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## Electrical Supply in Great Britain

THE sixteenth report of the Electricity Commissioners which has just been issued\* shows that the use of electrical energy in Great Britain is expanding very rapidly. Between April 1, 1935 and March 31, 1936, the consumption of electrical energy increased by 16 per cent as compared with the same period in 1934-35. Compared with the corresponding period in 1933-34, the increase is 47 per cent. A survey has been made from which it appears that at the end of 1934 the areas of supply of the 625 electrical undertakings contained more than 12 million premises, of which 53 per cent were connected to the public supply systems. Of the total number, 85 per cent were domestic premises, and 52 per cent of them were connected with supply systems. With regard to electricity charges, two-part tariffs for domestic supplies were being offered by 81 per cent of the supply companies. The fixed or service charge of the tariffs was based on a variety of principles, the most common being the rateable value of the premises (217) and, next to this, 161 undertakings based their charge on the size of the premises. Of the supply systems, 398 offered a two-part domestic service with a running charge of 1d. or less per unit, and in 105 of them the running charge was  $\frac{1}{2}$ d. per unit or less. In addition, statistics are given of the undertakings which offer 'assisted wiring schemes' and of those which provide show-rooms or make arrangements for 'house to house' canvassing.

While the survey reflects the great progress made in the development of the public supply of electricity since the end of 1934, it also discloses the great potentialities still before the supply

industry. There are still nearly six million unconnected premises, of which 87 per cent are domestic, and there are also great possibilities of a much-extended consumption for existing and additional purposes in the premises already connected. The existence of the Grid makes it possible to supply on much more uniform terms and in particular to offer a two-part domestic tariff with a low unit charge.

A recent event of particular interest to the electricity supply industry was the appointment by the Government, in July 1935, of a committee to consider and report upon the organization for the distribution of electricity in Great Britain. Its report was published in June last\* ; the committee is usually referred to as the McGowan Committee.

Another report, published quite independently by Political and Economic Planning† (PEP), is of interest and value. The individuals who form the group PEP prefer to remain anonymous. They are a non-party group, who are by vocation industrialists, officers of central and local government boards, university professors, etc. The group has already issued nearly ninety broadsheets, to many of which reference has been made in our columns, as well as long reports on coal-mining, the cotton and iron and steel industries. The present report extends to 70,000 words and contains 40 tables of statistics. The instructions to the group of experts who wrote it were that they should present the facts about the electric supply industry of Great Britain, including the Grid, and prepare

\* Ministry of Transport. Report of the Committee on Electricity Distribution. (London : H.M. Stationery Office, 1936.) 2s. net.

† PEP (Political and Economic Planning). Report on the Supply of Electricity in Great Britain : a Survey of Present-day Problems of the Industry with Proposals for Reorganisation of Electricity Distribution. Pp. vi+171. (London : PEP, 16 Queen Anne's Gate, S.W.1 (1936).) 6s. net.

\* Electricity (Supply) Acts, 1882 to 1936. Sixteenth Annual Report of the Electricity Commissioners, 1st April 1935 to 31st March 1936. Pp. 195. (London : H.M. Stationery Office, 1936.) 3s. net.



constructive proposals for making electricity more widely and cheaply available. The report does not conflict seriously with that of the McGowan committee.

From the consumer's point of view, there must be in the first place a supply readily available at cheap rates. There must be the necessary service and credit facilities, so that the cost of wiring, of appliances and of maintenance is not a heavy burden on the consumer. There must also be a method of charging which is reasonably simple to understand and which, so far as possible, follows the same lines all over the country. Finally, a standard voltage and frequency must enable appliances to be interchangeable, so that the consumer is not stranded with useless apparatus and the manufacturer loaded with inflated costs owing to having to supply an unnecessarily wide range of appliances for different voltages or frequencies or both.

Looking back over the last fifty years, it is seen that as the result of falling costs, cheap electricity plays a part in the life of a nation entirely different from that played by expensive electricity. The difference is one of kind and not one of degree. "As yet the limits of future development are not only not in sight but are beyond conjecture."

The Electricity Commission's major function is that of granting powers under statute to supply electricity. Local authorities must obtain the consent of the Commissioners, if they want to borrow money for electricity purposes, such as building new generating stations or extending existing ones. This led to the formation under the Act of 1926 of the Central Electricity Board, which performs for the whole country the co-ordination of generation and high-tension transmission which had been intended by the Act of 1919 to be done on a regional basis. The Board has no financial control over authorized undertakings, but it can force owners to form part of the national supply scheme. In the event of refusal, the station can be compulsorily acquired. Generation and distribution have been dealt with in this way. Schemes for more 'regions' have been carried into effect, and trading has begun in most of them. Electricity supply is available in bulk at tariffs of uniform type in all these regions, but the activities of the Board do not extend beyond the ends of the transmission lines.

The P E P report points out that on the distributive side the prospect is less reassuring. The areas served by the hundreds of undertakings

selling electricity to the public range from less than one square mile to 5,000 square miles, with widely different densities of population. Areas also vary widely in their wealth, their rates and many other factors. These numerous authorities record a considerable range of prices and methods of charging. There are several undertakings with a badly designed and inefficient system of supply (in one or two cases the units sold are only about 50 per cent of the units generated or purchased!). Credit facilities for the hire and hire-purchase of wiring and appliances seem abundant, and no efficient company should have any difficulty in finding the money to provide consumers with such facilities.

One of the fundamental problems for the supply industry is the price to charge the consumer. Should the best policy be to make each class of consumer equally profitable, in proportion to his consumption, to the undertaking, or should (as the railwaymen say) "the fat traffic pay for the lean"? Should rural consumers be helped by urban consumers? The P E P report offers no solution to this problem.

The all-in *1d.* a unit with a slot-meter used in certain working-class housing schemes is mentioned. It is successful in the East End of London, but future development of such a simple tariff demands close study. The report says that many supply undertakers are backward in their attitude to fundamental marketing studies; economic investigation would help them to provide a sound basis for long-period planning. Rural area supply is handicapped by the absence of trained specialist salesmen. Melton Mowbray is quoted as an example of excessive rating. In this town, local rates exceed in amount the whole cost of the electricity purchased from the Central Board together with the cost of the coal required for local generation.

The final chapter in the P E P report deals with the re-organization of electricity distribution, and is of real value. The recommendations are brief and overlap largely those of the McGowan Committee. Five proposals for legislation are suggested. First, that the Government should in consultation with the Electricity Commissioners appoint a committee of investigation. Six problems are stated in the terms of reference, agreed solutions of which would be a great help. Secondly, that an electrical development authority should be appointed with a constitution similar to that of the Central Electricity Board. The main functions of this



body would be development and research, transfer and administration of purchase rights, publicity, statistics and design. This authority should have the power to finance practical experiments in the application of electricity to agricultural, industrial and commercial uses. It is also suggested that it should have the power to set up a central institution for the testing of consumers' appliances and equipment. Thirdly, the powers of the Electricity Commission should be increased. Fourthly, existing legislation on electric lighting should be co-ordinated and simplified; and lastly, certain anomalies and restrictions should be removed.

To a large extent, as we have said above, the conclusions and proposals of the P E P report coincide with those of the McGowan Committee. Both reject nationalization—at least at the present

stage of evolution of the electrical supply industry. Both bodies prefer to proceed by the method of overhaul and consolidation and more efficient grouping of existing undertakings on a regional basis. The P E P proposal to set up an investigating committee is similar to the proposal of the McGowan Committee to set up district commissioners. The latter committee accepts as a guiding principle that larger undertakings are the remedy for present distribution difficulties, and contemplates schemes of amalgamation. The former committee sees some disadvantages in this. The P E P committee concludes by saying that "The public expects that the supply industry should hasten towards a future in which the maximum amenities will be available for the residential consumer, farmer and industrialist through the fullest freedom to use electricity".

## Civilizing Science

### (1) A Hundred Years of Medicine

By Wyndham E. B. Lloyd. (The Hundred Years Series.) Pp. 344. (London: Gerald Duckworth and Co., Ltd., 1936.) 15s. net.

### (2) The Next Hundred Years:

the Unfinished Business of Science. By Prof. C. C. Furnas. Pp. xx+366. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1936.) 8s. 6d. net.

### (3) A Short History of the Future

By John Langdon-Davies. Pp. xxi+272. (London: George Routledge and Sons, Ltd., 1936.) 10s. 6d. net.

THESE three books have two things in common. All of them attempt to link the present with the immediate past or the immediate future, by way either of historical summary or extrapolative prediction. All of them, almost inevitably, are largely devoted to considering scientific or technological development; to call this development progress would be to beg the question raised continually by two of them.

(1) Prof. Lloyd's book is the most specialized and the staidest of the three. How much so may, perhaps, be illustrated by quoting the second sentence of his final chapter, "Epilogue". He writes: "Any attempt to predict the purely medical developments of the future would be extremely rash". But the author's caution does

allow him to go so far as to say "that we are not using to the full even the knowledge that we have". His short expansion of this statement, though guarded to the point of indiscretion and including an unpleasant and snobbish reference to "the masses", again links his book thematically with the other two. In any event, it may be fairly said that books like this contribute much of the raw material out of which books like those of Prof. Furnas and Mr. Langdon-Davies are built.

The introductory part of the book makes a rapid survey from "The Origins of Medicine" through the eighteenth century to the nineteenth. Chapters are included on surgery, the hospitals, the sanitary condition and health of the people, some common infectious diseases, the organization of the medical profession and "The Sources of Modern Scientific Medicine". In Part 2 the author gets down to his central subject matter, and ranges over the whole of medical development in "the last hundred years". The new pathology, based on the cell theory; newer methods of diagnosis; anæsthetics; nutritional studies; the 'germ theory', antisepsis and vaccine therapy; hormones, vitamins and radiological methods; such is the wide field surveyed in some 140 pages. In Part 3 the author writes of "Health Organization", both hospital systems and State medicine being examined, and so to the "Epilogue", to which reference has already been made.



The accuracy of Prof. Lloyd's statements of fact could only be judged adequately by a board—and obviously a very large board—of specialists; the simple reviewer must analyse by sample. For example, it is entirely incorrect to imply that synthetic adrenalin still consists of an optically active mixture of isomers; see the 1932 British Pharmacopœia. The account of liver treatment for pernicious anæmia, on the other hand, though brief, is unexceptionable, as is most of what he has to write about the vitamins. But in a book published in 1936, there seems little justification for closing the vitamin C story with Szent-Györgyi's brilliant isolation of ascorbic acid, and making no reference to the equally sensational simultaneous syntheses by Haworth and Reichstein in 1933. However, for the student of medicine, in the widest sense, as well as for the medical student, this book, in spite of the absence of any strikingly original concepts and in spite of the slight austerity of the author's approach and style, should prove thoroughly informative and useful, and it makes an excellent addition to Duckworth's "The Hundred Years Series", of which it is the fourth in five.

(2) Prof. Furnas's exasperating, stimulating, indignant, encyclopædic, wrong-headed, fervid, naïve volume is altogether another pair of sleeves. Paradoxical in the extreme is the effect made by his attempt to show what tremendous distances science has to travel, for he could only do this by making abundantly clear how astonishingly long is the road already travelled, and at how break-neck a speed. The author works steadily through the sciences, or the main groups of sciences—biology, chemistry, physics and engineering—and concludes with three chapters on "Social Consequences" and a rather piquant "reading list" that ranges from Paul de Kruif to the U.S. Census, from the *Journal of Biological Chemistry* to *Time*, and from Wells, Huxley and Wells to Andrade.

The method of sampling applied to this book does not inspire over-confidence in the author's meticulous accuracy, as witness the statements about thyroxine that "Kendall and many helpers worked upon its exact molecular structure. An Englishman, Harrington, was also extremely active. These two . . . finally came to agreement". Truly, some of the worst examples of insularity come from people who live on the largest continents! The trans-Atlantic origin of this book—Prof. Furnas occupies a chair of chemical engineering at Yale—is shown not only by the innumerable American examples used to illustrate the arguments, but also by the characteristic tang of the writing (possibly originating in part from the author's *Time* studies) and his inability to resist the epigrammatic 'wise crack', at

whatever stretching of scientific accuracy. His advocacy of Epsom salts for preventing milk-fever in cows is scarcely in accord with the most scientific veterinary practice, and his declaration that vitamin C is "practically non-existent in animal tissues" is unnecessarily contemptuous of the adrenal cortex and many other tissues; nor ought he to be puzzled about the source of vitamin D for tropical peoples who live mainly on vegetable food. On the other hand, his attack on the streamlining of low-powered automobiles appeals to the commonsense of the user, if not to the pockets of the maker, but it is rather a schoolboyish jest to say of the second law of thermodynamics that "There is no danger of that law being repealed".

In spite of Prof. Furnas's attention to social phenomena, and his obvious concern with their bearing on scientific progress, he shows a curious blindness to the *reciprocal* effects of the two sets of forces—man's action on his environment conditioning the environmental forces that in turn act on man. While admitting up to a point this reciprocity in the world of machinery, he does not seem to have realized its far wider social implications, nor to conceive it possible that the complete change in social organization, which he somewhat reluctantly admits to be ethically and scientifically necessary, may be unexpectedly accelerated by changes in man himself, brought about largely by those very technological advances Prof. Furnas considers at present so incomplete as to be merely embryonic.

(3) Mr. Langdon-Davies, by profession an anthropologist, makes no such mistake; he errs on the other side. It is not in the least that he is unaware of actual or potential progress in applied science. For some years now he has been one of our leading popularizers of science; his own training has given him the necessarily objective and experimental outlook, while his education in the humanities has given him a directness, accuracy and flexibility of style that should be the envy of all purely scientific writers and most other popularizers. As an example of irony in the tradition of Swift and Samuel Butler, the reader should study Mr. Langdon-Davies's examination of the Government's proposals for safeguarding the civilian population from gas attacks.

In his book, Mr. Langdon-Davies presents us with a plethora of alternatives. Peace or war; Fascism or Communism; free-will or determinism; monogamy or polymorphism. He appears to see human evolution as a struggle between man's instrument of reason and the "social habit". His personification of this habit strikes me, at any rate, as curiously anthropomorphic. Mr. Langdon-Davies, I submit, has taken far too little into account the effect on that social habit both of



man's reason directly and, much more important, of the environment created by man's reason.

However that may be, and whatever relative emphasis we place on the forces so differently emphasized by Prof. Furnas and Mr. Langdon-Davies, both books are thoroughly well worth reading. "The Next Hundred Years" is chiefly commendable for its survey of the vast field of man's technical adventures already achieved, and only incidentally for its author's views about present or future. "A Short History of the Future" also fails to convince in its prophetic vein, but is of great value in its ruthless analysis of the world to-day around us, a world that is in

grave danger of passing out of the control of forces that alone could ensure peace and prosperity for the whole of mankind. As controlling influences, democracy and science have hitherto played unequal and unco-ordinated parts, but only those two forces, and only those two forces acting together in every department of man's social activity, can avoid the catastrophe the coming of which Prof. Furnas dimly and shrinkingly senses. Mr. Langdon-Davies, on the other hand, fully realizes the danger and faces it with pointed irony and a quite brutal bluntness; scarcely anyone could read his book without being healthily shocked.

A. L. BACHARACH.

## The Mind of a Medieval Cleric

Opicinus de Canistris :

Weltbild und Bekenntnisse eines Avignonesischen Klerikers des 14. Jahrhunderts. Von Richard Salomon. Mit Beiträgen von A. Heimann und R. Krautheimer. (Studies of the Warburg Institute, edited by Fritz Saxl, Vols. 1A, 1B.) Textband. Pp. viii+348. Tafelband. Pp. v+45 plates. (London: Cassell and Co., Ltd., 1936.) Paper, 50s. net; cloth, 57s. 6d. net.

A CURSORY glance at the volume of plates, reproducing for the first time a Vatican MS. of the early fourteenth century (*Cod. Pal. Lat.* 1993), might lead one to dismiss it as a mere curiosity, so strange is the jumble of fact and fancy displayed by the drawings. But this would be a mistake, for, as is clearly shown in the learned commentary which accompanies it, the work throws many interesting side-lights on the life and ideas of the late Middle Ages.

The MS. was virtually unknown until a few years ago, when attention was directed to it by the distinguished Vatican Librarian, Cardinal Ehrle. Independently of each other, two scholars have since examined it in detail, and one of them, Dr. F. Gianani of Pavia, published his results in 1927. He concerned himself chiefly with another MS. of Opicinus—his panegyric upon Pavia, his early home—an anonymous work to the authorship of which the present MS. has first given the clue. It does him credit by its intimate knowledge of Pavia under all aspects, as well as by its judicious tone, in which it differs markedly from his other known writings. The present study is of wider interest, and Dr. Gianani's previous work in no way renders it superfluous.

Without the autobiography, the proper understanding of the Vatican MS. would have been still

more difficult than it is. In his youth, the author's circumstances were far from easy and his education was somewhat fragmentary. After trying various occupations, he eventually became a cleric, but never advanced to any of the higher offices of the Church. Pavia was then distracted by the struggle between Guelfs and Ghibellines, and his advocacy of the Papal side forced him into exile, whereupon he betook himself to Avignon, and obtained a post as scrivener in the entourage of the Pope. There, in 1335, he began the present MS., and it could scarcely fail to be influenced by its *milieu*—a focus of the most varied currents of medieval life.

The parchment sheets offer a bewildering mixture of drawings and notes scattered over the whole surface, sometimes with no obvious connexion, and it needed the most persevering study to decipher and explain the whole. In this Herr Salomon has been singularly successful, and has wisely recorded the results in full detail, for few readers would have the knowledge or patience to unravel the puzzle for themselves. A recurring feature in the drawings is the map of the world, and the relative accuracy of its outlines shows at once that Opicinus deserves the credit of having followed the best models then available. It was just the time when the better knowledge previously confined chiefly to sailors was becoming more widely diffused, thanks largely to the cartographical work of Petrus Vesconti, one of whose maps may well have been known to the author. But whereas such maps did little for the interior of the lands, Opicinus shows a better knowledge in this respect than most of his contemporaries.

Characteristic of the Portolan type of map is the close network of direction lines, in the careful drawing of which Opicinus seems to have taken a special pleasure. The strange thing is the way in which



he used this correct knowledge as a starting point for wild flights of fancy, converting the outlines of land and sea into allegorical figures, and adding others to give a general picture of the religious side of life. The world-map seems to typify sin, as when it overlies the picture of Lazarus bound in grave-clothes, while the cure of sin is represented in another sheet by the healing streams typified by the system of the Po, *superimposed*, on a larger scale, on the general map. Quotations from Scripture abound, and here and there Old Testament curses are launched against the rival political party in Lombardy. Besides the maps, geometrical figures, especially circles, are freely used, and various sheets give attention to the calendar and astrological subjects, with the signs of the Zodiac and other associated symbols. In all this, Opicinus shows no decided

break-away from current ideas, his originality consisting in the way in which he represents them graphically.

The drawings show no definite order and were composed at different dates. Much that is abnormal may be explained by a serious illness mentioned in the autobiography—of the nature, it would seem, of a paralytic stroke. The author is morbidly self-centred, obsessed with a consciousness of personal sin, though at times he goes to the other extreme and claims to be an inspired teacher. Students of mental pathology might find an interest in the work from their own point of view, while the drawings are not without value for the history of art and architecture, as is shown in two appendixes contributed by other hands.

The Warburg Institute deserves great credit for undertaking this publication. E. H.

## The Study of Bird-Song

### Songs of Wild Birds

By E. M. Nicholson and Ludwig Koch. (Bird-Lovers' Manuals.) Pp. xxxi+216+18 plates. (London: H. F. and G. Witherby, 1936.) With 2 gramophone records, 15s. net.

MR. NICHOLSON has given us a book which, although in the form of a popular manual, is much more than a presentation of established facts. It indeed makes a real contribution to a neglected subject, giving the results of original observation and usefully indicating lines of further research. It has additional novelty, through the enterprise of Messrs. Witherby, in being a 'sound-book'—illustrated by gramophone records as well as by pictures. To these remarkable records of birds singing in the wild state reference has already been made (*NATURE*, Oct. 10, p. 610): the text now before us includes a chapter by Mr. Koch telling how they were obtained, and an appendix giving a detailed key to their contents.

Biological interest centres on the part which song plays in the life of the bird, a matter which is still very little understood. From a functional point of view, Mr. Nicholson tentatively distinguishes four different levels. At the simplest of these, song seems to serve no very definite purpose beyond possibly expressing a feeling of well-being: at this level, song is very near the 'sub-song' which more accomplished species exhibit in addition to their louder and more definite music. At the next level a sexual factor is added, in that song is used as a stimulus in courtship. Still higher, there is also an element of advertise-

ment, in announcing the presence of an adult male in breeding condition. In the extreme case there is a definite association with territory, and the song assumes the character of a challenge in addition to its other functions. In the British Isles at least, the species which utter typical loud song are all holders of individual territory, and the song is used by the male mainly in relation thereto.

The evolution of song presents a problem with several aspects. It is only the most highly developed birds, the passerines, that possess the anatomical apparatus necessary for producing the best type of song. On the other hand, among the species with this equipment, there is great inequality in the extent to which command over the voice has been achieved. Thirdly, Mr. Nicholson points out, even when both conditions are fulfilled, there must also be an adequate incentive among the conditions of life of the particular species, especially as regards its territorial and sexual behaviour. "A bird such as the starling has the equipment and the skill of a first-rate songster, but he is not one, presumably because song has not assumed an important enough function in his life to make him sing for all he is worth."

Apart from their function, songs are provisionally classified by Mr. Nicholson in four groups according to their structure. There are highly developed songs such as the music of the blackbird; finished song-patterns such as that of the chaffinch; and more primitive types, including rambling or indistinct utterances of low carrying power such as the twittering of the swallow. Finally, there are many breeding notes and song



substitutes, such as the call of the cuckoo: and here also may perhaps be included some non-vocal sounds such as the 'bleating' of the snipe.

About half of the book is occupied by a useful account of the songs of different British species. Mr. Nicholson recognizes that musical notation is of little service in transcribing sounds which lie largely outside the range of the instruments of human art; and that attempts at phonetic representation in words or syllables have at most a mnemonic value. He therefore rightly aims at a more objective method of description, and in

this he makes full use of exact timing of the length of the song, or of particular portions of it, and of the customary interval between each repetition. It is only in this way that accurate study can be made of such questions as local variations in the song of a species. Cases of regional 'dialects' are already known, and further study is desirable.

The book is full of welcome information and stimulating suggestion. With its accompanying records, it will surely be a source of both interest and pleasure to many.

A. L. T.

## Elementary Mineralogy

### (1) Mineralogy:

an Introduction to the Study of Minerals and Crystals. By Prof. E. H. Kraus, Prof. W. F. Hunt and Prof. L. S. Ramsdell. Third edition. Pp. ix+638. (New York and London: McGraw-Hill Book Co., Inc., 1936.) 30s.

### (2) Mineralogie

Von Prof. Dr. R. Brauns. (Sammlung Göschen, Band 29.) Siebente, verbesserte Auflage. Pp. 146. (Berlin und Leipzig: Walter de Gruyter und Co., 1936.) 1.62 gold marks.

(1) **T**HE popularity of "Kraus and Hunt", first published in 1920, has led to the appearance of a third edition and the enrolment of a third author. Some sixty further illustrations have been added to an already lavishly illustrated book, and there is additional material on physical properties, the polarizing microscope, crystal structure and X-ray analysis, and the formation and occurrence of minerals.

The first 226 pages are devoted to crystallography and the physical and chemical properties of minerals; the next (and briefest) section contains descriptions of 150 of the commoner species, while the remainder of the book, printed on paper of a different tint, contains determinative tables based principally on the characters of lustre, hardness and streak. The illustrations, which form so attractive a feature, include photographs of wooden crystal models, well-known mineralogists and mineral specimens. The latter are notoriously difficult to produce successfully, and there are many here which are of doubtful value as an aid to identification. Interesting information on the commercial uses of minerals is given in a special chapter, and a brief chapter on gem-stones is designed to introduce the student to an attractive branch of mineralogy in which the senior author is a specialist. In another chapter, the fundamentals of X-ray crystal analysis are clearly explained and

a valuable note on the structure of the silicates, as recently determined by X-ray methods, serves to clarify the complexity of this important class of minerals. Chemical (blowpipe) methods for identification are given in unusual detail.

There are some unexpected omissions. Goniometric methods are not even mentioned (the word 'goniometer' is not to be found in the index), and, while values for  $2V$  are usually given for each species, interfacial angles are not so given. The hydrostatic and heavy-liquid methods for determining specific gravity are not described, as the authors consider that "these methods are very accurate but time consuming. They are generally employed in mineralogical research and but rarely by students of elementary mineralogy". It is strange that the use of heavy liquids, by which more rapidly than in any other way the density of a small fragment of mineral can be determined, should be dismissed as "time consuming", when a description of the far more time consuming pycnometer method has been included.

In the descriptive portion, the specific gravities accorded to each species represent the extreme range, with no indication of the normal value for reasonably pure specimens of the mineral in question. Refractive indices, however, are usually given to three places of decimals as though constant for the species, no variation being indicated.

The book is chiefly to be recommended for its clear and attractive presentation of the subject: only in the literal sense of the term (it weighs three pounds) can it be said to make heavy reading.

(2) Into this miniature text-book, which would not seriously embarrass a jacket pocket, Dr. Brauns compresses a description of some 120 minerals, preceded by introductory pages dealing with crystallography and such easily determined properties as streak, hardness and specific gravity. The optical properties of minerals, except dichroism, are not mentioned.

B. W. A.



**British Rainfall, 1935:**

the Seventy-fifth Annual Volume of the British Rainfall Organization. Report on the Distribution of Rain in Space and Time over the British Isles during the Year 1935 as recorded by over 5,500 Observers in Great Britain and Ireland. (Air Ministry: Meteorological Office. M.O. 395.) Pp. xvi+285. (London: H.M. Stationery Office, 1936.) 15s. net.

THIS detailed account of the rainfall of 1935, based on returns from more than 5,500 co-operating observers, is the seventy-fifth annual issue of the series begun in 1861 by G. J. Symons, founder of the British Rainfall Organization. Like its predecessors in the series, the present volume includes maps, tables and descriptive matter dealing with the distribution of the rainfall each month and for the whole year, studies of heavy falls on individual days of particular interest and data in regard to rainfall duration, evaporation and spells of dry or wet weather.

The statistics show that the year's rainfall was about normal in Ireland; in other regions there was an excess averaging thirteen per cent over England and Wales, eight per cent over Scotland and nine per cent over the British Isles as a whole. During October, 22.92 inches fell at Inverary Castle, Argyllshire, and on February 15 a fall of 6.16 inches was measured at New Dungeon Ghyll Hotel, Westmorland. On the other hand, both March and July gave exceptionally low totals in certain areas.

The issue contains two special articles; one of these gives details of the remarkable hail-storm which occurred in the early morning hours of September 22 over Northamptonshire, probably the most destructive hail-storm that has occurred for many years in the British Isles. The other article, by the Superintendent, deals with the frequency of occurrence of heavy falls in short periods. An analysis of ten years autographic records leads to a new empirical formula connecting the rainfall amount, the time of fall and the frequency. On the basis of this formula, the curves used for defining "note-worthy", "remarkable" and "very rare" falls have been drastically revised. It is also suggested that data computed from the formula should form the basis of sewer and drainage works design.

**Tools of To-morrow**

By J. N. Leonard. Pp. vii+303. (London: George Routledge and Sons, Ltd., 1935.) Cheap edition, 5s. net.

IT is a truism that military leadership has seldom foreseen the conditions under which the next war would be fought, and has tended rather to plan its strategy and tactics in accordance with the experience of previous decades. The rate of impact of science on society is now increasing, or rather the period of industrial gestation is decreasing so rapidly that over whole spheres of our industrial and social life a like condition tends to prevail. Mr. Leonard could well have anticipated for this book the title of Sir Josiah Stamp's presidential address at Blackpool to the British Association. He is concerned with the

impact of science upon society and with the means of adaptation and change which science has put into our hands. The book, which is admirably written, can be commended to all who seek to form an intelligent opinion on social and technical change and the numerous grave problems arising out of them. While avoiding the sensationalism of many journalistic efforts in this field, it is lucid and always stimulating and well deserves a wide circle of readers. It is unfortunate, however, that Mr. Leonard should give fresh circulation to the mistaken belief that war stimulates development, more particularly as in one of the examples cited by him, namely, aviation, war needs have been the main factor responsible for warping its whole development.

**Electrical Laboratory Experiments—Theory and Practice:**

being an Abridgement of "Experimental Electrical Engineering". By Prof. Vladimir Karapetoff. Arranged and Revised by Prof. Boyd C. Dennison. Pp. xii+487. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1936.) 20s. net.

KARAPETOFF'S text on experimental electrical engineering had become so comprehensive that it became desirable for the production of the present abridgement for undergraduate purposes, but even so the number of experiments described—and these cover the 'heavy' or machine side only—are so varied and numerous that a normal undergraduate could expect to cover a fraction only. After all, it cannot be necessary that a student be taken through all the experiences possible; apart from training his hands, the purpose of laboratory work should be to give him faith in the theory that he obtains from books and lectures, supplemented by exercises, and he should be taught to depend on what he learns. Nevertheless, the present text would be invaluable in designing or improving laboratory courses. L. E. C. H.

**Magic Squares of  $(2n + 1)^2$  Cells**

Avec sommaire: Les carrés magiques impairs. By M.-J. van Driel. Pp. 90. (London: Rider and Co., 1936.) 10s. 6d. net.

THE author of this volume has evidently devoted much research to the interesting study of magic squares, and though many results of his work were published in Amsterdam in 1931, it is pointed out that this book is not a mere translation of that work. New methods of composing magic squares of order 5 are given and, by a development of the uniform step method, constructions for squares of an order greater than 5 are deduced. Original practical rules are then enunciated for simple and pandiagonal squares of order  $2n + 1$ . Symmetrical and bordered squares are also considered.

The text is not easy to follow, although it contains much valuable information based upon sound mathematical principles and substantiated by many references to original work on the subject. The book concludes with a summary which is written in French.



## The Flora of Krakatau

THE eruption of Krakatau, from May 20 to the end of August 1883, which killed the vegetation of the three islands of the Krakatau group and destroyed some two thirds of the island of Krakatau itself, was perhaps the most important volcanic outburst, from the point of view of the biologist, that has occurred in historic times. Its biological importance is, of course, due to the fact that Krakatau is now one of a group of four (formerly three) islands in the middle of the Sunda Strait, Krakatau itself being 40 km. distant from the nearest point of west Java, and the same distance from the nearest point, Varkenshoek, of south-eastern Sumatra. The nearest island to the group is the volcanic Sebesy Island, some 13 km. to the north, where the vegetation was not wholly destroyed. If, as has generally been accepted, the whole of the vegetation of the Krakatau islands was destroyed, then the study of the gradual recolonization recently published by Dr. W. M. Docters van Leeuwen is of unique interest and importance. Krakatau's historic eruption, however, is only one of a series each of which, could it have been studied, would have afforded invaluable information as to methods of plant distribution. From the geological evidence, there was originally a single volcanic island in the Straits about 2,000 m. high. This was destroyed, and the three main remaining portions are represented by Krakatau, Verlaten and Lang Islands, surrounding a deep circular sea basin. This eruption was followed by another violent one, and later, by the fusion of the two volcanoes Perbuatan and Danan, the historic island of Rakata or Krakatau, 9 km. long and 5 km. broad, was formed, two thirds of which were erupted and dispersed in 1883. Recently Anak Krakatau has been erupted.

Prof. Treub of Buitenzorg, it will be remembered, was the first botanist to visit Krakatau after the eruption in 1883. The earliest visitors to the island were Verbeek, two months, and Cotteau, the Frenchman, nine months after the eruption. Neither record the presence of any living plants, and Cotteau expressly states that he could not discern any vegetation on the island. It was the classic visit of Treub, nearly three years after the eruption, which focused attention on the problem

of its recolonization, when he pointed out that the first colonizers of the volcanic ash and cinders were the blue-green Algæ, which formed a hygroscopic layer in which fern spores could germinate, and that under the conditions obtaining in a volcanic island such as Krakatau, ferns would necessarily precede the phanerogams. Of the plants recorded by Treub

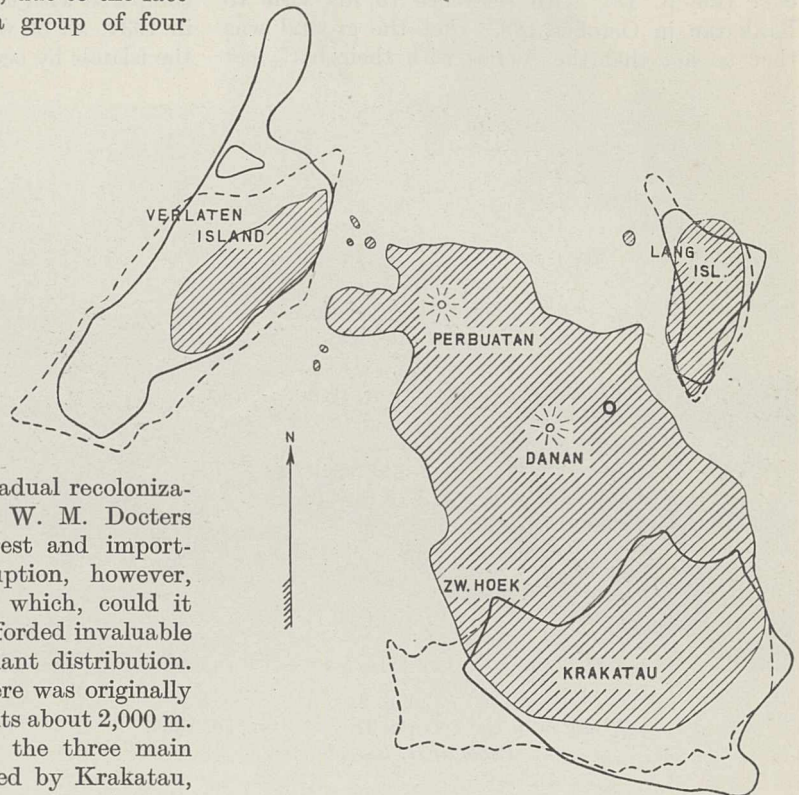


Fig. 1.

CHANGES IN FORMATION OF THE KRAKATAU GROUP.

in 1886, eleven were ferns, eleven dicotyledons and four monocotyledons. He also found a few mosses; the fifteen flowering plants were mainly those which are usually found on sea-beaches.

Were these twenty-six plants found by Treub immigrants from land across the Straits, or were some of them survivors from buried seeds or from trunks or rhizomes, not wholly killed, which were exposed by the tropical rains washing away the overlying mass of ash and pumice thrown up by the eruption?

Thanks to the exhaustive labours of Dr. Docters van Leeuwen, we are now in a position to give a definite answer to this all-important question. In his masterly treatise on the island now before us, he



has marshalled all the facts and discussed fully the evidence which has been produced for and against the total destruction of the vegetation of Krakatau by the eruption of 1883 with judicial fairness\*.

The circumstances, unfortunately, do not permit of an *absolute* 'yes' or 'no', since three years elapsed before the fairly full investigation of the island by Treub was made, and even then owing to the extreme difficulties in getting up the deep fissures and among the waste of volcanic ejecta, it was possible to examine only a relatively small portion of the island. Verbeek's statement, however (see p. 18), with reference to his visit to Krakatau in October 1883, that the ground was then so hot that the coolies with their bare feet

destructive effect of the hot gases, steam, etc. From the charred wood exposed by the washing away of the thick ash deposits, it seems clear that nothing in the way of stems or rhizomes could have survived. Buried seeds might have escaped destruction, had they been quickly exposed again by landslides or erosion, but the evidence for survival is very slight.

After all, Treub found only fifteen species of flowering plants three years after the eruption, and even if a few of these had grown from seeds which survived the eruption, their number is negligible compared with the 219 species which were recorded in 1934, all of which must have been brought to the islands by ocean currents, winds, birds or man.

Until the year 1908, no one appears to have questioned Treub's presumption of the complete sterilization of Krakatau. Penzig, who visited the island in 1897, Ernst in 1906 and Backer (on his first visit) in 1908, were all equally convinced.

The late Dr. J. P. Lotsy, writing in 1908, appears to have been the first to question the total destruction of the vegetation, on account of the finding of a large plant of *Cycas Rumphii* by Valetton in 1905, twenty-two years after the eruption! Based on the analogy of the growth of cycads in general, the objection might be a weighty one, but Dr. Docters van Leeuwen, on p. 346 in his detailed account of this plant, records how

rapid is the growth of this species when young, and has shown by his own experiments that a plant of this *Cycas* can grow from seed to a height of more than 1 metre in the space of five years.

Other dissentient views are fully discussed and as fully rejected; it was not until the year 1929 that any serious challenge to the generally accepted opinion was brought forward. We have therefore to thank Mr. Backer (whose work was reviewed in NATURE, 125, 627; 1930), since it is not only owing to his expressed disbelief in the sterilization of Krakatau, but also on account of the aspersions he has cast on the work of Treub and the veracity and competence of previous investigators, including particularly Dr. Docters van Leeuwen, that we owe this volume, which will be the classic work of reference on the subject



Fig. 2.  
WEST SIDE OF ZWARTE HOEK, JUNE 20, 1886.  
Photo by H. Busenbender.

could not stand still and that steam was issuing from the bottom of the gaps cut out by the rain, makes it seem highly probable that all plant life, even that of seeds buried under the hot ashes and pumice, must have been destroyed. Verbeek concludes his letter to Docters van Leeuwen with praiseworthy caution: "I believe," he writes, "that this question can never be settled with absolute certainty, though I, myself, am inclined to assume that everything was dead".

Before the eruption, the islands were covered with dense tropical vegetation up to the top of Mount Rakata on Krakatau, and after the eruption there was nothing living to be seen, owing to the thick covering of ashes and pumice and the

\* Krakatau, 1883-1933. By W. M. Docters van Leeuwen. A: Botany. (Annales du Jardin Botanique de Buitenzorg, Vol. 46-47.) Pp. xii+506+37 plates. (Leiden: E. J. Brill, 1936.) By the courtesy of the publishers, several of the illustrations are here reproduced.



for all time and a vindication of Treub's fine pioneer investigations.

It is unnecessary here to go over again the various points raised by Backer, but it is good reading to follow Dr. Docters van Leeuwen's judicious handling of Backer's assumptions, some of which would have been quite reasonable had they had a shadow of evidence for their support.

Dr. Docters van Leeuwen has devoted a chapter (iv) of thirty pages to a review of the recolonization of other territories all over the world, and it

present plant covering of the islands must consist wholly of immigrants.

The author devotes eight extensive chapters to the visits of the various botanists to the islands between 1884 and 1932, one being concerned with the stay of J. Händl on Krakatau, from 1916 until 1921, and the fate of any plants he and his workpeople may have introduced. He then gives a complete list of the flora of the island and records the different dates when the various species—now numbering 271—were first observed. These are



Fig. 3.

KRAKATAU, SOUTH-EAST SIDE, MAY 1928.

seems clear that had any seeds remained viable after the eruption, such as those of *Ficus fistulosa*, *F. hispida*, *F. toxicaria*, *Macaranga Tanarius*, or even of *Cycas Rumphii*—the two *Ficus* first recorded in 1897, the rest in 1905—the seedlings would have been so tall in 1886 (several metres in the case of the first four, judging by observations made on their growth in Sumatra) that Treub could not have failed to have noticed them!

I fully agree therefore with Dr. Docters van Leeuwen, after carefully reading his able review of all the evidence, that not a single valid argument has been given that any part of the original vegetation of Krakatau was saved, and that the

all dealt with in detail in the final chapters, which occupy 175 pages replete with valuable information. Chapter xvi deals with the means of transport by which the plants must have reached Krakatau—wind, sea, animals and man. Only the conclusions can be given here, but the discussion should be read in detail. Dr. Docters van Leeuwen feels justified in assuming that about 41 per cent of the plants now found in Krakatau (not counting the lower cryptogams), were transported by wind, 28 per cent were introduced by ocean currents, 25 per cent by animals, while not more than ten or fifteen plants, if as many, which may have been introduced by man, have survived.



An interesting chapter (xviii) is devoted to the recently erupted island of Anak Krakatau, which first emerged above sea-level on January 26, 1928, and a list of the seeds and plants found on this 'baby' island by the author includes many coconuts, forty-one of which had germinated. These

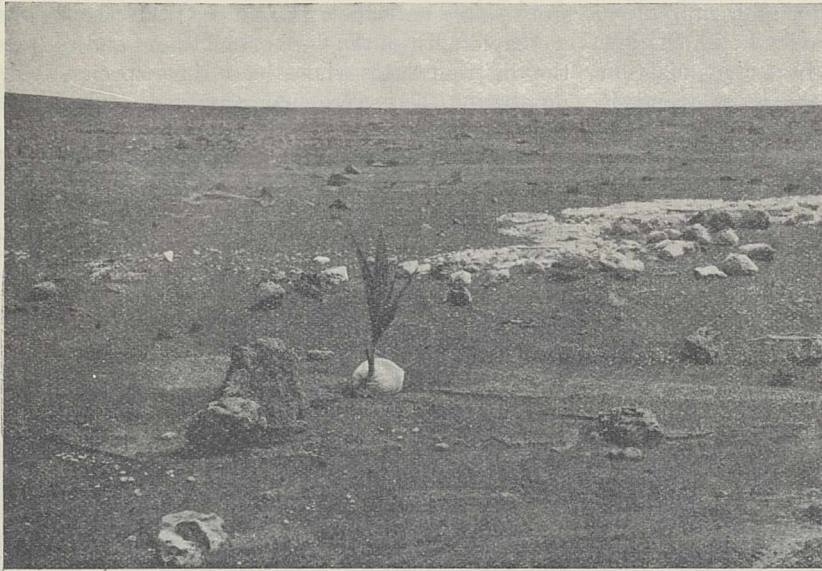


Fig. 4.  
ANAK KRAKATAU, MAY 1932.  
Photo by C. C. Reijndaan.

no doubt will be destroyed during the next eruption, but the colonization of this new creation affords possibilities of a very interesting study.

Dr. Docters van Leeuwen's chapter (xxi) on *Zoococcidia* is one of the most valuable in the book, not only because he is a leading authority on the

group, but also because these short-lived gall-producing insects and mites must have been destroyed by the eruption, so that all those now present on the island can only be immigrants.

No galls were found on the plants collected by Treub, though this does not prove that none had then arrived, but it is of interest that very few galls are known on the plants found by Treub on Krakatau in 1886. Dr. Docters van Leeuwen has collected no less than sixty galls on forty-four different plants on the islands. Since, then, it is inconceivable that these delicate insects can have survived the eruption, it is clear that the plants were the first immigrants, and when they had become established the gall-producers followed, being transported by the wind or ocean currents.

The value of the work is completed by the excellent bibliography and full index, and by the admirable illustrations, sixty-one in number, showing various stages

in the development of the vegetation on the islands.

Dr. Docters van Leeuwen has earned our grateful thanks for this convincing treatise—so well written in English—which he has most fittingly dedicated to the memory of Melchior Treub.

ARTHUR W. HILL.

## Prevention of Smoke and Dust Emission from Chimneys

THE weight of coal consumed annually in Great Britain is approximately 165 million tons, and of this only a small proportion is burned without smoke or grit being discharged into the atmosphere. It is, however, not possible to make even an approximate estimate of the extent to which the use of coal is responsible for atmospheric pollution and its attendant evils, on account of the wide differences which occur in the nature and quantity of smoke or grit produced by the combustion of unit weight of fuel. Both depend upon the type of coal used, the purpose for which it is burned and the skill employed in burning it, all of which vary from case to case.

When coal is burned on a domestic grate—and some 35 million tons are used annually for household purposes—the smoke produced consists of partially cracked tarry vapours formed by the distillation of a portion of the volatile matter in the coal. The quantity depends, of course, upon the type of grate and the nature of the fuel used. To burn soft bituminous coal smokelessly in an open fireplace is extremely difficult, but endeavours are being made to devise a suitable grate. Should they not be successful, it will be necessary, if smoke is to be avoided, either to abandon the open fireplace altogether, or to increase still further the use of smokeless



fuel, such as low temperature coke, and gas or electricity.

The same type of smoke as that produced from domestic fireplaces may also be emitted from small industrial furnaces. In this case, however, there is no real difficulty in avoiding incomplete combustion. Its cause is usually either incorrect operation or the fact that the furnaces are being forced beyond their capacity. Reservations must be made in favour of certain metallurgical and ceramic processes requiring a reducing atmosphere, but even in these, improvements in the design of the furnace, care in the selection of the fuel, and scientific operation can often mitigate the nuisance. Generally speaking, therefore, the excessive emission of tarry vapours or soot from an industrial furnace is inexcusable. Nevertheless, many industrial furnaces are sources of a form of atmospheric pollution far more difficult to prevent than that due to incomplete combustion, namely, the dust and grit carried through the furnace by the draught.

In order to obtain sufficiently high rates of heat liberation in the space available, the air supplied for combustion may pass through the fuel bed at such a velocity that it will carry with it small solid particles of ash and unburnt or partially burnt fuel, as distinct from smoke. These may be relatively large, up to say  $\frac{1}{8}$  in. in diameter, and as, for economic reasons, the fuel used may be small in size and contain a considerable percentage of ash, the weight of solid material carried over may be high. In the case of large boilers, such as those found in power stations, the combustion chambers are so designed that the weight of carbon discharged in the flue gases is relatively small, but a large proportion of the ash in the coal is inevitably carried through the boiler. As the fuel often contains 10 per cent or more of ash, the weight of dust and grits discharged daily from a boiler burning several tons of coal per hour is appreciable.

During the last few years, an increasing number of the furnaces used in boilers and for metallurgical purposes have been fired with powdered coal. With this fuel most of the ash particles are less than 10 microns in diameter, with the result that, unless some form of dust-arresting apparatus is employed, most of the ash in the fuel will find its way up the chimney. This, more than any other isolated fact, has probably been the origin of the present increased interest in the prevention of dust emission.

The most obvious way of reducing the amount of dust leaving a furnace is to reduce the amount of ash supplied to it, that is, to use cleaned coal. It is gradually becoming realized that dirty coal is not necessarily cheap coal, and the use of cleaned coal is rapidly increasing. Nevertheless,

it is not possible to clean boiler coal so as to reduce its ash content below a certain figure, say between 3 and 5 per cent on the average, so this method can provide only a partial cure.

A second method is to retain the ash in the furnace, and this is done to some extent in stoker-fired furnaces in which a large proportion of the ash fuses on the grate and is removed in lumps as clinker. The same method has been tried in certain pulverized fuel furnaces known as 'slag tap' furnaces, in which conditions are so arranged that the ash particles are caused to fuse into a pool at the base of the furnace, from which molten slag is run off at intervals. The arrangement is, however, not popular in Great Britain.

The remaining method, and the most generally used, is to remove as much dust as possible from the flue gases during their passage from the boiler to the chimney. For this purpose various types of dust extraction plant have been evolved, but their use is not so general as might be desired, mainly on account of expense.

In a few industrial processes the dust discharged has a commercial value and pays for its collection, but in most plants, including boiler furnaces, the dust produced is worthless and the cost of its collection is a complete loss, entailing not only capital, power and maintenance charges, but also the cost of disposing of the material caught.

Commercial dust extraction plants may be divided into two main groups, namely, dry and wet. The dry types include (a) those making use of gravity alone, (b) those using centrifugal force and (c) the electrostatic type; in these the collected material is removed in the form of a dry powder. In the wet types the dust is brought into contact with water sprays or films and is removed from the plant as a 'slurry'.

The simplest form of dry dust collector is a large empty chamber in which the solid particles settle out of the flue gases under the action of gravity. For such a chamber to be effective, a particle must be able to fall through the height of the chamber in less time than it takes the gas to travel through it. Now the rate of fall is proportional to the square of the radius of the particle, and the volume of flue gas leaving a boiler of only moderate size is very large; hence, in practice, an efficient settling chamber of reasonable dimensions is possible only with small boilers emitting large grits. Against this, the simple settling chamber has the great advantages that it requires no special fans or machinery and that no additional power costs are involved.

Many methods of reducing the size of settling chambers have been employed with varying success. Of these the most effective is the use of baffles or other devices which assist dust separation



by causing the flue gases to undergo sudden changes of velocity and direction. The application of such devices is, however, limited by the fact that they increase the small pressure drop in the flue gases which constitutes the main advantage of the settling chamber. If fan power becomes necessary, more efficient forms of collector are available.

When a pressure drop of the order of about 2 in. water gauge or more is permissible, it is possible to use a form of separator in which gravity is replaced by centrifugal force. The simplest device of this type is the well-known cyclone, in which the flue gases enter a short cylinder tangentially and leave through a central axial opening. The dust is thrown out by centrifugal force and is collected in an inverted cone below the cylinder, being finally withdrawn through a suitable valve at the base.

The common cyclone has been subject to many modifications with the object of increasing its efficiency and decreasing the capital and power costs involved in its use. In addition, a great variety of other centrifugal devices have been evolved, for some of which high efficiencies are claimed, even with pulverized fuel dust. All these apparatus have the advantage of comparative low cost and simplicity, but all are subject to certain inherent limitations: they are more effective with large than with small particles, and their efficiency depends upon the flue gases being constrained to flow at a high velocity in a circle of small radius. As a result of these limitations, centrifugal separators may in practice be regarded as eminently suitable for arresting the relatively large grits associated with hand and mechanical stoker firing, but distinctly less satisfactory for dealing with the very fine dust from powdered fuel furnaces.

During recent years, particularly as a result of the growing use of powdered fuel, increasing attention has been given to a form of dry dust extractor which, although more costly than the types already mentioned, has the great advantage of being able to deal with very fine dust as well as with grits, namely, the electrostatic precipitator. In this device the dust-laden flue gases are caused to flow between two electrodes, one of which is charged to a high negative potential and the other earthed. As a result of ionic discharge between the electrodes, the dust particles become negatively charged and move towards the earthed electrodes to which they give up their charge, and upon which they are collected. They are then caused to fall into some form of hopper from which they are removed from the system.

The method has the advantages of low pressure drop, low maintenance charges, low power costs

and, above all, its ability to give very high efficiencies with really fine dust particles. Against these there are the large space occupied by the plant and the use of high voltages. Its main drawback, however, is high capital cost.

All dry methods of cleaning flue gases have one fundamental disadvantage which is of major importance in the case of urban power stations, namely, the fact that no dry method of dust removal will also remove sulphur.

Before the problems associated with the contamination of the atmosphere by sulphur compounds reached their present importance, it was common practice to attempt to increase the efficiency of settling chambers and certain centrifugal separators by using sprays to wet the dust particles and so to increase their settling rate. The disadvantage of the method is that water does not readily adhere to fine dust, and in consequence the quantity of water required is very large indeed, involving not only the cost of providing and 'atomizing' the water but also the disposal of the 'slurry' leaving the plant—a task comparable in magnitude with that of the initial removal of the dust from the flue gases.

In spite of this, spray chambers are now being used on a very large scale, primarily to obtain sulphur removal and incidentally for dust removal. Thus in one large power station in Great Britain, one and a half million cubic feet of flue gases are scrubbed per minute in a system through which they take 30 seconds to pass, and 20 tons of water are pumped through sprays for every ton of coal burned. The slurry is dealt with partly by settling and partly by filtration through sand and rotary filters. The advantage of the system is that high efficiencies can be obtained with regard to both dust and sulphur removal, but against this must be balanced the high cost, the space and plant required and the necessity for large water supplies.

In some plants sprays are replaced wholly or in part by films of water in contact with metal surfaces, a system which still involves the use of large volumes of water and slurry treatment.

During the past few years, a new wet system has been evolved for the removal of dust and sulphur in places where large water supplies are not available. In this 'non-effluent' system, the gases are scrubbed by contact with special arrangements of wooden plates and grids, which are kept wetted by alkaline liquor continuously circulated through the plant. As with other wet systems, the solid matter suspended in the liquor has to be disposed of by settling and filtration, but the main problem, ingeniously overcome, is the prevention of scale formation in the scrubbing towers.



From this brief review it will be seen that adequate means are available for the prevention of excessive emission of dust and grit into the atmosphere. In the case of very large installations, public opinion has already compelled the use of admittedly expensive methods of dust removal, and there are signs that in the near future, whatever the cost, the demand made upon smaller plants

will be more exacting than in the past. There are, however, also indications, both in patent specifications and in the technical press, that increased public interest in atmospheric pollution has given rise to increased experimental work upon its prevention, and it is reasonable to hope that by the time a more rigorous standard is adopted, its cost will not be too heavy a burden upon industry.

## Obituary Notices

Mr. Thomas Crook, O.B.E.

**A**LIFE of strenuous and useful work with ripe experience terminated on January 6 when Thomas Crook, principal of the Mineral Resources Department of the Imperial Institute, London, died after an abdominal operation, at the early age of sixty years.

Crook was born at Burnley, in Lancashire, on January 12, 1876. On the examination results of the old Science and Art Department he gained in 1898 a Royal Exhibition to the Royal College of Science for Ireland, where he took the associateship (A.R.C.Sc.I.) in natural science in 1901. He then became assistant in geology to the late Prof. Grenville A. J. Cole. In 1905 he joined the Scientific Department of the Imperial Institute, and for six years (1919-25) he was chief of the Intelligence and Publications Section of the new Imperial Mineral Resources Bureau, which afterwards was incorporated with the Imperial Institute.

Thomas Crook, with his keenness for work and his balanced judgment, early gave promise of being a prominent scientific investigator; but in course of time, his energies became more and more devoted to economic problems in connexion with developing the mineral resources of the Empire. While in Dublin, he described with Grenville Cole rocks dredged from the Atlantic, and devised a method for the mechanical analysis of soils with the well-known Crook's elutriator. In London, under Sir Wyndham Dunstan, excellent mineralogical work was done, and papers were published on geikielite, carnotite, strüverite, ankerite and magnesite, on the electrostatic and electromagnetic separation of minerals, and on some curious optical properties of certain minerals. A paper with a philosophical bearing was "The Genetic Classification of Rocks and Ore Deposits", which several years later he expanded to form a book, "History of the Theory of Ore Deposits" (1933). Another excellent and useful book is his "Economic Mineralogy" (1921).

This promising scientific work gradually became eclipsed by a vast number of well-written abstracts and articles on the occurrence and possible uses of a great variety of mineral products, which appeared mostly in the *Bulletin of the Imperial Institute*, but without being keyed to an author's name (with the result that they were not always entered in biblio-

ographies, and not easily quoted). With the foundation in 1919 of the Imperial Mineral Resources Bureau, a still more intensive period followed. Then were issued long series of useful pamphlets and books dealing with some fifty different minerals and ores, each complete in itself, and with several editions bringing the statistics up to date. Authoritative statistical volumes of the world's mineral production were also issued annually. Another useful volume, "Minerals of the Empire", was issued for the Wembley Exhibition in 1924. This good work was continued on Crook's return to the Imperial Institute in 1925. All these publications bear evidence of his influence.

Content in his work, Crook did not strive for honours; but some did come at the end of the chapter. He was made O.B.E. in 1936. In November last he was elected a vice-president of the Mineralogical Society; and in December the honorary degree of B.Sc. was conferred on him by the National University of Ireland.

L. J. S.

### Dr. E. E. Prince

**DR. EDWARD ERNEST PRINCE** died at his residence in Ottawa, Canada, on October 10, at the age of seventy-eight years. A native of Leeds, he graduated from the University of St. Andrews, and taught in the University of Edinburgh and (as professor of biology) at the Royal College of Medicine, Glasgow. He was one of the group studying the development of fishes under Prof. W. C. McIntosh at the St. Andrews Marine Laboratory. His publications in this field gave him recognition as a fishery specialist, and as such he investigated the fisheries on the east coast of England and the west coast of Ireland.

In 1892 Dr. Prince was appointed commissioner of fisheries for Canada, which position he held until his retirement from active life in 1925. Being responsible for the application of science to fishery problems, he urged in 1894 the establishment in Canada of a marine scientific station, and the support of the Royal Society of Canada and of the British Association at its Toronto meeting in 1896 led to the Canadian Parliament voting the necessary funds in 1898. He was made director of the new station, which operated with a board of university men to manage it and was



located on the Atlantic coast. When a Great Lakes station and a Pacific station were afterwards developed, he continued to guide the work as chairman of the modified Board (incorporated in 1912 as the Biological Board of Canada), retaining this position until 1921 and remaining a member of the Board until his death.

Dr. Prince played a leading part on various fishery commissions in Canada, and with Dr. D. Starr Jordan formed the International Fishery Commission, established by treaty in 1908, which prepared common regulations for the fisheries in waters contiguous to Canada and the United States.

Dr. Prince was a keen naturalist and intensely interested in people. By charm of manner and breadth of interests he exercised a wide influence in a multiplicity of personal contacts throughout Canada and elsewhere. He was the author of more than fifty papers, nearly all on fishery subjects, and initiated or stimulated a large part of the investigations of Canadian waters, effectively applying to the first stage of fisheries research in Canada the knowledge and experience he had developed in Great Britain.

A. G. H.

#### Mr. G. P. V. Aylmer

WE regret to record the death of Mr. Gerald Percy Vivian Aylmer, African traveller and explorer, which took place on December 20 at Newcastle-on-Tyne in his eightieth year.

Mr. Percy Aylmer, as he was generally known, was born in 1857 and educated at Eton and Trinity College, Cambridge. Notwithstanding the fact that as a result of a fall in the hunting field at Cambridge one leg was permanently deformed, Mr. Aylmer on

leaving the University entered on a life of travel and strenuous adventure. In 1881, after taking a course of study in astronomy, he went to the Sudan with F. L. and William D. James and E. Lort-Phillips. The party entered the then unknown Basé country and mapped this region for the first time. Until then, it is said, no white man who had attempted to enter this country had ever returned. In 1884 the same party succeeded, where Burton, Speke and others had failed, in crossing the Horn of Africa and reaching the Webbe Sinbeli River. Here again uncharted lands were traversed; parts of Somaliland, including Wal-Wal, were then mapped for the first time. Observations on the natural history and natives of the country were noted in Aylmer's diaries, it is stated by Sir Alfred Pease in a communication to *The Times* of January 1; but unfortunately these have never been published.

WE regret to announce the following deaths:

Prof. J. A. MacWilliam, F.R.S., emeritus professor of physiology in the University of Aberdeen, on January 13, aged seventy-nine years.

Dr. R. J. Tillyard, F.R.S., formerly chief Commonwealth entomologist in Australia, on January 13, aged fifty-five years.

Dr. T. B. Wagner, consulting chemist on foods and chemical engineer, president of the American Institute of Chemical Engineers in 1913, and vice-president of the Society of Chemical Industry (London) in 1908, on November 12, aged sixty-seven years.

Dr. Theodor Wiegand, president of the Archaeological Institute of Berlin and director of excavations at Pergamon, aged seventy-two years.

## News and Views

### International Congress of Genetics and the U.S.S.R.

THE next International Congress of Genetics was to have been held at Moscow in August next, the preparations for it being in the hands of Russian geneticists. A wireless message from Moscow to the *New York Times*, which was published in *Science* of December 18, stated that the Congress had been cancelled by the Soviet Government; that genetics had been attacked as of no practical value by T. D. Lysenko, who is known for his work in the vernalization of wheat and other crops; that Prof. N. I. Vavilov, the distinguished head of the plant-breeding services in the U.S.S.R., had been arrested; and that Prof. S. G. Levit, who is director of the Maxim Gorky Medico-Genetical Institute and was general secretary of the Organization Committee for the International Congress of Genetics, had been heavily attacked in the Communist party press for allowing a member of his staff to publish a paper in which it is concluded that the Buryats of Siberia have a mental age of

twelve years. Prof. Vavilov has since sent to the *New York Times* a message, a copy of which has been sent to us by the Soviet Union Year Book Press Service, denying the story of his arrest and pointing out the large growth which has taken place in the Institute of Plant Breeding under his direction during the Soviet regime. According to a report circulated by Science Service, of Washington, D.C., Prof. H. B. Ward, permanent secretary of the American Association, has received a message from the U.S.S.R. indicating that the Congress of Genetics has been postponed but not cancelled. As the titles of papers for the Congress were to have been sent in soon, it is clear that a more definite announcement regarding the postponement is desirable, since many geneticists were already making arrangements to attend. These Congresses have been held every five years, the last being at Ithaca, New York, in 1932. No adequate grounds for a postponement have yet appeared.



## Prof. N. I. Vavilov

PROF. N. I. VAVILOV, whose work is mentioned above, was a pupil of Bateson at the John Innes Horticultural Institution, London, in 1913 and 1914. Profiting by the unexampled opportunities afforded by the Soviet Government, he began in 1919 to study the natural variation of the ancestral species of cultivated plants. His special method was to use the geographical distribution of particular gene variations in determining the centre of their diversity, which he presumed to be the site of their origin. He applied this method to all the principal crop plants, leading expeditions to all parts of the world. This enabled him to infer the centres of origin of these plants. The most interesting example of this method concerns the wheats. The cultivated forms were already known to fall into two inter-sterile groups, the tetraploids like *T. durum*, *T. turgidum*, *T. polonicum*, and the hexaploids like *T. vulgare* and *T. compactum*. Vavilov found that the hexaploids had arisen from a Central Asiatic centre, while the tetraploids had arisen from an entirely different centre in North Africa, hence the association of the two groups of wheat with different lines of human cultural development.

THE precise value of Prof. Vavilov's methods and the importance of his "Law of Homologous Series in Variation", and his principles of regional selection, are only beginning to be appreciated, but his published work undoubtedly represents the most important systematic attempt to study natural variation in plants since De Candolle and Darwin. Since 1921, Vavilov has been director of the Institute of Plant Industry. Under his control, this organization has come to embrace stations distributed all over the Soviet Union. Vavilov has used his centralized authority to secure a co-ordination of genetics, cytology, physiology and taxonomy, in which more than two thousand trained workers are engaged in problems of the efficient utilization of plants in the national economy. The work of acclimatization and hybridization carried out by the Institute bears witness to the success of his work, a success which is due to the combination of an enlightened method of inquiry with an industry, enthusiasm and organizing capacity suited to the heavy responsibilities given him by the Soviet Government.

## International Geological Congress, 1937

IN spite of the difficulties which the International Congress of Genetics appears to be meeting, Soviet geologists are busy preparing for the eighteenth International Geological Congress, of which the opening plenary meeting will be held in Moscow on July 21. The session will close on July 29. Excursions, both prior to and following the Congress, are being arranged for delegates and their families. Pre-Congress tours, beginning on July 1, include the following: (A 1) Karelia and the Kola Peninsula: Pre-Cambrian; igneous complexes; ore deposits; (A 2) Ukraine and Crimea: Pre-Cambrian; Donets Coal Basin; Crimean stratigraphy and tectonics; (A 3) Volga: stratigraphy of the East European

U.S.S.R.; Caspian depression; salt domes; engineering problems; (A 4) Caucasus: stratigraphy; tectonics; igneous activity and ore deposits; (A 5) South Urals, Kazan and Donets Basin: stratigraphy and palaeontology of the western slope of the Urals. The longer August excursions, the first two of which will occupy forty days, are as follows: (C 1) Urals, Caspian, Caucasus: the principal oil deposits of the U.S.S.R.; (C 2) Siberia: Caledonian, Variscan and Alpine tectonics; Palaeozoic and Mesozoic stratigraphy and associated coal and iron deposits; (C 3) Novaya Zembla: stratigraphy and tectonics; Caledonian granites and mineralization; (C 4) Urals: gabbro-peridotite and alkali complexes; mineral deposits of great variety. Full details and conditions of membership are given in the Third Circular, issued by the Organization Committee, copies of which may be obtained from the General Secretary, Moscow 17, Bolshaya Ordynka, 32. All arrangements for travelling, hotel accommodation, etc., are in the hands of Intourist, Ltd., Bush House, Aldwych, London, W.C.2.

## Races in the British Isles

IT is generally considered more or less a fixed point in discussion of the racial history of the British Isles that a fundamental element in the population, which appears at least as early as the long barrow, is of Mediterranean origin. It will, therefore, come as a surprise to many to find that arguments subversive of this view have been put forward recently by Dr. G. B. Morant (*J. Roy. Anthropol. Inst.*, 66, Pt. 1) in an analysis of the material upon which Dr. Cecil P. Martin based his study of the racial composition of the Irish people in "Prehistoric Man in Ireland" (London: Macmillan and Co., Ltd., 1935). Dr. Martin's conclusions pointed to a virtual identity of racial history in Ireland and Britain up to the intrusion of the Romans and Saxons in Britain. Ireland, however, on the whole was said to have a larger Iberian element and a smaller Nordic element than Britain. Dr. Morant, after a statistical analysis of the modern Irish material, has arrived at the conclusion that the modern Irish and the British Iron Age population are so similar that they might be samples from the same material, while the latter bear the same relation to the population of the White-chapel plague pit of the seventeenth century. The Anglo-Saxon is slightly removed; but the modern English and the modern Irish might well be considered variants of one race.

ON this argument, it would, therefore, appear that the Iron Age population absorbed the Anglo-Saxon type. Further, this race, with which Dr. Morant would class the British Neolithic, on comparison with Continental types, emerges as essentially Nordic. It is comparable with the prehistoric Scandinavian, the Reihengraber people, the Merovingians of northern France, and the Belgian Franks—all Nordics. Dr. Morant justifies the inclusion of the British Neolithic in this group on the evidence of stature and head-measurement, pointing out that



the extreme length characteristic of the Nordic skull, in which it exceeds any of the dolichocephalic Mediterranean skulls, is also a character of the British neolithic skull. He argues, therefore, that there is no evidence in skeletal remains for the early presence of a Mediterranean element in Neolithic Britain, but that this has been inferred on cultural evidence only. It will be noted that the important character of pigmentation does not enter into the argument; but as has been pointed out on more than one occasion, the argument from pigmentation in the classification of the prehistoric races of Europe rests solely on inference from modern distributions, until in the historic succession we come to the evidence reported in the classical writers.

### Colonial Medical Reports

MAJOR P. GRANVILLE EDGE read a paper before the Royal Statistical Society on January 19 entitled "The Demography of British Colonial Possessions", in which some of the outstanding details to be found in Colonial medical reports were summarized. It was pointed out that the British Colonies comprise upwards of fifty distinct Governments, with territories exceeding an area of two million square miles, of which more than nine-tenths lies wholly within the tropics, inhabited by a bewildering medley of races, religions, languages and customs. The bulk of the people of British tropical Africa are native-born Africans, but in British Malaya the Chinese outnumber the indigenous Malays, and in the British West Indies no traces of the original Carib inhabitants survive, the present population being composed of descendants of African slaves, East Indians, Europeans and other inter-racial mixtures. The Colonial medical reports contain records of population, births, and deaths, so far as these are known, and in addition survey the records of sickness in the Colonies with the view of discovering and removing the predisposing causes of various diseases. The incidence in different parts of the world of such diseases as malaria, helminthiasis, venereal affections, dysentery, sleeping sickness and tuberculosis were discussed by Major Granville, and the difficulties connected therewith commented upon. The public health services, wherever located, may be regarded as fighting organizations engaged in combating insanitary conditions, in raising defences against the invasions of disease, and in attempting to stave off the approaches of death. Without these services detailed sanitary knowledge cannot be acquired, and without such knowledge commercial and other development of the Colonial Empire must be precarious and costly in the face of unrealized menaces to life and health.

### Magnesium Alloys for Aircraft

As the standards of aircraft performance are raised, possible saving of weight is becoming of ever greater importance, so that more and more interest is being taken by aircraft constructors in metals lighter than aluminium. On January 14, Dr. C. H. Desch, superintendent of the Metallurgical Department of

the National Physical Laboratory, discussed, before the Royal Aeronautical Society, recent work on magnesium and other light alloys, much of which has been carried out at the National Physical Laboratory. Magnesium is too weak a metal to be used in the unalloyed state, and the metals which may be added to it to produce strong alloys are limited in number. In fact, taking all the factors into account, only aluminium and cadmium are suitable for alloying in comparatively large quantities, although calcium, cerium, nickel, cobalt and manganese have proved useful in small quantities. To those who have only known magnesium in the form of ribbon or powder for use in flashlights, it is rather surprising to find that magnesium alloys are remarkably easy to cast. This comes about, Dr. Desch said, from the fact that molten magnesium has very little power of dissolving gases, so that magnesium alloys do not suffer from porosity caused by the liberation of gases at the moment of freezing. It is necessary to use a suitable flux and a protective atmosphere during pouring. These conditions are now well understood, and no difficulties are experienced in the foundry. In annealing processes similar protection is necessary, and the special technique adopted has resulted in making a magnesium alloy foundry a remarkably clean and inoffensive place. Exhaustive search at the National Physical Laboratory for magnesium alloys capable of age-hardening has suggested that those containing silver are the most promising. The fact that silver is relatively costly is of little importance, since in the articles of the type produced the cost of manufacture is much greater than that of the material used.

### Afforestation in the Lake District

AN interesting pamphlet has been issued by the Forestry Commissioners entitled "Afforestation in the Lake District" (London: H.M. Stationery Office, 1936). The pamphlet embodies the report by the Joint Informal Committee of the Forestry Commission and the Council for the Preservation of Rural England which was set up early in 1935. The Committee commenced its task with the recognition that large-scale afforestation and the preservation of areas of typical natural beauty are both necessary on national grounds, and that the land available for both purposes is limited. This does not entirely represent the actual position of affairs. For the public in some cases in the past have not only been against new afforestation work, but also have de-claimed at old woods, such as are to be found in some of the enclosures in the New Forest, for example, being touched; in spite of the fact that it is evident that the old trees cannot last for ever. Towards the end of 1935, the Commissioners acquired an estate of 7,000 acres in the valley of the River Esk and the adjacent valley of Duddon, and prepared to plant. Objections were made by the public to the planting of conifers in the two valleys, especially in Upper Eskdale. It was agreed that some 440 acres of plantation land in Upper Eskdale should be omitted from the planting scheme, the Commissioners



undertaking to pay special attention to amenity in afforesting the remainder of the plantable ground. The total area of the estate which will be ultimately planted is less than 2,000 acres of the 7,000 acres purchased. It has become evident that afforestation in the Lake District offers considerable difficulties, as a countryside can be completely changed by stretches of woods, and especially coniferous woods. With this object in view, the Joint Committee has recommended that a central block of some three hundred square miles in extent should be excluded from afforestation work.

### British Films and the Cinema

THE Committee appointed by the Board of Trade to consider the position of British films in view of the approaching expiry of the Cinematograph Films Act, 1927, has now issued its report (Cmd. 5320. London: H.M. Stationery Office. 9d. net). It finds that in some important respects the situation is still the same as in 1926. The much greater home market available for United States films, which is represented by some 11,500 picture-houses and a seating capacity of about 10,000,000, as against 4,300 cinemas in Britain and a seating capacity, including that of the Dominions, of less than 6,000,000, offers a security encouraging a flow of capital to the American industry which finds no parallel here. The United States accordingly occupies a commanding position, contributing all but 25 per cent of the films shown in Great Britain, and the Committee was unanimous in its decision that the quota system should be continued and the quotas, under certain conditions, increased. The detailed proposals of the report are accordingly designed to deal with admitted flaws in the present system rather than to modify its principles. A quality test is proposed to restrict the deplorable output of bad films made simply to satisfy quota requirements. An increase in the penalty for blind booking, which is to apply to renters and not to exhibitors, removal of restrictions on advance booking but prohibition of block booking, and the application of the quota system to short as well as to long films are among other recommendations of the Committee. It is suggested that long and short films should be judged by different standards, and stress is laid upon the value of the short film as an opportunity of experimenting with new ideas within reasonably safe financial limits. The ultimate aim of the measures proposed is to reach a quota of fifty per cent in the next ten years, and to give effect to its recommendations and administer the provisions of the new legislation required, the report recommends the constitution of a Film Commission of members entirely independent of any professional or financial interest in the industry.

### Architectural Lighting

A PAPER by R. O. Sutherland published in *Light and Lighting* of December gives a history of the progress made in architectural lighting during the last ten years. He states that this kind of lighting

received great inspiration from the French Colonial Exhibition in 1925. As a result of the illumination shown at this festival, ornamental features in the form of tiles and richly decorated panels in moulded glass were popularized in buildings, especially those used for catering and entertainment purposes. The floral character of this lighting soon gave way to a more restrained treatment. Plain sheet opal glazing was largely substituted for moulded glass. This made it economical to have large areas of lighted panels. Once the idea of converting an architectural element into a lighting feature was established, it rapidly became a typical method of architectural lighting technique. A photograph of the lighting of the Egyptian Hall in the London Mansion House, and of the lighting in the library of the University of Cambridge, show how the architectural treatment is emphasized in a simple and dignified way by the illumination. To Londoners and visitors to London the lighting of some of the escalators on the underground railways is of interest. The barrel ceiling is lighted from standards placed at 8-foot intervals, each containing a 100-watt lamp in a suitable reflector. The illumination is ample for the needs of the traveller, and is sufficient for the vault sides to be used as advertisement space. In the lighting of the gallery of the Shakespeare Theatre at Stratford-on-Avon, the acoustic panels at the back of the auditorium are also utilized as light reflectors.

### Timber for Wood-Turning

AN interesting, and, from the point of view of encouraging small local industries in the countryside, practical report has been issued by the Forestry Commission (H.M. Stationery Office, 1936), entitled "On the Demand for Timber in Wood-Turning in Great Britain". The investigation was carried out in 1935, when 438 firms were visited, all but 14.8 per cent being wood-turners. The information upon which the report is based comes therefore from 373 firms ranging from single-handed turners who have one room or a small shed fitted up as a workshop, to mass-production factories with a hundred or more automatic or semi-automatic machines. Some of these latter specialize in the production of a single commodity, such as heels for shoes, legs for chairs, bobbins for textile mills, rollers for mangles, the manufacture of tool handles, or bungs for beer-casks; others are general turners, fabricating a wide variety of products. The majority of the firms are turners only. The last census returned 56,930 persons, including pattern makers (the latter being chiefly of wood), as employed in the United Kingdom in wood-turning. It is difficult to obtain figures of the actual consumption of wood in this industry; but, from information supplied, approximately two hundred firms are using 6,000,000 cubic feet of timber in wood-turning annually, of which about 53 per cent is home-grown and 47 per cent imported.

### Agricultural Meteorology

MR. J. W. HOPKINS has recently published a paper, entitled "Agricultural Meteorology: Some



Characteristics of Precipitation in Saskatchewan and Alberta", in which it is apparent that the author's investigations and their results may have a wider application than the merely agricultural (*Canadian J. Res.*, 14, No. 9, Sept. 1936). In previous agricultural meteorological investigations, Mr. Hopkins demonstrated statistically significant correlations between annual variations in rainfall and temperature, and the yield and nitrogen content of wheat crops grown in central and southern Saskatchewan and Alberta. In the present paper, the author gives the results of a study complementary to the previous one, dealing with some average characteristics of the seasonal precipitation in these districts, and also analysing the fluctuations which past experience has shown to occur from year to year in the precipitation at a given place, and from place to place in the same district during a given year. The investigations appear to be based on observations carried on between 1898 and 1934, the stations being Edmonton, Calgary, Battleford and Swift Current. "In spite of irregularities, to be expected in the limited sample of years available," says the author, "the frequency of distribution of seasonal precipitation at the stations showed no gross asymmetry, seasons with precipitation in the vicinity of the average being on the whole more numerous." The average (1916-32) percentage of days on which rain fell showed a distinct seasonal trend during spring and summer, being lowest in April and highest in June. Similar variation was noted in the average amount of rain per rainy day, which was lowest in April and highest in June and July. It would be of interest if in future observations some data could be collected on the subject of the possible influence of the forests on the atmospherical moisture content in these regions.

#### Plant Pathology in Devon and Cornwall

THE twelfth annual report of the Department of Plant Pathology at the Seale-Hayne Agricultural College, Newton Abbott, Devon, considers the pests and diseases of plants from an essentially local aspect, which should be much appreciated by growers in Devon and Cornwall. Mr. L. N. Staniland, the advisory entomologist, contributes a general section upon the more common pests of farm and garden. He has made a special study of eelworm troubles. Methods of combating this pest are discussed at considerable length, and a thorough reevaluation of the usual hot-water treatment has been made. It has been found that although eelworms are killed by seventeen minutes exposure to a temperature of 110° F., the technique of commercial treatment varies greatly. The usual period of three hours heating is shown to be inadequate in some cases, and various recommendations as to improved methods are made. Mr. A. Beaumont, the advisory mycologist, has made a further detailed study of the relation of potato blight to the weather of Devon, and has separate articles on "Tulip Fire and the Weather", "Snapdragon Rust; Trials of Resistant Varieties", and "Apple and Pear Fruit-rotting Fungi".

#### Vital Statistics for England and Wales for 1934

THE text volume of the Registrar-General's Statistical Review of England and Wales for 1934, recently issued, contains the official commentary on the two volumes of vital statistics already published (London: H.M. Stationery Office. 3s. 6d. net). The report deals with the statistics of births, deaths and marriages registered in 1934, estimates of population, and other matters. The estimated population of England and Wales in the middle of 1934 was 40,467,000 persons, of whom 19,412,000 were males and 21,055,000 females. The total is 117,000, or 0.29 per cent greater than the estimate for the previous year, and 515,000 or 1.3 per cent greater than the population at the census of 1931. The average ages of the estimated population, which are gradually increasing, are 32.4 years for males and 34.2 for females. In addition to reviewing the mortality from various causes, the report also contains several studies of mortality. One of these deals with the handicaps suffered by the winter-born compared with the summer-born child, and another with the mortality rate from pregnancy and child-bearing for the wives of men in various social groups.

#### Fall in French Birth-Rate

THE annual number of births in France reached its maximum towards the end of the Second Empire, when it was so high as 1,034,000 in 1868. In 1934 it had fallen to 677,000 and in 1935 to about 650,000, of which nearly 50,000 were the children of foreigners. The birth-rate has therefore diminished by 384,000 or nearly a third, although the population has increased since 1868 by three million immigrants or naturalized persons, which has resulted in increasing the population from 38 to 48 million inhabitants. During the period 1900-35, the birth-rate has decreased by nearly 100,000. The number of births per marriage has decreased even more rapidly. In 1800 the average number of births in France was 4.5 per marriage, at the end of last century it was 3, and to-day only 2.2, or a diminution of about fifty per cent.

#### The Value of Experiments on Animals

THE autumn issue of the *Fight against Disease* (24, No. 4), the quarterly journal of the Research Defence Society, contains extracts from the evidence given by Lord Justice Fletcher Moulton before the Royal Commission on Vivisection, 1906-8. The considered opinion of Lord Moulton, whose scientific knowledge and clarity of thought must have materially assisted the Commission in forming an opinion upon the anti-vivisection controversy, should help those who have to address meetings on the question, or have to deal with anti-vivisection propaganda.

#### Physics in Industry

AT the meeting at the end of October commemorating the fifth anniversary of the founding of the American Institute of Physics, the replies of fifty leading industrial physicists to the question: what



training is best for the scientific worker who wishes to enter industry, were summarized by Dr. Oplin, director of research at Kendall Mills, Boston. His summary has been taken up by Science Service, Washington, D.C., and circulated. His principal conclusions are: "Industries need physicists trained in the fields of optics, magnetism and acoustics", and "too little emphasis is placed on these fields in academic training" as "the best known scientists are working on the problems of cosmic rays, atomic disintegration and transmutation" and "students naturally look up to them for guidance". "Some training in engineering courses is advocated for future industrial physicists. Industry finds it better and easier to use a student trained adequately in physics and have him in the plant attain his additional engineering knowledge than to try to give the engineering student the additional knowledge of physics".

#### R.R.S. *Discovery II* Survey Party

CONSIDERABLE concern was caused by the announcement on January 18 from the commanding officer of the R.R.S. *Discovery II*, that a survey party which had been landed on King George Island, South Shetlands, was missing. Early on the following day, however, the reassuring message was received that the party had been located and had returned to the ship. The Discovery Committee states that the party consisted of: Lieut. R. Walker, R.N.R., chief officer; Dr. J. R. Strong, ship's surgeon; Dr. F. D. Ommanney, scientific officer; Mr. R. G. Gourlay, third engineer; Mr. J. Matheson, boatswain's mate; and Mr. J. Dobson, A.B.

#### Bureau of Human Heredity

ONE activity contemplated in setting up the Bureau for Human Heredity is the organization of information service for research workers in the subject. The value of such a plan has been demonstrated in the information service already established for workers on *Drosophila*, etc. Workers are requested to address to the Bureau a short paragraph describing the work on which they are engaged. These notices will be multiplied and circulated to all those co-operating. In the first instance, this bulletin will be issued every twelve months. Later supplementary bulletins will be issued more frequently. Those using this service are asked to subscribe 5s. Communications should be addressed to the Hon. General Secretary, Bureau of Human Heredity, 115 Gower Street, London, W.C.1.

#### Federal Council on Scientific Management

AN important step forward in the co-ordination of the varied activities of the many societies connected in some way or other with the several phases of scientific management was taken on January 12, when a British Management Council was formed. After the highly successful sixth International Congress for Scientific Management, held in London during July 1935, a committee was set up under the chairmanship of Dr. E. F. Armstrong both to take

all necessary action to ensure the proper representation of Great Britain at the next Congress, to take place in the United States in 1938, and to examine the factors involved in the formation of a national scientific management organization. A scheme of federation has been produced by this committee, and after discussion has met with provisional acceptance from the greater number of the associations concerned, numbering some thirty in all. The objects of the new Federal Council are: "To ascertain and represent both nationally and internationally the views of those bodies concerned in Management in Great Britain, and in particular as its immediate object to enter into relations and to co-operate with similar bodies in other countries, and to act as the representative of its Constituent Members in International Congresses and other activities concerned with Management." Lord Leverhulme has been elected as its first chairman, Dr. E. F. Armstrong as vice-chairman, Mr. G. R. Freeman as treasurer, and Mr. U. Baliol Scott as secretary. The new body is assured of the support and co-operation of the Federation of British Industries. It has an important function to fill and may be expected in time to exert a pronounced influence on the development of the functional management movement in Great Britain.

#### Botanical Society of America

AT its thirty-first annual meeting at Atlantic City, New Jersey on December 20-31, the Botanical Society of America elected the following botanists to be corresponding members: Dr. N. I. Vavilov, director of the State Institute for Experimental Agronomy, Leningrad; Dr. Agnes Arber, sometime fellow of Newnham College, Cambridge; and Dr. Lorenzo R. Parodi, professor of botany in the University of Buenos Aires. The following officers of the Society for 1937 were also elected: *President*, Prof. Edmund W. Sinnott, Barnard College, Columbia University, New York City; *Vice-President*, Prof. Loren C. Petry, Cornell University, Ithaca, N.Y.; *Secretary*, Prof. George S. Avery, jun., Connecticut College, New London, Conn.; *Treasurer*, Dr. F. E. Denny, Boyce Thompson Institute for Plant Research, Yonkers, N.Y. A new Section for Paleobotany was also organized with the following officers: *Chairman*, Prof. A. C. Noé, University of Chicago; *Secretary*, W. C. Darrah, Harvard University.

#### International Congress of Agriculture

THE seventeenth International Congress of Agriculture will be held at The Hague on June 16-23, 1937, under the patronage of the Queen of the Netherlands. The work of the Congress is divided among eight sections. Three are economic in character, and at The Hague will discuss the means which have been taken to deal with the depression in the agriculture of the Netherlands, the organization of the world butter market, the provision of credit to agriculture, the relation between State planning and agricultural co-operation, the effect on agriculture of the development of artificial wools, cottons and other products. Sections dealing with the technical and



scientific aspects of agriculture will discuss the vernalization of crops, a limitation in the varieties of plants in cultivation and the protection of producers of selected seeds, artificial fertilization in the improvement of livestock, animal nutrition and other subjects. Social and educational questions will include the teaching of agricultural economics, broadcasting in the service of agriculture and health and hygiene in the rural home, a subject to which the National Federation of Women's Institutes (England) will make the principal contribution. Further particulars may be obtained from the Secretary, British Corresponding Committee, International Congress of Agriculture, 10 Doughty Street, London, W.C.1.

#### An International Exhibition of Photography

UNDER the chairmanship of Gustave Fassin, of the Bausch and Lomb Scientific Bureau, Rochester, New York, a committee has been appointed to secure and arrange exhibits for the International Exhibition of Applied and Scientific Photography to be held in the Rundell Memorial Building at Rochester, New York, in March, under the auspices of the local section of the Photographic Society of America. This new and beautiful civic building has exceptional facilities for showing both pictures and apparatus. Men of science working in any of the following fields are invited to send exhibits to the Secretary, Mr. C. B. Neblette, Rochester Athenæum and Mechanics Institute, Rochester, New York: astronomy, meteorology, light-sensitive substances; photomicrography, microphotography, metallography; X-ray spectrography; cosmic ray photography and theoretical physics; press photography; high-speed photography; technique of colour photography; photography by invisible radiation; aerial photography.

#### Awards of the Geological Society

THE Geological Society has made the following awards: Wollaston Medal to Prof. Waldemar Lindgren of the Massachusetts Institute of Technology, for his researches concerning the mineral structure of the earth, and especially concerning the problems of mesasomatism, contact ore deposits and the application of physical chemistry to ore deposition; Murchison Medal to Dr. L. J. Spencer, in recognition of the value of his original contributions to mineralogical science and of his services to the publication of mineralogical literature; Lyell Medal to Mr. L. Richardson, for his contributions to the geology of the Jurassic rocks of Great Britain; Bigsby Medal to Prof. C. E. Tilley, in recognition of the value of his researches in petrological science, especially in the petrology of the metamorphic rocks; Wollaston Fund to Dr. D. Parkinson; Murchison Fund to Mr. S. H. Straw; a moiety of the Lyell Fund to Mr. J. F. Jackson; another moiety of the Lyell Fund to Miss M. E. Tomlinson.

#### Announcements

DR. E. J. BUTLER, secretary of the Agricultural Research Council; Dr. J. B. Conant, president of Harvard University; and Lord Hailey, director of

the African Research Survey, have been elected members of the Athenæum under the provisions of Rule II of the Club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

MR. J. RAMSBOTTOM, keeper of botany at the British Museum (Natural History), and a secretary to the Linnean Society of London, who is known for his mycological researches, has been elected an honorary member of the Quekett Microscopical Club.

MR. RICHMOND T. ZOCK, of the U.S. Weather Bureau, has been elected a foreign member of the Royal Meteorological Society.

THE annual general meeting of the Association of Technical Institutions will be held in the Carpenters' Hall, Throgmorton Avenue, London, E.C.2, on February 26-27. On February 26, at 10.45 a.m., the incoming president, the Right Hon. Lord Kennet, will deliver the presidential address. Further information can be obtained from Dr. H. Schofield, Loughborough College, Loughborough, Leicestershire.

THE fourth International Grassland Congress will be held in Great Britain under the presidency of Prof. R. G. Stapledon on July 8-23. The Congress will meet first at Oxford and will then proceed to various places of topical interest including Leicester, Birmingham, Cirencester, Hereford, Aberystwyth, Newcastle and Edinburgh. Further information can be obtained from the Joint Secretaries, Agricultural Buildings, Aberystwyth.

THE Associated Grocery Manufacturers Association of America at the annual banquet on December 1 presented Dr. George R. Minot of Boston with the annual award for research in the field of health leading to the prevention of disease and the advancement of health. The presentation address was made by Dr. Morris Fishbein, editor of the *Journal of the American Medical Association*.

DR. JOHN HOWARD NORTHROP, of the Rockefeller Institute for Medical Research, Princeton, N.J., has been awarded the Charles Frederick Chandler Medal of Columbia University in recognition of his fundamental discoveries concerning bacteria, the constitution of protein and the chemistry of digestion. The medal was founded in 1910 in honour of Prof. Chandler, who taught at Columbia University and was a pioneer in industrial chemistry.

DR. DAVIDE GIORDANO, president of the Italian Society of the History of Medicine and Natural Sciences; Dr. Bernhard Peyer, professor of palæontology at Zurich; and Dr. Brouwer, professor of neuropathology at Amsterdam, have been elected members of the Leopold Caroline German Academy of Natural Philosophy at Halle.



## Letters to the Editor

*The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 157.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

### Exchange of Phosphorus Atoms in Plants and Seeds

IN a letter to NATURE<sup>1</sup> we communicated the results of experiments carried out on maize plants using radioactive phosphorus as an indicator of the behaviour of the phosphorus atoms. The results obtained showed unambiguously that the greater part of the phosphorus atoms present in the leaves and in the roots of the plants investigated is not permanently in one place, but migrates from leaf to leaf. We extended the experiments described above and investigated the behaviour of phosphorus in the sunflower.

The plant was first grown in an ordinary nutritive solution until a set of leaves, which we will call 'lower leaves', appeared. We then placed the plant in a second nutritive solution in which the phosphorus atoms were replaced by 'labelled' phosphorus atoms (mixed with radioactive phosphorus atoms). The second set of leaves, which we will denote as 'upper leaves', were grown in this solution and contained accordingly labelled ('radioactive') phosphorus atoms. For the sake of simplicity we will assume that the 'lower' leaves did not grow further in the second solution but retained their original size; then we must distinguish between two extreme cases: (a) the phosphorus atoms do not migrate; (b) the phosphorus atoms migrate. In case (a) labelled phosphorus atoms should only be found in the upper leaves; in case (b) the labelled phosphorus atoms should be equally distributed between the upper and lower leaves.

TABLE 1.

Time in days	Part of the plant	Total P (mgm.)	Labelled P (per cent)	Unlabelled P (mgm.)
0	Lower leaf	0.980	0	0.980
	Upper leaf			
	Stem			
4	Lower leaf	0.848	43.6	0.478
	Upper leaf	0.840	51.5	0.407
	Stem	0.361	63.7	0.131
9	Lower leaf	0.742	66.9	0.246
	Upper leaf	2.838	65.6	0.976
	Stem	0.844	85.6	0.122

As is seen from Table 1, the lower leaves contain an appreciable amount of labelled phosphorus atoms, clearly showing that in the case of the sunflower, just as in that of the maize plant, a very considerable migration of the phosphorus atoms takes place, and the probability of a labelled phosphorus atom being found in a preformed leaf is not very different from the probability of its being found in a leaf grown in a labelled solution. In comparing the figure obtained for the lower and upper leaves, we have to take into account the fact that the lower leaves increase in size to some extent while the plant is in the labelled solution; however, this increase was found to be

very slight, as to be seen from the third vertical column of Table 1 and also from Fig. 1, which illustrates the plant at the three different stages of its growth.

From the above, it follows that the greater part of the phosphorus atoms are not fixed in position in the leaves but can migrate. The bulk of the phosphorus atoms found in plants are presumably present as inorganic phosphate, and carried about with the circulation stream in the plant. To what extent the phosphorus atoms present in organic combination are permanently localized is under investigation.

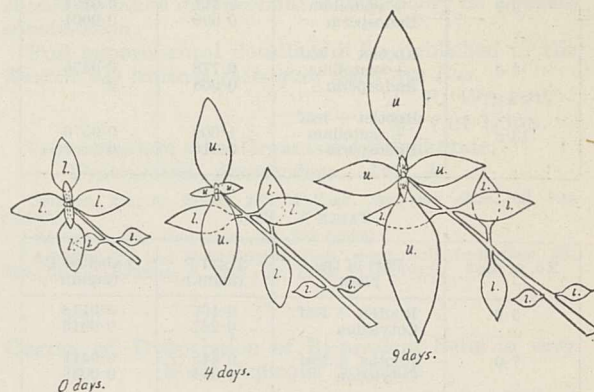


Fig. 1.

In connexion with the experiments discussed above, we tried to ascertain if any exchange of phosphorus atoms takes place between an isolated leaf and a nutritive solution. These experiments were carried out with the leaves of a sunflower grown in labelled nutritive solutions. Some of the leaves were ignited and analysed at once after separating them from the stem, while other leaves were placed for 48 hours in a nutritive solution containing unlabelled phosphorus to give a chance for exchange to occur between the labelled phosphorus in the leaf and the normal phosphorus in the solution. No labelled phosphorus could, however, be found in the nutritive solution.

In another set of experiments we placed cut leaves of sunflowers, grown in a normal nutritive solution, in labelled solution for 48 hours; in all the cases investigated an uptake of a few per cent of the labelled phosphorus atoms into the cut leaf was found. As was to be expected, a cut leaf takes up not only the solvent but also the solute from the solution in which it has been immersed.

Finally, we would like to mention some experiments carried out with seeds. Two different series of experiments were carried out, one with maize seeds, the other with those of the pea. In both cases



the seeds were germinated until rootlets 2-3 cm. long were formed. Then the seeds were placed in small flasks with the rootlets dipping into a nutritive solution containing labelled phosphorus. In the case of the maize seeds (Table 2) the germ and endosperm were removed after the lapse of 4-14 days and analysed separately. While the germ was found to contain an appreciable amount of labelled phosphorus taken up from the nutritive solution, the endosperm did not contain the slightest trace; this shows that no exchange takes place between the phosphorus atoms of the germ and the endosperm. In the case of the pea, there is no such marked distinction between germ and endosperm, the cotyledons occupying most of the space inside the seed, so that the labelled phosphorus atoms are taken up by the different parts of the seed. The concentration of the labelled phosphorus in the leaves and rootlets was here considerably higher than in the rest of the seed (cotyledons), as is seen from Table 3.

TABLE 2. MAIZE.

No. of days	Part of the plant	Total P (mgm.)	Labelled P (mgm.)
3.9	Rootlet + leaf + scutellum	0.511	0.0134
	Endosperm	0.098	0.0001
7.0	Rootlet + leaf + scutellum	0.778	0.0275
	Endosperm	0.068	0
13.8	Rootlet + leaf + scutellum	1.008	0.0576
	Endosperm	0.016	0

TABLE 3. PEA.

No. of days	Part of the plant	Total P (mgm.)	Labelled P (mgm.)
3.9	Rootlet + leaf	0.167	0.0118
	Cotyledon	0.281	0.0013
7.0	Rootlet + leaf	0.445	0.0411
	Cotyledon	0.314	0.0033
13.8	Rootlet + leaf	0.481	0.0508
	Cotyledon	0.151	0.0050

We wish to express our thanks to Prof. Niels Bohr and Prof. S. P. L. Sørensen for the kind interest taken in this work, and to Miss Hilde Levi for her assistance in the counting experiments.

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Nov. 24

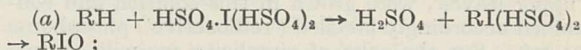
<sup>1</sup> NATURE, 137, 66 (1936).

### Organic and Inorganic Chemistry of Iodine Oxides

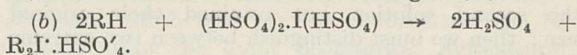
IN comparing multivalent iodine with multivalent nitrogen, I was led in 1933 to try the action of iodic acid upon aromatic compounds; an unexpected result was found, namely, the copious formation of iodonium salts. The existing knowledge of these proving to be inadequate, a long digression was necessary in which we were able to clear up the main chemistry of iodoxy-compounds and to discover (*inter alia*) that iodine can form compounds in which it recalls 'quinquevalent' arsenic as this is

seen in arsenic and arsonic acids; some of the ways in which iodonium salts are derived from iodoxy- and iodoso-compounds were elucidated<sup>1</sup>. Mr. Race and I then reverted to the initial reaction, which takes place in sulphuric acid media of hydration less than  $\text{H}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ ; from iodic acid and chlorobenzene, for example, one obtains in a single operation an 80 per cent yield of the *para*-iodonium derivative. Benzene similarly yields diphenyl-iodonium salts, and its derivatives with *o*-*p*-directing substituents (provided that these are not too highly activating) react in the same way; while *meta*-directing substituents like the nitro-group prevent the reaction. Particulars of this work will be published.

It appeared, however, that despite the high yields, the action of iodic acid was a secondary one, and that it ensued upon a prior reduction of the iodic acid at the expense of some of the organic reagent. In following this up, I find that if one starts with iodine sesquioxide (in the form of Chrétien's sulphate  $\text{I}_2\text{O}_3 \cdot \text{SO}_3 \cdot \frac{1}{2}\text{H}_2\text{O}$ ) instead of iodic acid, in a suitable sulphuric acid medium, the yields of iodonium salts from chlorobenzene become quantitative; and the reaction is very smooth. Further, iodine sesquioxide turns out to be an interesting reagent for effecting, very easily, two new aromatic substitutions. With benzene and its *o*-*p*-directing derivatives, one gets *para*-iodonium salts; with the other type, such as nitrobenzene or benzene sulphonic acid, one gets a direct introduction of the iodoso-group. The orientation of this is *meta*. Thus, for convenience regarding the inorganic reagent as virtually the hydrogen sulphate of trivalent iodine:

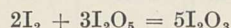


or, with the less inactive aromatic reagents,



The need to prepare iodine sesquioxide (as its sulphate) has caused me to study anew the inorganic chemistry of the lower oxides of iodine; for the method hitherto used, ultimately derived from Millon, is confused in theory and inconvenient in practice. It consists of heating iodic acid in strong sulphuric acid until iodine boils off along with oxygen, and then awaiting the very slow deposition of a small yield of the desired solid. Some of the main facts disclosed by the present experiments may be presented.

The reaction



is a reversible equilibrium; it is displaced towards the left by heat, and wholly (but not instantly) to the left by water, as this converts  $\text{I}_2\text{O}_5$  into the stable iodate anion; it is displaced to the right by an acid strong enough to convert  $\text{I}_2\text{O}_3$  into a salt (the cationic nature of trivalent iodine has been plainly indicated by Fichter<sup>2</sup> and others). Thus the sulphate can be got in quantitative yield from iodine and its pentoxide by merely shaking these in cold concentrated sulphuric acid in the proportions stated in the equation. This synthesis goes through an interesting stage; the two reagents, neither of them significantly soluble alone, rapidly dissolve in forming a very deep brown solute which is not iodine but is a compound of a suboxide; the present evidence suggests that it is the sulphate of a radical  $\text{I}_3^+$ . This then slowly attacks more dissolved pentoxide, the action being slightly reversible but driven towards completion by the insolubility of the product, the pure yellow



sulphate of  $I_2O_3$ . The dark solute is still being studied, since if the difficulties in the way of its identification can be overcome, it raises interesting points in the electronic behaviour of the iodine atom. It would clearly be related to  $I_3OH$ , the brown solute discovered in 1862 by Lenssen and Löwenthal and later examined by Skrabal<sup>3</sup>, which is hypoiodous acid coordinated with a molecule of iodine.

The thermal dissociations



can be exactly arrested at the middle stage if one heats iodine pentoxide in fuming (instead of concentrated) sulphuric acid, such acid being strong enough to stabilize trivalent cationic iodine as a soluble sulphate even at 220°. It may also be mentioned that fuming sulphuric acid oxidizes elementary iodine, even without heating, forming intense manganate-green or very deep blue solutions, like that of sulphur sesquioxide, and liberating sulphur dioxide.

As to the other intermediate oxides of iodine,  $IO_2$  and  $I_4O_9$ , there is good reason to agree with Fichter that they are iodous iodates, and their compositions can be generalized as  $I_2O_3 \cdot nI_2O_5$ .

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Dec. 24.

<sup>1</sup> Masson, Race and Pounder, *J. Chem. Soc.*, 1669 (1935).

<sup>2</sup> For example, Fichter and Kappeler, *Z. anorg. Chem.*, **91**, 134 (1915).

<sup>3</sup> Skrabal and Buchta, *Chem. Z.*, **33**, 1184, 1193 (1909).

### Bromination of Halogenobenzenes in the Gaseous Phase; Influence of Temperature and Catalysts on the Substitution Type

IN continuation of preliminary experiments<sup>1</sup>, we have studied the monobromination of bromobenzene, chlorobenzene and fluorobenzene in the gaseous phase at several temperatures between 380° and 500° C., in the presence of artificial graphite as a contact substance, under well-defined conditions of temperature and rate of gas flow. A few typical results are given in Table 1.

TABLE 1.

Temperature	Bromobenzene				Chlorobenzene		Fluorobenzene	
	380°	440°	480°	630°	375°	475°	360°	500°
Percentage <i>ortho</i>	23	26.0	25	18.9	28	20	} Not determined	
Percentage <i>meta</i>	25	47.2	51	59.9	20	53		
Percentage <i>para</i>	52	26.8	24	21.2	52	27		

In these circumstances, the bromination of the halogenobenzenes belongs to the *ortho-para* type (according to the definition of A. F. Holleman<sup>2</sup>) at temperatures below 400°, but to the *meta* type at temperatures above 450°. These results are in disagreement with current theories on benzene substitution.

However, quite different results are obtained when the bromination is carried out with ferric bromide as a catalyst. Within the range 200°–450°, no change of substitution type is observed, but only a gradual change in the relative amounts of isomerides, as is shown in Table 2 for the bromination of bromobenzene:

TABLE 2.

Temperature	Percentage <i>ortho</i>		Percentage <i>meta</i>		Percentage <i>para</i>	
	Found	Calc.	Found	Calc.	Found	Calc.
200°	16.6	17.3	8.0	7.0	75.4	75.7
250°	20.6	20.1	9.6	8.8	69.8	71.1
300°	23.4	22.4	9.8	10.6	66.8	67.0
350°	23.9	24.4	12.3	12.3	63.8	63.3
400°	25.9	26.2	13.4	13.8	60.7	60.0
450°	27.8	27.6	14.2	15.3	57.8	57.1

The theoretical aspect of the influence of the temperature on substitution reactions in the benzene nucleus has been treated by Scheffer<sup>3</sup>. Using his formula, we were able to calculate the relative proportions of isomerides formed: the agreement between calculated and observed figures is excellent.

It follows from our experiments that in the case of typical *ortho-para* directing substituents like fluorine, chlorine and bromine atoms, the nature of the substituent is not the only determining factor for the substitution type; but that the substitution reaction, in this case a bromination, may belong to the *ortho-para* type or to the *meta* type, depending on the temperature at which the reaction is carried out and on the nature of the catalyst. These new facts should be taken into account in any theory on benzene substitution.

Full experimental details will be published in the *Recueil des travaux chimiques des Pays-Bas*.

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Universiteit, Amsterdam. Dec. 4.

<sup>1</sup> Wibaut, Van de Lande, and Wallagh, *Rec. trav. chim.*, **52**, 795 (1933).

<sup>2</sup> Holleman, *Rec. trav. chim.*, **42**, 355 (1923).

<sup>3</sup> Scheffer, F., and Kohnstamm, *Proc. Acad. Sci. Amsterdam*, **13**, 789 (1911); Scheffer, F., *ibid.*, **15**, 1109, 1113 (1913).

### Degree of Dissociation of Bi-bivalent Salts in very Dilute Aqueous Solution

THE measurements carried out by Shedlovsky<sup>1</sup> of the equivalent conductivities of solutions of uni-univalent salts in aqueous solution are in good agreement at high dilution with the theoretical equation developed by Onsager<sup>2</sup>, but such measurements of conductivities of bi-bivalent salts as are available indicate deviations from theory beyond the magnitude of possible errors of experiment. The equivalent conductivity in this case diminishes far more rapidly with rise of concentration than is predicted by Onsager's equation. Attention has been directed to this point by Davies<sup>3</sup>, who calculates dissociation constants for this class of electrolyte. On the other hand, La Mer and collaborators<sup>4</sup> take the view that bi-bivalent electrolytes are completely dissociated in dilute aqueous solution, and support their contention by measurements of activity coefficients of zinc sulphate and cadmium sulphate.

The theory of Onsager has been extended to mixtures of electrolytes by Onsager and Fuoss<sup>5</sup>. According to this treatment of the problem, the mobilities of the cations in a mixed solution, for example, of potassium chloride and hydrochloric acid, are not the same as in solutions containing either of these substances at the same total concentration; and the effect of each cation on the mobility of the other has been calculated. The results have been applied to interpret experimental data for mixed partially dissociated electrolytes in non-aqueous solution by



Mead, Fuoss and Kraus<sup>6</sup>. In a mixed aqueous solution of two completely dissociated electrolytes containing two cations of practically equal mobility and a common anion, this effect should be negligible, and the conductivity of such a mixture should depend only on the mobilities of the ions and on the total concentration. In other words, if the equivalent conductivities of the two electrolytes separately are known over the appropriate range of low concentrations, it should be possible to calculate the conductivity of any mixture of the two, assuming that the conductivities are additive and depend only on the total concentration.

To test this point, I have measured the conductivities at 25° C. of very dilute aqueous solutions over the range 0.00005–0.001 equivalent of calcium and strontium dithionates and the corresponding sulphates, and of their mixtures in which dithionate and sulphate respectively are the common negative ions. The following results appear:

(1) The corresponding calcium and strontium salts have almost the same equivalent conductivity throughout the range of concentrations examined. (2) The graph of the equivalent conductivity plotted against the square root of the equivalent concentration deviates sensibly from a straight line only at the highest concentrations examined. (3) The slope of this line is in all cases much greater than that predicted by Onsager's equation, using values for equivalent conductivity at infinite dilution obtained by linear extrapolation over a range of a few units. (4) For calcium and strontium dithionates the observed slope is 506, the calculated slope 366 and the equivalent conductivity at infinite dilution 152; the corresponding figures for the two sulphates are 646, 354 and 142 respectively. (5) The salts with the higher equivalent conductivity at infinite dilution give the smaller slope, a result at variance with Onsager's equation. (6) The conductivities of all mixtures examined are additive, usually within the probable limits of experimental error, indicating complete dissociation.

It is intended to extend this work as opportunity offers to the selenates of calcium and strontium and to other bi-bivalent salts. The determination of activity coefficients in dilute mixed solutions, if practicable, should yield results interesting in this connexion.

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<sup>1</sup> *J. Amer. Chem. Soc.*, **54**, 1411 (1932).

<sup>2</sup> *Phys. Z.*, **23**, 277 (1927).

<sup>3</sup> *Trans. Faraday Soc.*, **23**, 351 (1927).

<sup>4</sup> *J. Amer. Chem. Soc.*, **53**, 2040 and 4333 (1931).

<sup>5</sup> *J. Phys. Chem.*, **36**, 2639 (1932).

<sup>6</sup> *Trans. Faraday Soc.*, **32**, 594 (1936).

### Surface Temperature of Rubbing Solids and the Formation of the Beilby Layer

RECENT letters<sup>1</sup> have discussed the structure of the Beilby layer, and it may be of interest to describe experiments which throw some light on the mechanism of its formation. Macaulay<sup>2</sup> has suggested that polishing is due to a melting of the surface, but the majority of investigators, Newton<sup>3</sup>, Rayleigh<sup>4</sup>, Herschel<sup>5</sup>, French<sup>6</sup>, Adam<sup>7</sup>, Hamburger<sup>8</sup>, considered that the process is essentially one of abrasion. French embedded a thermometer in the polisher, and concluded that the rise in temperature of the surfaces was negligibly small.

If the sliding contact of two different metals is used as a thermo-couple, the surface temperature can be measured. Experiments show that the local temperatures at the points of contact may be very high; under many conditions of sliding, sufficiently high to cause a real melting of the metal<sup>9</sup>. Even if the surfaces are well lubricated or flooded with water, these local high temperatures still occur. In the case of non-metals of low thermal conductivity such as glass, silk, alumina, etc., the surface temperatures will be very much higher. This localized frictional heating should play a large part in the process of wear, surface flow and polishing of solids. If this view is correct, we should expect the process to be greatly influenced by the *relative melting point* of the polisher and solid. If the polisher melts or softens at a *lower* temperature than the solid, it will melt and flow first, and will have comparatively little effect on the solid. Experiment has shown this to be the case. Surface flow, polish and the formation of the Beilby layer readily occurred on metals, crystals and glasses, provided the melting point of the polisher was higher than that of the solid. The *relative hardness* as normally measured at room temperature was comparatively unimportant.

For example, *camphor* (m.p. 178° C.) readily polished Wood's alloy (m.p. 69° C.) which melts below it, but would not polish higher melting metals such as tin (m.p. 232° C.). *Oxamide* (m.p. 417° C.) polished tin, type metal, etc. and all solids melting below 417° C., but had no effect on speculum metal (m.p. 745° C.). *Lead oxide* (m.p. 888° C.) polished speculum metal, but had no effect on nickel (m.p. 1452° C.) and molybdenum (m.p. 2470° C.). Similar results were obtained for numerous glasses and crystals. Calcite, for example, which melts at 1333° C., was readily polished by *zinc oxide* (m.p. about 1800°) but not by *cuprous oxide* (m.p. 1235° C.) or *oxamide* (m.p. 417° C.). The mechanical strength of many solids falls to a low value at temperatures well below the melting point, so that appreciable surface flow can occur at these lower temperatures. This has been observed in many cases.

The process of polishing is a complicated one, and will be discussed more fully elsewhere. These experiments indicate, however, that an important part of the process is an intense local heating at the points of contact. The melted or softened solid flows, or is smeared, over the surface, and very quickly solidifies to form the characteristic Beilby layer. The extent to which this layer is microcrystalline or 'amorphous' will naturally depend upon the conditions of polishing, rate of cooling, etc., and upon the physical properties of the solid. If oxidizable solids are polished in air, we should expect this local heating to cause rapid surface oxidation. Electron diffraction experiments<sup>10</sup> have shown that the polished layer on copper and aluminium is, in reality, metallic oxide.

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Cambridge. Dec. 12.

<sup>1</sup> Finch, *NATURE*, **133**, 1010; **137**, 516 (1936).

<sup>2</sup> *NATURE*, **118**, 339 (1926).

<sup>3</sup> "Opticks" (Book II), 68 (1704).

<sup>4</sup> "Coll. Works", **4**, 452.

<sup>5</sup> "Encyclopedia Metropolitana", Optics, 447 (1830).

<sup>6</sup> *NATURE*, **119**, 527 (1926).

<sup>7</sup> *NATURE*, **119**, 162, 279 (1926).

<sup>8</sup> *NATURE*, **130**, 435 (1932).

<sup>9</sup> Bowden and Ridler, *Proc. Roy. Soc., A*, **154**, 640 (1936).

<sup>10</sup> Dobrinski, *NATURE*, **138**, 31 (1936). Preston and Bircumshaw, *Phil. Mag.*, **148**, 654 (1936).



Are Viruses Organisms or Autocatalysts?

(1) THE absence of a limiting surface between the material of a virus and its host; (2) the high speed of the transmission of its characteristic symptoms (10-30 cm. per hour) in the tissues of the host; (3) its rapid increase; (4) the vanishingly small quantities needed for inoculation, made me many years ago form the opinion that viruses are more properly regarded as autocatalytic substances than as specific organisms. From 1922 on, I have mentioned the idea in my lectures.

This view is now strikingly supported by Stanley's separation from a virus-infected plant of a crystallizable protein, which, when inoculated into a healthy one, produces the symptoms of the virus disease<sup>1</sup>. From the work of Bawden, Pirie, Bernal and Fankuchen<sup>2</sup>, it further appears that the molecules of this protein are rod-shaped and are built up of sub-units of the same character.

The facts recently emphasized in Dr. John Caldwell's article<sup>3</sup>, namely, that viruses spread most rapidly from growing tissues, where presumably the sub-units of the protoplasmic proteins are in great abundance, and that they travel from cell to cell by way of the plasmodesmata, accord well with the autocatalytic theory. Furthermore, they cannot penetrate through a barrier of dead cells, or through unperforated cell-walls.

No doubt the present workers will test, or have already experimentally tested, the ability of Stanley's protein to catalyse its own production in the extracts from otherwise uninfected cells. It must be remembered that Olitsky has already reported that he has been able to cultivate tobacco mosaic in a simple medium presumably free from cells<sup>4</sup>.

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Dec. 24.

<sup>1</sup> *Phytopathology*, 26, 305 (1936).

<sup>2</sup> *NATURE*, 138, 1051 (Dec. 19, 1936).

<sup>3</sup> *NATURE*, 138, 1065 (Dec. 19, 1936).

<sup>4</sup> *Science*, 60, 593 (1924).

Spontaneous Chromosome Changes in Pollen Grains

IN preparations showing the first post-meiotic mitosis in pollen grains of two genera, *Tradescantia* and *Hyacinthus*, I find evidence of spontaneous structural changes in the chromosomes occurring with a high frequency. Some of these changes are of the kind that can be produced artificially by the action of X-rays on the post-meiotic resting stage. They depend on breaks and rejoins between chromosomes or chromatids, according to whether the changes occur before or after the chromosomes have split (Riley<sup>1</sup>, Mather unpub.). These breaks and rejoins lead to the formation of dicentric chromatids and acentric fragments (those having two or no centromeres or spindle attachment chromomeres respectively<sup>2</sup>). At anaphase and telophase the dicentric chromatids form bridges connecting the two daughter nuclei, while the fragments lie passively on the equator.

I have found bridges of this kind in *T. virginiana* ( $2n = 18 = 3x$ ) (Fig. 1a). One or more bridges may be present together with a corresponding number of fragments, although these are occasionally not

visible. The free arms of the bridges may be equal (Fig. 1a) or unequal, showing that at least in some cases non-homologous chromatids have joined up. The difference of size between the chromosomes in this species, however, is slight, so that they are not individually recognizable. Cells containing these bridges often occur in groups of two or three, although the aggregate number of changes observed is only of the order of ten or twelve in each flower. The original frequency of change must be greater than this, since the results can be readily detected only at anaphase, and a small proportion of nuclei only are undergoing mitosis at any one time.

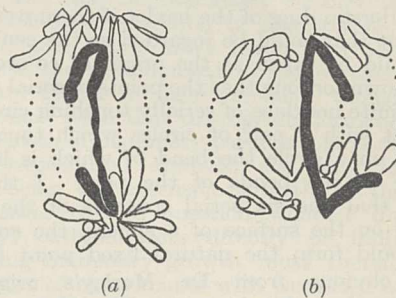


Fig. 1.

ANAPHASE OF POLLEN GRAIN DIVISION IN UNTREATED MATERIAL OF (a) *Tradescantia virginiana* ( $3x = 18$ ) AND (b) *Hyacinthus orientalis* VAR. "WILLIAM MANSFIELD" ( $2x = 16$ ). EACH CELL CONTAINS A DICENTRIC CHROMATID FORMING A BRIDGE. NO FRAGMENT IS VISIBLE.  $\times 1600$ .

In *Hyacinthus orientalis* variety "William Mansfield" ( $2n = 16 = 2x$ ) (Fig. 1b), similar bridges occur with a somewhat lower frequency, but acentric fragments have not usually been seen with them. The bridge is always formed from one of the long chromosomes, and its free arms are always equal. The separation of the remaining chromosomes is normal and there is no evidence of non-disjunction. In such cases, therefore, one of the chromatids of the bridge chromosome must have joined up with its sister, as may also happen with induced changes (Husted<sup>3</sup>). Since fragments are rarely seen, and since the bridge appears to be approximately equal in length to the sum of the free arms (all the long chromosomes have median centromeres), it is presumably the ends that have joined. This conflicts with previous inferences of the inability of chromosome ends to fuse<sup>2</sup>.

These structures cannot be the result of crossing-over in inversions at meiosis, since one and not two sister chromatids form the bridge, and further, in the case of the diploid, the normal complement of chromosomes excludes the possibility of non-disjunction. They are therefore the result of spontaneous changes, and changes which differ in both character and frequency from those hitherto inferred.

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Dec. 17.

<sup>1</sup> Riley, H. P., *Cytologia*, 7, 131 (1936).

<sup>2</sup> Darlington, C. D., "Recent Advances in Cytology" (2nd ed., London, 1937).

<sup>3</sup> Husted, L., *Genetics*, 21, 537 (1936).



## The Hexlet

DR. FRANK MORLEY has given in NATURE of January 9, p. 72, a very elegant proof of my hexlet theorem which incidentally has enabled me to solve, almost at sight, a further problem on which I had been spending fruitless months. He derives the hexlet with its attendant trio in general from a very simple assemblage, by inversion, namely, from a central sphere surrounded by a ring of six equal spheres between two parallel planes, or spheres of zero bend. The latter invert into two of the spheres of the trio, the central sphere being the third.

To the engineering type of mind at any rate, if not the mathematical, it would be a help to the better understanding of the hexlet if there were some fixed point that could be regarded as the centre and which could be taken as the origin of co-ordinates. I have known for long that the points of serial contact of the infinite necklace of serially touching circles, all in contact with a pair of circles which touch each other, lie on a circle the bend of which is half the difference of the bends of the pair. I therefore expected that the six serial contacts of the hexlet would lie on the surface of a sphere, the centre of which would form the natural fixed point desired.

It is obvious from Dr. Morley's originating assemblage that this is true. The plane midway between the two parallel planes, which contains the six serial contacts and the six contacts of the individual beads of the hexlet with one of the trio, also inverts into a sphere the surface of which cuts all the twelve contacts enumerated orthogonally and passes between the other two members of the trio at their point of contact tangentially. Its radius and centre must therefore be those of the 'circle of contacts' of the plane figure, when the assemblage is sectioned through the plane containing the centres of the trio. That is, the centre of this 'sphere of contacts' lies on the line through the centres of the two of the trio between which it passes tangentially, and its bend is half the difference between the bends of these two. I have established this *ab initio*.

The beauty of these propositions, concerning four mutually touching circles and five mutually touching spheres which underlie these assemblages, is that there is absolutely no distinction mathematically between the four circles or five spheres, respectively. It follows that there are, centred in the plane containing the centres of the trio, three different 'spheres of contacts' to each hexlet, intersecting each other, all of which contain the six points of serial contact of the hexlet, and each of which in addition contains the six points of contact of the individual beads of the hexlet with one of the trio, and the point of contact of the other two. This obscured the problem until Dr. Morley's letter furnished the clue. I had actually obtained the correct solution, but since only two of the trio were involved had rejected it as impossible!

Since the line of intersection of spheres is a plane circle, and the six serial contacts of the hexlet lie on the intersection of three spheres, the latter must intersect in the same circle, so that their centres must be in line. I am indebted to Mr. Hodgkinson here for identifying this line for me as one of the axes of similitude of the trio (see Casey's "Sequel to Euclid", 2nd ed., p. 84). It follows that the centres of the six spheres of the hexlet and the six serial contacts lie in a plane. This much simplifies the nature of the assemblage.

The bend,  $\alpha$ , of the circle of six serial contacts of the hexlet is given by

$$3\alpha^2 = \alpha^2 + \beta^2 + \gamma^2 - (\alpha\beta + \alpha\gamma + \beta\gamma)$$

or

$$3\alpha^2 = \alpha^2 + \beta^2 + \gamma^2 - \rho^2,$$

where  $\alpha$ ,  $\beta$ ,  $\gamma$  and  $\rho$  are the bends of the trio and of the circle inscribed in the triangle joining their centres, respectively. The second form is applicable without ambiguity only when all the bends are positive. By similar reasoning, the contacts of the six beads of the hexlet with each of the trio, respectively, must also lie on a plane circle.

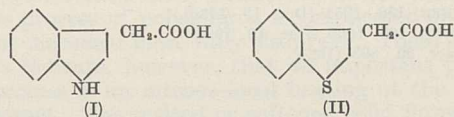
Any hexlet may be fixed and the individual bends of the trio varied, so long as both the sum, and the sum of the squares, of the three bends remain unchanged. So long as the bends of any hexlet associated with a given trio are all positive, one of the bends of the trio may be made zero without changing the hexlet. Thus every such hexlet may be touched by two planes on either side of and equally inclined to the plane of its centres (since it is symmetrical with respect to this plane). This interesting property was discovered experimentally for some of the hexlets of the model illustrated in NATURE (Jan. 9, 1937, p. 78) by Mr. F. March, the mechanic of the Old Chemistry Department, who constructed it. In the limiting case where the bend of one of the beads of the hexlet at its minimum becomes zero, the two planes converge into one normal to the central plane of the hexlet.

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## Synthetic Plant Growth Hormones

INDOLE- $\beta$ -acetic acid or heteroauxine (I) is a product found in normal urine and is well known to have great growth-promoting action on plants, as shown by both the bending of the decapitated oat (*Avena*) and the pea curvature tests.



Thionaphthene- $\beta$ -acetic acid (II) has been synthesized as follows: Thionaphthene  $\rightarrow$   $\beta$ -bromothionaphthene  $\rightarrow$  thionaphthene- $\beta$ -carboxylic acid chloride  $\rightarrow$   $\beta$ -thionaphthene acetic acid, using the reaction of F. Arndt and B. Eisert<sup>1</sup>. The compound melts at 109°, and has a much smaller growth activity than might be expected from its similarity with (I). The oat and pea tests are given by concentrations greater than 1 in 70,000 and 1 in 100,000 respectively, whilst (I) gives a response in dilutions about thirty times greater. It is interesting that an isomeric thionaphthene acetic acid, m.p. 141°, in which the position of the acetic acid group is not yet known, has about the same activity towards peas as (II), but is without effect on oats. A positive response by one method of testing and a lack of response by another method is not unknown; K. V. Thimann<sup>2</sup> shows that coumaryl-*l*-acetic acid gives a positive pea test but no activity in the oat bending test. This and other evidence indicates that the two tests are not necessarily strictly comparable.

Naphthalene- $\alpha$ -acetic acid is several times more powerful than (II), as shown by both oat bending



and pea tests. As these two compounds and (1) have many close chemical analogues, it is evident that the biological response is sensitive to very minute changes in the structure, or perhaps diffusibility, of the substances applied.

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<sup>1</sup> *Ber.*, 68, 200 (1935).

<sup>2</sup> *Proc. Acad. Sci. Amsterdam*, 38, 896 (1935). Read in *Chemical Abstracts*, 30, 2600 (1936).

### Carotene Therapy of Retinitis Pigmentosa

THE loss of dark adaptation and night blindness which characterizes the earliest stages of retinitis pigmentosa suggested to us the possibility that one of the fundamental features of the pathological physiology of the disease is failure of utilization of carotene and vitamin A.

Feeding of these substances by mouth in large doses was found to have no effect upon the course of the disease or upon the symptoms in question. We thereupon administered carotene in oil intramuscularly in a series of cases, and were gratified to find a rapid and prompt response and relief of the night blindness. We administered carotene in doses of 30,000–60,000 New U.S.P. units intramuscularly, one to three times a week in our cases. In all the early cases of retinitis pigmentosa, improvement began to be noticeable within one week after institution of therapy; and dark adaptation became comparable to normal, and in some cases, normal within one to four months, with a corresponding improvement in the night blindness. In the more advanced cases with extensive chorio-retinal atrophy, no improvement has yet been noticed.

Our findings indicate that in retinitis pigmentosa there is a failure of assimilation of vitamin A and its precursors. We are planning a study of this phase of the subject. Another finding of interest is that, judging by the response of the cerebral circulation to bilateral carotid pressure—epileptiform convulsions and more or less prolonged loss of consciousness or coma—the arterial circulation of the brain of these cases is as much impaired as is that of the eye.

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### Diphenyl Compounds and Mammary Growth

DODDS and Lawson<sup>1</sup> have found that it is possible to obtain the œstrus response in castrated animals with substances which do not contain the phenanthrene nucleus. Various dihydroxydiphenyl compounds were tested and found to be active if the two hydroxyl groups were in the *para* position. Certain other compounds, for example, diphenyl- $\alpha$ -naphthyl carbinol, were also found to be active.

Since these substances have œstrogenic properties, it might be expected that they would also function as initiators of mammary growth. Three compounds have been investigated for this effect, *p-p'*-dihydroxy diphenyl, 4-4'-dihydroxy-3-3'-dimethyl diphenyl,

and diphenyl- $\alpha$ -naphthyl carbinol. The compounds, suspended in sesame oil, were injected subcutaneously into young adult male guinea pigs, 100 mgm. being given once a week for three weeks.

With the diphenyl- $\alpha$ -naphthyl carbinol, nipple growth commenced in a few days, and at the end of the three weeks the nipples had reached a size comparable to that at the end of the first pregnancy in the adult female. Histological examination revealed a limited duct growth, and several fairly extensive lobules of acinar tissue were present. Since the testicles were enlarged, and in some cases protruded through the abdominal wall, it is possible that the compound produced its effect through the endocrine system, and that the mammary response is perhaps due to increased secretion of testosterone. Collip, McEuen, and Selye<sup>2</sup> have found that testosterone can cause the development of acinar tissue in the mammary glands of male animals; though Turner and Gomez<sup>3</sup> state that œstrogenic hormones cannot cause growth of mammary parenchyma in completely hypophysectomized animals, the only effect observed being an extensive growth of the nipple. The answer to the question whether diphenyl- $\alpha$ -naphthyl carbinol acts directly or indirectly in promoting mammary growth must therefore await the results of experiments with castrated and hypophysectomized animals.

In the doses given, the *p-p'*-dihydroxy diphenyl caused a slight but definite response, while the 4-4'-dihydroxy-3-3'-dimethyl diphenyl was inactive.

These observations were made during the progress of some experiments designed primarily to investigate the possible effect of the above compounds on lactose synthesis in the mammary gland.

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<sup>1</sup> Dodds and Lawson, *NATURE*, 137, 996 (1936).

<sup>2</sup> Collip, McEuen and Selye, *Amer. J. Physiol.*, 116, *Proc.*, 29 (1936). *Proc. Soc. Exp. Biol., N.Y.*, 34, 201 (1936).

<sup>3</sup> Gomez and Turner, *Proc. Soc. Exp. Biol. N.Y.*, 34, 320 (1936).

### Temperature Variation of the Abnormal Unidirectional Diamagnetism of Graphite Crystals

As is well-known, graphite crystal exhibits some remarkable magnetic properties. The susceptibility along the hexagonal axis of the crystal,  $\chi_{11}$ , is about  $-22 \times 10^{-6}$  per gm., at room temperature, while that along directions in the basal plane,  $\chi_{\perp}$ , is  $-0.5 \times 10^{-6}$  only—the latter value being nearly the same as that of diamond. The abnormal diamagnetism of graphite is thus more or less confined to one direction. Further, this abnormal diamagnetism is very sensitive to any chemical treatment of the crystal. For example, on treating the crystal with a mixture of strong nitric and sulphuric acids, when it swells up to 'blue graphite',  $\chi_{11}$  diminishes numerically from  $-22 \times 10^{-6}$  to less than  $-2 \times 10^{-6}$ , whereas  $\chi_{\perp}$  remains practically unchanged. Also an indefinite diminution in the size of the crystal appears to have the same effect.

We have recently studied the temperature variation of the principal susceptibilities of graphite, and the results may be of some interest in connexion with recent discussions on the contribution of 'free' electrons to diamagnetic susceptibility and its



dependence on temperature<sup>2</sup>. The results are represented graphically in Fig. 1. As will be seen from the curves, the magnetic anisotropy of the crystal, namely,  $\chi_{\parallel} - \chi_{\perp}$ , which was measured directly, diminishes numerically from about  $-28 \times 10^{-6}$  at

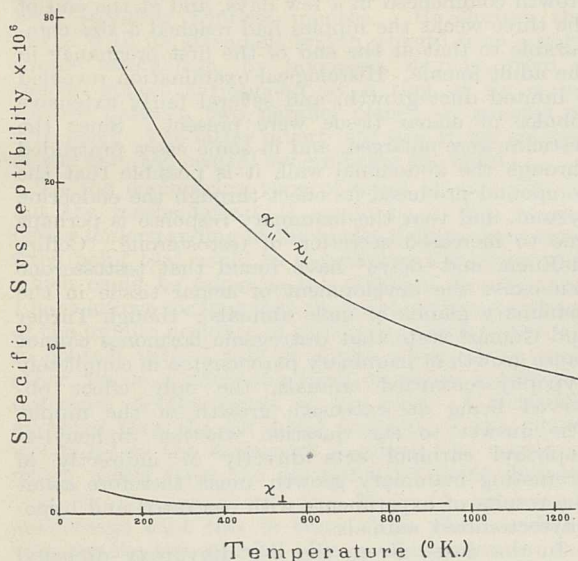


Fig. 1.

140° K., to about  $-7.8 \times 10^{-6}$  at 1,270° K., whereas the corresponding variation of  $\chi_{\perp}$  is from about  $-1.4 \times 10^{-6}$  at 100° K., to  $-0.5 \times 10^{-6}$  at room temperature, and to  $-0.4 \times 10^{-6}$  at 940° K.

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<sup>1</sup> NATURE, 133, 174 (1934); *Ind. J. Phys.*, 8, 345 (1934); *Current Science*, 3, 472 (1935); *Phil. Mag.*, 21, 355 (1936).

<sup>2</sup> See Shoenberg and Zaki Uddin, *Proc. Roy. Soc.*, A, 156, 687 (1936); and Stoner, *Proc. Roy. Soc.*, A, 152, 672 (1935).

### Examination of Passive Iron by Electron Diffraction

By Dr. U. R. Evans's method<sup>1</sup> of electrolysis, almost transparent thin films were detached from the surface of electrolytic iron made passive by immersion in potassium chromate solution. These films were examined by means of a cathode ray of about 50 kilovolts. Spacings of the diffracting substance were calculated from the diameters of several diffraction rings and it was found, as the accompanying table shows, that the films are composed of  $\gamma\text{-Fe}_2\text{O}_3$  or  $\text{Fe}_3\text{O}_4$ .

Rings	Indices of planes	Spacings (A.)	Side of unit cube (A.)
1	(200)	4.22	8.44
2	(220)	2.95	8.34
3	(311)	2.51	8.32
4	(400)	2.07	8.29
5	(422)	1.68	8.24
6	(440)	1.48	8.38
7	(600)	1.39	8.34

mean  $a_0 = 8.34$  A.

$a_0$  for  $\text{Fe}_3\text{O}_4$  (X-ray) = 8.37 A.  
 $a_0$  for  $\gamma\text{-Fe}_2\text{O}_3$  (X-ray) = 8.4 A.; 8.30 A.

As  $\gamma\text{-Fe}_2\text{O}_3$  and  $\text{Fe}_3\text{O}_4$  have almost the same spacings, it is impossible to distinguish between the

two oxides. From chemical tests, however, we believe this oxide to be  $\gamma\text{-Fe}_2\text{O}_3$ . The films are ferro-magnetic and it is certain that they are not  $\alpha\text{-Fe}_2\text{O}_3$ , contradicting the views of many previous workers. Good films are difficult to detach from the surface of iron (not passive) polished in air; but a few samples, fortunately obtained after considerable efforts, proved to be also  $\gamma\text{-Fe}_2\text{O}_3$ . The conclusion is that passive iron is a state of iron the surface of which is covered in a perfectly compact manner by a thin film of  $\gamma\text{-Fe}_2\text{O}_3$ . No clear diffraction pattern was obtainable by the reflection method, but three spacings (4.22 A., 2.51 A. and 1.48 A.) were calculated from the vague rings. No rings were observed by the reflection method from iron made passive in concentrated nitric acid, and no film was detached from it.

Details will be reported in the Scientific Papers of this Institute.

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<sup>1</sup> Evans, U. R., *J. Chem. Soc.*, 127, 1020 (1927).

### Geodesics within Matter

THE difficulties regarding the physical interpretation of null-geodesics and time-like geodesics inside matter, discussed in a recent letter by Dr. Silberstein<sup>1</sup>, may be met by recourse to a process analogous to that employed in the classical theory of attractions. Thus, to measure intensity of force at a point in a medium, we carve out a small cavity and measure the force (or acceleration of a free particle) in the cavity.

There does not appear to be any difficulty in accepting Einstein's postulates that null-geodesics give the histories of light-pulses and time-like geodesics the histories of free particles, provided that in the application of these principles inside a continuous medium we understand that a thin tunnel in space-time is hollowed out to allow the light-pulse or particle to travel freely *in vacuo*. On that understanding, the Newtonian acceleration inside a small cavity in a liquid sphere agrees with the Einstein acceleration, as expressed in Dr. Silberstein's letter.

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<sup>1</sup> NATURE, 133, 1012 (1936).

### Feeding Habits of Stick Insects

IN reference to the communication from Mr. Sidney T. E. Dark<sup>1</sup>, and the observations from the Notre Dame Training College, Glasgow<sup>2</sup>, relating to the eating of dead cellulose by *Carausius*, it may be of interest to record that these insects will occasionally eat paper.

When, some years ago, living stick insects were placed on exhibition in this Museum, temporary labels were suspended inside the cages. The labels were of two kinds, some of common white card resembling Bristol board, but not so tough, and others of thin strawboard faced with white paper. Some of the adult insects used to feed on the edges of these labels—arranging themselves astride the



labels in the same attitude as when they fed on the fresh privet leaves with which they were provided. In the course of two or three days, the labels—particularly those of strawboard—were so mutilated and diminished in size as to be useless, and they had to be removed and replaced by others protected by glass. The insects were not observed to eat their sloughs; the nibbling of the antennæ of individuals in an akinetic condition seems to be a common habit of those in captivity.

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Dec. 30.

<sup>1</sup> NATURE, 138, 1058 (1936).

<sup>2</sup> NATURE, 138, 886 (1936).

### Adjustable Resonators and Orchestration

The major difficulty in adopting Prof. Osborne's idea<sup>1</sup> of adjustable resonators in orchestral instruments is that it is not easy to make a change of pitch in an instrument without a change of quality. The same is true, to a less extent, of the voice. The wood-wind have resonators the length of which is

adjusted to vary the pitch, but there is a consequent difference in timbre between the upper and lower notes of their registers, notably in the clarinet. To preserve the same quality while the pitch varies would involve a complicated system of levers to alter the bore of the—presumably flexible—tube, which would render the execution of rapid passages impossible. On keyboard instruments, with one or more vibrators to each note, another difficulty would arise. Adjustments of the resonator would react on the vibrator, whether string, reed or edge tone, to such an extent as to cause considerable changes of the intensity, or even complete stoppage of the sound.

Sounds received by membranes loaded on one side—to imitate the ear-drum and associated ossicles—have been analysed by Waetzmann<sup>2</sup>. His object was to find how much distortion was introduced by this asymmetric loading of the receiver, and he was thus able to explain the formation of 'subjective' combination tones in the ear.

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Dec. 22.

<sup>1</sup> NATURE 138, 1059 (1936).

<sup>2</sup> Z. Phys., 1, 271 and 416 (1920).

### Points from Foregoing Letters

By growing sunflower plants which have already developed their lower leaves in nutritive solutions containing radioactive phosphorus, Prof. G. Hevesy, K. Linderström-Lang and C. Olsen find that, as in the case of the maize plant, a considerable migration of phosphorus atoms takes place from the lower to the upper leaves during the subsequent growth. The bulk of the phosphorus is present as inorganic phosphate, and probably moves about in the plant, but none of it escapes when cut leaves are placed in a nutritive solution. Germinating maize and pea seeds take up the labelled (radioactive) phosphorus in the germ but not in the endosperm, showing that there is no phosphorus exchange between the two.

Prof. Irvine Masson reports a number of new interrelated facts in the organic and inorganic chemistry of iodine, including the one-stage formation of aromatic iodonium salts, the direct replacement of aromatic hydrogen by the iodoso-group by a new substituting reagent, and the principles controlling the reactions between iodine, its pentoxide and its sesquioxide and a coloured suboxide, especially in sulphuric acid media.

Tables showing the influence of temperature and catalysts upon the position (*ortho*-, *meta*-, *para*-) taken by bromine and other halogen atoms when they are substituted in the benzene molecule are given by Prof. J. P. Wibaut and M. van Loon.

Some measurements of the conductivity of mixed solutions of bi-valent salts are described by E. A. O'Connor. These are considered to favour the complete dissociation theory, although the measurements are not in agreement with the results to be expected from Onsager's equation.

Dr. F. P. Bowden and T. P. Hughes give examples showing that polishing takes place when the melting point of the polishing material is higher than that of the solid to be polished. The relative hardness, as normally measured at room temperature, is comparatively unimportant. This agrees with the

observations that the high temperatures developed during friction are sufficient to cause surface flow. Such high temperatures have been observed at the sliding contact of two different metals acting as a thermocouple.

Using as criteria of 'organisms' the presence of a limiting surface, low speed of transmission, slow rate of increase, and lack of crystallinity, Prof. H. H. Dixon classifies viruses as autocatalysts and not as organisms.

Structural changes in the chromosomes of the pollen grains of the hyacinth and of *Tradescantia* are described by Miss M. Upcott. These changes are apparently due to breaks and rejoins between the chromosomes and lead to the formation of bridges connecting the two daughter nuclei during certain phases of the division process (anaphase and metaphase).

Several new properties of the "hexlet" and propositions concerning four mutually touching circles and five mutually touching spheres are described by Prof. F. Soddy.

The growth-promoting effects upon oat and pea seedlings of certain synthetic organic compounds (thionaphthene- $\beta$ -acetic acid, coumaryl-*l*-acetic acid) are briefly described by E. M. Crook, Dr. W. Davies and Miss N. E. Smith. There are indications that the pea and oat tests of these compounds are not strictly comparable.

Favourable results in the treatment of night-blindness by intramuscular injection of carotene or vitamin A are reported by Drs. E. M. Josephson and M. Freiberger.

According to Prof. J. L. Synge, if thin tunnels of matter are removed from a continuous medium to permit the free passage of a light-pulse or particle, the difficulties recently raised by Dr. L. Silberstein, regarding the physical interpretation of Einstein's geodesic principles inside matter, disappear.



## Research Items

### Prehistoric Motives in Modern Chinese Art

MR. CARL SCHUSTER, who is at present engaged in collecting examples of folk design in western China, chiefly in the form of cross-stitch embroidery, points out in *Man* of December that these designs often show a marked divergence from the rest of Chinese art, and are evidence of early foreign influence. The design here under consideration in particular is a wavy line similar to the M or W marks which occur frequently in archaic Greek pottery and in pre-dynastic Egyptian art, where they have been interpreted by Herbert Kuhn as signs for water and, by extension, for fertility. This interpretation has also been applied to the zig-zag which appears in European prehistoric pottery from neolithic to iron age times. The suggestion is supported by their occurrence on vessels which would have been used for storing liquid. A favourite motive in western Chinese embroidery design is a vessel, out of which grows a plant, the Tree of Life. On these pots the zigzag decoration is persistent, but it rarely appears in any other examples of this class of work. The zigzag as a mark on vessels is not confined to embroidery. It also appears on vessels in stone carving, as, for example, on a wayside shrine. It also appears in blue tape on the seat covers of the rickshaws of the city of Ch'ungking in Szech'uan, where it forms an essential part of the design, though this has been much simplified. In the embroidery designs, folk art has sometimes borrowed from the professional. It shows the 'professional' scale pattern on the bottom of the vessel, while the popular zigzag appears on the neck, thus expressing the same idea in two 'languages'. As these embroideries are some eighty years old and are not made by the present generation, no trustworthy account of their meaning can be obtained. Of the alternative origins, independent invention and an unbroken cultural transmission, the latter is thought to be the more probable.

### Tumours Transplantable with Viruses

DR. W. E. GYE and Dr. F. Pentimalli each discuss the problem of the transmission of tumours from one animal to another by means of viruses, in papers read at the cancer congress in Brussels last autumn ("Reports of the Second International Congress of Scientific and Social Campaign against Cancer", Brussels, 1936). It is twenty-five years since Peyton Rous discovered fowl tumours which could be transmitted to other fowls with cell-free filtrates. The agent concerned in the transmission of these tumours is particulate and approximately 0.1 micron in diameter. With the growth of the tumour, these particles multiply, but the fact that they never increase outside the cells of the host and that their behaviour in immunological reactions is like that of proteins suggests that they are non-living agents. Peyton Rous has recently experimented with a papilloma of a cotton tail rabbit which can be filtered like other viruses, and this virus injected into an animal bearing a non-malignant papilloma produced by painting with coal tar causes such a papilloma to become rapidly

malignant. Dr. Gye suggests that the carcinogenic tar prepares the tissue so that it gives a malignant reaction to a virus. When the virus of a fowl tumour is injected into mammals, the mammalian serum acquires the power of neutralizing the virus of the tumour, and this anti-tumour serum will inactivate extracts of the original tumour and of other fowl tumours even without complement. If extracts of normal fowl tissue are injected, the mammalian serum will only neutralize the fowl tumour virus in the presence of complement and differs from the anti-tumour serum in that the tumour neutralizing power is absorbed by normal fowl cells. The tumour virus thus seems to have two parts, one probably typical of the fowl and another more specific part possibly derived from nuclear material from the malignant tissue.

### Japanese Cœlenterates

IN 1935 (*Mem. College of Science, Kyōtō Imperial University, Series B, 10*), Dr. Taku Komai described *Stephanoscyphus*, the scyphostome stage of the primitive peromedusa *Naurithoë* from shallow waters around Seto. He now finds a second form ("On Another Form of *Stephanoscyphus*, found in the Waters of Japan", *ibid.*, 11, No. 3; 1936) of this peculiar cœlenterate, which is probably specifically distinct. This is provided with conical projections on the inner wall at regular intervals, exactly as in the forms previously described by Allman and Schulze from the Mediterranean, and these projections are absent in the specimens from Seto. On this feature and other differences, the author classifies the genus *Stephanoscyphus*, distinguishing four different kinds. In a second paper ("The Nervous System of Some Coelenterate Types. (1) *Coeloplana*") the same author uses the vital staining method with rongulit white. He finds that in *Coeloplana bocki* the dorsal side contains no nerves except in the marginal zone where nerve cells, probably sensory, are found in abundance. The ventral side shows nervous elements all over, but especially in the marginal region. In the polar plates "nerve-cell-like" bodies occur in the region between the central and marginal areas. Otherwise there is no element resembling nerves in the sense-organ or in the parts surrounding it.

### The Sub-Genus *Proto-peridinium*

IN a recent paper (Report of the Biological Survey of Mutsu Bay, 30. Notes on the Protozoan Fauna of Mutsu Bay. III, Sub-genus *Proto-peridinium*: Genus *Peridinium*. *Sci. Rep. Tōhoku Imp. Univ.*, Fourth Series (Biology), Sendai, Japan, 11, No. 1. July 1936), Tohru Hidemiti Abé re-adopts the sub-genus *Proto-peridinium* Gran and Paulson in a somewhat modified form, whilst Dr. Böhm (Bull. 137, Bernice P. Bishop Museum) does not use it at all. Dr. Abé's paper only includes 7 species, 4 of which are new, and none of these is mentioned in Böhm's paper. The subdivision of the genus *Peridinium* is always controversial, and the fact that Dr. Abé has found a close relation between the general features of the ventral area and its plate patterns on one hand, and the type of the



hypotheca other than the ventral area on the other hand, together with some diversities in the type of ventral area and constancy in the structural relations of this area, seems to be a distinct advance in our knowledge of the structure of these forms. Six groups are recognized in the sub-genus, three of which are here considered, the other three being left for a later paper. The details of the ventral area in the species described are beautifully figured, and the paper is an important contribution to the morphology of the genus.

#### Germinal Layers and the Larva in Amphibia

If a slit be made in the neurula of an Amphibian egg, it is possible by means of glass needles and a hair loop to remove the internal germinal layers, that is entoderm and mesoderm, entirely, or such parts of them as may be selected. O. Mangold (*Naturwiss.*, Nov. 27, 1936) has employed this method to analyse the extent of the co-operation between the germinal layers in the formation of the larva. The removal of the entire entoderm may result in a fairly normal embryo in appearance but lacking gill slits, gill bars, alimentary canal except for the ectodermal proctodæum, most of the blood corpuscles; also the heart is only poorly developed. On cutting the embryo transversely and removing the entoderm from the two halves, the front half develops into a more or less distorted head end often associated with the approximation of the eyes or the establishment of a cyclopic condition. The tail half produces an almost normal tail end including a proctodæum. If the entoderm is extracted whole, the anterior fifth swells to form a vesicle representing the fore gut, but the hinder four fifths remain in a clump not forming liver, pancreas, stomach, etc. Further experiments include the insertion of the entoderm of *Triton taeniatus* into the ecto- and mesoderm of *T. alpestris* in a normal, inverted, or reversed position.

#### Cordyceps and Isaria Fungi

*Cordyceps militaris* is one of the spectacular fungi; it forms perithecia upon lepidopterous larvæ. *Isaria farinosa* is also an entomogenous fungus which occurs upon a wide variety of insects, from which it produces small white, floury conidiophores. The mycologist Tulasne considered *I. farinosa* to be the conidial stage of *C. militaris*, and though considerable doubt prevailed, his conclusions were generally accepted. Mr. T. Petch has recently elucidated the problem (*Trans. Brit. Mycol. Soc.*, 20, Parts 3 and 4, Nov. 1936). He has shown that the two fungi are quite distinct. The conidial stage of *C. militaris* is not *Isaria*, but a species of *Cephalosporium*. The perithecial stage of *I. farinosa* is unknown; it has no connexion with *Cordyceps*.

#### Lilacs

THE term lilac is usually interpreted to mean the European shrub *Syringa vulgaris*. Flowers of this plant are indeed beautiful, but a paper by Mr. H. G. Hillier (*J. Roy. Hort. Soc.*, 61, Part 11; 1936) shows that most of the other twenty-seven species of the genus *Syringa* are no less worthy of attention by gardeners. Lilac species are, with the exceptions of *S. vulgaris* and *S. josikaea*, Asiatic plants, and their advent to horticulture is due to the activities of plant collectors in comparatively recent times.

*S. japonica*, *S. pekinensis*, *S. reflexa* and *S. pinnatifolia* are specially commended for attention by virtue of the photographs which embellish the paper, but full descriptions of many other species also appear. Practical considerations of propagation and culture, and a comprehensive description of varieties of the common lilac, are also included.

#### Non-Disjunction and Trisomics in *Oenothera*

AN analysis of the disjunction arrangements in an *Oenothera* having a ring of fourteen chromosomes has been made by Mr. C. E. Ford (*J. Genetics*, 33, No. 2), who found a non-disjunctional arrangement in 46 per cent of the pollen mother cells. In *O. biennis*, with rings of 6 and 8, he found only 17 per cent. In the ring of fourteen, three cytologically distinguishable types of non-disjunction were recognized: (1) double non-disjunction on opposite sides, (2) on the same side, (3) three-in-a-row non-disjunction. Three varieties of type (1) will occur, but all will produce non-viable gametes. Type (3) leads to the formation of type A gametes, having all the chromosomes of one complex plus one from the other complex, and certain classes of them will be viable. In type (2) the disjoining chromosomes may be separated by 1 and 9, 3 and 7 or 5 and 5 chromosomes in the ring, thus forming the B, C and D types of 8-chromosome gametes. There will be 14, 14 and 7 different gametes of these types respectively, thus making a total of 49 possibly viable different 8-chromosome gametes. As non-disjunction occurs in the megaspores while non-disjunctional pollen grains are not functional, and each of the 49 different 8-chromosome megaspores can combine with either complex of the pollen, 98 possibly viable primary trisomic mutants can result. The possible trisomics in species with chromosome rings of different sizes are also determined, as well as the catenations in various interchange trisomics. It is found that the latter should occur in *O. Lamarckiana* about once in 100,000 plants.

#### Solar Radiation at Calcutta

PROF. P. N. GHOSH, Dr. A. C. Ukil and Mr. M. K. Sen (*J. Ind. Med. Assoc.*, November 1936), in a paper on the extent and intensity of extreme ultra-violet solar radiation at Calcutta, review the literature and describe a photographic photometric method which they devised not only to determine the intensity of the extreme ultra-violet biologically active solar rays but also to ascertain their daily and monthly modifications at Calcutta. The method consists of two operations. The first consists in taking spectrograms of the desired radiation along with that of a standard source, while the second is a measurement of the degree of blackening produced in the different spectral regions by the two sources as well as the estimation of the characteristics of the plate in these regions. The authors' investigations, which are illustrated by tables and charts, show that the ultra-violet intensity of the biologically active region of sunlight at Calcutta is highest during June, though the maximum extension was found in July. It decreased rapidly, however, in May as well as in July. The curves for March, April and May indicated a very weak ultra-violet intensity, while during the period May to September the afternoon intensities were much more pronounced than those of the morning. In the winter months, the reduction in intensity was very marked during the mornings. In conclusion,



the authors emphasize the importance of the estimation of intensity of biologically active rays in the selection of sites for sanatoria in different parts of India and especially in the different hill stations.

#### Excitation of Phosphors in a Neon Discharge Tube

INTERESTING work on the excitation of zinc sulphide and zinc silicate phosphors by ultra-violet and Schumann radiation is reported by A. Rüttenauer (*Phys. Z.*, 37, 810; 1936). The phosphors were placed in the neon discharge, the exciting radiation being the ultra-violet region of the discharge (4000–2500 Å.), and the resonance lines of wave-length 736 and 744 Å. By a special arrangement of tubes, it was possible to separate the phosphorescence due to excitation by these two regions. The zinc sulphide phosphors were excited in both regions, but the phosphorescence in the Schumann rays was less intense the higher the current density. Commercial samples of zinc silicate were not excited at all; but it was found possible to prepare specimens which were strongly excited in the Schumann region, but not in the ultra-violet. The phosphorescence radiation converts the usual red colour of the neon discharge into yellow. It seems possible that discharge tubes containing phosphors may find commercial application.

#### The Micro-Gap Switch

In a paper read to the Institution of Electrical Engineers on December 17, Prof. W. M. Thornton described the micro-gap switch, which should prove useful in the thermostatic control of the temperature of electrically heated water. The alternating current circuits to be broken are those of the heaters controlling the hot-water or air supply for buildings. To do this, the switch is operated by a bimetallic device which, in the hot-water thermostat, consists of a non-expanding rod contained within an expanding sleeve. The length of the gap is adjusted so that the A.C. current, after passing through its zero value, cannot restrike. On a 250-volt circuit, the opening of the gap is about 0.005 inch. When the contacts separate, the current can have any value from zero to the maximum. Oscillographic records show that at whatever point in the cycle the contacts open, the current stops at the next zero point and does not restrike. If a break greater than the free sparking distance were formed instantly in a non-inductive circuit, there would be no arc, for the contacts would not have time to get hot, no electrons would be emitted, and the arc or break-spark could not form. To keep the contacts cool at break, many devices have been invented. In general these are for large power circuits. For relatively small powers and circuits which are practically non-inductive, the micro-gap switch is available and it is stated to act perfectly.

#### Physico-Chemical Factors in Cancer

WORKING in Buenos Aires, Dr. A. H. Roffo has obtained tumours in more than seventy per cent of animals exposed to the sun or to the light from mercury vapour lamps. The tumours developed on those parts which are not protected from radiation, such as the ears, eyes, nose and forelegs, but also on other parts of the body if hair were artificially removed. The radiation produced an increase in cholesterol content of the skin, and cholesterol in the presence of ultra-violet light becomes photo-active, possibly

by being changed to a hydrocarbon and emitting photo-electrons. The production of cancer by solar radiation may therefore be due to a physical radiation or to a chemical carcinogenic agent produced by the photochemical action of such radiation. The results of this work are discussed in a paper in the "Reports of the Second International Congress of the Campaign against Cancer" (Brussels 1936). The photoluminescence and fluorescence of cholesterol and the relation of other physical conditions to cancer is discussed in the same volume by Vles and de Coulon.

#### Mandelic Acid in Urinary Infections

THE treatment of the troublesome *Bacillus coli* infections of the urinary tract has advanced during the last two years by the introduction of mandelic acid. Several preparations of this acid can now be obtained for treatment (see NATURE, 138, 649; 1936), one of the latest introductions being the "Collosol Brand Phospho-Mandelate" of the Crookes Laboratories, Park Royal, London, N.W.10. An essential condition for successful treatment with this drug is an acid condition of the urine, which at first was obtained by the simultaneous administration of ammonium chloride, the taste of which is, however, objectionable, and this is replaced in the Crookes Laboratories preparation by ammonium phosphate, which is not unpleasant as well as being more efficient for the purpose than ammonium chloride. On the first day of treatment, four doses of ammonium phosphate only (contained in a blue envelope in the package) dissolved in water are given to establish a proper acidity, and on subsequent days four doses of ammonium phosphate and of mandelic acid (contained in a white envelope) are similarly given in water. Test-papers are also supplied, by means of which the proper acidity of the urine may be determined. Six days' treatment will frequently clear up an obstinate and long-standing infection, provided this is caused by the *Bacillus coli*.

#### Photo-electric Photometry of Stars

MENTION was made in NATURE (133, 801; 1934) of a new photo-electric photometer constructed by J. S. Hall for obtaining infra-red magnitudes of stars. Dr. Hall has recently used another photometer of similar type in conjunction with the 24-in. refractor at Swarthmore College (*Astrophys. J.*, 84, 369). Infra-red magnitudes of 281 K-type stars were obtained from comparisons of the effective stellar energy at 8300 Å. with that of a controlled incandescent lamp, the zero point being determined from similar observations of 40 stars. These infra-red magnitudes were compared with Hertzsprung's photographic magnitudes to form one measure of the colour magnitude for each star, which was then combined with published values of colour from Sproul and Berlin-Babelsberg to give a mean value of colour. A mean of three accurate spectral classifications (Harvard, Mount Wilson and Victoria) was used as the adopted spectral type for determining the colour excess. A discussion of the results shows that the correlation between colour excess and absolute magnitude suggested in the previous paper is confirmed for giant stars of types K1–M0 and possibly for the G4–K0 types, though it is much weaker for the latter stars. As a method of determining absolute magnitudes of giant K-type stars it is simpler than the spectroscopic method, though probably not so accurate.



## Prize Awards for 1936 of the Paris Academy of Sciences

AT the annual public meeting of the Academy of Sciences held on December 21, 1936, the prizes and awards for the year 1936 were announced as follows:

*Mathematics.*—The Poncelet Prize to Paul Lévy, for the whole of his mathematical works; the Francœur Prize to Claude Chevalley, for his work on the theory of bodies of classes.

*Mechanics.*—The Montyon Prize to Louis Bergeron, for his work on hydraulic machines; the Fourneyron Prize to André Tenot, for his work on hydraulic turbines; the Boileau Prize to Max Teissié-Solier, for his hydraulic researches on the natural turbulent regime; the Henri de Parville Prize to Henri Poncin, for his work in hydrodynamics.

*Astronomy.*—The Lalande Prize to Louis Boyer, for his work on the minor planets; the Benjamin Valz Prize to André Couder, for his work on optical instruments; the Janssen Medal to Henry Norris Russell, for his important work on stellar astronomy.

*Geography.*—The Delalande Prize to Jean Rothé, for his observations and researches on the physics of the globe and physical geography carried out in Greenland (Scoresby Sound); the Gay Prize to the Institut scientifique chérifien, for work on the natural resources of Morocco; the Binoux Prize to Edouard de Martonne, for the whole of his work on colonial cartography.

*Navigation.*—The Prix de la Marine to René Perrin, for his studies on the working of self-propelled torpedoes; the Plumey Prize to René Norguet, for his studies on marine boilers.

*Physics.*—The L. La Caze Prize to Jean Becquerel, for the whole of his work in magneto-optics; the François Hébert Prize to Georges Albert Boutry, for his researches on photo-electric cells and their applications; the Hughes Prize to Marcel Laporte, for his researches on the electric discharge in gases; the Paul Marguerite de la Charlonie Prize to Henri Abraham, for the whole of his scientific work; the Clément Félix Foundation to Mlle. Nine Choucroun, for the continuation of her work on electrophoresis.

*Chemistry.*—The Montyon Prize (Unhealthy Trades) to Paul de Graeve, for his work on phosgene; an honourable mention (1,500 francs) to Jean Le Bras, for his contribution to the study of the extinguishing powers of various materials on flames; the Jecker Prize to Charles Dufraisse, for his work in organic chemistry; the L. La Caze Prize to Paul Job, for his work on inorganic complex compounds and on the application of physical methods to chemistry; the Cahours Foundation to Arthur Brunel, for his researches on fungi; the Houzeau Prize to Maurice Rangier, for his work on uric acid and its complex compounds; the Charles Adam Girard Prize to Georges Kravtsoff, for his work on the electrolysis of organic salts of copper.

*Mineralogy and Geology.*—The Cuvier Prize to Emile Félix Gautier, for his work on the physical geography of Madagascar and the Sahara; the Victor Raulin Prize to Henri Longchambon, for his researches on clays.

*Botany.*—The Desmazières Prize to Camille Sauvageau, for his work entitled "Sur quelques algues phéopores de Guéthary"; the Montagne Prize

between Germain Chalaud, for his work "Groupe de Cryptogames: les Hépatiques", and Jean Chaze, for his work on the culture of the Saprolegniæ and the diseases of cultivated mushrooms; the De Coincy Prize to Désiré Bois, for the whole of his work.

*Rural Economy.*—The Demolombe Prize to Félicien Bœuf, for his work entitled "Les bases scientifiques de l'amélioration des plants".

*Anatomy and Zoology.*—The Da Gama Machado Prize to Pierre Cappe de Baillon, for his work on phasmid insects; the Savigny Foundation to René Dieuzeide, for his work on the Algerian coastal fauna and their parasites; the Jean Thore Prize to Gaston Portevin, for his book on the natural history of French Coleoptera.

*Medicine and Surgery.*—The Montyon Prize between Léon Delhoume (2,500 francs), for his book entitled "Dupuytren", Marius Piéry (2,500 francs), for his book on biological and medical climatology, and Pierre Rigaud (2,500 francs), for his book entitled "Le labyrinthe, étude physio-pathologique et clinique"; honourable mentions (1,500 francs) to Jacques Courtois and Raoul Lecoq, for their work on puerperal infections, and to André Feil, for his book entitled "Le travail de l'ardoise et la pathologie professionnelle de l'ardoisier"; a mention (1,500 francs) to Maurice Sourdille, for his book "Traitement chirurgical de l'otospongiose"; citations to Emile Gilbrin and to Georges Fabiani; the Barbier Prize to Bernard Gouzon, for his book "Sur l'étude de quelques Porphyries naturelles. Application aux pigments fluorescents de l'œuf des oiseaux"; the Bréant Prize to Jean Laigret, for his work on yellow fever and preparation of the vaccine; the Godard Prize to Pierre Feyel, for his book "Le tube urinaire dans le série animale"; the Mège Prize to Joseph Magrou, for his memoir on the scientific work of Maurice Nicolle; the Bellion Prize to Marcel Belin, for his book "Coquillages et fièvres typhoïdes"; the Baron Larrey Prize to Pierre Oudard, for his memoir on the organization and working of the health service of the navy at sea in time of war; the Charles Bouchard Prize to Mario Lebel, for his work on traumatism of the liver; the Jean Dagnan-Bouveret Prize to Claudius Regaud, for the whole of his researches in histophysiology and in normal and pathological radiophysiology.

*Cancer and Tuberculosis.*—The Roy-Vaucouloux Foundation to Léon Velluz, for his work on experimental production of cancer with polycyclic hydrocarbons; the Louise Darracq Prize to Charles Oberling and Maurice Guérin, for their work on the production of tumours by means of transmissible leucæmia of fowls; the Eugène and Amélie Dupuis Prize to Ernest Coulaud, for the whole of his work on tuberculosis.

*Physiology.*—The Montyon Prize to Georges Vanhems, for his work on the biochemistry of potassium; the L. La Caze Prize to Charles Dhéré, for his physiological work especially on the spectrography of biological materials; the Pourat Prize to Roger Gautheret, for his memoir on the culture of plants, and attempts at the culture of meristematic tissues; the Martin-Damourette Prize to Daniel Bovet, for his pharmacological researches especially on the derivatives of aminomethylbenzodioxan.



*Statistics.*—The Montyon Prize to Michel Huber, for the whole of his work in statistics.

*History and Philosophy of Science.*—The Binoux Prize between Paul Nève de Mévergnies (2,000 francs), for his memoir on Jean Baptiste van Helmont, and Charles Cabanes (1,500 francs), for his work on Denys Papin.

*Works of Science.*—The Henri de Parville Prize between Georges Bruhat (3,000 francs), for his book on thermodynamics, electricity, optics and physical mechanics, Guillaume Grandidier (2,000 francs), for his atlas of the French colonies, protectorates and territories under French mandate, and Pierre Gauja (2,000 francs), for his study on "L'Académie des Sciences de l'Institut de France".

*Medals.*—The Berthelot Medal to Paul de Graeve, Paul Job and Maurice Rangier.

*General Prizes.*—Prize founded by the State (mathematical sciences) to Maurice Gevrey, for his work on partial differential equations; the Bordin Prize to Henri Termier, for his important geological studies on central Morocco and the northern Moyen-Atlas; the Lallemand Prize to Ivan Bertrand, for his memoir on micrography in infra-red light and its application to renal cytology; the Vaillant Prize to Père Lejay, for his researches on the determination of gravity in the Far East; the Le Conte Prize to the late Julien Costantin, for the whole of his work; the Jean Reynaud Prize to Alfred Lacroix, for the whole of his scientific work; the Baron de Joest Prize to Paul Robert, for his researches on anallagmatic geometry and its relations with projective geometry; the Houlléviqgue Prize to Etienne Wolff, for his researches in experimental embryogeny and teratogenesis; the Parkin Prize (2,400 francs) to

Jean Jacques Bouckaert and Fernand Jourdan, for their work on the pharmacodynamics of the cerebral vessels; an encouragement (1,000 francs) to Bernard Ménétrel, for his memoir on intravenous activated carbon in therapeutics; the Saintour prize to Robert Weill, for his work entitled "Contribution à l'étude des Cnidaires et de leur nématocystes"; the Lonchamp Prize to Paul Meunier, for his researches on aluminium in animals; the Henri Wilde Prize to Georges Dupont, for the whole of his chemical work; the Caméré Prize to Lucien Chadenson, for his work in hydraulics; the Gustave Roux Prize to Henri Erhart, for his treatise on pedology; the Thorlet Prize to Paul Dorveaux; the Albert I of Monaco Prize to Fernand Holweck, for his work on the Holweck-Lejay pendulum; the Marquet Prize to Gustave Ribaud, for his researches on high temperatures; the Alexandre Darrasq Prize to Etienne Audibert, Ferdinand Vallette and Francis Michot-Dupont (20,000 francs each), for methods of preparing petrol and benzene from materials obtained in France.

*Prizes of the Grandes Ecoles.*—The Laplace Prize to Robert Gachet; the L. E. Rivot Prize between Robert Gachet, Paul Cusset, Charles Mallet and Albert Jouvent.

*General Foundations for Scientific Research.*—The Gegner Foundation to the late Maurice Parat, for his work on the physiology of the cell; the Jérôme Ponti Foundation to Henri Besairie, for his work on the geology of Madagascar; the Hirn Foundation to Albert Arnulf, for his work in applied optics; the Henri Becquerel Foundation to Carl Benedicks, for his discoveries on the homogeneous thermoelectric effect.

(To be continued.)

## Progressive Teaching in Geography

### THE GEOGRAPHICAL ASSOCIATION

THE Annual Conference of the Geographical Association was held at the London School of Economics on January 5-7.

At the first lecture meeting, Dr. L. Dudley Stamp dealt with Portugal in 1936 and entered a plea for geographers to accord separate consideration to Spain and Portugal rather than to group the two together, which they frequently do, as the Iberian Peninsula. The cultural background and history so clearly demarcate the two that the visitor cannot help being struck by the differences, which indeed recent events have emphasized. By means of lantern slides the remarkable changes witnessed in a traverse from north to south were demonstrated, and a tentative division of the country was suggested into the north-west, the north-east, the middle Douro basin (the port-wine area), the coastal belt, north centre, south centre (these two separated by the Tagus), the southern Sierra, and the Algarve.

On January 6, Sir William Beveridge took the chair at an important symposium on "Whither Population?" in which Prof. C. B. Fawcett stressed the spatial distribution of the world's population, and Dr. R. R. Kuczynski the changing distribution in time. Prof. Fawcett demonstrated that modern development and migration are *not* filling up the

empty spaces of the world but, on the contrary, the great cities are increasing relatively to the whole and the pioneer fringe is moving back. Even in densely populated Great Britain, rural depopulation has been in progress for many decades, and one-fifth of the land surface has more than fifty-eight per cent of the people (compared with fifty-one per cent ten years ago). In Canada, forty-two per cent of the people live on less than one per cent of the land; in the United States, more than fifty per cent on less than two per cent; in Australia, more than fifty per cent in the capital cities alone. Dr. Kuczynski developed his now well-known theory of population increase—that the true measure is the relation between women of child-bearing age and births of female children—between the mothers of to-day and the mothers of to-morrow. Where this net reproduction-rate falls below 1, the population must decrease. It is actually below 1 in all the countries of northern and western Europe, except the Irish Free State and Poland. It reaches its highest European figure now in the U.S.S.R. (more than 1.2). In Japan it is about 1.4. At present in Great Britain it is about 0.75, representing a decrease of one per cent per annum. The population at this rate will fall below 30 million by 2000 A.D. and below 20 million in 2036. As Sir



William Beveridge, in a masterly summary, pointed out, this may be desirable, but the process of change is bound to be painful. The arrest of the decline can be accomplished only slowly and in one way alone—by increasing the *desire* of the people to have children. Reference was made to existing tax concessions as being a bad joke or, alternatively, a penny in the pound towards the cost of child-rearing. It was suggested that serious State action has nowhere been attempted. The two great questions are thus: Do we want to stop the decline? If so, can we?

A valuable discussion was that on broadcast geography lessons, at which the teachers, the inspectors, the B.B.C., and broadcasters were represented. There was general agreement that systematic lessons should not be attempted, but that first-hand travel talks to be used as 'background' material, and accurate as well as useful and stimulating in content, should be the aim.

Dr. H. A. Matthews detailed suggestions for the study of local climate and had some remarkable illustrations of local variations—the frost pockets by walls so well known to gardeners, the contrasts between the wind rose at the head of a valley (with one calm day per month and predominantly south-west winds) and at a village in the valley only one mile away (with fourteen calm days and the wind predominantly north-west or down the valley).

Mr. G. H. J. Daysh summarized his very important recent work on Tyneside and the north-east, emphasizing two points specially—the contrast between the reviving water-side areas and the stagnant inland coal mining areas, and secondly, his own faith in emigration as the solution.

Mr. S. H. Beaver dealt with the scope of railway

geography, and two meetings were devoted to joint sessions with the Leplay Society—with Dr. Stamp on Poland and Dr. L. R. Wood on Norway.

Sir Josiah Stamp's presidential address on "Geography and Economic Theory" can only be described as epoch-making in that it defined clearly, for the first time, the points of impact of two modern disciplines and has provided a gospel for future workers.

#### INSTITUTE OF BRITISH GEOGRAPHERS

The Institute of British Geographers held its annual meeting at the London School of Economics on January 6-7, Prof. R. N. Rudmose Brown replacing Prof. C. B. Fawcett in the presidential chair.

Mr. W. V. Lewis developed the theme of glacial plucking and corrie formation from the *bergschrund* hypothesis of Willard Johnson, stressing the importance of glacial sapping at the foot of corrie cliffs and the potency of summer melting. Dr. S. W. Wooldrige considered the later stages in the physiographical evolution of the London Basin, thus continuing his well-known work published in the *Proceedings of the Geologists' Association*.

Mr. F. H. W. Green gave a succinct and well-illustrated account of the water-meadow systems of Hampshire; Mr. K. H. Huggins suggested a functional classification of English towns into five major groups: primary production, major industries, other industries, local services and regional services. Miss A. F. A. Mutton presented a detailed study of the Black Forest region and Mr. R. A. Pelham a study of the wool industry in the fourteenth century.

L. D. S.

## Mathematical Association

### ANNUAL MEETING

THE annual meeting of the Mathematical Association was held at the Institute of Education, London, W.C.1, on January 4-5. At the business meeting, Prof. L. N. G. Filon was elected president for the ensuing year, and the officers were re-elected as follows: *Treasurer*: Mr. K. S. Snell; *Secretaries*: Mr. G. L. Parsons and Miss M. Punnett; *Librarian*: Prof. E. H. Neville; *Editor of the Mathematical Gazette*: Mr. T. A. A. Broadbent.

The report of the Council refers to the continued growth of the Association, which now numbers nearly 1,600. The library of the Association has been enriched by gifts from the Royal Technical College, Glasgow, and Mr. C. O. Tuckey; also by an exchange effected by Prof. Neville with the Centre National de Documentation Pédagogique, Paris, as a result of which a very complete collection of French textbooks has been acquired. Reference is also made in the report to reviews of French and German textbooks which have appeared in the *Mathematical Gazette*. The Teaching Committees announce that a supplementary report on the teaching of geometry will appear shortly and also that a sub-committee has been appointed to collect information about mathematical films. The Association has become affiliated to the Conference of Educational Associations.

The outgoing president, Prof. A. R. Forsyth, in his address entitled "Applied Mathematics in School Training: Some General Considerations", compared the standards demanded of an entrance scholar to Cambridge at the present time with those demanded sixty years ago. He noticed that, while there has been some modification of method rather than of matter in pure mathematics, applied mathematics is in a general way practically the same at the present day as it was when he himself was an undergraduate. This, he considers, is scarcely less than surprising, having regard to modern applications, and he went on to offer some general observations on the ways in which this defect might be rectified.

Prof. Georg Wolff, of Düsseldorf, read a paper entitled "The Development of the Teaching of Geometry in Germany". He referred to the revolt against the traditional teaching of Euclid which occurred in England partly owing to the work of the A.I.G.T. (afterwards the Mathematical Association) and partly owing to the attacks of Prof. Perry and others. He outlined the phases of a similar revolt which took place in Germany, culminating in the report of the German Sub-Commission of the International Commission on the Teaching of Mathematics. In the newest developments of the subject (which date from



1925), he directed attention to the emphasis placed on descriptive geometry, especially on general topics of transformation such as orthogonal and point projection and perspective.

The proceedings of the second day opened with a discussion on the teaching of astronomy. Mr. J. A. Edgar outlined the work which might be done with boys up to lower sixth form level and gave valuable suggestions for practical work in constructing star maps, plotting the plane of the ecliptic and the measurement of time. Mr. R. L. Marshall directed attention to some dangers which, in his opinion, might attend the addition of astronomy to the curriculum, while Dr. L. E. Lefèvre urged the claims of astrophysics in the work done by science specialists, referring especially to the various results obtained by spectrum analysis. In the ensuing discussion, Mr. W. F. Bushell mentioned the importance of the alliance between geography and astronomy.

Dr. R. R. Kuczynski read a paper on "Population Trends". He explained that, while an adequate device for the measurement of mortality has long been known, a good method of measuring fertility has only recently been evolved. He showed how these two measures can be combined to give the 'reproduction-rate' of a population. He stated that if fertility and mortality remain as at present, the population of western and northern Europe appears likely to drop from 194 to 150 millions by the end of the century. The U.S.S.R. is apparently an exception, and the figures here suggest an increase from 175 to 650 millions. He concluded by warning his audience that a very clear distinction should be drawn between estimates meant as forecasts and estimates meant to show what, on certain definite assumptions, the population trend would be. The figures given were to be taken as belonging to the second of these categories.

Mr. R. M. Gabriel, in the next paper, urged the inclusion of the history of mathematics in the course of study both of schools and universities. Of the different methods of presenting the history of the subject, he preferred that which dealt with the history of various topics as they occur in mathematical work. He pointed out how the history of the subject serves to throw a light on the character of times and men (for example, Cardan and Tartaglia

in relation to the Renaissance; Newton in relation to the seventeenth century). He instanced several mathematical types in which a knowledge of mathematical history would assist both teacher and pupil. In the course of a useful discussion, Sir Thomas Heath, Mr. A. W. Siddons, Prof. E. H. Neville, Mr. M. Black and Mr. G. L. Parsons offered additional suggestions with regard to topics and bibliography.

In the afternoon, Dr. A. C. Aitken read a paper on "Arithmetical Recreations". He stated that his observations were really concerned with approximation, which will assume greater importance as mechanical devices for calculation are developed. After a preliminary discussion of the mental equipment needed by a good computer, Dr. Aitken demonstrated rapid methods of division and squaring, and as an illustration of his methods, squared several numbers of three and four digits mentally with great rapidity. He next showed how the periods of recurring decimals can be determined. These methods of approximate evaluation of a square root were considered and their relative errors dismissed. Dr. Aitken concluded with some remarks on the nature of memory, in which he stressed the rhythmic element, illustrating this by writing down from memory the first two hundred figures in the value of  $\pi$ .

The concluding paper was given by Mr. A. Romney Green on "Geometrical Design". He commenced by describing the construction of certain polar curves and showed how these curves can be used for vases, brackets and other articles capable of being made in the school workshop. He also directed attention to the close conformity with Nature exhibited by certain leaf-designs derived from these curves. He next referred to the use of the conic (drawn as an envelope) and pointed out the superiority of these curves (used in Greek mouldings) over the circular mouldings in general use. The paper was illustrated by slides, including illustrations of pieces of furniture designed by the author.

In consequence of the indisposition of the president, Mr. A. W. Siddons presided over the meetings on the second day. The meetings were well attended throughout, and the usual publishers exhibition was held. A full account of the various papers will appear in the *Mathematical Gazette*.

## Mechanized Farming\*

### OXFORD CONFERENCE

THE second Conference on Mechanized Farming was held in Rhodes House, Oxford, on January 5-8, under the auspices of the agricultural departments of the University, and attracted about 350 visitors.

The opening papers dealt with agricultural and technical problems arising from the extended use of tractors. An important technical problem arises from the use of paraffin rather than petrol as fuel. Under ordinary agricultural conditions, the use of the heavier fuel frequently results in rapid deteriora-

tion of lubricating oil, due to its dilution with unburned fuel components. In practice, therefore, the immediate economies which result from the use of paraffin are liable to be offset by increased consumption of lubricating oil, or, since farmers generally do not change the diluted oil often enough, by rapid wear of the engine. Measurements on tractors in the field and on test show that the solution of the difficulty is to maintain the temperature of the cooling water at as near boiling point as is practicable, to avoid changing over from the starting petrol to paraffin until a sufficiently high engine temperature has been reached, and to load the tractor as fully as possible.

\* Papers can be obtained from the Institute for Research in Agricultural Engineering, University of Oxford, 1s. 6d. post paid. A supplement embodying the informal discussions is to be published at a later date.



Another group of papers was concerned with cultivation problems. Mechanization offers so many opportunities of simplifying the traditional routine of cultivation, for example, by the use of rotary cultivators or trains of implements, that it becomes important to examine scientifically both the traditional treatments and the newer technique which may supplement them. Two papers described the work which is being done with this object at Rothamsted and Cambridge. It was suggested that certain tillage operations which are traditionally supposed to conserve soil moisture cannot be expected, in the light of modern theories of soil water movement, to exercise much direct control, although they may conserve soil moisture indirectly by removing the competition of weeds. Again, in statistical field experiments the ultimate effects of tillage operations on crop yields are frequently insignificant, although well-marked effects in soil structure can be demonstrated, for example, by the use of an instrument which automatically records the resistance to the penetration of the soil by a steel probe. Both papers concluded that traditional methods are liable to include many operations the utility of which is doubtful. This conclusion was criticized in another paper written from the farmer's point of view. It was suggested that the mental attitude of the experimenter towards cultivation operations is often at fault: that to regard the ultimate yield in a statistical experiment as the sole criterion is misleading; and that modern experimental technique is too rigid for the study of what may be considered as still an art.

Another paper opened a discussion on the maintenance of fertility, with particular reference to the part played by organic manures. It was suggested that the function of organic matter might appear less important as the science of tillage is developed and more is known about the application of such elements as boron, manganese and zinc. On the other hand, a better understanding of the part played by auxins, animal hormones and plant toxins might lead to a contrary conclusion.

Considerable interest was also aroused by several papers on grass-drying. These, however, were concerned more with questions arising from fitting the new process into farming routine than with drying technique.

Other subjects which received consideration at the Conference were equipment enabling tractors to be used for row crop work and recent developments in combine harvesting.

## Science News a Century Ago

### The Analysis of Organic Compounds

"At a meeting of the Medico-Botanical Society held on January 25, 1837, Mr. Everett made some observations on the essential oil of almonds, the result of the examination of which by different continental chemists, led to the hope that the mathematical accuracy impressed upon inorganic compounds would soon be developed in organic compounds. In the analysis of almonds, a substance called amygdaline was produced. From this substance the German chemists have produced a liquid hydruet of benzoïn, which by contact of atmospheric air, produces benzoic acid. With this discovery, M. Berzelius was so pleased

as to suggest to MM. Dumas and Leveque (to whom the scientific world is indebted for this information) to give it a name signifying 'Dawn of Day' or 'Orb of Day', illustrative of the new era which it opened in organic chemistry. M. Mitscherlich, of Berlin, has also by the distillation of benzoic acid with quicklime, obtained an oily fluid identical with that procured in the condensation of oil gas, and described by Faraday as a liquid bi-carburetted hydrogen."—(*Athenæum*.)

### Structure of the Brain in Marsupial Animals

ON January 26, 1837, Richard Owen, Hunterian professor of anatomy to the Royal College of Surgeons, read a paper to the Royal Society "On the Structure of the Brain in Marsupial Animals". The official abstract of the paper said: "The author describes a remarkable modification in the commissural apparatus, apparently provided with a view to establish communication between the cerebral hemispheres, which he has observed in the brains of marsupial animals and which has hitherto been regarded as constituting the essential difference between the brains of oviparous and mammiferous vertebrata. . . . On comparing the structure of the brain in the Beaver and in the Wombat, he finds that the corpus callosum, or great commissure which unites the supra-ventricular masses of the hemispheres in the former, as well as in all other placentally developed mammalia, and which exist in addition to the fornix, or hippocampal commissure, is wholly absent in the latter animal: and that a similar deficiency exists in the brain of the Great and Bush Kangaroos, of the Vulpine Phalanger, of the Ursine and Mange's *Dasyrus*, and of the Virginian Opposum. . . ."

### Cultivation of Rice in England

THE *Athenæum* of January 28, 1837, records the attempts of Mr. Anderson, the curator of the Apothecaries Garden at Chelsea, to cultivate mountain rice from Nepal, the experiment having been made to see whether it could be grown in Great Britain as an agricultural crop. The seed was sown in March in a hot-house and soon germinated. In May, when the seedlings were removed to the greenhouse, they had become stout healthy plants. At the end of June, they were transferred to a sheltered place in a basin for aquatic plants, having nine inches of water and twelve inches of mud. They grew and promised well until the beginning of August, but the weather becoming cool they all sickened and died without flowering.

### Medical Literature in 1836

"DURING the year 1836 there were published in France alone upwards of 300 volumes on the various branches of medical science. These 300 volumes, added to the numerous brochures, memoirs and other smaller tracts which have appeared, raise the quantity to 115,000 pages, which together with the journals and theses brought out at the same time render the total about 180,000 pages. Now should there be found a reader intrepid enough to undertake the perusal of all this, his monthly task must be to wade through nearly 16,000 pages, and his daily performance must be on the average 500. So much for French medical literature merely; add English, American, German, etc.!"—(*London Medical Gazette*, January 28, 1837.)



## University Events

ABERDEEN.—The King has, on the recommendation of the Secretary of State for Scotland, approved the appointment of Prof. John Stirling Young, professor of pathology in the Queen's University, Belfast, to be regius professor of pathology, in succession to Prof. T. Shennan, who has resigned.

CAMBRIDGE.—D. V. Davies and Dr. W. R. M. Morton have been appointed University demonstrators in the Department of Anatomy.

At Gonville and Caius College, Prof. J. A. Ryle, regius professor of physic, has been elected into a professorial fellowship.

At Pembroke College, W. E. Burcham, Trinity Hall, has been elected into the Stokes studentship for research in physics. Mr. Burcham is engaged in research work in the Cavendish Laboratory.

At St. John's College, Prof. H. A. Harris, professor of anatomy, has been elected into a professorial fellowship.

LONDON.—The Court of the University has accepted an offer of the Harry Price Library of Magical Literature to be on permanent loan in the University Library, and has passed a vote of thanks to Mr. Harry Price for the benefaction.

Dr. F. E. Zeuner has been appointed hon. lecturer in geochronology at the Institute of Archæology.

## Societies and Academies

### Paris

Academy of Sciences, December 28 (*C.R.*, 203, 1477–1556).

LOUIS BLARINGHEM: A new variety of *Zea Mays* with mahogany-coloured seeds.

GABRIEL BERTRAND and LAZARE SILBERSTEIN: New researches on the comparative amounts of sulphur, phosphorus and nitrogen in plants cultivated on a given soil. Figures are given for fifteen species of plants. Exceptional results were obtained with celery: whilst in forty-six species of plants the ratio sulphur to phosphorus did not exceed 4.02, celery gave a ratio of 11.1.

CHARLES POISSON: Some magnetic rocks in the neighbourhood of Tananarive.

ALEXANDRE MYLLER: The mean torsion of a surface.

ALBERT EDREI: Certain limit invariants of integral series.

VICTOR LALAN: Kinematics and the theory of groups.

OCTAV ONICESCU: Physical laws expressed by statistical chains.

GEORGES FOURNIER: The upper limit of the atomic numbers. On the basis of certain geometrical assumptions, 136 would be the maximum atomic number.

PIERRE JOLIBOIS and ROBERT BOSSUET: Some properties of a spark arising from the surface of an electrolyte connected to the negative pole.

GEORGES COSTEANU and PIERRE BARCHEWITZ: The absorption spectrum of ammonia in the very near infra-red (6000 Å.–9500 Å.).

JEAN LECOMTE: Infra-red absorption spectra and the modes of vibration of organic compounds possessing an ethylene linkage.

JOSEPH BERTHENOD: Connexions by means of couplings with permanent slipping.

RENÉ DELAPLACE: The thermal conductivity of the gaseous saturated hydrocarbons at low pressure.

Results for hydrogen, methane, ethane, propane, normal butane and isobutane are given as curves. For pressures between 0.001 mm. and 0.2 mm. of mercury, the homologues of methane have thermal conductivities increasing with their molecular weights.

WILFRIED HELLER: The slowing down of thixotropic solidification by the amino-acids.

JEAN CHÉDIN: The quantitative study of the intensity and the depolarization of some Raman lines emitted by sulphonitric mixtures.

PIERRE PEYROT: Absolute measurement of the light diffused by liquid benzene.

ALBERT PORTEVIN and EUGÈNE HERZOG: The action of various additions in small proportions on the marine corrosion of extra-mild steel. Results are given graphically of the effects of the presence of aluminium, chromium, nickel, silicon and phosphorus.

PAUL LAFFITTE and ANDRÉ PARISOT: The detonation of ammonium nitrate. Summary of results obtained by the photographic recorder method.

LOUIS MÉDARD and FRANÇOIS DÉGUILLON: The Raman effect of some organic sulphur compounds.

RAYMOND DELABY: The  $\beta\gamma$ -ethylenic nitriles and some of their derivatives.

LÉON PALFRAY, SÉBASTIEN SABETAY and PIERRE MASTAGLI: The reducing action of benzylalcoholic potash and of sodium benzylate on aldehydes. Studies on three aldehydes of different type, cuminic, cenanthic and  $\alpha$ -amylcinnamic aldehydes.

GUSTAVE VAVON and ISRAËL CHILOUET: The structure of the menthylamines.

ALBERT KIRRMANN and ROBERT JACOB: Study of the allyl transposition: a trichlorisobutene.

ROBERT FORRER: The intensity of the orbital interaction in salts. The factor of the ions.

Mlle. VÉRA MALYCHEFF: Contribution to the study of the soils of western Morocco. The brown soil formed at the expense of hamri.

RAYMOND JOUAUST, ROBERT BUREAU and LOUIS EBLÉ: The probable causes of the sudden fading of short radio-electric waves and their relation with magnetic phenomena. There is no evidence to connect these disappearances with magnetic storms.

PIERRE MARIE: The utilization of the Foraminifera in stratigraphy.

ROBERT LEMESLE: The vessels with scalariform perforations of *Eupomatia* and their importance in the phylogeny of Polycarps.

LÉON BERTIN: A series of *Leptocephalus* belonging to the genus *Saccopharynx*.

MME. YVONNE KHOUVINE, BORIS EPHRUSSI and MORRIS HENRY HARNLY: The extraction and solubility of substances intervening in the pigmentation of *Drosophila melanogaster*.

ANDRÉ KLING and GUY LECORDIER: The influence exerted by two war vesicants and by their products of hydrolysis on the values of the interfacial tensions of lipids towards physiological serum and on their absorption.

Mlle. LISE EMERIQUE: Avitaminosis A and nitrogen metabolism.

MME. MARGUERITE AITOFF: The transformations of the fermentation reactions of a dysenteric bacillus by passage through animals.

MAX ARON: Serological researches on the nature of the principle contained in the urine of cancer patients.

JEAN CUILLÉ and PAUL LOUIS CHELLE: Can the disease known as "tremblante du mouton" be inoculated? This disease is infectious and inoculable. The virus exists in the nerve centres.



## Cape Town

Royal Society of South Africa, October 21.

G. D. B. DE VILLIERS and S. M. NAUDÉ: Effects of oil sprays on the transpiration of peach twigs. Oil sprays diminish the transpiration of twigs by about fifty per cent. Twigs sprayed with oil build up a greater reserve of sap than the unsprayed twigs. Hence when the buds open up, less danger exists of their drying out and the phenomena of delayed foliation and die-back occurring. Screening tends to decrease the transpiration in comparison with an unshielded tree. Such trees, sheltered from the sun's rays in winter by screens or windbreaks, develop more normally than unsheltered trees.

I. DONEN: Studies in deciduous fruit. (4) Distribution of nitrogenous fractions in the pulp of the Kelsey plum (*Prunus salicina*). Extracts of the nitrogenous fraction in the pulp of Kelsey plums were obtained by (a) water extraction of fresh tissue, (b) alcoholic extraction of frozen tissue, (c) expressing the juice, and (d) water extraction of pulp dried at 50° C. In young fruit, preservation of the tissue by freezing or drying resulted in hydrolysis of protein. In mature fruit the distribution of total soluble nitrogen, amide, amino acid and ammonia nitrogen, in the resulting extracts is not greatly affected by any of the methods of extraction used. (5) Preliminary observations on the relationship between nitrogenous metabolism and internal breakdown of Kelsey plums in cold store. Changes in the proportions of protein and non-protein nitrogen as well as changes in the ammonia, amino and amide nitrogen fractions in the flesh of Kelsey plums were followed by analysis of fruit stored at 35°, 50° and 70° F. Rapid hydrolysis of proteins takes place in plums under all conditions of storage, but the course of protein hydrolysis stops short at the amino-acid nitrogen stage. Conditions of maturity and storage which interfere with the course of progressive breakdown of nitrogenous compounds are also the conditions which interfere with the normal ripening of the fruit.

W. E. SHARPLES: A Middle Stone Age site at Tygerberg, near Prince Albert.

T. A. STEPHENSON, A. STEPHENSON and C. A. DU TOIT: The South African inter-tidal zone in its relation to ocean currents. (1) A temperate Indian Ocean shore.

H. ZWARENSTEIN: Experimental induction of ovulation (see NATURE, Jan. 16, p. 112).

B. F. J. SCHONLAND, D. B. HODGES and H. COLLENS: Combined oscillographic and camera studies of lightning. The leader process in all cases observed lowers a negative charge towards ground. The stepped leader involves an intermittent decrease of negative electric moment with corresponding radiation in the form of a ripple which always precedes the main radiation field caused during the return stroke. The dart leader process involves a continuous decrease in moment. Discharges taking place in a thundercloud are less important sources of atmospheric than those passing to ground.

## Cracow

Polish Academy of Science and Letters, November 9.

M. PETROVITCH: Remark on the zeros of the Laplace-Abel integrals.

L. KOZLOWSKI: Kerr's electro-optical phenomenon in mixtures of nitrobenzene and hexane. For

mixtures of low concentration, the relation between the Kerr coefficient and temperature is nearly linear. There is an anomaly in the region of the critical temperature of solution.

M. CENTNERSZWER and M. BLUMENTHAL. (1) The thermal dissociation of lithium nitrate. Lithium nitrate, at a temperature above its melting point, decomposes into lithium nitrite and oxygen. The reaction is reversible, and the author has determined the Nernst equation. (2) The thermal dissociation of silver nitrate.

H. LICHE: Observations on the behaviour of the Gerrides (heteropterous Hemiptera).

M. BULAWA: The lymphatics in the skin of the teleosts.

## Moscow

Academy of Sciences (C.R., 4, No. 1; 1936).

W. SIERPINSKI: Semi-continuous functions.

P. P. LAZAREV and Z. V. BOULANOVA: (1) The influence of muscular work on the adaptation in peripheral vision. (2) Changes in the peripheral visual adaptation in infants during a day.

P. P. LAZAREV and M. R. SEMENOVYCH: Changes in the peripheral visual adaptation during a year.

A. OBRUČEVA and A. FRUMKIN: Attainment of a potential by platinum in solutions of silver salts.

I. A. GOLJANICKIJ and I. S. BELONOSOV: Reduction of the inactivated *l*-ascorbic acid.

O. S. VIALOV: Classification of oysters (*Ostreinae*).

A. S. SEREBROVSKIJ: Second variant of the  $M-\sigma^2$ -triangle method.

E. ŠESTAKOV and L. I. SERGEEV: Changes in the permeability of protoplasm and the dynamics of frost resistance of winter cereals in connexion with their passage through the light stage.

E. G. ANDREEVA: The proportions of the leg bones of some *Bovinae*.

A. J. BAZIKALOVA: A new form of Amphipoda from Lake Baikal (*Gammarosphaera insularis*, gen. et sp. n.).

## Vienna

Academy of Sciences, October 29.

STEFAN MEYER: Possible existence of an isotope of polonium in the thorium series.

ERICH TSCHERMAK-SEYSENEGG: True, derived, and doubtful wheat-rye hybrids (wheat-like forms).

RUDOLF INZINGER: Infinitesimal geometry of contact transformations.

W. J. MÜLLER: Theory of metal potentials (1).

L. KAHOVEC and A. W. REITZ: Studies of the Raman effect (61). Raman spectra of organic substances (benzene derivatives).

November 5.

OTTO AMPFERER: Were the Alps unglaciated between the Würm and the final glacial periods?

ZORA KLAS: *Thiosiphon*, a new species of sulphur bacterium.

FRANZ URBACH and HELENE SCHLESINGER: Mechanical and acoustical tests of pianofortes.

ANTON KAILAN and WALTER MELZER: Influence of neutral salts on velocity of esterification and viscosity in solutions of hydrochloric acid in ethyl alcohol.

MAX TOPERCZER: The earthquake at Obdach on October 3, 1936.



## Forthcoming Events

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

## Monday, January 25

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. H. R. Ing: "Chemical Structure and Pharmacological Action". (Succeeding lectures on February 1, 8, 15, 22 and March 1.)\*

INSTITUTE OF ACTUARIES, at 5.—F. J. C. Honey: "The Estimated Population of Great Britain, 1941-1971".

BEDFORD COLLEGE FOR WOMEN, at 5.15.—Prof. R. F. A. Hoernlé: "Theory of Knowledge". (Succeeding lecture on January 26.)\*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Prof. W. Bullock, F.R.S.: "The Development of Bacteriology with an Account of some of the Pioneers who made it a Science" (Heath Clark Lectures. Succeeding lectures on January 28 and February 1, 4 and 8.)\*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A. R. Glen: "Northeast Land, 1935-36".

## Wednesday, January 27

ROYAL SOCIETY OF ARTS, at 8.—J. T. Randall: "Luminescence and its Applications".

## Thursday, January 28

KING'S COLLEGE, LONDON, at 5.30.—Arthur Gardner: "English Medieval Sculpture". (Succeeding lectures on February 11 and 25, and March 11.)\*

## Friday, January 29

GEOPHYSICAL DISCUSSION, at 4.30.—(at the Royal Astronomical Society).—Discussion on: "Terrestrial Heights" to be opened by Dr. J. de Graaff Hunter, F.R.S.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, at 7.—Prof. A. L. Mellanby: "Land and Marine Steam Generators, with Particular Reference to Future Developments" (Andrew Laing Lecture).

ROYAL INSTITUTION, at 9.—Sir William Bragg, F.R.S.: "Recent Crystallography".

## Saturday, January 30

BRITISH MYCOLOGICAL SOCIETY, at 11.—(at University College, Gower Street, London, W.C.1).—Symposium and Discussion on "Antagonism of Micro-organisms" to be opened by G. Samuel.

## Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

CIVIL ENGINEER in the Rangoon Development Trust—Messrs. Binnie, Deacon and Gourley, Artillery House, Artillery Row, London, S.W.1 (January 27).

TWO ASSISTANT CHEMISTS for the London Shellac Research Bureau—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (January 30).

ASSISTANT GUIDE-LECTURER (archaeology and natural history) in the Leicester Museum and Art Gallery—The Director (February 10).

PROFESSOR OF ZOOLOGY in the University of Cambridge—The Vice-Chancellor (February 26).

PROFESSOR OF PHYSIOLOGY in the University of Cambridge—The Vice-Chancellor (March 4).

PROFESSOR OF GEOLOGY in the University of Oxford—The Registrar (March 6).

PROFESSOR OF SOCIAL ANTHROPOLOGY in the University of Cambridge—The Vice-Chancellor (March 9).

ASSISTANT DIRECTOR OF METALLURGICAL RESEARCH in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88a Gower Street, London, W.C.1.

## Official Publications Received

## Great Britain and Ireland

British Chemicals and their Manufacturers: the Official Directory of the Association of British Chemical Manufacturers (Incorporated). Pp. 466. (London: Association of British Chemical Manufacturers.) Free. [41]

University of Cambridge: School of Agriculture Memoirs. Memoir No. 8: A Brief Summary of the Papers published by the Staffs of the School of Agriculture and its Associated Research Institutes during the period Oct. 1st, 1935-Sept. 30th, 1936. Pp. 54. (Cambridge: School of Agriculture.) 1s. net. [41]

Department of Scientific and Industrial Research: Water Pollution Research. Summary of Recent Literature. Vol. 10, 1937. Pp. ii+36. (London: H.M. Stationery Office.) 2s. net. [51]

Booklet 7: Geology's Interest hinges on Changing Climates. Pp. ii+34. (London: Moses B. Cotsworth.) 2s. 6d. net. [71]

Technical Publications of the International Tin Research and Development Council. Series A, No. 48: The Production of Black Anodic Coatings on Tin and Tin Alloys. By Dr. R. Kerr and D. J. Macnaughtan. Pp. ii+7+2 plates. (London: International Tin Research and Development Council.) Free. [111]

British Industries Fair, 1937, Olympia and White City, London, February 15th to 26th. Organised by the Department of Overseas Trade. Special Overseas Advance edition. Pp. xvi+400+Ad. 128+Ad. xii. 1s. Alphabetical Lists of Exhibits. Pp. 128. (London: Department of Overseas Trade.) [111]

## Other Countries

Memoirs and Observations of the Czech Astronomical Society at Prague. Vol. 1, No. 1: Aktivité solaire en année 1934. Bar B. Nováková. Pp. 11. Vol. 1, No. 2: Nebulosité difuses et obscures d'Orion. Par F. Schüller. Pp. 4+1 plate. (Prague: Czech Astronomical Society.) [41]

U.S. Department of the Interior: Geological Survey. Professional Paper 182: The Tertiary Floras of Alaska. By Arthur Hollick: with a Chapter on the Geology of the Tertiary Deposits, by Philip S. Smith. Pp. iii+185+122 plates. (Washington, D.C.: Government Printing Office.) 1.00 dollar. [41]

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 773-C: Artesian Water in the Florida Peninsula. By V. T. Stringfield. (Contributions to the Hydrology of the United States, 1936.) Pp. iv+115-195+plates 6-16. 20 cents. Water-Supply Paper 773-D: Ground-Water Resources of Kleberg County, Texas. By Penn Livingston and Thomas W. Bridges. (Contributions to the Hydrology of the United States, 1936.) Pp. ii+197-232+plates 17-21. 10 cents. Water-Supply Paper 777: Water Levels and Artesian Pressure in Observation Wells in the United States in 1935; with Statements concerning Previous Work and Results. Prepared under the direction of O. E. Meinzer and L. K. Wenzel. Pp. iii+268. 30 cents. Water-Supply Paper 784: Surface Water Supply of the United States, 1935. Part 4: St. Lawrence River Basin. Pp. 170. 20 cents. Water-Supply Paper 787: Surface Water Supply of the United States, 1935. Part 7: Lower Mississippi River Basin. Pp. 150. 20 cents. Water-Supply Paper 791: Surface Water Supply of the United States, 1935. Part 11: Pacific Slope Basins in California. Pp. 361. 45 cents. Water-Supply Paper 793: Surface Water Supply of the United States, 1935. Part 13: Snake River Basin. Pp. 197. 25 cents. Water-Supply Paper 794: Surface Water Supply of the United States, 1935. Part 14: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. 167. 20 cents. (Washington, D.C.: Government Printing Office.) [41]

The Biochemical Research Laboratories of the Franklin Institute. Pp. 77. (Philadelphia, Pa.: Franklin Institute.) [41]

Forest Research and Indian Industry: the Work of the Forest Research Institute at Dehra Dun and its Utility to Government Departments and Industrialists in India. Pp. iv+24+9 plates. (Delhi: Manager of Publications.) [41]

U.S. Department of Agriculture. Farmers' Bulletin No. 1759: Game Management on the Farm. By J. N. Darling, H. P. Sheldon and Ira N. Gabrielson. Pp. ii+22. 5 cents. Farmers' Bulletin No. 1760: The Use of Bluegrass Sod in the Control of Soil Erosion. By R. E. Umland. Pp. ii+13. 5 cents. (Washington, D.C.: Government Printing Office.) [41]

New Zealand: Department of Lands and Survey. Annual Report on Public Domains and National Parks of New Zealand. Pp. 8. (Wellington: Government Printer.) 6d. [41]

Department of Agriculture, Mauritius: Sugarcane Research Station. Bulletin No. 10: Some Data on the Effect of a Late Heavy Dressing of Nitrogenous Fertilizer on the Growth and Metabolism of Sugarcane in Mauritius. By Dr. H. Evans. Pp. 10. (Port Louis: Government Printer.) [41]

Science Reports of the Tokyo Bunrika Daigaku, Section A. No. 54. Resultanttheorie bei Formen in zwei Variablenreihen. Von Tikara Tôya. Pp. 111-121. (Tokyo: Maruzen Co., Ltd.) 20 sen. [81]

## Catalogues, etc.

X-Ray Couches. Pp. 8. (London: Newton and Wright, Ltd.)  
Navigation, Geography, Travels, Shipbuilding, Trade and Commerce, Economics; with a Collection of French Royal Administrative Acts relating to the Navy, the Post and Road Transport in France. (Catalogue 42.) Pp. 97. (London: E. P. Goldschmidt and Co., Ltd.)  
Calendar for 1937. (Edinburgh: Heriot-Watt College.)  
Chronica Botanica Calendar 1937. (Leiden: Chronica Botanica, Ltd.)