with higher molecular or micellar weights. There is to be found, in addition to the three layers, a solid at the bottom of the centrifuge tube, representing inert impurities present in the



enzyme extract. This method has been applied for the fractionation of inulinase and invertase which always occur in mixtures in certain fungi extracts.

	Original extract	Fractions		
		Top	Middle	Bottom
Inulinase units	7.0	1.2	6.0	11.0
Invertase "	6.5	4.5	6.5	6.0

Results typical of a fractionation with inulinase extract are given in the accompanying table, which shows clearly that a separation of the two components can be effected by this method. Each of the fractions can be similarly treated to secure a more efficient separation of the components.

In addition to effecting the concentration and fractionation of enzymes, the method gives us a comparative idea of the relative molecular weights of the enzymes. A low temperature, and an elimination of adsorbents and elutants which characterises the operation, renders the method applicable to the most labile and sensitive of enzymes. The method is capable of wide application in the study of protein hydrolysates, viruses and toxins. A detailed account of the method will shortly appear elsewhere.

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#### A Reducing Substance in Tumours

THE indications previously obtained<sup>1</sup> that the high reducing capacity of tumours in our dichlorophenolindophenol test is due principally to a substance other than vitamin C have now been confirmed. In determinations of vitamin C content, by the histological tooth protection method, groups of guinea pigs were given 5 gm. each per day of freshly excised Jensen rat sarcoma (kindly provided by Mrs. Barbara Holmes). The various control groups received 0, 1, 2, 3 and 4 c.c. of orange juice, and 5 c.c. of orange juice plus 5 gm. of sarcoma. The degrees of protection afforded were found to be 1-2 for the sarcoma, 0, 1-2, 2-3, 3, 3-4 respectively for the orange juice controls, and 3-4 for orange juice plus sarcoma (4 = complete protection). It follows that 5 gm. of the tumour is equivalent in vitamin C content to no more than about 1 c.c. of orange juice.

Had the reduction titre of the tumour been due entirely to vitamin C, 5 gm. of tumour would have equalled about 3.3 c.c. of orange juice. Hence some two-thirds of the reduction is due to a constituent other than vitamin C. Tests by the Sullivan method show that no appreciable quantity of cystein is present. Other reducing substances known commonly to occur in animal tissues do not titrate under the conditions of our test. It follows that the actively growing cell structure of the tumour tissue contains notably high concentrations of a hitherto unrecognised and unusually powerful reducing substance, for which, for ease of reference, the name 'reducytin' may be employed.

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<sup>1</sup> Harris, NATURE, 132, 27, July 1, 1933.

#### Association of Hippoboscids with Lice

ON July 2 a Song Thrush was captured in the Vicarage Garden, North Mimms, Herts, by Messrs. D. Buxton and J. F. Shillito. The bird was a young one and in a very weak condition, being unable to stand up for more than a few seconds at a time when it was caught. It was noticed that there were at least twenty specimens of a Hippoboscid on the bird. Four of these were caught, the rest escaped. The Hippoboscids together with the bird were brought to the British Museum and Dr. F. W. Edwards determined the Hippoboscids as *Ornithomyia avicularia* Linn., a widely distributed parasite of many passerine and raptorial birds.

At the suggestion of Dr. Edwards the bird was brought to me by Mr. Shillito to examine for Mallophaga. I succeeded in obtaining thirteen specimens of lice and one flea. On examining the lice I found representatives of the following three species: *Degeeriella marginalis* Nitzsch (7♂♂4♀♀), *Degeeriella merulensis* Denny (1♀) and *Philopterus merula* Denny (1♀).

I also examined the Hippoboscids, and on the posterior margin of the abdomen of one of them, a female, I found three lice firmly attached by their mandibles. These lice proved to belong to the species *Degeeriella marginalis* Nitzsch which is a common parasite of birds of the genus *Turdus*.

As a result of this record coming to my notice I decided to examine all the specimens of *Ornithomyia avicularia* Linn. in the National Collection in order to see if there were any with lice attached to them. I found one specimen, a female, with eleven examples of the species *Degeeriella marginalis* Nitzsch fixed to the posterior portion of the abdomen. The data relating to the capture of this Hippoboscid is as follows: "Caught on window, Surrey, Woking, 9-vii-1910, G. C. Champion."

So far as I am aware, these records bring the number of recorded instances of lice being carried by *Ornithomyia avicularia* Linn. to a total of thirteen. The previous records for England number only two, the earliest record of all by Dr. Sharp<sup>1</sup> in 1890 and the recent one by Warburton<sup>2</sup> in 1928. Of the remaining nine records, six are for North America, two for Finland and one for Germany.

Ewing<sup>3</sup> (1927) summarised the data relating to previous records of lice being carried by Hippoboscids and pointed out that nearly all the instances relate to the one species *Ornithomyia avicularia* Linn. and that the species of lice found on the Hippoboscids have, in every case except two (in the case of Dr. Sharp's record the lice were not determined and efforts to trace Dr. Sharp's specimens have been unsuccessful), been found to belong to the genus *Degeeriella*.

The total number of recorded instances of lice found on Hippoboscids is now sixteen. The question whether this association has a definite object naturally arises. Ewing has put forward the following suggestions in the form of questions as possible explanations of this Hippoboscid-lice relationship:—"1. Could the lice be attached to the bird-flies for reasons other than transportation? 2. Are the lice attempting to obtain some of the blood the flies have imbibed from their bird hosts? 3. Do the lice attach to the flies because the latter have become temporarily warmed by contact with the skin of the bird host? 4. Could the bird-fly give off any odour or secretion that is attractive to the lice?"



Since the total number of records is only sixteen and there is no evidence to substantiate any of these suggestions, they are of little value. It is possible that the phenomenon has a wider significance than a mere Hippoboscoid-louse relationship, especially in view of the following records: Calandruccio<sup>4</sup> (1890) has noted instances of *Pediculus* being conveyed by flies; Mitzmain<sup>5</sup> in connexion with research on the insect transmission of surra in Carabaos has found a species of Dipteron, *Lyperosia* sp. carrying the louse *Haematopinus tuberculatus* Burmeister (1,800 flies yielded 620 specimens of lice); and Peus<sup>6</sup> (1933) has published two instances of the louse *Trichodectes tibialis* Piaget being found attached to *Culicidae*. Ewing's suggestion that the lice attach themselves to the Hippoboscids as a result of the latter becoming temporarily warmed by contact with the skin of the bird is certainly wrong, because the lice which are already on the bird have presumably the temperature of the host, and therefore the acquired host temperature of the Hippoboscids is no inducement for the migration of the lice to the flies. Many more records and experimental research are necessary before conclusions of any value can be arrived at concerning these relationships.

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<sup>1</sup> Sharp, *Proc. Ent. Soc. Lond.*, p. 30.

<sup>2</sup> Warburton, *Parasit.*, 20, 175-178.

<sup>3</sup> Ewing, *Ann. Ent. Soc. Amer.*, 20, 245-250.

<sup>4</sup> Calandruccio, *Atti Accad. Gioenia di Sci. Nat. in Catania*, 2, p. 135.

<sup>5</sup> *Philipp. Agric. Rev.*, 5, 673-674.

<sup>6</sup> Peus, *Z. Parasit.*, 5, 740-741.

### Creepers and Single-Comb Linkage in Fowl

Recently we have reported on linkage tests between the genes for single comb and for the creeper traits in fowl<sup>1</sup>. Afterwards, the back-cross matings of heterozygous rose-combed Creeper hens to Leghorn cocks were continued through the third laying year of the hens. During this period we obtained a total of 781 offspring (hatched chicks and classifiable dead embryos), distributed as follows:

Normal Rose comb	Creepers Single comb	Creepers Rose comb	Normal Single comb
358	420	1	2

There was 0.38 per cent of crossing-over. These data added to our earlier ones bring the total offspring of matings between heterozygous Creeper females and normal males to 4,313 individuals with 0.56 per cent of crossing-over, and the total offspring of all back-crosses to 7,408 chicks with 0.39 per cent crossing-over.

The results of matings of heterozygous Creeper females and Leghorn males during the first three laying years were as follows:

	Number of offspring	Per cent crossing-over
1st laying year	2,347	0.68
2nd " "	1,185	0.25
3rd " "	781	0.38

While with such a low frequency of crossing-over it is

difficult to obtain critical evidence for slight changes of crossing-over with age, it may safely be concluded from our results that, in the case of this autosomal linkage group, no striking changes in the percentage of crossing-over take place with advancing age of the hens. Haldane and Crew have reported an increase with age in the frequency of crossing-over in sex-linked genes of the fowl<sup>2</sup>. While sex-linked genes may well behave differently in this respect, a verification of their results by further tests would seem highly desirable.

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<sup>1</sup> Landauer, W., "Studies on the Creeper Fowl. V. The Linkage of the Genes for Creeper and Single-Comb", *J. Genetics*, 23, 1932.

<sup>2</sup> Haldane, J. B. S., and F. A. E. Crew, "Change of Linkage in Poultry with Age", *NATURE*, 115, 641; 1925.

### Co-operation in Science

A MATTER of some importance is raised by Dr. S. C. Bradford's letter in the issue of *NATURE* for September 23, for there can be little doubt that a greater measure of co-operation is needed between the various abstracting journals in Great Britain. I beg leave to doubt, however, whether Dr. Bradford's remedy is the best one for the present state of affairs. Are we not in danger of forgetting that the Universal Decimal Classification (or any other) is only a means to an end, and that the ultimate user of the abstract or index is the main person to be considered? The adoption of the U.D.C. by the various abstracting and indexing bodies would give us no improvement in their service, except in the direction of a consolidated bibliography covering all the sciences (which is not their immediate aim), and would leave the compiler and the user of the service faced with all the overlapping and the gaps that exist to-day, whilst the suggestion that abstracting and indexing bodies should do the abstracting and classification for subjects other than their own, and pass these on to the appropriate sister bodies, is one that would surely be destructive of reliable and efficient work.

Indexing is far from being mechanical, requiring for any particular piece of work a single mind; and it is to be hoped that no one responsible for the issue of an abstract or index journal will accept second-hand contributions from those over whom he has no control and who are working in possibly quite distinct fields. The main purpose of abstract journals is to give those interested a summary survey of what is being done here and abroad—only secondarily is it a work for subsequent reference—and reliability and completeness is the first requisite of such a journal, and not the precise method of arranging the entries, which can safely be left to those responsible for its publication.

Co-operation by other methods than the common adoption of a particular classification scheme is wanted. When this has been achieved, standardisation of format, of arrangement, and of classification, could be considered—but from the only point of view that would justify it, namely, whether it would increase the value to the user, who, be it remembered, is not represented only by large bibliographical institutions.

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## Research Items

**New Excavations at Věstonice.** Dr. Karel Absolon, who has been conducting excavations in the diluvial basin of south Moravia since 1928, has described in a recent issue of the Brno daily journal, *Lidové Noviny*, further interesting discoveries made at Věstonice. These include numerous plastic works and figures which the mammoth hunters of 20,000 years ago had assembled there. They consisted of representations of the heads of various animals such as bears, lions and horses, torsos of these animals and some heads lacking definite form or with ears, eyes or nose deliberately omitted. These objects were discovered associated with mammoth teeth and skulls and with the bones of diluvial lions, wolves and bears; Dr. Absolon is of the opinion that they indicate a mystic cult of the ancient huntsman of prehistoric Moravia. By modelling the animal's body without its head, or the head without eyes, the hunter imagined that he prevented the animal from seeing him. In support of this view Dr. Absolon points out that in some parts of Siberia the peasants still hold similar notions. Věstonice lies in a valley directly on the route from Warsaw to Vienna, a route known to have been followed by prehistoric animals in their summer and winter migrations, and the excavations during the past few years have definitely established that the hills and caves at Věstonice were inhabited by the mammoth hunters who were presumably contemporaries of the Cro-Magnon folk of France.

**Prehistoric Finland.** Dr. C. A. Nordman has written (*J. Roy. Anthropol. Inst.*, 53, pt. 1) a sketch of the main features of Finland's prehistory, regarding the country as an area on the border-line between different cultures belonging to widely different races which have made themselves felt with varying force. The whole of Finland's past has consisted of a form of dualism. Towards the end of the Stone age, two cultures exist side by side—the boat-axe culture in the south-west and the comb-ceramic culture, adopted by nomadic fishermen and hunters and found from Königsberg and the Gulf of Bothnia, to the east of the Urals. The former, it is suggested, may be Indo-European and the latter pre-Finno-Ugrian. Germanic characters of the south-west Bronze Age are balanced by an eastern element witnessed by finds in the interior of the country. In the pre-Roman Iron age, a strong Gothic-Finnish current leads settlers to West Finland; but a strong Swedish expansion of the Migration period creates Swedish districts of settlement and Gothic-Finnish is replaced by Swedish-Finnish. The Swedish element wears thin in the time of the Vikings and is perhaps assimilated, while the connexions with the south are strengthened again. An addition to the population from Esthonia then gives a new character to the finds in the south-west and provides an opportunity for the rise of the tribe of Finland proper, while a Carelian culture is built up of elements derived from West Finland, Sweden and East Finland in the time of the Crusaders. At this point, where prehistory and history meet, the latest pagan tombs provide a wealth of archaeological material affording evidence of an essentially Finnish culture, with local variation, and entirely different from any Swedish culture existing at that time. At the moment of its culmination this culture dies; the Crusades dealt it a death-blow.

**Experimental Studies on Amphibian Nerve Development.** S. R. Detwiler gives an admirable account (*Biol. Rev.*, 8, No. 3, July 1933) of recent experimental studies on nerve development in Amphibia, arranged under the following heads—experimental alteration of the direction of growth in spinal nerves, developmental responses of primary motor neurones following limb excision and transplantation, segmentation of spinal nerves, cellular proliferation within the spinal cord, heterotopic and heteroplastic spinal cord grafts. It is possible to indicate here only a few of the conclusions. By means of grafting embryonic limbs and other rudiments, it has been possible to alter the direction of growth in spinal nerves. Experiments involving limb and somite excision and grafting are described as they bear on the development of primary somatic and sensory neurones and on the segmentation of spinal nerves. The results indicate a fundamental difference in the growth response of motor and sensory neurones to peripheral changes. They also support the view that segmentation in the spinal cord is entirely subservient to mesodermic metamerism. The autoplasmic interchange of various embryonic segments of the spinal cord, as well as heteroplastic grafts, and limb and somite grafts, indicate that forces within the central nervous system are chiefly responsible for proliferation therein, rather than growth influences from the periphery. The paper is illustrated by twenty figures and graphs.

**Genetics of Rice.** In a series of four papers in the *Indian Journal of Agricultural Science*, vol. 3, June 1933, K. Ramiah discusses various genetical problems connected with the inheritance of flowering duration and height of plants in rice. The two factors are first dealt with separately in detail, and then the genetic association between flowering duration and plant height is considered in relationship to other characters in rice. The study of the six crosses up to the  $F_2$  and  $F_3$  generations confirms the existence of a strong association between the two characters, height and flowering duration. The  $F_2$  and  $F_3$  results have been explained satisfactorily both on the multiple factor and on the inhibitory factor hypothesis, but the former gives more scope to account for the wider variability arising from a greater number of pheno-type combinations which arise in the  $F_2$  generations.

**Correlation of Colour with other Properties of Pulverised Coals.** Dr. A. Shimomura, of the Shimomura Laboratory, Kyoto, Japan, by observations on the colour of samples of pulverised coal, has found a certain correlation between colour and the caking and swelling power of the coals, which he has described at length in a communication addressed to the Editor. The caking coals were found to be brownish and the non-caking blackish. Unfortunately, for the lack of a colour scale in these shades, the colour grading had to be made visually. The samples of coal were graded according as they were brownish or blackish, and then compared as to percentage of hydrogen and 'volatile matter' (dry ash-free) and percentage of 'phenol extract'. The percentages of volatile matter ranged from 47 down to 10. The correlation between colour and bitumen content or caking power was considered unmistakable. It was also observed that



the phenol extract was brown, whereas the residue was black. Moreover, the so-called  $\gamma$  constituent was brown whereas the  $\alpha$  constituent was black. The fusible portion in both cases had a brown colour. Partially hydrogenated coals were browner than the original material, and the view is advanced that the brownish shade may be used as a rough criterion of caking or swelling power, without resort to chemical tests.

**Rainfall in Southern Rhodesia.** The meteorological report of the Department of Agriculture of Southern Rhodesia for the year ended June 30, 1932, which has recently been received, contains summaries of many records of rainfall and of a relatively small number of general climatological records made on standard lines. The rainfall statistics are arranged in six groups which are defined topographically without any consideration for administrative boundaries. In the definition of the various forecast areas an equally logical system is followed, these being obtained by selecting certain key stations and finding the rate of decrease of similarity of weather with distance from these, lines of equal percentage similarity being chosen as district boundaries. The usual seasonal forecast of the general rainfall of Southern Rhodesia was published early in December 1931, and foreshadowed a rainfall above the normal. This excess of rainfall was realised. The results of the last three of these forecasts are as follows:

Season		Estimate	Actual
1929-30	.. ..	-1.2	-1.9
1930-31	.. ..	-5.3	-4.5
1931-32	.. ..	+6.1	+1.5

This forecast is based upon a formula which makes use of relationships that have been established between Rhodesian rainfall and antecedent values of (1) barometric pressure at Rio de Janeiro in August-October; (2) Bulawayo minimum temperature in June and July; (3) Mauritius temperature October-November and (4) the Nile Flood August-September. These give a combined correlation coefficient of +0.77. The general body of the report follows that of its predecessors. Twenty-six new meteorological stations have been opened and twenty old stations have been closed.

**Cosmic Rays.** Part 15 of the Mathematics and Physics section of the *Sitzungsberichte* of the Prussian Academy of Sciences contains a summary by Drs. V. F. Hess and R. Steinmaurer of the results obtained between September 1, 1931, and November 30, 1932, at the research station on the Hafelekarr near Innsbruck at an altitude of 2,300 metres (see NATURE, 130, 816, and 933, 1932; also 131, 713, 1933). An increase of one millimetre of mercury in the height of the barometer is found to cause a decrease of the rate of ionisation in the constant temperature ionisation chamber of 4 parts per 1,000 when the chamber is completely lead clad and a decrease of 5 parts per 1,000 when the upper part of the lead covering is removed, that is, when it is half-clad. An increase of temperature of the free air of 1° C. causes a decrease of 1 part per 1,000 for the fully clad and a much smaller effect for the half-clad chamber. No regular variation with the time of year has been observed. The day ionisation rate exceeds that of the night by 2 parts per 1,000 for

the fully clad and 3 parts per 1,000 for the half-clad chamber, the maximum rate occurring at 14 o'clock. No connexion appears to exist between the intensity of cosmic radiation and sidereal time (see also p. 601 of this issue of NATURE).

**Emission of Positive Ions from Kunsman Sources.** Brata and Powell (*Proc. Roy. Soc.*, August) have examined the emission of positive ions from iron oxide surfaces as used in Kunsman sources. It was found possible to produce sources to emit ions of gallium, indium and thallium by evaporating the metals on to a sintered mass of the oxide. The ions were identified by determining their mobilities in nitrogen by the four gauze method. The mobilities, plotted against the masses of the ions, fall on a smooth curve with those of the alkali ions and of some cluster ions of alkali plus ammonia. The mobilities of the ions in helium, neon and argon were determined, but these do not lead to satisfactory identification of the ions because, in the case of helium, the mobilities do not lie on the curve, while in the other rare gases the curve is flat and makes unambiguous identification impossible. The mechanism of emission was examined and experiment showed that thallium evaporates as neutral atoms from the metal, and it appears that the ions are ionised by the hot oxide surfaces on account of the high work function of the latter. The mechanism is thus the same as is known for the alkalis. It was found that of a known number of atoms deposited on the surface a very large proportion came off as ions. The number of atoms deposited would form a layer many atoms thick on the apparent surface of the oxide and the authors conclude that they must be distributed over the surface of the micro-crystals forming the source, and that they diffuse to the surface during the emission.

**Midget Valves for Ultra-Short Waves.** Among the technical papers presented at the Eighth Annual Convention of the Institute of Radio Engineers, held at Chicago in June, was one entitled "Vacuum Tubes for Use at Extremely High Frequencies" by B. J. Thompson and G. M. Rose. This paper described the construction and operation of special triodes and screen-grid valves, in which the dimensions have been reduced to about one tenth of those of the conventional receiving valve in order to make them suitable for use on very short wave-lengths, 100 cm. or less. The reduction of the physical dimensions did not seriously change the characteristics, but the inter-electrode capacitances were reduced to a fraction of those obtained in larger valves. Samples of these valves, which are about three-quarters of an inch in length and diameter, have been made to operate successfully in a conventional retroactive oscillator circuit at a wave-length of 30 cm. with an anode current of 3 milliamperes at 115 volts. The screen-grid type of valve has also been used in receivers at wave-lengths of 100 cm. and 75 cm., a tuned radio frequency amplification of four per stage being obtained at the longer wave-length. The construction of valves with such very small electrode dimensions presents serious practical difficulties, and there appears to be some doubt as to whether they can be successfully manufactured in quantity, although they would undoubtedly find application in the use of ultra-short waves for radio communication purposes.



## Oestrogenic Hormones

RESEARCH on the chemistry of the substances which produce oestrus in spayed animals is throwing light on their nature and constitution, and confirmatory evidence is being obtained from investigations of their physical properties and physiological activities. The amount required to produce the oestrous reaction varies not only with the compound but also with the precise technique used in the assay, so that the same substance may apparently show different potencies in the hands of different observers, with the result that doubt is thrown upon the identity of compounds which appear, from their chemical and physical characteristics, to be the same. The details of technique will become of less importance with the general use of the international standard of ketohydroxyoestrin.\*

A. Butenandt<sup>1</sup> has recently reviewed the biology and chemistry of the sexual hormones. Some of his work has already been described in NATURE<sup>2</sup> whilst later results obtained with H. A. Weidlich and H. Thompson have recently been published<sup>3</sup>. Ketohydroxyoestrin has the formula  $C_{18}H_{22}O_2$ , and trihydroxyoestrin is  $C_{18}H_{24}O_3$ . The latter is converted into the former by distillation over potassium hydrogen sulphate, the two alcoholic hydroxyls losing a molecule of water, whilst the acid hydroxyl group is unaffected<sup>4</sup>. The molecule contains three double bonds in an aromatic nucleus, the third hydroxyl group being phenolic in character. Micro-zinc dust distillation produced an aromatic hydrocarbon, absolutely stable to boiling permanganate solution, of the composition  $C_{18}H_{14}$ : this composition points to the presence of four rings condensed with each other. The carbonyl group of ketohydroxyoestrin or the two alcoholic hydroxyl groups of trihydroxyoestrin are in one of the three saturated rings, since potash fusion results in the formation of the phenolic dicarboxylic acid  $C_{18}H_{22}O_5$ .<sup>5</sup>

Reviewing the evidence, Butenandt considers that oestrin probably contains four condensed rings, one being aromatic in character and one containing only five carbon atoms, the constitution being similar to that of the sterols and bile acids, and pregnandiol. Further proof was, however, required that the three 6-carbon rings are condensed as in the phenanthrene ring system, and as to the position of the aromatic ring and point of attachment of the methyl group.

Butenandt, Weidlich and Thompson have now shown that the dicarboxylic acid  $C_{18}H_{22}O_5$ , on dehydrogenation with selenium, eliminates carbon dioxide and passes into dimethylphenanthrol, which on distillation with zinc dust is converted into 1:2-dimethylphenanthrene. This compound was then prepared synthetically and finally obtained by dehydrogenation of atibibilanic acid, prepared from cholanolic acid.

The authors conclude that the oestrin molecule consists of a partially hydrogenated phenanthrene ring system with a 5-membered ring fused to it; that the methyl group is attached to carbon atoms 13 or 14; that the carbonyl group of ketohydroxyoestrin is situated in the terminal 5-membered ring as are the two adjacent secondary alcoholic groups of trihydroxyoestrin and that oestrin is closely related to the sterols and bile acids. Moreover, since one of the two methyl groups of the phenanthrene originates in the acetic acid residue of the dicarboxylic

acid, it follows that at least one of the two carbon atoms carrying the methyl groups must be a point of attachment of the 5-membered ring.

Confirmatory evidence has been obtained from experiments on the surface films formed by derivatives of oestrin<sup>6</sup>. The triacetyl derivative of trihydroxyoestrin and the diacetyl methyl ether, in which the phenolic hydroxyl is methylated, form both gaseous and condensed films on the surface of water. In the former, the molecules are lying flat in the surface; in the latter, the molecules are standing on end and occupy an area of about 33 sq. Å. Since the pressure required to produce the condensed film is greater in the case of the triacetyl compound, it appears that the molecules are standing with the two adjacent alcoholic hydroxyls to the water. The reduction product of ketohydroxyoestrin forms a condensed film, the molecules occupying an area of about 47 sq. Å. at no compression. It is almost certain that the phenolic hydroxyl must be in the end ring next the water, that is, the aromatic nucleus is at the opposite end of the molecule from the 5-membered ring carrying the two alcoholic hydroxyls. Molecules, such as that of  $\psi$ -cholesterol, which have a hydroxyl in the second 6-carbon ring, occupy a much larger area.

The suggestion that oestrin is related in constitution to the sterols and bile acids provides an explanation for the fact that a number of different compounds of both animal and vegetable origin have some oestrogenic activity. J. W. Cook, E. C. Dodds and C. L. Hewett have already described some of their experiments with synthetic substances in these columns<sup>7</sup>, and Dodds and Cook have recently summarised the results obtained up to the present time<sup>8</sup>. The substances in solution in sesame oil were injected into spayed rats, 100 mgm. being given in divided doses. The most active substance examined was 9:10-dihydroxy-9:10-di-*n*-butyl-9:10-dihydro-1:2:5:6-dibenzanthracene; 1-keto-1:2:3:4-tetrahydrophenanthrene was less potent, whilst only slight activity was exhibited by neo-ergosterol, 5:6-cyclopenteno-1:2-benzanthracene, 1:2-benzpyrene, calciferol, and ergosterol. Several of these compounds are carcinogenic but there is no evidence that oestrin is converted into a carcinogenic substance in the body.

In addition to ketohydroxyoestrin, of which three isomers have been described by Butenandt, distinguished by their physical constants and biological activities, and trihydroxyoestrin, two other oestrogenic compounds, equilin and hippulin, have been isolated from mare's urine by Girard. They apparently contain one double bond more than the other substances and have only one seventh of the activity of ketohydroxyoestrin. Related non-oestrogenic compounds are pregnandiol, found in human urine in pregnancy and equol,  $C_{18}H_{14}O_3$ , which has been isolated recently from mare's urine by Marrian and Haslewood<sup>9</sup>. It appears to contain two phenolic hydroxyls; the third oxygen atom is neither in an alcoholic hydroxyl nor in a ketonic group. Butenandt points out that the testicular hormone is similarly accompanied in the urine of men by a number of substances closely related to it and from which it is only separated with difficulty. The hormone is a hydroxyketone, is saturated and contains no phenolic hydroxyl. In constitution it may be related to the oestrin group of substances.

\* Names recently proposed for substances of the oestrin group were given in a letter which appeared in NATURE of August 5, p. 205.



The effect of variations in the technique of the test upon the potency of different preparations of oestrin has been examined by J. H. Burn and G. K. Elphick<sup>10</sup>, and by J. S. L. Browne<sup>11</sup>. Burn and Elphick found that the rat and mouse unit of trihydroxyoestrin were identical when the dose was injected in aqueous solution in five portions at intervals of 12 hours; Coward and Burn had previously obtained a similar result when the material was injected in a single dose in oily solution. It was found that when ketohydroxyoestrin was injected in aqueous solution in four doses into spayed rats it had 85 per cent of the activity of trihydroxyoestrin, given under the same conditions, but that when it was injected in a single dose in oily solution it was 4.5 times more potent. Burn and Elphick quote figures showing that, according to the technique adopted, the potency of ketohydroxyoestrin varies from 940 to 3,000 rat units per mgm. or from 8,000 to 16,600 mouse units per mgm.; in the case of trihydroxyoestrin the variations are from 210 to 1,960 rat units per mgm. or from 1,510 to 8,000 mouse units per mgm. It is to be hoped that most of these variations will be eliminated by the general adoption of the international standard.

Browne has investigated the activity of the two oestriins with the use of adult and immature spayed rats, immature normal rats and immature spayed and grafted animals. The trihydroxyoestrin was isolated from human placenta and appears to be identical with Collip's emmenin: it is closely related to Doisy's theelol, which is, however, usually identified with trihydroxyoestrin. In all assays the total dose was given in aqueous solution in six injections over 36 hours, and the amount required to produce oestrus in 50 per cent of the animals determined. On the adult spayed rat, emmenin had a potency of about 68 units per mgm., whilst theelol was 5-10 times more active and ketohydroxyoestrin (theelin) still more potent. On the immature intact animal emmenin had a potency of 550-1,100 units per

mgm. The same result was obtained when the dose was given by mouth over three days, and theelol and theelin were equally active on subcutaneous injection. On the immature spayed rat, the potency of emmenin, injected 2-4 days after ovariectomy, was only 100-150 units per mgm.: theelol was three times more active. Transplantation of the ovaries from 21-day old rats into the spleen of immature ovariectomised animals reduced the dose of emmenin and theelol necessary to produce a positive response in 50 per cent of the animals injected to the amount required by the immature intact animal. It was found that ovariectomy did not change the sensitivity of the animals to theelin, but that the first dose sensitises both normal and spayed animals to a subsequent injection of the same material, when the animals are injected every seven days.

The author suggests that the immature ovary increases the efficiency of utilisation of emmenin by increasing its rate of conversion into a more active oestrogenic substance, probably some form of ketohydroxyoestrin. The low activity of emmenin in the adult spayed rat may be compared with the small figure given for the potency of trihydroxyoestrin by Butenandt, namely, 75 mouse units per mgm. It might be suggested that the employment of different types of test animals, in combination with the use of the international standard, would prove of value in the future in the identification and differentiation of this group of compounds.

<sup>1</sup> *Naturwiss.*, 21, 49; 1933.

<sup>2</sup> *NATURE*, 130, 238, Aug. 13, 1932.

<sup>3</sup> *Chem. and Ind.*, 52, 289; 1933.

<sup>4</sup> See also G. F. Marrian and G. A. D. Haslewood: *Biochem. J.*, 26, 25; 1932.

<sup>5</sup> G. F. Marrian and G. A. D. Haslewood, *Lancet*, 2, 282; 1932; D. W. MacCorquodale, S. A. Thayer and E. A. Doisy, *J. Biol. Chem.*, 99, 327; 1933.

<sup>6</sup> N. K. Adam, J. F. Danielli, G. A. D. Haslewood and G. F. Marrian, *Biochem. J.*, 26, 1233; 1932; Danielli, Haslewood and Marrian, *ibid.*, 27, 311; 1933.

<sup>7</sup> *NATURE*, 131, 56, Jan. 14, 1933.

<sup>8</sup> *Chem. and Ind.*, 52, 288; 1933.

<sup>9</sup> *Biochem. J.*, 26, 1227; 1932.

<sup>10</sup> *Quart. J. Pharmacy and Pharmacol.*, 5, 192; 1932.

<sup>11</sup> *Canad. J. Res.*, 8, 180; 1933.

## Cattle Research in Northern Queensland

ENCOURAGING success has attended the first year's work at the Animal Health Research Station at Townsville in North Queensland, administered by the Commonwealth Council for Scientific and Industrial Research but financed by the Empire Marketing Board (50 per cent) and the graziers and Government of the State. Dr. A. W. Turner, officer-in-charge, and Dr. Legg have restricted attention mainly to tick fever (redwater), pleuro-pneumonia and 'peg-leg' disease of cattle.

Formerly, tick fever in Australia was regarded as due solely to *Piroplasma bigeminum*, but following a visit to Onderstepoort, South Africa, Dr. Legg was able to identify three other organisms, *Theileria mutans*, *Anaplasma marginale* and a species of *Babesiella*. Of these, *A. marginale* causes quite a severe form of redwater and is probably a much more serious parasite than *P. bigeminum*. An explanation is therefore available of frequent past failures to immunise susceptible beasts by injecting blood taken from an animal which had recovered from the fever. The practice was satisfactory so far as *P. bigeminum* was concerned, but the unsuspected introduction of the virulent *A. marginale* often led to fatal results. As a vaccine against the latter, it may be necessary to use a weak strain of *A. centrale* from South Africa,

since the adoption of the Queensland forms of *A. marginale* is scarcely possible because of their marked virulence.

Inoculation against pleuro-pneumonia with a virus obtained from a living animal in an advanced stage of the disease is often difficult in North Australia because of rapid deterioration and the immense distances over which the virus has to be transported. While endeavouring to develop better methods of immunisation, Dr. Turner has improved the existing position by showing that if the virus is dried under vacuum at a low temperature it can be kept satisfactorily for considerable periods.

Study of the blood complement fixation test has led to an improved method making possible with comparative ease the determination of carriers. This will be of practical importance over considerable areas, but particularly in Western Australia where, though pleuro-pneumonia is infrequent, 'overlanding' cattle south from the 20th parallel is forbidden lest carriers be present in the mob. This embargo is a serious matter for pastoralists.

'Peg-leg' disease is characterised by obvious malnutrition, stiffness of gait and frequent fractures of bones, and is a condition of great economic importance. A preliminary conclusion is that at least one



of the causes of the trouble is phosphorus deficiency. Some of the soils near Charters Towers are lower in phosphorus than the worst South African soils reported upon by Sir Arnold Theiler and his co-workers. A special field station has been established by a number of pastoralists and decisive experiments are in progress.

Had it not been for the Empire Marketing Board, this work in Northern Queensland would not have

been initiated. The abolition of the Board may perhaps be a logical sequel to the Ottawa Conference; but Empire team work in agricultural research will sadly miss its stimulus unless the Dominions, India and the Colonies rally to the support either of the Executive Council of the Imperial Agricultural Bureaux or of some new body fitted to take the vacant place in this respect.

A. C. D. R.

### Panstereoscopic Photography

THE thirty-first Traill-Taylor Memorial Lecture was delivered before the Royal Photographic Society on Tuesday, October 3. The lecturer was Dr. H. E. Ives, of the Bell Telephone Laboratories, who chose as his subject "Panstereoscopic Photography and Cinematography".

Ordinary stereoscopic pictures consist of two views, taken from two positions. When observed by some device (a stereoscope) which presents one view to each eye, a single image is seen, exhibiting solidity or relief. A limitation of this simple stereoscopic system is that each observer of such a pair of pictures must be equipped with apparatus closely in front of his eyes. If stereoscopic pictures are projected upon a screen, this requirement demands as large a number of viewing devices as there are spectators.

Viewing apparatus at the eyes may be eliminated if the direction of the two views to their appropriate eyes can be done from the plane of the pictures. The first device to do this was the parallax stereogram of Frederic E. Ives. The two stereoscopic pictures were divided into many narrow alternating strips, and placed behind and slightly separated from a grid or grating, the clear spaces of which exposed all the elements comprising one image to one eye, and those comprising the other image to the other eye. Photographic transparencies made in this way show stereoscopic relief, but must be observed from a definite direction and distance.

A further extension of this idea was made by C. W. Kanolt, who substituted for the pairs of image strips, a series, forming minute panoramas. These, when viewed through a grating with very narrow

clear spaces, or through a transparent plate impressed with cylindrical lenticular ridges, show stereoscopic relief through a wide observing angle, the range of distances.

Parallax panoramagrams, as these pictures have been called, can be adapted for projection to large size, by using a projection screen consisting of cylindrical lens elements, on the back of which the panoramic strip images are imaged in accurate registration. The step from this to the projection of moving pictures exhibiting stereoscopic relief depends upon the possibility of taking the original panoramic strip negatives by instantaneous exposures, and upon means for the accurate registration, at high speeds, of the projected images. The earlier parallax panoramagrams were made by moving cameras, necessitating exposure times quite prohibitive for motion pictures.

Recently a form of camera has been developed which embodies a large diameter concave mirror, the various elements of which view the object from a wide range of angles, which in combination with a grating over the sensitive plates, makes possible instantaneous exposures. The projection of these, constituting an experimental demonstration of motion pictures in relief, has been accomplished by mounting a series upon a continuously rotating metal disc, illuminated by a flashing lamp. The extreme accuracy of registration required in projection and the overall complexity of the process make its practical application to film appear remote. This development does, however, constitute a sound scientific solution of the problem.

### Organisation as a Technical Problem

A DISCUSSION arranged by the Department of Industrial Co-operation of Section F (Economic Science and Statistics) at the British Association meeting at Leicester on September 7 was devoted to "Organisation as a Technical Problem". Dr. E. F. Armstrong, who presided, emphasised the place which scientific management should hold in the conduct of modern industrial enterprise and referred to the Sixth International Congress for Scientific Management to be held in London in July 1935 under the presidency of Sir George Beharrell. The programme of this Congress includes the consideration of the principles of scientific management in small- or medium-sized works, budgetary control of production and forecasting as well as training with particular reference to the supply of men for the larger commercial undertakings and public administration. Many of the normal actions and methods of business are unscientific and, even if of monetary use to the individual, are injurious to a trade as a whole, to the State and to the community. There is a great opportunity and need for definite constructive

work, and in particular, Dr. Armstrong stressed the opportunity for the application of scientific method to salesmanship.

Major L. Urwick urged that there are principles which can be reached inductively from the study of human experience of organisation and should govern arrangements for human associations of any kind. Such principles can be studied as a technical question irrespective of the purpose of the enterprise, its personnel and any constitutional, political or social theory underlying its creation. They cover the method of subdividing and allocating to individuals all the various activities, duties and responsibilities essential to the purpose contemplated, the correlation of those activities and the continuous control of the work of individuals so as to secure the most economic and efficient realisation of the purpose. It is almost impossible to exaggerate the practical importance of this subject in existing world conditions, which are largely caused by humanity's failures in its capacity for association or organisation.

A critical review of recent literature on organisation



was given by Major Urwick, who drew freely on military organisation to illustrate his principles and points, while his series of diagrams and charts greatly enhanced the value of the paper. The main principle of organisation is that of co-ordination, and the task of leadership is largely that of adjusting and correlating continuously the various authorities and responsibilities which arise in any large organisation where the work of individuals must be divided not merely horizontally into different tasks, but perpendicularly into different levels of authority and responsibility. The psychological conception of 'the span of attention' has its administrative counterpart in 'the span of control' and neglect of the recognised administrative principle, that in practice no human brain should attempt to supervise directly more than five or at most six other individuals whose work is inter-related, creates insoluble problems in administration.

Specialisation is essential in business and industrial enterprise, and if it is to be effective, specialisation must be to some extent authoritative. This consideration complicates the work of co-ordination, and the compromise so far adopted in practice, known as the 'staff and line' system, often suffers from a lack of understanding and confused thinking about the relationships involved. Even the most authoritative students of business organisation frequently miss the significance of the military distinction between the

specialist troops and services and the 'staff' proper. Failure to appreciate the proper functions of officials in a 'staff' or advisory capacity or to recognise the necessity for this third type of control distinct both from 'line' and from 'specialised authority' are the chief obstacles to more effective co-ordination in civil administration. Lack of this co-ordinating mechanism multiplies the number of committees, in itself expensive, but still more serious is the petrification of leadership caused by overloading of administrative work, including the loss of the personal touch. This last, which is commonly attributed to the size of modern enterprise, is essentially due to the absence of staff organisation.

Rapid growth in scientific knowledge has placed an unprecedented strain on man's power of organisation, and the effects of that strain are becoming apparent. As Herbert Spencer wrote: "socially as well as individually, organisation is indispensable to growth: beyond a certain point there cannot be further growth without further organisation."

A review of the principal types of trade associations and combinations was given by Mr. A. B. Blake. He discussed their status and inherent advantages and disadvantages in an attempt to estimate their significance in the new world order and the methods by which they might be ordered for the general advantage.

### Cosmic Rays and Nuclear Physics

PROF. R. A. MILLIKAN, in an address delivered at the Chicago Century of Progress meeting of the American Association for the Advancement of Science, discussed some of the recent work on cosmic rays, interpreting it in the light of his well-known view that the primary rays are super-gamma rays, and that they may be produced in the synthesis of atomic nuclei (*Science*, Aug. 25).

Prof. Millikan's earlier work on the absorption of the cosmic rays in deep mountain lakes led him to regard the radiation as composed of three or more energy bands distinguished by their absorption coefficients of roughly 0.35, 0.38, 0.04, 0.02 (per metre of water). The assignment of energies to these bands depended at the time on extrapolation of  $\gamma$ -ray absorption formulæ. Millikan now points out that the processes involved in the absorption of the rays are mainly nuclear, and that the extrapolation of formulæ dealing with absorption by extra-nuclear electrons is not legitimate.

The new data come from the observations of ionising particles of high energy made in Wilson chamber experiments by Anderson, Kunze, and Blackett and Occhialini. The particles observed are electrons and positive particles of electronic mass (positrons) and the curvature of their tracks in a magnetic field indicates that their energies lie mostly in the range of 60-3,000 million volts. Millikan considers that they are secondary rays produced by the absorption of photons, and this view is supported by the fact that Anderson and Neddermeyer have observed the production of photons by  $\gamma$ -rays from thorium C". The hard thorium C"  $\gamma$ -rays have an energy of 2.6 million volts and when they pass into lead, paired positrons and electrons are frequently liberated. In many cases, the total energy of the pair is about 1 million volts less than the energy of the primary  $\gamma$ -rays. Following Dirac, it is suggested that the whole of the energy of a primary quantum is

absorbed in a nuclear encounter of this type, and that the million volts energy deficiency appears as the mass of the two particles. Even apart from this theory, the experiments possibly show that the energy of the pair of particles may approach that of the primary rays.

Now Anderson finds that the positive and negative particles are about equally frequent in the photographs of cosmic ray tracks, and Millikan thinks that in this case, too, the particles are produced in pairs by the absorption of photons and that the energies of the pairs correspond closely with that of the primaries. In this case, about 30 per cent of the rays at sea-level lie in the range below 350 million volts. The effect of lead screens on the ionisation in an electroscope is consistent with this distribution of the energies of the ionising particles, and with a higher proportion of low energy particles at high altitudes. These absorption measurements do not, of course, throw new light on the relation between primary rays and ionising particles.

The energies thus ascribed to the cosmic rays correspond in order of magnitude with those that would be liberated by the synthesis of moderately light atoms from hydrogen nuclei with the disappearance of mass corresponding to the atomic weight data.

There are, of course, other difficulties in ascribing the origin of the cosmic rays to a multi-body condensation. Prof. Millikan, moreover, does not account for the coincidences observed by Rossi and others when two counters are separated by a heavy lead screen. It would require an electron of 3,000 million volts to penetrate the screen in one of Rossi's experiments, and such particles are very infrequent in Anderson's photographs. It is difficult to escape the conclusion that if the primary rays are photons, they may produce secondary particles at widely separated points.



## University and Educational Intelligence

CAMBRIDGE.—An election to the Isaac Newton studentships will be held early in the present term. These studentships are for the furtherance of advanced study and research in astronomy and physical optics. Those members of the University are eligible who have obtained a degree in the University and were under the age of twenty-five years on January 1, 1933. Applications should be sent to the Vice-Chancellor.

P. W. Brian, of King's College, has been appointed to the Frank Smart university studentship in botany for one year from October 1.

The Founders' memorial lecture at Girton College will be given by Sir Arthur Eddington on October 14 at 5 p.m. The title of the lecture is "The Present Outlook of Physics".

OXFORD.—In the oration delivered on October 4, on the termination of his first year of office, the Vice-Chancellor (the Rev. F. J. Lys, provost of Worcester College) directed attention to the need of benefactions for the expansion of the scientific work of the University. In enumerating the works undertaken for scientific purposes during the past year, he made special mention of the purchase of new apparatus for the Observatory, of the completion of the Soil Science Laboratory, of the extension of the Institute for Research in Agricultural Economics and of the Botanical Laboratories, and the reconditioning of the lecture theatre of the Old Chemistry Department. While the cost of these undertakings has been provided by the University from its own resources, generous support from outside sources has been given to the Experimental Bureau of Animal Population, in which important investigations have been carried on as to the means of spread of serious epidemics.

ST. ANDREWS.—At the graduation ceremony on October 6, the honorary degree of Doctor of Laws was conferred on emeritus Prof. J. E. A. Steggall, who has retired after fifty years' service in the chair of mathematics in University College, Dundee.

REGIONAL survey as an introduction to or element in education for the administrative side of industry was discussed in an address on September 8 by Dr. P. W. Bryan in opening a symposium on "Education for the Industries of the East Midlands" in Section L (Educational Science) at the Leicester meeting of the British Association. The address included a sketch of Leicester City as an industrial centre, which exemplified the application of the doctrine that regional surveys have an important part to play in helping to raise the standards of training for business. It is, indeed, obvious enough that "knowledge of sources of power supplies, methods of transport, purchasing powers of different areas, possibilities as to markets and the effective and harmonious utilisation of land areas together with a broadening of the whole outlook" ought to find place in such training, and the techniques of study which have come to be associated with the phrase 'regional survey' are likely to prove as useful in this connexion as in the town and country planning movement. A stage in the growth of this movement is marked by the first Town and Country Planning Summer School recently held at Welwyn and destined to develop into a permanent institution. Dr. Bryan directed attention to another manifestation of it: an exhibition

at Leicester University College organised under the joint auspices of the Council for the Preservation of Rural England and the Department of Geography of the College. The cumulative effect of such shows in different parts of the country must be considerable. The increasing complexity of industries, referred to by Dr. Bryan as calling for the application to business of the same degree of trained intelligence as has for long been held requisite for the 'learned' professions, was well illustrated in a paper by Mr. J. Chamberlain in the same symposium, on education for the hosiery industry. So vast is the field of study that the educational courses available are sectionalised in four alternative branches and the highest certificates (of the City and Guilds of London Institute) call for at least five years of evening or three years of full-time day study.

## Calendar of Nature Topics

### St. Luke's Summer

It is said that about St. Luke's day, October 18, there is frequently a spell of fine dry weather, which has received the name of 'St. Luke's summer'. The weather of October is often variable, with occasional fine intervals between the storms, and by the laws of chance, in many years one of these fine spells will fall near enough to October 18 to give colour to the belief, but meteorological statistics do not support the existence of any tendency either to warmth or dryness on St. Luke's day. The 90-year averages of temperature at Greenwich show a steady fall throughout the greater part of October, interrupted only by a slight rise near the end of the month. The 85-year daily averages of rainfall in London (1826-1910) show great irregularity, as would be expected, but October 18 has not been especially dry—in fact rather the reverse. During that period, October 13 and 14 were mainly dry, but there is no reason for supposing that this is more than an accident, and that future years will give the same result.

### Migration of American Monarch Butterfly

One of the features of the autumn in the United States is the great southward migrations of the Monarch, Milkweed, or Black-veined Brown butterflies (*Anosia plexippus*). Indigenous to North America, the Monarch flies south to more congenial temperatures when the cold weather comes, and has circled the world and established itself in at least three new continents. It has crossed the Pacific Ocean by means of shipping to Malaya and Australia, where it established itself, and has frequently occurred in the British Isles. The first records of this American butterfly in Great Britain were in 1871, when four were captured—one at Glamorgan, the first in Europe and now in the British Museum, two in Sussex, and one in Dorset—while more than thirty examples have since been taken in the southern counties, but only about one in Ireland. C. B. Williams described before Section D (Zoology) of the British Association in 1930, in a paper entitled, "Migration among Lepidoptera", how, though found so far north as Hudson Bay in summer, the Monarchs flew more than one thousand miles south to the Gulf States or Southern California, where they spent the winter clinging in masses to the trees; in the spring the masses break up, the butterflies flying north to lay eggs, some completing another 1,000-1,500 miles flight on the return journey.



### Autumn Movements of North American Butterflies

Similar autumn migrations are observable on other species in North America. S. F. Aaron (*Scientific American*, April 1929) describes encountering a vast autumn flock of Milbert's Angleming butterfly (*Vanessa milberti*) in November a few miles inland from the southern New Jersey coast, though the most southern summer haunt of the species is the New England States in the lowlands, and North Carolina in the higher altitudes. The same writer also records, in October, the migration of *Vanessa j-album*, with a similar breeding range to *V. milberti*, and in the cold weather of January, finding a specimen hibernating in a fallen chestnut tree in Pennsylvania. The passing of a swarm of Monarch butterflies on October 14, in Southern Delaware, took more than an hour, the day being mild and sunny. In the Rio Grande area of Texas in September, and later, at the breaking up of the dry season, the prairies teem with numbers of *Kricogonia lyside*, all flying from the north (the species is by no means common in the area in spring and summer) towards the south, where it may travel so far as mid-Mexico, and in April and May another flight, though in much reduced numbers, takes place northwards.

### Winter Keep

The minds of stock farmers in Great Britain will now be turning to this question with more than usual anxiety. The season just past has been far from favourable to the production of an abundant supply of fodder for the next six months. The root crop, which in its various forms comes in from November until April, has in most areas been seriously reduced by the drought. Hay, although fairly plentiful and secured in good order, has been required in many cases long before the usual time, for seldom have the pastures been able to give less help than at the end of this burning season. Even water, which is rather taken for granted as a feeding stuff in the ordinary way, may be a consideration for some time in the less fortunate districts: and this year the difference of water content between succulent and dry fodders will not be a matter of indifference. Formerly, in seasons of scarcity the livestock suffered real hardship; indeed in our early agriculture they had to be slaughtered in large numbers at the onset of winter. Nowadays, short keep is reflected in increased bills for concentrated feeding-stuffs, and a tendency to rush half-finished stock to the market.

Agricultural customs and calculations in England have been based on a moderate and exceedingly well distributed rainfall. When this fails, dislocation and loss is bound to occur in certain departments of the farm. Mixed farming has the advantage of more specialised systems in that it can take up these shocks with the least disturbance.

### The Harvest Moon

Capt. C. J. P. Cave, Stoner Hill, Petersfield, writes: "The note on the Harvest Moon in NATURE of Sept. 30 is not quite correct. The small differences between successive risings of the moon when round about full, at the autumnal equinox, is due to the fact that the moon is moving northward along the ecliptic at that time. The difference between the plane of the moon's orbit and the earth's equator comes in in a secondary way and enhances or reduces the harvest moon effect according to circumstances."

### Societies and Academies

#### LONDON

Society of Public Analysts, Oct. 4. L. H. LAMPITT and H. S. ROOKE: The occurrence and origin of lead in canned sardines. Canned sardines have been found to be seriously contaminated with lead. Solder on the cans evidently causes some contamination with lead, but sardines cooked on grills covered with so-called 'tin' containing appreciable quantities of lead are badly contaminated with this metal, whereas, if pure tin is used on these grills, the lead-content of the sardines falls to a negligibly low figure. The lead-content of canned sardines should not be substantially more than 5 to 8 parts per million; figures above this indicate avoidable contamination during the preparation of the sardines before canning. H. E. COX: The chemical examination of furs in relation to dermatitis (2). *p*-Phenylenediamine penetrates the dead skin readily, but does not pass through or into living skin under normal conditions. With blood and serum it coagulates the proteins and becomes oxidised at their expense; the oxidases present in blood suffice to bring about certain reactions, and, if hæmoglobin is present, these reactions proceed further. Irritation is determined by the abnormal penetration of the diamine through the skin, followed by its local reaction with certain constituents of the blood or serum yet unknown. H. IKUTA: The investigation of Japanese beeswax (3). A new hydroxy fatty acid,  $C_{16}H_{32}O_3$ , provisionally termed 'hydroxypalmitic acid', has been isolated from the mixed fatty acids of Japanese beeswax. It melts at  $73.8^{\circ}$ – $74.2^{\circ}$  C., and has a neutralisation value of 205.8. It is readily soluble in alcohol, chloroform and ethyl acetate, but is insoluble in cold petroleum spirit and ether. It is sparingly soluble in hot petroleum spirit, and separates in aggregates of white, needle-shaped crystals as the solution cools.

#### CAPE TOWN

Royal Society of South Africa, July 19. R. S. ADAMSON: Notes on *Rhopalota aphylla*, N.E.Br. This is a small succulent plant of subaquatic habit, found on the summits of the Cedarberg. The plant produces only two connate leaves. Buds arise which form short-lived extensions on which flowers are borne. The plant is hygrophytic and when dry loses water very rapidly and wilts but readily recovers. Absorption is carried on both by the roots and by the aerial parts. CLARICE G. CROCKER: Anatomical and cytological studies of *Clematis brachiata*, *Clematopsis Stanleyi*, and hybrids. *Clematis brachiata*, Thunb., a white-flowered climber, and *Clematopsis Stanleyi*, (Hook) Hut., a pink-flowered erect under-shrub, grow along the Witwatersrand. In certain localities where they occur in close proximity, natural hybrids have appeared. In spite of the range of combination of characters shown by the hybrids, anatomical differences are slight, and no cytological differences were detected. The haploid number of chromosomes is eight, and meiosis is regular in both parents and in all the hybrids studied. The latter appear to be fertile and set seed freely.

#### CRACOW

Polish Academy of Science and Letters, June 12. AUERBACH: Poisson's integral. E. ZYLINSKI:



Remark on functions with limited variation. E. ZYLINSKI: Remarks on networks. A. PIEKARA: The dielectric polarisation of mixtures of hexane and nitrobenzene. Electric moment and association of nitrobenzene. Three methods of determining the electric moment of nitrobenzene from the experimental data available are discussed by the author. Basing the calculations on the polarisation  $P_\infty$  at one temperature and the polarisation of the substance considered in the solid state, the electric moment of the molecule of nitrobenzene is given as  $3.96 \times 10^{-18}$ . M. HLASKO: The atomic weight of lithium. The value found is 6.934. L. MARCHLEWSKI and J. PIZLO: The absorption of the ultra-violet rays by certain organic substances (31). The substances studied included aniline, the three isomeric toluidines, quinoline, isoquinoline and their salts. J. KOZAK and F. PAZDOR. The photokinetics of bromination reactions. The bromination of naphthalene in ultra-violet light. J. KOZAK and A. KALMUS: The synthesis of tricycloquinazoline. L. MARCHLEWSKI and W. URBANCZYK: The transformations of chlorophyll in the animal organism. MLE. I. TUROWSKA: Studies of the microflora of the sulphur springs of Poland (1). The sulphur organisms flourish under very varying conditions: temperatures  $0^\circ$ – $75^\circ$  C., acidities pH from 6 to 10, salinity up to 10 per cent. B. PAWLOWSKI: Studies on the delphiniums of Central Europe belonging to the section *Elatopsis* (2). F. BIEDA: Remarks on the nomenclature and classification of certain species of *Nummulites*. A. DEMIANOWICZ: The terrestrial isopods of Bessarabia. W. MICHAJLOW: The larval stages of *Tricnophorus nodulosus*. The proceroid. BR. CHROSTOWSKI: The decomposition of the nitrogenous substances in horse dung and in manure. L. K. PAWLOWSKI: The parasite rotifer *Drilophaga bucephalus*.

July 3. L. MARCHLEWSKI and WL. GOSLAWSKI. The absorption of the ultra-violet radiations by certain organic substances (32). Completing their previous work on the optical properties of phloroglucinol, the authors conclude that this substance, in alcoholic solution, is a trihydroxyl compound and not a ketone. L. MARCHLEWSKI and MLE. G. HERTZ: The absorption of the ultra-violet radiations by certain organic substances (33). Discussion of the absorption spectra of various aryl acids, their salts and esters. L. MARCHLEWSKI and MLE. G. HERTZ. The absorption of the ultra-violet radiations by certain organic substances (34). A description of the absorption spectra of the osazones of glucose, arabinose, maltose and rhamnose. ST. KREUTZ: The luminescence of fluorites at low temperatures. B. PAWLOWSKI: Studies of the delphiniums of Central Europe belonging to the section *Elatopsis* (3). MLE. H. WIAZOWNICKA: The solubility of the phosphorus compounds of wheat flour and the faculty possessed by phytine of combining with the protein substances in the flour. W. JAROSZ: The hydrolysis of the phytic compounds extracted from the seeds of hemp, horse bean, flax, horse-chestnut, wheat and the embryos of rye. E. GRABDA: Researches on a parasite of the crayfish (*Potamobius fluviatilis*) known under the name of *Psorospermium haeckeli*. MLE. H. GAJEWSKA: The lymphatic vessels of the skin of *Axolotl*. F. ROGOZINSKI and ZB. GLOWCZYNSKI: The nutritive value of the seed of smut (*Agrostemma Githago*). Z. KOZMINSKI: The morphological grouping of the species belonging to the sub-genus *Cyclops*.

## SYDNEY

Linnean Society of New South Wales, July 26. JOYCE W. VICKERY: Vegetative reproduction in *Drosera peltata* and *D. auriculata*. The underground parts of *Drosera peltata* and *D. auriculata* are described, and their development followed from the time of germination of the seed until the tuber is situated a few centimetres below the surface of the ground. The development of the adventitious buds which sometimes occur on the leaves of *Drosera* is described. These buds arise by division of adult cells situated immediately at the base of a glandular hair. The bud is in vascular continuity with the parent leaf. These buds arise only under very moist conditions. Axillary buds have also been observed to give rise to new plants. F. A. CRAFT: The surface history of Monaro, New South Wales. Various normal landscapes are found in different parts of Monaro associated with characteristic stream development in each case: the northern and western portions of the region have resisted peneplanation, but the remainder was reduced in stages prior to the extrusion of upper Tertiary basalts. Since that time, erosion has been a fairly constant quantity along the main streams, and the principal change effected has been in the removal of much of the basalt. The stream systems have been stable over a long period of time, and no evidence was found to indicate capture between the Snowy and Murrumbidgee. Present land forms have developed mainly as the result of normal erosion by existing streams, and warping and faulting have played a subordinate part in the development of the landscape. H. CLAIRE WEEKES: Distribution, habitat and reproductive habits of certain European and Australian snakes and lizards with particular regard to their adoption of viviparity. The proportion of viviparous to oviparous reptiles in the Great Dividing Range and the inland plain of south-eastern Australia is extraordinarily high. It is suggested that the failure of the oviparous species to establish themselves on the inland plain and at 4,000 ft. and more above sea-level is due to desiccation of their eggs by the heat and to cold interfering with the development of the eggs in the nest respectively. It is also suggested that the factors determining the adoption of viviparity may be either definitely associated with the altitudes to which these lizards are restricted or that they may work most efficiently under the conditions existing at such altitudes.

## VIENNA

Academy of Sciences, June 30. PHILIPP GROSS, AMALIA JAMÖCK, and FRANZ PATAT: Optical determination of ionic equilibria in dilute ethyl alcohol solution. ANTON KAILAN and FELIX ADLER: Velocities of esterification of alcohols in formic acid (3). Measurements with allyl, benzyl,  $\beta$ -phenylethyl,  $\gamma$ -phenylpropyl, *o*-, *m*-, and *p*-nitrobenzyl alcohols, and methyl-, ethyl- and propyl-phenylcarbinols are recorded. Introduction of a phenyl group, a double linking, or a nitro group lowers the velocity of esterification, to the greatest extent when as near as possible to the hydroxyl group. G. WALTER, R. HÜBSCH, and H. POLLAK: 1:1'-Bisbenzthiazine, and certain regularities in the formation of thiazoles and thiazines. ERNST SPÄTH and ERICH ADLER: Constitution of chonhydrin. Study of the Hofmann degradation of chonhydrin gives results which confirm the formula ascribed by Löffler and Tschunke, and



by Hess and Eichel to this compound. The course of the degradation is similar to that occurring with substituted cholines. ERNST SPÄTH and FRIEDRICH BOSCHAN: Cactus alkaloids (10): constitution of pelletin and anhalonidin. FRITZ WESSELY, FRANZ LECHNER, and KONSTANTIN DINJASKI: Ononin (2). Ononin, one of the extractives of the root of *Ononis spinosa*, is an isoflavone glycoside. Preparation of the pure product is difficult, and the substances known as ononin, formononetin and onospin are not chemical individuals but mixtures. GEORG KOLLER and ADOLF KLEIN: A synthesis of pinacric acid. Condensation of *p*-methoxybenzyl cyanide with benzyl cyanide and ethyl oxalate yields *p*-methoxypulvinic dinitrile, which, on hydrolysis, yields an impure dilactone and pinacric acid. LEOPOLD SCHMID and FAJEK TADROS: (2) Chemical investigation of amber. The principal constituent of amber, succinin, readily undergoes dehydrogenating break, down, giving mainly 1:7-dimethylphenanthrene and a new hydrocarbon,  $C_{15}H_{14}$ , for which various structural formulæ are possible. GUIDO MACHEK: Action of nascent thiocyanogen on di- and tri-hydric phenols. KARL MORSCH: Action of ammonia, methylamine and diethylamine on methyl acrylate. A number of new compounds were obtained. ILSE MERHAUT and HELMUT WALLNER: Reflection of  $\alpha$ -particles at atomic nuclei (3). LEO RENDULIC: Stability of compound sections. KASIMIR GRAFF: A red cloud in Orion, and visual colours of the stars and their relation to the galactic width. J. ROSENHAGEN: A fire-ball of July 25, 1932. GERDA KREIBICH: Antagonistic action of infundin and adrenalin on the nuptial dress of *Rhodesus amarus*, Ag. HANS PRZIBRAM and EDGAR LEDERER: The animal green of the grasshopper as a mixture of colouring matters. This animal green, and probably that of caterpillars and frogs, consists of yellow carotin and of a blue, water-soluble, crystalline colouring material. TILLI WLK: Artificial change of the state of reaction of the tree-frog in black surroundings. ANTON SKRABAL and WALTHER STOCKMAIR: Velocity of reaction of the two methyl crotonates; velocity of reaction and configuration. The less volatile ester reacts the more rapidly and has the trans-configuration, the other isomeride being the cis-compound. MAX PESTEMER and PAULA BERNSTEIN: Ultra-violet absorption of binary liquid mixture (3): Propionaldehyde-ethanol. This absorption indicates the existence of the semi-acetal, which is in equilibrium with the aldehyde and alcohol only in the equimolecular mixture. MICHAEL HESCH: Letts, Lithuanians, and White Russians—anthropology of the East Baltic.

### Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

#### Monday, October 16

UNIVERSITY COLLEGE, LONDON, at 5.30.—Mr. F. J. Richards: "The Practical Value of Human Studies".\*

NATIONAL INSTITUTE OF INDUSTRIAL PSYCHOLOGY (at London School of Economics), at 6.—Mr. Angus Macrae: "The Experiences of a Vocational Adviser" (succeeding lectures on Oct. 23 and 30).\*

#### Wednesday, October 18

UNIVERSITY OF LONDON (at London School of Hygiene and Tropical Medicine), at 5.—Prof. C. L. Burt: "The Normal and Sub-Normal Mind" (Heath Clark Lectures); succeeding lectures on Oct. 25, Nov. 1, 8 and 15.\*

KING'S COLLEGE, LONDON, at 5.30.—G. Winthrop Young: "Aspects of Education in other Countries, especially Germany" (succeeding lectures on Nov. 1, 8, 15 and 22).\*

#### Thursday, October 19

KING'S COLLEGE, LONDON, at 5.30.—Dr. S. J. Davies: "Injection and Combustion in High Speed Oil Engines" (succeeding lectures on Oct. 26, Nov. 2, 9, 16 and 23).\*

CHEMICAL SOCIETY (at Royal Institution), at 8.—Prof. W. A. Bone: "The Combustion of Hydrocarbons" (with experiments).\*

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at Manson House, 26, Portland Place, W.1), at 8.15.—Sir Leonard Rogers: "The Methods and Results of Forecasting Cholera, Smallpox and Plague in India" (Presidential Address).

### Official Publications Received

#### GREAT BRITAIN AND IRELAND

The Proceedings of the Physical Society. Vol. 45, Part 5, No. 250, September 1. Pp. iv+625-753. (London: Physical Society.) 7s. net.

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 63, January to June. Pp. xxv+268+17 plates. (London: Francis Edwards, Ltd.) 15s. net.

London University Guide and University Correspondence College Calendar, 1934-1935. Pp. 217. (Cambridge and London: University Correspondence College.)

League of Nations: International Committee on Intellectual Co-operation. Report of the Committee on the Work of its Fifteenth Plenary Session, submitted to the Council and to the Assembly. (A. 14, 1933. XII). Pp. 62. (London: George Allen and Unwin, Ltd.) 2s. 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 20, N.S., Nos. 37-40: Award of the Boyle Medal to Professor Paul A. Murphy; Report of the Irish Radium Committee for the Year 1932, including Reports by Oliver Chance, Oswald J. Murphy and John A. Geraghty; A New Silver Filter for Ultra-Violet Light, by G. C. Brock; A Study of the Crinkle Disease of Potatoes and of its Constituent or Associated Viruses, by Dr. Phyllis Clinch and J. B. Loughnane. Pp. 547-596+plates 48-49. 4s. Vol. 20, N.S., No. 40: A Study of the Crinkle Disease of Potatoes and of its Constituent or Associated Viruses. By Dr. Phyllis Clinch and J. B. Loughnane. Pp. 567-596+plates 48-49. 3s. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

#### OTHER COUNTRIES

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bd. 104, Nr. 11: The Scoresby Sound Committee's 2nd East Greenland Expedition in 1932 to King Christian IX's Land—Coelenterata, Ctenophora and Chaetognatha. By P. L. Kramp. Pp. 20. (København: C. A. Reitzel.) 1.00 kr.

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 74: Observations on Soil Moisture and Water Tables in an Irrigated Soil at Griffith, N.S.W. By Eric S. West. Pp. 40. Pamphlet No. 41: The Grading of Western Australian Timbers; Report on, and Suggested Specifications for, the Grading of Jarrah and Karri based on Investigations in 1932. By F. Gregson and R. F. Turnbull. (Division of Forest Products, Technical Paper No. 8.) Pp. 105. (Melbourne: Government Printer.)

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 8, No. 2, Août. Rédigé par E. S. Russell. Pp. 145-306. (Copenhagen: Andr. Fred. H. st et fils.) 4.50 kr.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 11, No. 2, August, Research Papers Nos. 584-592. Pp. 163-308. (Washington, D.C.: Government Printing Office.) 25 cents.

Department of Agriculture: Straits Settlements and Federated Malay States. Scientific Series, No. 11: Lac in Malaya. Part 1: Observations on a Lac Insect (*Laccifer Javanus*, Chamb.) and an Account of Attempts to Propagate It. By N. C. E. Miller. Pp. ii+24+3 plates. 50 cents. Scientific Series, No. 12: The Valuation of Tuba Root. By C. D. V. Georgi and Gunn Lay Teik. Pp. 30. 50 cents. (Kuala Lumpur.)

The Indian Forest Records. Vol. 17, Part 9: Entomological Investigations on the Spike Disease of Sandal. (2) Bostrychidae, Platypodidae and Scolytidae (Col.). By C. F. C. Beeson. Pp. iii+12. 4 annas; 5d. Vol. 18, Part 9: Immature Stages of Indian Coleoptera. (13) Bostrychidae. By J. C. M. Gardner. Pp. ii+19+4 plates. 1 rupee; 1s. 9d. (Delhi: Manager of Publications.)

The Tôhoku Mathematical Journal. Vol. 37: First Memorial Volume dedicated to T. Hayashi, Founder and Chief Editor of this Journal, on his 60th Birthday, by his Friends and Pupils. Pp. v+502+1 plate. (Sendai: Maruzen Co., Ltd.) 8.00 yen.

Bulletin of the Fishery Experiment Station of the Government-General of Chosen. No. 4: Studies on the Winkler's Method for Determining Oxygen in Sea-Water. By Zinzirô Nakai. (Series D (Oceanography), No. 3.) Pp. v+62+10. Annual Report of Hydrographical Observations. No. 5-6: For the Years 1930-31. Pp. 119. Oceanographic Charts for the Year 1932. (Appendix to Annual Report of Hydrographical Observations, No. 7.) Pp. 147. (Fusan.)

Contributions to Paleontology from Carnegie Institution of Washington. Studies of the Pliocene Paleobotany of California. (Publication No. 412.) Pp. iii+134+18 plates. (Washington, D.C.: Carnegie Institution.)