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Organisation of Industry

THE object of industry is to make commodities for the people : one reason for organising industry is to make more commodities at a lower price so as to raise the standard of living. This is the primary purpose for which industry exists, though necessarily every firm must carry out its operations at a profit, otherwise it cannot continue to operate when its resources have been expended. The profit is claimed by capital as a reward for the risks incidental to participating in business : if there were no such reward, there would be no incentive to invest in other than gilt-edged securities. Wages and salaries are paid as part of the cost of production ; they do not depend directly on profits, though in bad times the weekly wage-earner suffers lack of employment. A large school of modern thought seeks to make labour a more active partner in every manufacturing enterprise and would limit the reward to capital. In theory the idea is excellent, and where profits are good and more or less regular so that new capital is easy to obtain, its introduction into actual practice is attended with success. There are, however, industries and enterprises which are liable to fluctuations and therefore contain a considerable element of risk. These are difficult to finance, provide precarious employment and often no dividends ; in them the risks and the misfortunes have to be borne by capital and labour alike ; there is hardship to both.

When such industries are of the magnitude of the iron and steel or the cotton industry, the hardship is widespread, whilst the numbers of the workless or partially employed or lowly paid give them a political influence to express their grievances which tends to obscure the real nature of the problem and the steps which must be taken to solve it, always regarding the problem from a

scientific angle as influenced by, and depending for its solution on, ascertainable facts and circumstances.

It is to the credit of the present Government that much of the real revival which has taken place in industry is based on the removal of difficulties of one kind and another by sound and non-political methods, sometimes by means of tariff protection or by other form of Government assistance, at other times by financial assistance in the form of refinancing with cheap money.

The need for industrial reorganisation to meet the changing problems of the day is an obvious one. Various schemes for doing this have been put forward ; some of them are of a drastic character, among which may be included those involving nationalisation.

It must be realised, though the fact is not always stated, that the ultimate prosperity of any particular firm depends on the individuals who manage it, and though they cannot rise superior to the bigger economic difficulties caused by world happenings, they can do much to mitigate the incidence of these. Too much importance may be attached to machinery and too little to leadership.

If it be granted that national prosperity depends on the level of industry, then to maintain this at a high level requires the elimination of the upsets caused by alternate booms and depressions. It is agreed that these ought to be preventable and that industry requires organising with this end in view. Whilst fair competition within an industry is essential, it should be possible in certain circumstances for an industry to act as a whole, either in relation to other home industries or when negotiating with the competitive industry in foreign countries. The subjects which concern an industry as a whole are numerous ; they

include research, propaganda, co-operative selling and buying, the collection of information and statistics, relations with labour, training, and more particularly the relations with our own Government in its many branches.

Such combination is effected by trade associations which, as experience is gained, are becoming more efficient, more comprehensive, more powerful and of greater use to their members and to the State. They have been developed alongside the changing conditions in industry. It is impossible to anticipate the changes or to provide for them, for they follow no rules: the more alert industries, which incidentally are those which are most scientific, are able to organise the most closely in point of time to the altered conditions.

It is essential that such organisations are entirely free from political partisanship and based only on strict economic considerations, and the same applies to the central organisation, the Federation of British Industries, which embraces all the separate trade associations as well as individual firms in its membership. Primarily formed to deal with questions of common interest presented by various Government departments during and after the War, the sphere of influence and utility of the Federation continues to increase, and it presents an organisation in advance of anything existing abroad.

Trade associations are purely voluntary, both in regard to membership and the decisions taken as the result of a majority vote. Recently the question has been widely ventilated, partly on the initiative of Lord Melchett, as to whether compulsory powers should be given to them through Order in Council, on the supposition that a full measure of industrial co-operation cannot be obtained through voluntary effort.

The compulsion of minorities is a principle which is so largely alien to British ideas that considerable attention has been given to the Bill introduced by Lord Melchett in the House of Lords. An influential committee was appointed by the Federation of British Industries to ascertain the views of trade associations and report the considered opinion of collective industry: this has been largely used in compiling the publication before us.* On this particular point it is stated by the F.B.I. Committee that the procedure of putting into force by Order in Council the decisions of the majority of an industry, when approved by an appointed tribunal and by the President of the

Board of Trade, would be an undesirable addition to bureaucratic powers.

It is essential that Parliament should appreciate, as it has generally failed to do in the past, that our whole national structure is dependent on industry, and that it must assist industry to maintain its efficiency. At bottom, industry must be financially sound, working at a profit, well and scientifically managed; redundancy, overlapping and waste must be eliminated. Though it would be tempting to have powers within an industry to force the scrapping of certain plant or prevent the extension of another factory where sufficient manufacturing capacity already existed, it is widely felt that the undue extension of compulsory methods would endanger the freedom of thought and action which we enjoy to-day.

Generally speaking, voluntary methods are proving successful; and although progress by such means is often slow, it can be speeded up very rapidly and without formalities when action is agreed. Compulsion by a majority introduces the effect of rigidity and would have a cramping effect on leadership. Indeed minorities, when progressive, are often in advance of general opinion and responsible for the new inventions and methods which bring prosperity.

There have been, of course, instances in which the failure of a trade to agree has brought increasing distress to workers and shareholders alike. The F.B.I. Committee, whilst emphasising their rarity, admits the necessity of dealing with these from without, and suggests a procedure involving examination by a tribunal appointed by the president of the Board of Trade. Lord Melchett, in favouring the appointment of such statutory committees, cites the success of the Tariff Advisory Committee and considers they would enable highly specialised industrial and technical problems to be dealt with by impartial and experienced individuals.

The Report, the consideration given to the question by the individual trade associations, the addresses given by Lord Melchett to various bodies, and those given by others who take an opposite view, have served to focus attention not only on what is a relatively minor point of compulsion versus voluntary co-operation, but also on the need for organisation within an industry. The importance and the value of co-operative effort have been emphasised in no uncertain manner, and the realisation that the firms in each and every industry must act nationally for the

* Survey of Britain's Recent Commercial Policy. Pp. 50. (Federation of British Industries, 21 Tothill Street, London, S.W.1.) 1s.

good of all rather than individually for the profit of the moment is proceeding apace. Instances multiply where several firms co-operate to make a new product instead of each setting up individually in competition; there is evidence that British industry is solving the new problems of the day:

hence perhaps our trade revival, our recovery of such export markets as exist in spite of exchange and similar restrictions. It remains as the next step to carry this spirit of co-operation out into the Empire, to build on the foundations of amity laid at Ottawa.

Science and Philosophy

The Frontiers of Psychology

By William McDougall. (The Contemporary Library of Psychology.) Pp. xii+235. (London: Nisbet and Co., Ltd.; Cambridge: At the University Press, 1934.) 5s. net.

THE need for re-examining and redefining the boundaries of these two fields of intellectual activity has been felt more and more in recent years, and may be said to have become acute with Sir James Jeans's presidential address at the Aberdeen meeting of the British Association. The incursion of the physicist into metaphysics is a new and, to the psychologist no less than the philosopher, a most striking phenomenon. Time was, not so long ago, when the right of the psychologist to be regarded as a scientific worker was challenged on the ground that his pretended science was not science at all, but metaphysics, and no one challenged more loudly or more insistently than the physicist. There is doubt whether some physicists would concede the claims of the psychologist even yet, but it is certain that they must now formulate their challenge in different terms.

Prof. W. McDougall's little book is certainly well-timed in view of the metaphysical tendencies of the new physics. Possibly the author shows a tendency to exaggerate the importance of the position of psychology. After all, psychology is a very young science. He cannot be said to exaggerate the importance of including in our scientific account of the 'mysterious universe' phenomena which fall within the field of study of the psychologist, and his deprecation of the gap that has been created between the world of the new physics and the world as experienced is at least thought-provoking. The tone of the book is controversial—at some points pugnaciously so. Possibly also the author makes rather too much of inconsistencies in the writings of well-known physicists, which are due as much to the inadequacies of our language as to the doctrines of the new physics. None the less, the book is one which required to be written, and the author has presented clearly and cogently a case that required to be presented.

Among the many interesting problems on the frontiers of psychology with which McDougall deals there are two of fundamental importance. One is the relation between science and philosophy; the other, which is really involved in the first, is the place of the conception of causality in a scientific universe of discourse.

With regard to the first of these problems, it is very doubtful whether either scientific worker or philosopher would accept McDougall's solution. According to his view, science deals with facts, philosophy with values; science aims at knowledge, philosophy at wisdom. Truth has therefore a different meaning, and the criteria of truth are different for man of science and for philosopher respectively. For the man of science, a statement or proposition is true when it corresponds to facts, and the criterion of truth is the pragmatic one, that our anticipations based on the statement should be fulfilled. The pragmatic criterion, however, has no meaning for the philosopher. As concerned with values, he seeks validity rather than truth in the scientific worker's sense.

It is true that the points of view of science and philosophy are different, and when this difference is neglected, science may become a day-dream and philosophy a nightmare. Some scientific workers of the present day—McDougall cites Needham, but there are others—seem prepared to accept the view that modern science is a figment of the mind, representing the world of concrete reality as little as a day-dream. McDougall contends, and it seems to us rightly, that such a view of science, physical or biological, is untenable, since it involves the negation of the essential principle of science itself. The philosopher, however, is scarcely likely to accept McDougall's restriction of his sphere of influence to the realm of values. On such a view, logic, ethics and æsthetics would be included in philosophy, but metaphysics would be excluded. The philosopher seeks rationality in the world of fact as well as validity in the world of value. McDougall has apparently presented us with a view of science that might satisfy the philosopher, but would not

satisfy the man of science, and a view of philosophy that might satisfy the man of science, but would not satisfy the philosopher.

The problem of the place of the conception of causality in a scientific universe of discourse is clearly one aspect of the larger problem. The notion of causality is derived from the human being's experience of his own activity and its results. McDougall argues in effect that the scientific worker's distrust of anthropomorphism has led him to an impossibly extreme rejection of anything in the nature of agency, force, power, as concepts which may be legitimately employed in the scientific description of natural phenomena. He points out that science began in the search for causes in the naïve sense of the word, and that the search for causes is still in a very real sense the life-blood of science.

If such words as truth and causality are to have different connotations in science and philosophy respectively, it can only be regarded as a grave

misfortune, and McDougall's plea for reconsideration from a psychological point of view merits at least a sympathetic hearing. After all, science and philosophy are both attempts to give a consistent and rational account of human experience. The hypostatizing of abstractions, with which McDougall charges physicists, has as little justification as anthropomorphism, and less than a limited and reasonable anthropomorphism. Human experience itself is a fact of the universe which any comprehensive scientific description of the universe must include.

Other fundamental problems discussed by McDougall, such as progress and value, raise the same difficulties as regards the divergence and inconsistency of scientific and philosophical points of view. One may not always agree with McDougall's conclusions, but the value of the service he has rendered in the formulation of questions of pressing urgency for both science and philosophy can scarcely be denied.

Mathematical Methods in Meteorology

Physical and Dynamical Meteorology

By Prof. David Brunt. Pp. xxii+411. (Cambridge: At the University Press, 1934.) 25s. net.

PROF. BRUNT'S book covers the field that links meteorology with physics. The treatment is mathematical wherever tractable problems can be defined, and elsewhere more descriptive. As a whole, the book gives an impressive review of the growing success of mathematical methods within such an empirical science as meteorology. Much of this progress is of a rather recent date and a considerable portion of it is due to the efforts of British investigators, so that it is very much to be welcomed that one of these pioneers has now found the opportunity to present the whole field of physical and dynamical meteorology in text-book form.

Let it be said at once that the book is an admirable piece of work, well arranged, sound and clear. The chapters on thermodynamics and on turbulence deserve to be mentioned especially in this connexion. They are also more complete than has hitherto been the case in meteorological works.

The following few points of criticism are less concerned with the correctness of the book's statements than with the questions of what might have been included.

The description of the heat balance of the atmosphere seems to imply that the stratosphere loses heat to space through the so-called *W*-radiation (mostly wave-lengths greater than 14μ)

without having it sufficiently replenished. The theory of Albrecht (briefly referred to on p. 105, but not accepted) concerning the breaking up of the *W*-radiation band into separate lines at low temperature and pressure is the only one to my knowledge that mitigates the difficulty, in that it makes the upper troposphere the place where there is a net loss of radiative heat and where a corresponding amount of heat can be received by advection and convection.

Brunt gives a very good and up-to-date description of synoptic meteorological problems. The map illustrations are well chosen, but they would have been still more convincing if they had been based on a denser network of land stations and as many ship observations as possible. The lack of detail in the maps is, however, partly overcome by the reproduction of autographic records from selected stations, which show good examples of the various kinds of frontal passages. (On p. 320, by mistake, autographic records from Valencia and Holyhead have been interchanged.)

Whereas the frontal description of the life-history of cyclones seems to have met with Brunt's approval, this is not the case with the attempt to formulate a mathematical theory of these phenomena. The reviewer agrees with Brunt in considering the waves of Helmholtz-Wegener (1921) and of V. Bjerknes (1921) as inadequate analogies to the nascent cyclones. Both of these are purely gravitational waves in horizontal surfaces of

discontinuity on a non-rotating earth. But it must be remembered that the contributions in question formed only the very first beginning of a general exploration of all possible small disturbances of an initial state of rest or of steady motion in the atmosphere. These disturbances have to begin with the character of stable or unstable waves. The stable ones remain small and unimportant, whereas the unstable ones grow larger and more intense. Unstable waves with wave-lengths as long as those observed in nascent cyclones were not found until the waves were transferred to a sloping surface of discontinuity on a rotating globe (Solberg, 1928-33). These waves, of a composite gravitational-inertial character, also show the following features: quasi-horizontal

orbits of the air particles, periods longer than $12/\sin \varphi$ hours and uni-directional wave-propagation. Waves having all these properties seem to be justifiably analogous to the nascent polar front cyclones.

It is to be hoped that the wide field of atmospheric wave-motions, with its applications to tides, polar front and tropopause waves, wave-clouds and acoustics will be represented in a later edition of Brunt's book.

The reviewer's suggestions should of course not be taken as signs of severe criticism. After all, Prof. Brunt's book is in nearly all fields so masterly that it is bound to prove indispensable to all students of dynamical meteorology for many years to come.

J. BJERKNES.

Kükenthal and Krumbach's Zoology

Handbuch der Zoologie:

eine Naturgeschichte der Stämme des Tierreiches. Gegründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. (Berlin und Leipzig: Walter de Gruyter und Co., 1932-35.)

(1) Bd. 2: Vermes Amara, Vermes Polymera, Echiurida, Sipunculida, Priapulida. Lief. 15. Pp. 113-240. 16 gold marks. Lief. 16. Pp. 193-320 + xiv. 18 gold marks. Lief. 17. Pp. 241-352. 14 gold marks. Lief. 18. Pp. 161-278 + xviii.

(2) Bd. 3, Hälfte 2: Chelicerata, Pantopoda, Onychophora, Vermes Oligomera. Lief. 4. Pp. 96. 12 gold marks. Lief. 5. Pp. 97-192. 12 gold marks. Lief. 6. Pp. 65-138 + 6. 10 gold marks. Lief. 7. Pp. 193-288. 12 gold marks. Lief. 8, Teil 1. Pp. 33-96. 8 gold marks.

(3) Bd. 4, Hälfte 2: Insecta 2. Lief. 1. Pp. 893-1036. 18 gold marks. Lief. 2. Pp. 1037-1132. 12 gold marks.

(4) Bd. 5, Hälfte 2: Tunicata. Lief. 1. Pp. 96. 12 gold marks. Lief. 2. Pp. 97-192. 12 gold marks. Lief. 3. Pp. 193-272. 10 gold marks. Lief. 4. Pp. 273-400. 16 gold marks. Lief. 5. Pp. 401-544. 18 gold marks.

(5) Bd. 6, Hälfte 1: Acrania (Cephalochorda), Cyclostoma, Ichthya. Lief. 2. Pp. 113-208. 12 gold marks. Lief. 3. Pp. 209-336. 16 gold marks. Lief. 4. Pp. 337-448. 14 gold marks.

(6) Bd. 7: Sauropsida, Allgemeines; Reptilia; Aves. Hälfte 1, Lief. 2. Pp. 129-224. 12 gold marks.

(7) Bd. 7: Sauropsida, Allgemeines; Reptilia; Aves. Hälfte 2, Lief. 7. Pp. 657-768. 14 gold marks. Lief. 8. Pp. 769-899 + xi. 18 gold marks.

(1) THESE four parts complete the second volume of the "Handbuch der Zoologie". The fifteenth and seventeenth, about

230 pp., are devoted to an excellent account of the Hirudinea which is commendable for its attention not only to general structure and morphology, biology and development, but also to the neurones and other details of histology. About a third of the 300 illustrations are due to the senior author, Dr. J. A. Scriban. Appended is a list of rejected names of genera and species of leeches and the corresponding names now considered to be valid.

The sixteenth part contains the concluding portion of Prof. E. Bresslau's account of the Turbellaria. Regeneration and regulation, so much studied in the triclads, ecology and geographical distribution receive full consideration. A useful list is given of parasitic Turbellaria and their hosts. Prof. Bresslau and Dr. E. Reisinger have contributed a competent and well-illustrated account of the Temnocephalida.

In the eighteenth part is the excellent index to the entire volume.

This second volume, the publication of which has extended over nearly six years, is divided into two halves. The first half, which forms a volume of nearly 1,400 pages with a similar number of figures, contains the descriptions of the flatworms, Nematelminthes, Rotifera, Gastrotricha and the Bryozoa Entoprocta. The second half is devoted to the Annelida and the Gephyrea and contains about 850 pages and 860 figures. The volume has been planned on a scale sufficient to enable the authors to deal with their respective subjects in a thoroughly adequate manner, and the result is a volume of great interest and usefulness.

(2) Of the five parts of the third volume noted above, one (the sixth) is devoted to the account of

the Onychophora (*Peripatus*) and the other four to some of the orders of Arachnida.

Dr. F. Zacher summarises present knowledge of the anatomy, geographical distribution and classification of the Onychophora and refers to some features of their biology, for example, their power of fasting and their mode of locomotion. Some reference to the histology of the alimentary canal might have been included. The paucity of our knowledge of the physiology of these animals emphasises the interest of the investigations now in progress.

The fourth, fifth and seventh parts contain accounts by Dr. A. Kästner of the Pedipalpi, Palpigradi, Ricinulei and Solifugæ (incomplete), and by Dr. Max Beier of the Pseudoscorpionidea. Both authors have given useful and adequate descriptions of the anatomy and biology of these orders and have contributed new illustrations.

Prof. Gerhardt contributes in the eighth part a useful account of the Xiphosura (*Limulus*) which, however, does not include notice of the interesting observations of Carlson and others on the physiology of the heart.

(3) Of these parts the first, by Dr. A. Handlirsch, is on the Hymenoptera and the second, by Prof. Meixner, on the Coleoptera (unfinished). The treatment of the morphology, natural history and classification of the Hymenoptera follows the usual lines. In the very brief section on physiology we do not find any information on the enzymes of the alimentary tract, on visual acuity and how bees recognise their own hive, or on the observations of von Frisch on colour vision, smell and taste in bees. Nor do we find any reference to the effects on external characters, sex and reproduction produced by the parasite *Stylops* in the Hymenoptera in which it is present, or to the occurrence of the Pupiparan *Braula* on bees.

(4) The first and second parts of the fifth volume (second half) contain a monograph of about 200 pages on the Appendicularia by Prof. Hans Lohmann, whose studies on these ascidians, extending over forty years and including the examination of collections from many expeditions, give him a special claim to write this account. He describes in detail the anatomy, development and biology of the members of this class and devotes a good deal of attention to the formation and structure of the 'house' of *Oikopleura*, to the ingoing and outgoing currents, and to the basket-work which forms the food-collecting mechanism. The geographical distribution and the classification (into twelve genera) are carefully considered, and in a useful diagram Prof. Lohmann represents eight stages in the probable evolution of the genera of the family Oikopleuridæ.

The third part begins with a brief general introduction to the natural history of the Thaliacea—*Pyrosoma*, *Doliolum* and *Salpa*—by Prof. G. Neumann, who has had long experience in the investigation of these floating ascidians. The emission of light by *Pyrosoma*, first seen by Péron in 1804, is discussed, and the recent work on the symbiotic bacteria in the mycetocytes in which the light is produced is carefully set forth. A detailed account of the Pyrosomida and the Cyclomyaria, in which the development and budding receive particular attention, is completed in the fourth part.

In the fifth part the last order of the Thaliacea (*Salpa* and its congeners) is well described by Prof. Ihle, who adds an appendix on the aberrant genus *Octacnemus* discovered by the *Challenger* Expedition and found only twice since then.

(5) Dr. V. Pietschmann provides, in these three parts, an account of the Cyclostomes which, however, will require at least one further part for its completion. Ninety pages, a disproportionate amount of space, are devoted to the account of the structure of the brain and spinal cord, including studies of the neurones from the work of Retzius and other neurohistologists. The numerous illustrations are well chosen and excellently reproduced.

(6) Dr. Otto von Wettstein completes his description of the anatomy of *Sphenodon*, the nervous system, sense organs, alimentary respiratory, vascular, excretory and reproductive systems being successively considered. The development is briefly sketched, the fossil relatives of *Sphenodon* are discussed, and what is known of the biology of the animal is adequately summarised.

(7) In these two parts, Prof. E. Stresemann's important volume on the birds is completed. In the first fifty pages are discussed the many aspects of migration, and examples of various kinds of migration are described. Among the examples of long flights in migration he states that it appears almost impossible that a snipe, *Capella hardwickii*, should fly without resting, twice in the year, from its breeding place in north Japan to its winter quarters in eastern Australia and Tasmania, where it lives from September until January. The distance between its two homes is 5,000 km. and the bird has never been found in any intermediate station. The work done on a shorter migration by a moderate-sized plover, *Charadrius dominicus fulvus*, flying from the Aleutian Islands to its winter quarters in the Hawaiian Islands, the shortest passage between which is 3,300 km., is represented by about a quarter of a million strokes up and down of the wings. The bird is estimated to travel 26 metres a second and to make two strokes of the wings a second over the flying period of

35 hours. Estimates for other birds give periods of pauseless flights of 40–48 hours. The reserves available in the body to meet this great demand for energy are fat, glycogen and protein, of which fat is by far the most important. Writing of the heights attained by birds, the author records that two British aviators saw two large birds, probably cranes, at a height of 15,000 ft., that a flock of rooks was once observed at 11,000 ft. and that plovers were seen at more than 5,000 ft. But, according to aviators, birds fly as a rule at a height of less than 1,000 metres and the smaller ones below 300 metres. This part of the work is of great general interest.

A list is given of the helminthes and arthropods parasitic in or upon birds and, in connexion with the Mallophaga, a brief consideration of these insects as possible indicators of the affinities of their hosts, leads to the conclusion that such a method must be applied with the greatest care and that at least one of the cases cited cannot be supported.

The classification which follows contains also notes on structure and biology, and is illustrated by drawings of skeletal and other anatomical features and by photographs of birds in Nature.

Prof. Stresemann's volume of 900 pages is a well-balanced and exceedingly interesting account of the structure and life of birds.

When the first part of this "Handbuch" was published nearly ten years ago, the work was advertised to be completed in five volumes. It has expanded to seven volumes, each of which except the first is divided into two halves. It would be of advantage to many subscribers if the editors and publishers, who are probably now within sight of the end of their labours, could give some idea when the remaining parts of the work are likely to be completed. Meantime we offer them, and the contributors of the parts above noted, cordial congratulations on the high quality of their work and on the extent of the output during the last three years.

Stainless and Chromium Steels

(1) The Book of Stainless Steels:

Corrosion resisting and Heat resisting Chromium Alloys. Edited by Ernest E. Thum. Second edition. Pp. xii+787. (Cleveland: The American Society for Steel Treating, 1935.) 5 dollars.

(2) Chromium Steels

By Dr. Richard Henry Greaves. (Department of Scientific and Industrial Research.) Pp. vi+321+4 plates. (London: H.M. Stationery Office, 1935.) 7s. 6d. net.

(1) THE introduction of steels having a high resistance to corrosion is probably the most important advance made in the metallurgy of steel in the last twenty-five years. Beginning with the invention of 'stainless' cutlery steel by Brearley, the range of composition of corrosion-resisting steels has been widened, until now products having the most diverse mechanical properties have been obtained. By using nickel and chromium together and keeping the percentage of carbon low, alloys are made which can be pressed, drawn, or otherwise worked without injury to their chemical properties. It was found, however, that exposure to high temperatures, either over long periods as in superheater tubes, or intensely for a short time as in the making of welded joints, may cause a peculiar kind of brittleness, and much research was necessary to find means of overcoming this difficulty, mainly by the addition of small quantities of other elements.

In the present work, which has soon reached a second edition, steels of this class are discussed from every point of view by a large team of authors. The manufacture, constitution, properties and uses in the engineering and chemical industries are fully discussed, and the precautions to be taken in welding and in the construction of plant are explained with great thoroughness. As is natural in such a composite work, there is some overlapping, and the contributors do not always agree on matters of detail; but in general the information proves on testing to be full and accurate. It may be mentioned that eleven pages are occupied by a list, classified according to composition, of the trade names of the 'stainless' steels, although only American brands are included.

(2) Chromium is an essential component of steels of the stainless class, but it also enters into the composition of many other steels of technical value, among them the nickel-chrome steels so widely used in engineering. The simple chromium steels, except perhaps those used for ball-bearings, are less frequently discussed, and Dr. Greaves has rendered a valuable service in presenting so detailed an account of their properties. Many of the experimental data are derived from work at the Research Department, Woolwich. The information is clearly given, and illustrated by excellent photomicrographs. Full references at the end of each section make it easy to consult the original publications.

The Fundamentals of Chemical Thermodynamics
By Dr. J. A. V. Butler. Part 1: Elementary Theory and Electrochemistry. Second edition. Pp. xv+253. (London: Macmillan and Co., Ltd., 1935.) 7s. 6d.

IN the second edition, the general plan of this book has been retained, but several chapters have been rearranged and partly rewritten. This revision has improved the utility of the book. About fifty pages of new material have also been added. These include a discussion of heterogeneous solid-gas equilibria, dealing with the carbon-oxygen reaction and its participation in the blast furnace; the methods of electrometric hydrogen ion determination and potentiometric titrations, which are very briefly dealt with; oxidation-reduction indicators, which are briefly but clearly explained; and a section on electrolysis which includes a discussion of over-voltage from the modern point of view.

It is doubtful whether the treatment of freezing point depression on p. 76 has any advantage over the usual one, in which the thermal properties of the solution are eliminated, since no proof of the validity of the second equation is given. The name 'isochore' applied to an equation for constant pressure (p. 98) seems misplaced. The author adopts the American definition of free energy and introduces the term 'net work' for its diminution, that is, the actual work minus the work done against external pressure, which seems a useful procedure. The book is clearly and accurately written, and the new edition is likely to increase its popularity and usefulness.

The Discovery of Specific and Latent Heats

By Dr. Douglas McKie and Niels H. de V. Heathcote. Pp. 155+6 plates. (London: Edward Arnold and Co., 1935.) 6s. net.

THIS scholarly treatise emanates from the School of History, Methods and Principles of Science at University College, London, and its authors must surely have devoted many hours of patient study and research among the original eighteenth century works in order to obtain the material for their book. As Prof. E. N. da C. Andrade, in his eulogistic preface points out, the subject of the book is no less than the very foundation of the modern science of heat. Most of the writings to which reference has been made have been consulted in the original languages, including the Swedish of Wilcke. The authors have established by these studies that his work, while independent of Black's, was "both later and less satisfactory". The credit for the discovery of specific and latent heat may therefore be fully attributed to Black.

Portraits of the leading figures are reproduced; some of the lesser-known ones have only been secured after much trouble. A valuable feature of the book is the inclusion of extracts from the originals, showing the care and trouble with which these early experiments were carried out. It has often been urged that present-day students should study the early masters, and this book provides a convenient means so far as the subject of heat is concerned. H. R. L.

Research: the Pathfinder of Science and Industry
By T. A. Boyd. Pp. xvi+319. (New York and London: D. Appleton-Century Co., Inc., 1935.) 10s. 6d. net.

IN this volume the author tells in a pleasing way just what research is, and what the ordinary research worker does. The book is divided into five parts. In the first, the distinction between pure and applied research is explained; in the second the organisation of modern research and the general lines followed are discussed, including useful sections on the financing of the projects and the selling of the results. The third and fourth sections, "Men" and "Qualifications", contain information which must prove of value not only to those responsible for appointing the staffs of laboratories but also to those anticipating scientific research as a career. Part V, "Achievement", should prove a fruitful source of replies to those who doubt the wisdom of spending time and money on research. Part VI consists of miscellaneous essays.

The reading is apt to be a little discontinuous owing to the continual introduction of anecdotes and quotations, some of which are repeated more than once. *Bons mots* uttered by certain leading American directors of research laboratories are also liberally sprinkled throughout the book. The value of these excellent essays might have been enhanced had the author included information and facts concerning present-day research in countries other than America; it would have been of value to read in such a book some of the important pronouncements of a few of the leading European directors of research, alongside those of their American contemporaries. H. R. L.

Principles of Mechanism

By Prof. C. E. Pearce. Pp. ix+283. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1934.) 21s. 6d. net.

INTENDED to be used as a textbook in classes entering upon the study of mechanisms and having little familiarity with the details or operation of machinery in general, Prof. Pearce's "Principles of Mechanism" provides a useful elementary survey of the subject. The matter is much more on the practical side than the title suggests, and the arrangement is designed to lead up to the general principles through a detailed discussion of a number of the more important and representative applications such as: friction, toothed and screw gearing; belt, rope and chain drives; intermittent motions; ordinary and epicyclic wheel trains. Then, after explaining in detail and by numerous examples the method of analysis by centro or virtual centre, the author concludes with linkages, cams, and the geometrical problems involved in straight line motions, motor-car steering gears, etc.

While the book as a whole deals with matter which is not new, the author has succeeded, by his arrangement of the subject, the explanatory text and the examples chosen, in putting it before his readers attractively and convincingly. A valuable feature for the student is the comprehensive range of problems presented for solution. J. A. C.

The Rev. John Kerr, F.R.S., Inventor of the Kerr Cell

By Dr. Robert C. Gray

ONE of the many problems in television reception is that of modulating the brightness of the spot of light that, travelling very rapidly over the screen, gives the sensation of a completely moving picture. In one system a neon lamp is used, and the brightness of the lamp is varied by the incoming signals being allowed, after suitable amplification, to alter the voltage across the lamp. A neon lamp is not very bright, compared with a filament or arc lamp; and the next development was the use of a bright lamp, the brightness of the beam of light being altered after the light had left the lamp.

The first experimenters who tried this latter method found that the necessary apparatus was already available in the Kerr cell; it had been invented in 1875 by a Glasgow man, and had been lying for more than fifty years awaiting a practical application.

John Kerr was born at Ardrossan, Ayrshire, on December 17, 1824. He was the second son of Thomas Kerr, who owned a fleet of fishing vessels, and he received part of his education in a village school in Skye. He entered the University of Glasgow in 1841 as a divinity student, and took the usual classes for the degree of master of arts. During the session 1845-46, he took the class of natural philosophy, when it was taught during the illness of Prof. Meikleham by David Thomson, afterwards professor of natural philosophy at Aberdeen. In 1846 William Thomson, who later became Lord Kelvin, was appointed to the chair of natural philosophy. William Thomson was only six months older than Kerr, and there sprang up a close friendship between these two young men, professor and student, each

twenty-two years old, a friendship that was to last for more than sixty years until their deaths, within four months of one another, in 1907. Kerr continued his studies in physics under Thomson for three more years, gaining special prizes, in successive years, on the subjects of "The Mathe-

matical Theory of Magnetism", "The Mathematical Theory of Electricity", and "The Distribution of Electricity on Spherical Conductors". He graduated master of arts in 1849, eight years after his first matriculation, "with Highest Distinction in Mathematics and Natural Philosophy", and was awarded the Earl of Eglinton's Prize of twenty sovereigns as the most distinguished student in mathematics and natural philosophy. He engaged in teaching for some time, and was ordained to the ministry of the Free Church of Scotland, but did not preach very often.

In 1857 Kerr was appointed lecturer in mathematics and physical science in the Free

Church Training College for Teachers, Glasgow. In 1863 he published a pamphlet entitled "The Metric System: its Prospects in this Country", and in 1867 a book on what he called "Rational Mechanics". In the following year the senate of the University of Glasgow, on the recommendation of Profs. Thomson and Blackburn, conferred on Kerr the honorary degree of doctor of laws.

From 1848, Prof. Thomson was gradually converting what had been the old professorial wine-cellar into a physical laboratory for students, the first in the world. Thomson invited his students to help him in his measurements, and Kerr was one of the earliest members of the pioneer team, composed, strangely enough, mostly of divinity students. This experimental training under an

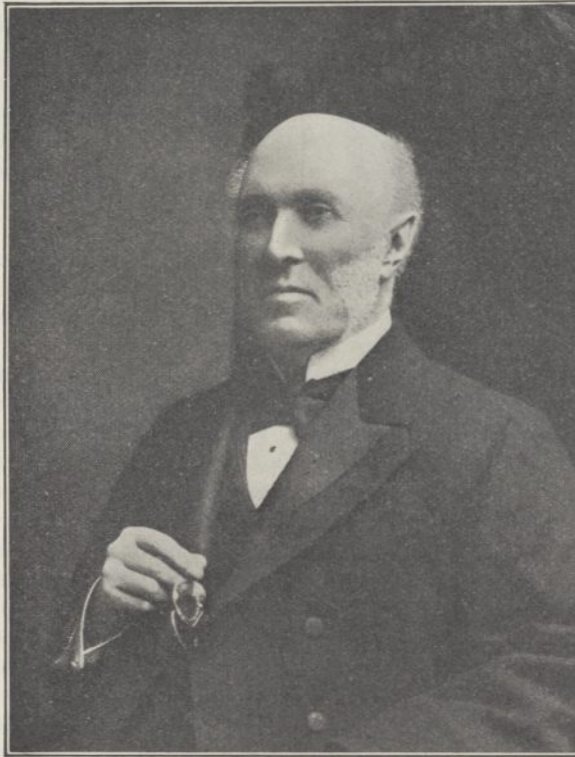


FIG. 1. The Rev. John Kerr, M.A., LL.D., F.R.S. (1824-1907).

enthusiastic leader had a great influence—as such training generally has—on Kerr's after-life, and when he joined the teaching staff of the training college, he utilised a cellar there for experimental work. Afterwards he worked in the basement of his house. He was fifty-one years of age when in 1875 he made his first and most important contribution to science, by a publication, in the

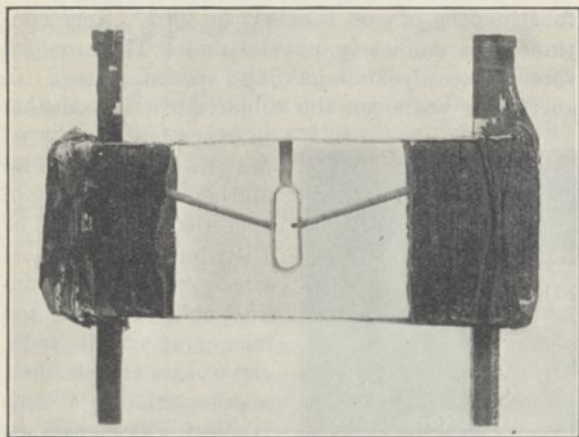


FIG. 2. The first Kerr cell, used by Dr. John Kerr in his discovery of the Kerr electro-optic effect.

Philosophical Magazine, of the discovery of what came to be known as the Kerr electro-optic effect. It is this effect that is utilised in the Kerr cell used in television reception. Faraday in 1834 thought that this effect might exist; he tried to detect it, but failed. William Thomson in 1845 suggested that it might be worth while to search for the effect; his attention was directed to Faraday's negative result, and he abandoned the idea. Thirty years later, Kerr looked for the effect, and found it, first in glass, later in certain liquids.

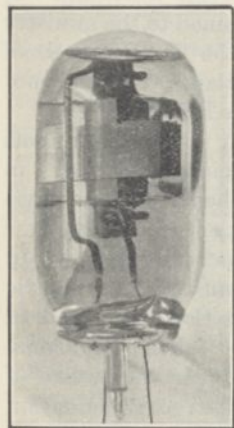


FIG. 3. Kerr cell (1935) as used by Baird Television, Ltd., in television reception.

The original piece of apparatus with which Kerr detected the effect in glass was a simple slab of glass, measuring six inches by three inches, and three quarters of an inch thick; two collinear holes, each an eighth of an inch in diameter, were drilled from the two ends, parallel to the long edges, the ends of the holes being about half an inch apart. Down each of these holes was passed a wire from one pole of an induction coil, and polarised light was passed from one face of the slab to the opposite face. When the induction coil was operated, Kerr found, as he expected, that the

glass had become doubly refracting. He followed up this discovery by searching for, and finding, the same result in liquids. The original cells that he used are in the care of the University of Glasgow, and a photograph of the first cell used for liquids is reproduced as Fig. 2. For comparison, a photograph of a modern Kerr cell is also reproduced (Fig. 3). In the original Kerr cell, the cavity in the centre was closed at the sides by plates of glass, and was filled with liquid through the channel drilled from the top; wires that carried the varying electric potential will be seen passing down the sloping holes; polarised light was passed through the liquid from one side of the slab to the other. In the modern Kerr cell, the voltage is applied between two sets of alternate plates; the liquid used is nitrobenzene, and the light is passed through the liquid in a direction parallel to the planes of the plates. When in 1898 Lord Lister, president of the Royal Society, was presenting a Royal Medal to Dr. Kerr, Lord Lister said: "It has been a matter of admiration and wonder to subsequent investigators that Dr. Kerr should have been able to learn so much with the comparatively simple and ineffective apparatus at his disposal". It is related that Dr. Kerr, then seventy-four years old, was much peeved at Lister's remarks: "Simple it may be," he protested, "but not ineffective; rude, but not crude".

In 1876 the British Association met in Glasgow, and Kerr read a paper on his second discovery, the Kerr magneto-optic effect, which has been of much importance in the theory of magnetism. Altogether Kerr published, between 1875 and 1901, only ten papers, but each is of permanent value. In 1890 he was elected a fellow of the Royal Society, and in the following year Sir Arthur Rücker, speaking at the British Association, referred to Kerr's outstanding discoveries and said: "The generations which reap the harvest which earlier students of the science of electricity have sown will not forget the name of Dr. Kerr as that of a physicist who completed in the laboratory of a training college a chain of evidence of which Faraday and Maxwell had forged the first links". In 1898 the Royal Society awarded him the Royal Medal, now in the Hunterian Museum of the University of Glasgow. At the dinner that followed the presentation of medals, Sir Oliver Lodge, who had been awarded the Rumford Medal at the same time for his researches in radiation, replied for the medallists; speaking of Dr. Kerr, he said that Dr. Kerr had made two first-class discoveries in science, and his name would go down to posterity linked with these discoveries for all time; ten centuries later the Anglo-American race would know and remember the name of their medallist, John Kerr. Kerr retired from his lectureship at

the Training College in 1901 after forty-four years' service. His country recognised his work by giving him, in 1902, a Civil List pension of £100 a year. He died on August 18, 1907, three months before Lord Kelvin, in his eighty-third year.

Dr. Kerr was a well-built man, over six feet in height, of attractive and lovable personality. The late Prof. Andrew Gray wrote of him: "The name of this quiet and unostentatious teacher and

experimentalist will be linked for all time with that of Faraday. He would not himself have desired any better immortality"; and Prof. Magnus Maclean, who had been a student under Kerr and is still with us, said at Kerr's retirement: "No one could have passed through Dr. Kerr's class without observing and being influenced by the singular simplicity, the sincerity and the loveliness of his character".

The Draft Poisons List and Poison Rules

The Chemical Manufacturer and the Chemist

Interpretation of the Rules

THE report of the Poisons Board together with the draft Poisons List and Poison Rules, which was discussed in NATURE of June 22, p. 1013, raises a number of questions of detail of interest to many besides the pharmacist. The more important of these questions are those which affect the chemical manufacturer particularly, and those which concern the profession of chemistry as a whole.

The first set of questions was considered at a meeting convened by the Association of British Chemical Manufacturers on July 4, which was attended by Mr. M. D. Perrins, secretary of the Poisons Board, to discuss the interpretation of the draft Poisons List and Rules. At the outset, Mr. Perrins pointed out that the only real distinction between Part I and Part II of the Poisons List, that between poisons which can be sold by retail to the general public by authorised sellers of poisons, that is, by registered pharmacists, and those which can be so sold only by listed sellers and authorised sellers of poisons, does not affect the sales with which the chemical manufacturer is concerned. The distinction between substances in the First Schedule and those which are not is, generally speaking, that those in the First Schedule have various restrictions applied to them, such as that the purchaser must be known to the seller and a record must be kept. On the other hand, for practical purposes, the only restriction on substances not in the First Schedule is that they must be labelled in accordance with the Act and Rules and they must be in the type of container required by the Rules.

Mr. Perrins also pointed out that preparations sold by manufacturers to doctors or veterinary surgeons more or less in bulk do not come under the heading of medicines 'made up ready', and

emphasised that the Rules are to be administered by those who could be trusted to act with common-sense. The view taken in the report of the Departmental Committee is that the control of poisons is such an intricate and complicated matter, so liable to change, that it is impossible to deal with it by restrictions set out in an Act of Parliament. Much elasticity is necessary and questions of control must be dealt with by regulations which can be altered from time to time. Should it be found, for example, that these Rules work harshly on the trade in a particular raw material which does not in practice afford any danger to anyone, a fact which may have been overlooked, then that can be dealt with by a Rule adding it to the general exemptions or special exemptions as may be required.

In the discussion which followed, a number of points were raised in regard to the detailed interpretation of the Rules. It was emphasised that there are no responsibilities placed on the manufacturer as to whom he sells poisons, provided he does not sell them by retail to members of the public.

The question of abbreviated names was raised, the abbreviations used in the British Pharmacopœia being regarded as official, and it was suggested that the Association should recommend that the ordinary abbreviated names used in the trade should be considered to be accepted scientific names, a proposal which will not commend itself to the profession of chemistry generally. Various questions relating to transport and labelling were raised, but as the Report itself emphasises, the Board does not propose to include any industrial poisons in the List solely on the ground of the possibility of danger arising during transit, in view of the rules to be issued under the Petroleum

(Consolidation) Act, 1925, for the control of the transport by road of dangerous liquids and liquefiable gases.

It was pointed out that as Rule 20(a) stands, analytical laboratories which cannot claim to be engaged in education or research must have their bottles fluted, and it was suggested that samples used in examinations do not constitute supply and accordingly need not be specially labelled.

The second set of questions has been raised in a letter in *The Times* of July 6 by Prof. E. C. C. Baly and relates to the qualifications to be possessed by those authorised to supervise or control the manufacture of poisons and particularly to the nature of the prescribed qualification in chemistry. Prof. Baly points out that in Paragraph 65 of its Report, the Board, after recommending that the control of the manufacture of pharmaceutical preparations for the internal treatment of human ailments should be restricted to registered pharmacists, medical practitioners, fellows and associates of the Institute of Chemistry, and persons who have been continuously engaged in the control of the manufacture of pharmaceutical preparations for a period of three years, makes the erroneous statement that there is in Great Britain no recognised body other than the Institute of Chemistry that issues certificates or other documentary evidence of competency in chemistry as such. Not only does the British Association of Chemists issue such documentary evidence but also the universities, and the Report refers to

university degrees and diplomas in such a way as to suggest that a university degree does not confer competency in chemistry as such.

Prof. Baly also directs attention to the suggestion in the Report that the societies named are included because they can exercise disciplinary action by removing a name of a member guilty of unprofessional conduct. Exactly the same action can be exercised by the British Association of Chemists, and Prof. Baly emphasises that the statements in the Report are the more unacceptable to a large body of chemical opinion because the Institute of Chemistry does not represent more than 40 per cent of the chemists in Great Britain.

In a reply in *The Times* of July 11, Sir Gerald Bellhouse points out that the proposed rule only applies to the manufacture of pharmaceutical preparations for the purposes of the internal treatment of human ailments, and not to the manufacture of the ingredients of the composition. The statement regarding the Institute of Chemistry, challenged by Prof. Baly, was primarily a reference to the fact that the Institute of Chemistry is the only institution connected with the profession of chemistry which has acquired the right, granted by Royal Charter, to confer definite qualifications in chemistry. The Board's recommendations in regard to the supervision of manufacture should be considered in regard to all the various legal and administrative questions set out in Paragraph 65 of its Report.

Norwich Meeting of the British Association

Final Programme

THE full programme of the Norwich meeting of the British Association should be in the hands of members next week, if they have intimated intention to be present. The programme has taken shape no less effectively than usual out of the general plans which were prepared at the meetings of organising sectional committees in January last. There is no doubt that the now regular practice of calling all these committees to meet early in the year on one day and in one place (recently, Birkbeck College, London) is the most successful administrative reform introduced into the working of the Association in recent years. It has had a notable effect upon the co-ordination of the final programme, which was urged as desirable in the columns of *NATURE* shortly after

the Association had resumed its post-War activities. It is due to the memory of the late general treasurer, Dr. E. H. Griffiths, to associate his name with this exceedingly valuable measure: he introduced it.

The subjects of the presidential addresses have been indicated in an earlier notice (*NATURE*, May 11, p. 778). They range as usual from strictly technical essays in the pure sciences to those to which the layman will listen with ease, such as that of Dr. Pickard-Cambridge under the provocative title of "Education and Freedom". Some of the addresses will introduce discussions in their Sections: examples are that of Prof. W. N. Haworth on the molecular structure of carbohydrates, Prof. F. Balfour-Browne's on the

species problem, and Dr. J. A. Venn's on the financial and economic results of State control in agriculture.

Most of the sections have developed the practice of ranging many, if not all, of the communications they are to receive under specific headings of discussions or symposia: it is probable that sufficient opportunity is still left for independent speakers on their own individual subjects; and the provision of major topics adds weight, and, from the public point of view, interest to the programme. One can even conceive of lay members finding their way to Section C (Geology) for the sole purpose of discovering what is meant by rank in coal. Nor should even these members, the cultivation of whose interests is a first charge upon the Association, be neglectful of the opportunities offered by such discussions as those in Section A on nuclear physics (to be opened by Lord Rutherford) and on new stars; the geological relations of early man in East Anglia, or, again, denudation chronology (Section C); and the herring problem (Section D).

Our previous article has referred to other discussions which need not be recapitulated; but the bald titles set out in the preliminary programme issued last May are now found to have concealed unexpected interests. For example, the subject of noise then entered under Section A is seen to indicate a demonstration lecture by Dr. G. W. C. Kaye involving elaborate and generous preparation. Films now find their regular place in Association programmes, thanks to the help of those who are willing to lend and demonstrate them, though it is to be feared that arrangements for showing them must have added to the task of the local executive. The Department of Industrial Co-operation has in its programme films illustrating industrial-educational and industrial management features. Dr. Sydney Long will show to the Conference of Delegates of Corresponding Societies a film illustrating the Norfolk bird sanctuaries. Section D (Zoology) has an afternoon and evening devoted to film work, including Col. Seymour Sewell's lecture on the John Murray Expedition to the Arabian Sea, Prof. Julian S. Huxley's "Private Life of the Gannets", and an exhibit by British Gaumont Instructional Films. The Gaumont-British Corporation, Ltd. will show to Section L (Educational Science) films illustrating physical education.

Both Norwich and the neighbourhood have taken advantage of the readiness of the Association to provide public lectures if desired. Sir Arnold Wilson will speak at Norwich on "Science and Population Problems", and Prof. W. Garstang will speak to young people on the songs of birds. There will be external lectures at Cromer, Faken-

ham, Yarmouth, King's Lynn, Lowestoft and Thetford, and the speakers will be Mr. A. Corless, Dr. B. A. Keen, Mr. M. Graham, Prof. A. Ferguson and Prof. W. T. Gordon.

The "Scientific Survey" which now, on a systematic plan, is published annually in lieu of the old local handbooks (which, however excellent in themselves, followed no model) will cover briefly every scientific aspect of Norwich and its neighbourhood. Of the unusually extensive interests of the district, the ample and wide-ranging series of sectional excursions affords evidence. In addition to the usual publications connected with the meeting, it should be observed that through the generosity of Sir Sidney Harmer copies of the paper and the fine map dealing with the distribution of erratics and drift, by his father, the late F. W. Harmer, will be available for distribution in the geological and geographical sections (C and E); furthermore, the local committee will provide for distribution in Sections E (Geography) and M (Agriculture) copies of the appropriate maps prepared by the Land Utilisation Survey.

In addition to the customary civic reception by the Lord Mayor and Lady Mayoress, which will be given in the quite unusually fine setting of the Castle Museum, there will be a garden party given by H.M. Lieutenant for Norfolk, Mr. Russell Colman, and Mrs. Colman, in the beautiful grounds of Crown Point. It is satisfactory to notice that an attempt is made to keep the time of this engagement, which falls on the Tuesday afternoon, clear of the encumbrance of official engagements. The usual hour of the Committee of Recommendations has been advanced, and the final meeting of the General Committee will be held on the last Wednesday at noon, instead of the Tuesday afternoon. There will also be a garden party at Norwich Aerodrome, when special displays will be given by the Royal Air Force in conjunction with the Norfolk and Norwich Aero Club.

Among other amenities connected with the meeting, the programme indicates the flood-lighting of the Guildhall, the Castle Museum and some of the buildings adjacent to the Cathedral.

As not uncommonly happens, there is an unnecessary impression abroad that lodging accommodation will be difficult to obtain in Norwich. It is true that the hotels are full, and so will be the Training College hostel, but other accommodation can still be obtained, and is not likely to fall short, while for those whose freedom of action permits of their spending their nights in one of the coast resorts, special railway facilities are promised.

Obituary

Mr. G. E. Collins

THE melancholy accident on July 30 that deprived England of a soaring pilot of international reputation has also caused a serious loss to meteorology. Mr. G. E. Collins only began gliding in 1932, and with extreme rapidity acquired very great technical skill. But above all he had insight and imagination: he was always trying to increase, and to apply, our knowledge of air-currents. He was in close touch with some of the finest German pilots, and like them made use of cumulus clouds and 'fronts' to gain height that could be converted into horizontal travel. He learned from Wolf Hirth the method of soaring in a spiral in a 'thermal' (an up-current without a cloud to mark it) by the use of a variometer, steering in the direction in which the uplift was greatest; but he soon discovered a method of soaring in thermals without a variometer, using his body sensations and steering towards the wing which was the more strongly lifted. To-day probably a dozen British pilots can climb in thermals, but they owe much to Collins's peculiar gifts.

Collins was among the foremost to make use of the up-currents suggested by theory under the long lines of cloud that form parallel to the wind direction, realising their value for flights down-wind. Accordingly, in August 1934 he employed these 'cloud-streets' in a flight of 98 miles from Dunstable to Holkham Bay, still the British record: he reached the Norfolk coast at a height of 3,000 ft., and showed that it is only the dimensions of our island that impose the limit on cross-country flights.

In July last year, Collins extended ideas by providing a reply to the criticism that gliders can only sail down-wind. In a flight in a west-south-west wind, he passed over Watford and alighted at Hanworth, due south of it; his speed relative to the air was not only much faster than the wind, but its direction must have been within 45° of straight into it. Now that tacking is possible, much can be done.

It had been hoped that Collins's skill might have been employed in carrying self-recording instruments round and through clouds in order to get much needed data procurable in no other way; may his fine example inspire others to take up this work.

G. T. W.

Dr. Helen Chambers

By the death of Dr. Helen Chambers on July 21, Great Britain has lost one of its most devoted workers in the cause and treatment of cancer. She received her medical education at the London School of Medicine for Women, took her M.B. with first-class honours in 1903, and was a gold medallist. At twenty-four years of age, she was appointed pathologist to the Royal Free Hospital, a post she held until 1915, when she resigned to take up a similar position at the Endell Street Military Hospital.

Before the War she had been doing part-time research work in the Cancer Research Laboratories of the Middlesex Hospital, and when the military hospital closed she accepted full-time work there under the Medical Research Council.

Only the comparatively few people who came into intimate touch with Dr. Chambers realised her full value. Her wide experience of general pathology and extraordinary ability to concentrate entirely on the matter in hand made her invaluable for research work. It was mainly due to her foresight and inspiration that the Marie Curie Hospital at Hampstead came into being. She realised that for satisfactory radium treatment it was essential to have the close co-operation of surgeon, physicist and pathologist, and the excellent results of treatment of uterine cancer at that hospital show to what an extent she succeeded in securing this collaboration.

Dr. Chambers contributed many papers to the scientific press on the effects of radiation on malignant and normal cells. The fact that animals, after the absorption of malignant tumours which had been very accurately irradiated, were often immune to tumour growth was always at the back of her mind for its possible clinical application. So recently as last winter she spent several months in Paris, where she carefully studied the X-ray treatment of cancer of the breast by Prof. Coutard, whose methods she felt gave more hope of attaining this desired effect than any other treatment of the disease in use at the present time.

Mr. J. H. Ronaldson

JAMES HENRY RONALDSON, who died on August 5, was a very well-known and much respected consulting mining engineer and geologist. He was born in the county of East Lothian and received his scientific and technical education at the Universities of Edinburgh and Liège. He travelled widely, but was probably best known in Australia and South Africa, where he had resided for comparatively long periods. He made London his headquarters as from 1910, and his business, until the outbreak of the Great War, took him to all sorts of countries. Shortly after the outbreak of the War, he found himself in the Ministry of Munitions, but after a short period of service there, Messrs. Brotherton and Co., Leeds, who had gone in for the manufacture of munitions, applied for his services, and he supervised their manufacture of explosives until 1918. After that he continued his practise, and for a few years was associated with Dr. William Cullen in consulting business.

Ronaldson was not only an excellent mining engineer but also a very good geologist, and it was this happy combination which made his reports so valuable to those who employed him. Moreover, he was the soul of integrity, and he never allowed

himself to be carried away by the influence of others who may have examined the same property. His clients, therefore, knew that when he prepared a report it was an honest one, and uninfluenced by expectations on one side, or performances on the other. Although he was connected with many scientific and technical institutions, he was never addicted to the writing of papers. Indeed the only

one on record is a joint one by Dr. Cullen and himself, which deals with a purely technical aspect of mining, but which is still of reference value.

He did not take an active part in discussions on technical subjects, but whenever he did intervene he was always listened to with great respect, because his audience recognised that his experience covered a very wide field.

News and Views

Dr. Griffith Evans's Centenary

DR. GRIFFITH EVANS celebrated his hundredth birthday by an at home at Bangor on Wednesday, August 7 (see *NATURE* of August 3, p. 173). He had on the previous evening been visited by two veterinary colleagues, Capt. W. H. Savage and Sir Frederick Hobday. Although, through the bad luck of two very severe accidents involving fracture of each thigh, Dr. Evans is bedridden, his mental faculties are wonderfully alert. In accordance with his own request the presentation from his Alma Mater, the Royal Veterinary College, was the first of the series of the ceremonies which had been arranged to do him honour. Sir Frederick Hobday, in presenting the congratulatory scroll, said: "As a great pioneer we are proud of what you have done for veterinary science and we wish you continued good health to see still further, for many years to come, the progress in comparative medicine—which was initiated by the discovery you made of the parasites in the blood—when investigating (whilst a veterinary officer in the British Army) the disease known as 'surra' in horses and camels". The presentation scroll is framed in a piece of the wood of the old College. In acknowledging the presentation, Dr. Evans referred to his early years at the Royal Veterinary College and recalled characteristics of his teachers, Profs. Spooner, Simmons and Morton. After this address, a telegram sent on behalf of Their Majesties the King and Queen was handed to Dr. Evans; it read as follows:—"The King and Queen are much interested to hear to-day you are celebrating your hundredth birthday, and desire me to convey to you their hearty congratulations. Their Majesties are aware of your distinguished services to veterinary science and send you their best wishes on this great anniversary." Telegrams of congratulation were also received by Dr. Evans from H.R.H. The Prince of Wales, Mr. Lloyd George, the Council of the Royal College of Veterinary Surgeons, and the citizens of Bangor, among others.

Unknown Papua

A SURVEY expedition to northern Papua under Mr. J. G. Hides, assistant resident magistrate, and Mr. James O'Malley, patrol officer, returned to Port Moresby on July 20 after an absence of eight months,

in which at the cost of great hardship much previously unexplored country was crossed, and unknown groups of natives encountered. The area explored lies between the sixth and seventh parallels of south latitude and the 142 and 114 meridians of east longitude. The party started in December last, travelling up the Fly and Strickland Rivers and then along the Carrington River, an unexplored tributary of the Strickland, until navigation became impossible. Boats were then abandoned, and the expedition struck across country overland for the Purari River, which was reached after an arduous four months in which the party was reduced to the verge of starvation, owing in part to the attitude of the natives who, though at times graciously friendly, at other times refused them food and generally displayed an attitude of contemptuous and thinly veiled hostility.

ACCORDING to an account of the expedition which appeared in the Melbourne *Argus* of July 23, after leaving the Carrington, the party in twenty days passed through a desolate limestone barrier and penetrated a vast fertile valley, 20-30 miles broad, under cultivation by a large population of short, brown-skinned, mop-haired people of an "Asiatic type", calling themselves Tari Furora. Both men and women till the ground, using wooden spades. They refused gifts of steel. No communal villages were observed, and the people seem to live in individual families. The same people were found on a high grass tableland traversed in April and May, where an estimate of their numbers is given as 100,000. As the party travelled east and south-east the type gradually changed and men were observed wearing bear's tusks as nose ornaments. A preliminary report on the expedition's work has been presented to the Lieutenant Governor, Sir Hubert Murray. An official account was published in Australia on August 13, and an account appears in *The Times* of August 14.

Further Discoveries at Colchester

EXCAVATION, resumed on the Romano-British site at Colchester early in July, continued to produce evidence, mainly in the form of pottery, of the importance of the pre-Roman city as a centre of foreign trade and native British industry. Early in

August, however, investigation was given a fresh impetus by the discovery of vestiges of a remarkable character of what at first sight was thought to be a building of considerable size, assigned tentatively to the last decade of the first century A.D., on the evidence of a coin found on the floor of what appeared to be a kitchen. Further excavation showed that this identification of the character of the structure was premature. The new discovery can now be seen to be of far greater importance, and indeed, in certain respects it seems unique. The wall, so far as at present uncovered, a distance of some 230 ft., according to a report in *The Times* of August 10, runs east and west almost in a straight line. The foundations, which remain *in situ* to a height of several inches, vary in breadth from 2 ft. 6 in. to 3 ft. At regular intervals of 17 ft. on both faces of the wall are small buttresses, 2 ft. square in plan. The method of construction is interesting. It points to a severe economy on the part of the builders, no doubt owing to the scarcity of suitable stone in East Anglia. The core of the wall is composed of a coarse gravelly rubble with a frequent mixture of broken amphoræ, mortaria and roof-tiles. Only a few fragments of the stone coping remain. The excavators hesitate to offer any conjecture as to the purpose of the wall; but they are of the opinion that it is probably unique in the British Isles.

Civilian Respirators

UNDER the title "Civilian Respirators" an article in the August issue of the *Industrial Chemist* discusses the general requirements of apparatus for the protection of the civilian population in the event of hypothetical hostilities involving the use of lethal gases. It is well known that public opinion is divided on the question whether it is desirable to discuss these matters in the present temper of Europe. Some hold that peace is endangered by even humanitarian preparations in case of war; others consider that it would be folly to ignore the possibilities of a new form of warfare, and that common prudence dictates the examination of all measures necessary to combat it. In any event, if measures are to be taken, it is at least common sense to take the best available; and in this matter of the design of respirators suitable for civilian use, the article to which we refer suggests to potential inventors the following general requirements: (1) A canister should be attached directly to a complete facepiece. (2) The canister should provide a protection of 2 minutes against 1 per cent of phosgene, and 20-30 minutes against 0.1 per cent. The resistance should not exceed 3 in. of water. Protection of 10 minutes against 1 in 5×10^7 of diphenylchlorarsine or diphenylaminechlorarsine should be provided. The canister should be readily replaceable and should last for at least five years. (3) The facepiece, of rubber or leather, should be gastight, in not more than three sizes, and should incorporate eyepieces or a window. It should be simple in design, should interfere as little as possible with ordinary duties, should be suitable for mass production from materials available in Great Britain, and should last for at least five

years. (4) The cost should be as low as possible. Let us equally bear in mind that industrial respirators and their possibilities are already familiar in chemical factories, and that any new advances will be of great interest in many peaceable occupations.

Direction Finding and Blind Flying for Civil Aviation

It has been announced that the Directorate of Civil Aviation, Air Ministry, and the National Physical Laboratory, are co-operating in the study of problems relative to 'blind' flying as applied to air-line operation. The immediate necessities are three-fold, and the use of wireless transmission appears to offer the most likely means of their solution. They are: (1) The transmission of direction finding information over as long a range as possible, probably by short-wave radio. (2) Devices for warning the pilot of the proximity of obstructions such as high masts, or even other aircraft, in conditions of poor visibility. (3) The accurate guiding in and landing of aircraft when an aerodrome is obscured by fog, or in any similar conditions of reduced visibility. The Air Ministry is using a Vickers "Viastra", until recently the property of the Prince of Wales; it will be fitted with the necessary apparatus as soon as preliminary experiments have indicated the most promising type, and will be flown by Imperial Airways pilots. The aerodromes from which they will operate will probably be Croydon, Gatwick, and Gravesend. Imperial Airways will also be invited to send out signals at pre-arranged times, to the pilots of their normal machines, when over Africa and on the way to India and Australia, from which the reliability of different systems can be judged. A type of 'approach' beacon for blind landing, giving out a short aural note over a range of 20-25 miles, has already been ordered for experiment. If this is successful, the problem will then be to develop the use of a long-range direction finding system for use in conjunction with the short-range system, but without interfering with it.

Television in Great Britain Next Year

THE Postmaster-General has now authorised the B.B.C. to make arrangements with the Baird Television Co., Ltd., and the Marconi-E.M.I. Co., Ltd., for the provision of complete transmitting equipment for the operation of their respective systems at the Alexandra Palace, where constructional work has already begun. It is hoped that transmissions will start in the early part of next year, and will be followed as soon as practicable by a regular public service. As ultra-short waves will be transmitted, it will be possible to broadcast scenes in much greater detail than can be done to-day. Doubtless before very long many listening-in sets will be furnished with a television screen. In Germany, television is being pushed forward for political reasons; but in the United States although experimental television is an accomplished fact the business and advertising aspects of the new industry have to be carefully considered. In Great Britain luckily advertisement does not need to be considered, and the Government

dominates the whole position. The masts on the Alexandra palace will probably be about 600 ft. above sea-level, and there are few local obstructions. In the London area, it is understood that a wavelength of 6.6 m. will be employed for the visual and 7.2 m. for the sound broadcasts. As these rays are propagated in practically straight lines, their range does not extend much further than the visual horizon. The London area will be roughly a circle of radius 30 miles. There are some outstanding financial problems that have to be settled, such as the relative values of the televising and broadcasting rights of a prize fight. In the cinema industry, coloured pictures have greatly improved, so that it only needs stereoscopic projection to perfect them.

Effects of the 1934 Drought in the United States

It was only to be expected that the American drought of 1934 would extend well into the growing season of 1935, in some parts of its extensive area, and this is proving to be the case. In a number of articles that have been issued by Science Service, Washington, D.C., during the past few months, the gradual contraction of the stricken area has been traced. In one such article, dated March 13, early spring rains in the Plains were mentioned, and a great excess from the Ohio Valley to the Gulf, sufficient to delay spring ploughing. On March 27 light rains were described as having eased the situation in the northern part of the western drought area; but dust storms were reported in the completely dry region in eastern Colorado and western Kansas and in Texas. On April 20 an improvement was noted in Texas and Oklahoma, and a hope on the part of the forecasters in the Weather Bureau that western Kansas and eastern Colorado might soon be relieved by invading depressions. Articles dated May 1 and 2 showed that this hope had not been fulfilled, the area in question remaining to represent the temporary "Great American Desert". A faint sprinkle of rain was described as having evaporated as fast as it fell in Dodge City. In the relieved areas, the cold weather and sodden fields, and the resultant delay in farming work, were said to be accepted with complacency after the previous extremes of drought and heat.

Dust storms, leading to the loss of the cultivated surface soil, had become a commonplace occurrence in the United States before the drought had nearly reached its greatest extent, causing great inconvenience and material damage to the States lying to the eastward of the driest region, as well as to western farmers. The drought itself is held, however, to be only partly responsible, as the dry soil would not have been blown away had the Plains not largely been deprived of their former permanent grass covering, of which the roots would have bound the soil in place through even the worst periods of deficient rainfall. Another article describes one of the processes whereby the drift of loose soil has been to some extent countered. This process, known to farmers as 'listing', consists of specially deep ploughing with the aid of motor-driven tractors. A special plough is used, which throws the soil on both sides; the

furrows may be as many as fifteen feet apart, and are driven at right angles to the prevailing winds, which are generally from the north-west. Where the soil is heavy the tops of the ridges are covered with something more coherent than the normal surface tilth, and this partly accounts for the efficacy of the method, which, however, is due mainly to the fact that as the loose soil begins to move under the action of the wind, it tends to fall into the furrows and to be trapped in them. It is stated that the Soil Erosion Service does not regard this 'listing' as a solution of the problem of wind-erosion, the real solution being to restore the permanent grass, much of which was ploughed up during the War so that cereals could be grown.

List of British Vertebrates

Few naturalists have at hand complete lists of the various groups of British vertebrata, and yet in the absence of such lists reference and checking often become unutterably tedious. The suggestion of the Association of British Zoologists that a complete check list of all British vertebrates should be compiled was, therefore, a sound proposal, and the list as it now appears will prove of value in many ways, especially to workers of wide interests. This is clearly due to the way in which the British Museum (Natural History) has applied itself to carrying out the suggestion, for apart from the Bird list (by B. W. Tucker) the work of compilation has fallen upon the Museum staff, and for the editing and publication it also has been responsible (pp. 66, price 1s.). The list is a check list and no more, giving the Latin and English names of species and often indicating by letter symbols something about the status. In contrasting this check list with the lists of other countries, one's first impression is that it is a short list, representing a land fauna not outstandingly rich in variety, and a second strong impression is that, much less than other countries, Britain has been subjected to the successful introduction of foreign animals. To the short list of animals marked as introduced should be added, amongst the mammals, the rabbit, the black rat and the brown rat, and the Japanese deer, *Cervus sika*, which is very much at home in part of the western highlands of Scotland and was introduced so long ago as 1887; amongst the birds, several species of pheasant, for *Phasianus colchicus* is now a rare species in the coverts, its place having been usurped mainly by *P. torquatus*.

Traffic-actuated Road Signals

In a paper read before the Institution of Railway Signal Engineers by F. Edwards, an abstract of which appears in *Roads and Road Construction* for July 1, the development of systems of road signalling is described. There are two main developments which may be regarded as milestones in the progress of street traffic signalling. The first system is time-controlled and, thanks to the specification issued by the British Standards Institution, it works fairly well. Up to the end of February of this year, grants had been issued for the erection of signals at more than

1,700 crossings in Britain, and naturally the installation of all these crossings is costly. The second step in advance was the introduction of the vehicle-actuated method of control, which has several advantages over the time-controlled system. With the time-controlled apparatus the 'right of way' is given to each of two or more intersecting roads for definite periods of time in sequence, quite regardless of the relative volume of traffic on the roads at any particular moment. One of the essentials of any form of control is to keep traffic moving, and this should only be subordinate to safety. The time-controlled system is powerless to differentiate between the volumes of the flow of traffic in the various directions. Many attempts were made in the past to produce a system which would provide maximum traffic facilities with maximum safety. There are now two systems of vehicle-activated control in practice, called the electromagnetic and the autoflex respectively. In the former, a vehicle passing over a pad makes contact and completes an electric circuit; in the latter the air in a channel in a rubber moulding is compressed and the compressed air produces the contact. The problem of co-ordinating a series of crossings is now being satisfactorily solved. Oxford Street, London, from Marble Arch to Tottenham Court Road is a good example of the advantages of this kind of control.

Invention of the Venturi Meter

In connexion with an article on "Early Hydraulic Engineering", in which the work of Clemens Herschel (1842-1930) is referred to, *Engineering* in its issue for August 2 reproduces a letter from Herschel to the late Dr. Unwin describing his invention of the Venturi Meter. The letter is dated June 5, 1888, and addressed from the hydraulic engineer's office of the Holyoke Water Power Co., Mass. In his letter, Herschel says he tested a one-inch Venturi Meter, under 210 ft. head: "I am now satisfied that here is a new and pregnant principle to be applied to the art of gauging fluids, inclusive of fluids such as compressed air, illuminating or fuel gases, steam, etc. Further, that the shape of the meter should be trumpet-shaped in both directions; such a meter will measure volumes flowing in either direction, which in certain localities becomes a useful attribute. . . . And we are but in the beginning of the art of measuring pressures, and differences of pressure. When these shall be delicately measured, the Venturi Meter will have become as delicate in its lower limits of capacity, as any other and it is on this score *alone*, that it is as yet inferior to some of the volumetric meters." The letter was found among the papers placed at the disposal of the Unwin Memorial Committee by Miss Unwin.

Electric Welding in Industry

THE American Welding Society has awarded the S. W. Miller Medal to J. C. Lincoln, the founder of the Lincoln Electric Company, as the first to apply the electrical arc to building construction, and for his improvements in the art of arc welding. Mr.

Lincoln has pointed out that by arc welding the cost of the repairs of machines has been greatly reduced. It has eliminated the noise of the riveting hammer in building construction. A joint made by arc welding is often stronger than the parent metal; while a joint made by riveting never is. The amount of the material needed for the structure is therefore considerably reduced. It is of particular importance in marine construction, where the smooth outline rendered possible by welding appreciably increases the speed of the ship. The most widely used application of all is the replacement of steel and iron castings by welded structural steel. This application gives a method of having a lighter, stronger and cheaper material than it is possible to get by casting. Already about one and a half million tons of castings a year have been eliminated by this method. Mr. Lincoln thinks that welding will entirely eliminate the rivet as a method of joining structures. It will also largely increase the value of worn and broken parts.

Industrial Physicists

THE *Review of Scientific Instruments* reproduces in its issue of February the conclusions of the Conference held in New York to consider "the place of physics in industry and the best methods by which that place can be fully occupied". The Conference demands a training which shall develop: (1) a broad knowledge of the principles of physics with a leaning towards classical physics; (2) an intimate working knowledge of the more elementary branches of mathematics; (3) a grounding in the principles of chemistry sufficient for physical research; (4) power of expression in technical and especially non-technical language; (5) realisation that a research worker in industry is justified only by his value to the industry. It would be of great interest to discover whether these are the demands of industry in Great Britain, and if so, whether the training required is being provided by our educational methods.

Institute of Plant Industry, U.S.S.R.

A LIST of the publications during 1933 of the Institute of Plant Industry, Leningrad, compiled by Strumillo, appears as Bibliographical Contributions No. 4 of the Institute. The list of publications of this Institute, and of the old Bureau of Applied Botany which preceded it, is thus now complete from 1908 to the end of 1933. It covers 57 publications, is published in Russian and English, and the titles of all contributions of every volume are given in English even in cases where the originals contain no English summary. Most of the Institute's publications of specialised character have English summaries; those publications in this list which are not provided with one are indicated. The *Bulletin of Applied Botany, of Genetics and Plant Breeding*, together with its supplements, occupies the major portion of this list. The remainder is occupied by non-serial publications and by publications originating from the Institute, but issued by other publishers. "Plant Industry in the U.S.S.R." and "Agricultural Turkey" are two important contributions in the latter category.

Indexes arranged according to subjects and to authors are provided. The importance of the work of the Institute of Plant Industry, the extent of its activities, and the diversity of its serial and non-serial publications, make its bibliographical publications indispensable to applied botanists.

Ocean Transportation of Petroleum in Bulk

OWING to world trade depression and to production problems within the industry, there is now actually available excess oil tanker tonnage over demand. Of the world's steam tanker tonnage 44 per cent is, however, more than fifteen years old, consequently new tankers will shortly have to be constructed to replace these and to meet anticipated increase in demand when trade recovers. Mr. R. F. Hand read a paper on April 5 before the North East Coast Institution of Engineers and Shipbuilders, in which he indicated some of the problems attendant on ocean transportation of petroleum in bulk. Great care must be exercised in allocating vessels for specific work, account being taken of condition, size, position and capability of the tanker to carry the cargo in question. Freight cannot be imposed on a basis of cost plus a reasonable margin of profit, but must be fixed at a rate which the traffic can bear. Ultimate profit must be envisaged over a number of years, and provision made for periods when goods may actually have to be carried at a loss. A classification is suggested for petroleum products from the point of view of marine transport and types of vessel most suitable for carrying the various grades indicated. Operating costs are difficult to assess at the present time owing to the complex foreign exchange situation; but such data as are available prove that though the motor tanker is more economical for long hauls it is not always so in the case of short hauls.

The Science Museum

ACCORDING to the Report of the Science Museum for the year 1934 (London: H.M. Stationery Office, 1935, 1s. net) well over a million visitors have made use of the Museum, including more than a thousand organised groups and parties of about thirty, and the attendances at lectures were well over 30,000. The policy of holding special exhibitions to illustrate the advance of science into industry has been most successful, and the attendance at those on refrigeration from April until September 1934 and on rubber from November 1934 until April 1935 was very gratifying. The children's gallery has been visited by 13,000 children in school parties, and the introductory collection installed there has proved very attractive. Short accounts are given in the Report of the progress in each of the five divisions: industrial machinery and manufactures, mechanical and civil engineering, air and water transport, mathematics, astronomy and chemistry, physics and geophysics, and it is quite evident that the delay in reconstructing the central block is a serious obstacle in the way of a more instructive display of the material now crowded into inadequate cases. The Science Library now possesses a quarter of a million books, and

nearly 50,000 readers have made use of them. The free space for new books is nearly exhausted and temporary housing will have to be provided until the central block becomes available.

Fuel Research Institute of South Africa

DR. J. G. VOGEL, director of the Fuel Research Institute of South Africa, has recently described the activities of the Institute (*S. African J. Sci.*, 31, 194-209, Nov. 1934). Initially, the Union Government wished to encourage the export trade in coal, and prevent the damaging effect on the export of coal of unreliable grade. Now all coal loaded for export or bunkers must be graded by the Institute before shipment. The programme is determined by the fact that the coal industry is neither very old nor extensive, and the information available is limited. A first step is therefore a chemical survey. Already the Institute has made a notable contribution to the difficult problem of coal sampling by devising a novel sampling device. It consists essentially of a rotary drill working inside a sheath, up which a rapid current of air passes. The air and the coal abraded by the drill are drawn into a container after the manner of a vacuum cleaner, where the solids are retained. This apparatus not only enables samples to be collected from seams, but also from waggons—a problem which has not hitherto received a satisfactory solution. The Institute is equipped for research in coal chemistry and coal processing, and also for the study of liquid and gaseous fuels.

Census Statistics

THE normal series of publications dealing with the figures of the 1931 census is completed by the issue of General Tables, a volume of some two hundred and fifty pages (London: H.M.S.O. 11s.). It contains tables giving the populations by sex of the constituent regions of England and Wales—counties, boroughs, urban and rural districts—showing the changes that have occurred in recent intercensal periods. It also gives an analysis of the age and marital condition of the population at successive censuses during the last ninety years. Particulars are given of the birth-places and nationalities of the population in regions, boroughs and other urban areas, and comparative figures for England and Wales at successive censuses. There are also figures of population speaking the Welsh language. Much of the information given in the volume has hitherto been obtainable only by laborious extraction from separate county records.

The Imperial Institute

WE have received the annual report of the Imperial Institute, recently presented by the director, Sir Harry A. F. Lindsay, to the Board of Governors (London: Imperial Institute, 2s.). This gives a general account of the activities of the Institute and details of many special investigations which have been made with Empire products. These comprise work on silk, cordage fibres, tung oil, shellac, hides and leather, oil seeds, tanning materials, drugs and insecticides,

and the analyses and investigations of various minerals. The report directs attention to the wide range of valuable minerals produced in the Union of South Africa. The use made by the public of the exhibition galleries, and the provisions made for educational purposes are dealt with in the report, which indicates clearly the very useful purposes served by the Imperial Institute.

The Italian Seismological Society

THIS well-known Society has now existed for forty years, and the first number of the new volume of the *Bollettino* (33, 10-21; 1935) contains a brief survey of its history by the present secretary, Prof. G. Agamennone. The study of earthquakes as a whole in Italy may be said to have begun in 1870 with the works of Bertelli and De Rossi; but the issue of the *Bullettino del Vulcanismo Italiano*, founded by the latter in 1874, was declining after twenty years. The Italian Society, in imitation of its Japanese predecessor, was founded in 1895 under the direction of Prof. P. Tacchini, the director of the Central Office of Meteorology and Geodynamics, and continued ten years later under that of his successor Prof. L. Palazzo, the present president being Prof. G. Cicconetti. The activity of the Society may be judged from the volumes of the *Bollettino* so far published, which contain nearly 500 papers occupying more than 9,000 pages.

Cambridge Microtomes

THIS year the Cambridge rocking microtome, one of the most familiar instruments in biological laboratories, attains its jubilee. The Cambridge Scientific Instrument Co., Ltd., has issued a new folder, illustrating this instrument and also a more heavily built and modified form of it for cutting flat sections of larger objects. The folder shows in addition a massively built sliding microtome, the design of which was completely overhauled two years ago, which cuts large sections, 60 mm. x 60 mm., in either paraffin or celloidin, and a freezing microtome of new design. Hints on the care and sharpening of microtome knives are added.

International Society of Leather Trades' Chemists

THE bi-annual conference of the International Society of Leather Trades' Chemists, in conjunction with that of the Internationalen Vereins der Leder Industrie Chemiker, will be held on September 1-6 at the Institut des Arts et Metiers, 50 Boulevard de l'Abattoir, Brussels, Belgium. The reception of members and visitors will take place on Sunday evening, September 1, at 8 p.m., at the Palace Hotel, Place Rogier, while the official banquet, at which the Burgomaster of Brussels will be present, together with other representatives of civic, commercial and scientific bodies, is fixed for Wednesday, September 4. Some thirty papers are to be read and discussed. Further details can be obtained from M. A. Fievez, 7 rue d'Audiger, Soignies, Belgium, or from the Honorary General Secretary of the I.S.L.T.C., 17 Market Street, London, S.E.1.

Announcements

PROF. J. A. NIXON and Dr. R. E. Lane have been appointed to fill vacancies in the membership of the Industrial Health Research Board.

THE following appointments have recently been made by the Secretary of State for the Colonies: Mr. A. W. Gledhill, to be veterinary officer, Uganda; Mr. R. M. Davies, district agricultural officer, Tanganyiki, to be senior agricultural officer; Mr. S. P. Teare, game ranger, Tanganyika, to be game warden.

THE Managers of the Royal Institution have awarded the Dewar research fellowship to Mr. A. R. Ubbelohde, formerly Senior Scholar of Christ Church, Oxford, and at present holder of a senior research award of the Department of Scientific and Industrial Research. Mr. Ubbelohde will take up his new appointment in the autumn. His researches have been largely in physical chemistry, and it is expected that his experience will be valuable in connexion with the researches directed by Sir William Bragg at the Royal Institution on the structure of matter.

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

Scientific Officers (Ref. A. 764), junior scientific officers (Ref. A. 765), and assistants, grades I-III (Ref. A. 766-8) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (Aug. 17).

An assistant signals officer and a signals officer in the Signals Branch, Air Ministry—The Secretary (S 1, Room 436), Air Ministry, Adastral House, Kingsway, W.C.2 (Aug. 19).

A senior lecturer in the Department of Pure and Applied Science, Loughborough College—The Registrar (Aug. 24).

An engineer officer in the Public Works Department, Buildings and Roads Branch, Punjab—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Aug. 26).

An assistant lecturer in the Department of Zoology, University of Leeds—The Registrar (Aug. 31).

An assistant lecturer in the Department of Physiology, University College of South Wales and Monmouthshire—The Registrar (Aug. 31).

A lecturer in morbid anatomy in the Department of Pathology, University of Aberdeen—The Secretary (Sept. 15).

A professor of mathematics in the University of Aberdeen—The Secretary (Sept. 30).

Temporary architectural and engineering assistants in the Directorate of Works and Buildings, Air Ministry, and at various aerodromes in the United Kingdom—The Secretary (W.B.9, Room 161), Air Ministry, Adastral House, Kingsway, W.C.2.

Temporary assistant mechanical and electrical engineers—The Secretary, Air Ministry (W.B.9), Adastral House, Kingsway, London, W.C.2.

A lecturer in geography and mathematics at St. Hild's College, Durham (Diocesan Training College for Women)—The Principal.

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. 264.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Beta Processes and Nuclear Stability

1. It is well known that the stability of the atomic structure is closely connected with the mechanical conservation laws. It has been shown that even the stability of the atomic nucleus, in particular the nuclear beta stability, is subject to conditions which can at least formally be interpreted as conservation laws for the mechanical integrals of motion¹. It may be pointed out, however, that the application of the usual mechanical conservation laws only is not sufficient to account for nuclear stability.

If one assumes a coupling of the nucleus with the electron field, the mechanical conservation laws alone would not exclude transitions in which a nucleus emits two electrons simultaneously and thus changes its charge by two units. This process would not involve the occurrence of a so-called neutrino, and we should expect considerable transition probabilities for such transformations. The radioactive transformations, however, show no indication of this type of double processes. RaD, for example, emits only a single electron, a second electron being afterwards emitted by the product nucleus, RaE. We have to conclude from this fact that the simultaneous emission of two electrons is a higher order transition of very small probability, involving the simultaneous occurrence of two 'neutrinos'.

The question arises why the neutrino occurs even if the mechanical conservation laws do not require such a particle. We are led to conclude that the beta-transitions are subject to an additional condition. The simplest form in which such a condition can be expressed seems to be the following: "Any production of particles has to involve the simultaneous production of an equal number of antiparticles". Attributing a positive sign to particles, a negative sign to antiparticles, the above condition can be regarded as a conservation law for the total number of particles. In the case of the natural beta decay this rule can be easily satisfied if one calls the hypothetical second particle an 'antineutrino'.

So long as we confine our attention merely to the production of pairs of differently charged electrons, the conservation of the total number of particles is secured by the conservation of charge and thus does not require the introduction of any special assumption. Any theory of the beta decay using the concept of a neutrino has to abandon this connexion and has to introduce an additional condition beside the conservation of charge.

2. It has been suggested by several authors that the interaction between nuclear particles might be due to beta processes of higher order. The small probabilities of the beta transformations, however, make it extremely difficult to account for the actual order of the nuclear interaction. Prof. Lauritsen

and Prof. Oppenheimer have kindly pointed out to me that the possibility of very high beta decay probabilities for high decay energies is incompatible with recent investigations on the beta decay of Li⁸ and B¹² and that therefore the beta decay must be due to an extremely weak coupling energy. This fact is very likely connected with the occurrence of the so-called neutrino.

I should like to point out here that it seems to be inconsequential to connect the nuclear interaction with the natural beta decay so long as there is no necessity to assume a neutrino to be involved in nuclear binding. We have to expect that the coupling between a nucleus and the electron field is very much stronger than the interaction with what is called a neutrino. It is only due to the restrictions implied by the conservation laws discussed above that the coupling between nucleus and electron field does not become effective in the natural beta decay. If we proceed, however, to higher order processes such as are involved in the above considerations on nuclear binding, these restrictions do not hold any longer and the weak coupling with the neutrino can be entirely neglected in comparison with the production of electron pairs. It may be found difficult, however, to reconcile even the known facts on the production of pairs and on the small isotope shift observed in spectral lines with the strong nuclear binding forces.

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¹ For example, NATURE, 132, 967; 1933.

Beta Ray Spectra of Artificially Produced Radioactive Elements

WE have investigated a series of β -ray spectra emitted by radioactive elements obtained by neutron bombardment. The results of the measurements together with those previously published by us in NATURE are given in the accompanying table.

Atomic No.	Element	Half-life period (τ)	Max. energy (in kv.)	$\tau.F(\eta_0)$
7	N	11 m.	1,400	58
13	Al	2.3 m.	3,000	340
15	P	3.2 m.	3,600	1,400
15	P*	14 d.	2,050	630,000
25	Mn*	2.5 h.	3,200	50,000
35	Br*	18 m.	2,000	480
35	Br*	4.2 h.	2,050	15,000
35	Br*	36 h.	950	5,900
45	Rh	44 s.	2,600	170
45	Rh	3.9 m.	2,100?	420
47	Ag	22 s.	2,800	130
53	I*	25 m.	2,100	3,700
79	Au	2.7 d.	1,100	17,000
77	Ir	19 h.	2,200	585,000

Substances marked with an asterisk were separated by chemical methods analogous to those used by Szilard and Chalmers¹. The radioactive manganese was separated from a solution of potassium permanganate, the radioactive P³² from carbon disulphide.

We tried to relate our results to Fermi's theory of β -ray decay. For this purpose it is necessary to calculate for each radioactive element Fermi's² function $F(\eta_0)$, where $\eta_0 = H\rho_{\max.}/1700$. According to Fermi, the values of $\tau.F(\eta_0)$ should be distributed in two groups, differing from each other by a factor of about 100. The first group should correspond to allowed transitions, the second to the forbidden ones. As can be seen from the table, such a sharp separation into two distinct groups, as obtained by Fermi for natural β -active elements, can scarcely be found for the substances we investigated; also, the data obtained by us do not fit the well-known Sargent diagram.

A. I. ALICHANOW.
A. I. ALICHANIAN.
B. S. DŽELEPOW.

Physical-Technical Institute,
Leningrad.
July 3.

¹ L. Szilard and T. A. Chalmers, *NATURE*, **134**, 462; 1934.
² E. Fermi, *Z. Phys.*, **B**, **88**, 161; 1934.

Velocity of 'Slow Neutrons'

A NEUTRON source (beryllium and 300 millicurie radon) was placed in the centre of a block of paraffin wax, of about 20 cm. diameter in all dimensions. After emerging from the paraffin, the neutrons had to pass, on their way to the detecting apparatus, through the marginal parts of a wooden disc of 50 cm. diameter and 2 cm. thickness, which could be made to rotate with a speed of 4,000 rev. per minute. This speed corresponds to a velocity of about 9×10^8 cm./sec. of the parts of the wood through which the neutrons penetrated. From former experience one would expect each slow neutron, while passing through the disc, to suffer a number of collisions with the protons contained in the wood, and therefore the velocity of the disc would be superimposed on their velocity distribution with the disc at rest. Assuming that a large part of the neutrons have thermal velocities, which are for neutrons of the order of 2×10^5 cm./sec., an asymmetrical distribution of the directions of the neutrons emerging from the rotating disc would result, about ten per cent more slow neutrons being emitted in the direction of rotation than in the opposite direction.¹

In order to get evidence of this asymmetry, we placed a cadmium screen with a hole of 6 cm. \times 6 cm. near the rotating disc, defining thereby a region where the neutrons were allowed to emerge from the wood. Two boron-lined ionisation chambers were placed behind the screen in such a way that they collected the neutrons projected at less than 45° and 135° relative to the direction of motion, respectively. The chambers could in turn be connected to a linear amplifier and mechanical counter; and alternative countings of equal duration were made with the disc rotating alternately one way or the other.

The experiments revealed indeed an asymmetry of the expected order of magnitude. Adding together the counts of the chamber which lay in the direction of motion of the disc, we get 11,100 particles against

10,644 for the corresponding sum of the counts in the other chamber. The observed difference is, therefore, 4.2 per cent, with a probable error of one per cent. When comparing this value with the before-mentioned theoretical value of 10 per cent, we must take into account that only part of the counts was really due to the action of slow neutrons. By screening off the slow neutrons by means of a cadmium plate, the number of counts was reduced to about one half; these remaining counts were probably partly due to fast neutrons, partly to the natural contamination of the chamber. The result of the experiment may, therefore, be taken as evidence that the main part of those neutrons which are strongly absorbed in cadmium have very nearly thermal velocities.

In conclusion, we would like to thank Prof. J. Franck for many stimulating discussions.

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E. T. SØRENSEN.

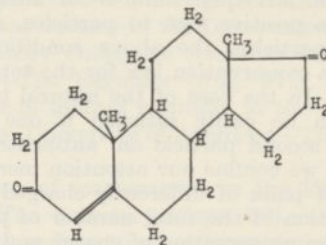
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¹ Experiments with a similar arrangement, but yet on slightly different lines, have recently been performed by Amaldi, d'Agostino, Fermi, Pontecorvo and Segrè, *La Ricerca Scientifica*, **vi**, 1, No. 11-12.

Activity of Androstendione on the Sexual Organs of the Male Rat

It has repeatedly been stated that the relation between the results of capon test and rat test varies with preparations having male hormone action^{1,2}. A definite number of capon units, applied in the form of testicular extracts, has a stronger activity on the sexual organs of the male rat than pure androsterone or hormone fractions from male urine. Gallagher and Koch², moreover, showed that boiling alkali destroys the hormone action of testicular extracts only, but not of the urine extracts. In fact, androsterone and *trans*-dehydro-androsterone, the existence of which in the urine has been described by Butenandt, are not altered by treatment with alkali.

Recently, L. Ruzicka and A. Wettstein have prepared *trans*-dehydro-androsterone from cholesterol and transformed it by oxidation into androstendione of melting point 173°-174°. Like corpus luteum hormone, it is an unsaturated diketone, and has the following formula :



It is now well known that the boiling of corpus luteum extracts with alkali destroys the hormone action. L. Ruzicka and A. Wettstein therefore recently suggested that androstendione or analogous compounds might be responsible for the peculiar action of the testicular extracts.³

As Ruzicka and Wettstein have already reported, the capon unit for androstendione and likewise for the saturated androstandione amounts to about 100 γ , according to the 6-day test used in this

laboratory. These substances are therefore somewhat less active on the comb than androsterone (60 γ), and particularly the diol (15 γ) obtained by hydrogenation of androsterone. In the meantime, I have examined these and related compounds also on the young castrated male rat. The first experiments have already shown that androstendione influences the seminal vesicles much more strongly than androsterone. In the following table, the results of a further series of experiments are shown, daily doses of 50 γ , 100 γ and 200 γ of the different preparations having been administered:

	Capon unit	Weight of the seminal vesicles in mgm.			Weight of the penis in mgm.		
		γ	50 γ	100 γ	200 γ	50 γ	100 γ
Androstendione	100	25	51	285	85	100	150
Androstandione	100	16	27	51	57	89	92
Androsterone	60	11	14	17	46	60	65
Diol	15	14	25	40	48	89	98
Diol-monoacetate	15-20	13	—	—	64	—	—
Diol-diacetate	15-20	13	—	—	60	—	—

The rats were castrated at a weight of 70-80 gm., and only used 4 weeks after the castration. They received the above-mentioned doses once daily for 20 days. On the twenty-first day the animals were killed and the seminal vesicles and penis weighed. The weights of these organs at the beginning of the experiment were about 6 mgm. and 50 mgm. respectively. Three to ten animals were used for each experiment.

The table clearly shows the high activity of androstendione on the seminal vesicles and the penis. The increase of weight of the seminal vesicles amounts, for example, with a dose of 50 γ to three times, with a dose of 100 γ to five times and with a dose of 200 γ to twenty-three times that of the androsterone animals. Also androstandione of m.p. 132° shows a considerable activity on the sexual organs of the rat, similar to that of the diol. In this connexion it must be remembered that A. Ogata and S. Hirano⁴ report the isolation of an active substance of m.p. 129° from testicles, which may perhaps be identical with androstandione. The testosterone recently described by David, Dingemans, Freud and Laqueur⁵ of m.p. 154°-154.5° resembles more the diol in its activity. The fact that androstendione, even in the absence of the substance X postulated by Laqueur and his co-workers, and in spite of its rather moderate activity on the capon comb, influences the sexual organs of the young male rat to an extraordinary extent, gives further support to the hypothesis of L. Ruzicka and A. Wettstein that androstendione, or a similar unsaturated ketone like 3-keto-17-hydroxy androstene, may be identical with the less stable male hormone or hormones of the testis.

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A Crystalline Fluorescent Dehydrogenation Product from Vitamin B₁

THE production of fluorescent solutions on oxidation of vitamin B₁ (antineurin) has been indicated in these columns by Peters¹, but no crystalline fluorescent product has hitherto been reported.

An alkaline solution of potassium ferricyanide transforms the vitamin hydrochloride (C₁₂H₁₈ON₄SCl₂) into a pale yellow, sulphur-containing compound (crystals m.p. 221°, from chloroform) having, in neutral or alkaline solution, an intense blue fluorescence; it possesses all the recorded properties of the 'thiochrome' (C₁₂H₁₄ON₄S) of Kuhn and his colleagues², including a similar absorption spectrum. This result is to us the more interesting, as thermal decomposition of the vitamin also yields a blue fluorescent compound³, C₉H₁₀ON₄, which may have a related constitution.

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¹ NATURE, 135, 107; 1935.

² R. Kuhn, Th. Wagner-Jauregg, F. W. van Klaveren and H. Vetter, *Z. physiol. Chem.*, 234, 196; 1935.

³ G. Barger, B. C. P. Jansen, and A. R. Todd, *Chem. and Ind.*, 54, 596; 1935.

A New Alkaloid of Ergot

SOME years ago, Chassar Moir¹ demonstrated by clinical experiments that aqueous extracts of ergot, so far from being valueless as maintained by pharmacologists, contain an oxytocic principle with a remarkably rapid action on the human puerperal uterus. This principle was isolated by Dudley and Moir² and found to be a water soluble alkaloid, which they named ergometrine. During the process of manufacture of this alkaloid, we have isolated in addition a new alkaloid which is isomeric with ergometrine and convertible into it. The relationship is apparently similar to that existing between the alkaloidal pairs ergotoxine-ergotinine and ergotamine-ergotaminine. We have accordingly named it ergometrinine. In the above-mentioned pairs, one member in each case is comparatively inert. Whether the new alkaloid has the same clinical action as ergometrine or is a relatively inert isomeride remains a question for clinical investigation.

Ergometrinine has the formula C₁₉H₂₅O₂N₃. It is fairly soluble in chloroform and has $[\alpha]_{5461}^{20} = +520^\circ$ (in chloroform $c = 1$). It decomposes at about 195°. It forms a crystalline nitrate B.HNO₃, hydrobromide, B.HBr and an acid sulphate B.H₂SO₄. The salts are easily soluble in water and give dextrorotatory solutions.

It is of interest to recall that ergine³, C₁₆H₁₇ON₃, a degradation product of the ergot alkaloids, has a high optical rotation, $[\alpha]_{5461}^{20} = +598^\circ$ (in chloroform $c = 1.5$) similar to that of ergometrinine, and it seems probable that the latter has the same configuration.

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¹ B.M.J., 1, 1119; 1932.

² B.M.J., 1, 520; 1935.

³ Smith and Timmis, *J. Chem. Soc.*, 763, 1543; 1932. 674; 1934.

¹ Laqueur und Münch, *Ber. ges. Physiol.*, 61, 3-4; 1931. Matsuzaki, *Jap. J. Med. Sci.*, 7, No. 1; 1934. Dingemans, Freud und Laqueur, *NATURE*, 135, 184; 1935.

² Gallagher und Koch, *Endocrinology*, 18, No. 1, 107; 1934. See also A. Ogata and S. Hirano, *J. Pharmac. Soc. Japan*, 53, 153; 1933.

³ L. Ruzicka and A. Wettstein, *Helv. Chim. Acta*, 18, 986; 1935.

⁴ A. Ogata and S. Hirano, *J. Pharmac. Soc. Japan*, 54, 199; 1934.

⁵ David, Dingemans, Freud und Laqueur, *Hoppe-Seyler's Z. physiol. Chem.*, 233, 281; 1935.

Expansion of Films of Myosin on Potassium Lactate

By suitable manipulation, it has been found possible to spread true monolayers of proteins on various substrates. These monolayers can be examined both in the Langmuir trough and by the method of surface potentials. In the course of an investigation on the properties of monolayers of myosin, it has been found that when this protein is spread on potassium lactate at pH 7, it assumes a much more expanded form than it does on potassium chloride and other neutral salts, at the same normality and pH. It is interesting to note that it is a hydroxy-acid which causes this expansion, as neither acetates nor propionates are effective; the extension is noted, although to a less degree, with tartrates.

Furthermore, on lactate, as the substrate increases in alkalinity, the film assumes an even more expanded form, whereas no such change is noticeable with potassium chloride. The effect seems to be specific in regard to myosin, for egg albumin shows no such difference.

In the accompanying table are given the approximate values for the area occupied by a gram of myosin on various substrates, and the phase boundary potential difference caused by the film.

pH	Substrate	ΔV max. (milli-volts)	Area per gram (square metres)	
			(1) At commence- ment of uni- formity of the monolayer	(2) At the point of maximum boundary potential
7	M/2 Potassium chloride	275	525	310
7	M/2 Potassium lactate	160	1450	600
10	M/2 Potassium lactate	160	2200	1000
4	M/2 Potassium lactate	170	1300	250

These facts may be interpreted as indicating a tendency of the myosin to extend in the presence of lactate ions. The role allotted to lactic acid at the present time in the physiology of muscle is admittedly a subordinate one, but it is certainly interesting to find that the lactate ion and the contractile substance have this mutual relationship. If the lactate does take any active part in the cycle of events during contraction, it might conceivably be that of facilitating an active relaxation of the fibrils during recovery.

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ERIC K. RIDEAL.

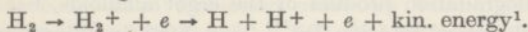
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Molecular Orientation and the Probability of Dissociation of Molecules by Electron Impact

HYDROGEN when bombarded by electrons with energy greater than 27 e.v. dissociates according to the following scheme:



In such a case, the dependence of the probability of the process upon the molecular orientation toward the electron beam will be shown in the angular distribution of the dissociation products, for they fly apart swiftly (at a velocity of 7-11 volts) along the line in which the molecular axis lay at the moment of excitation; strictly, however, a small deviation caused by the translational and the rotational motion must be considered. Our recent measurement of this distribution shows conclusively that the probability

increases rapidly as the molecular axis approaches, from the perpendicular position, that parallel to the electron beam.

In Fig. 1a, hydrogen molecules stream downward from the jet A to be bombarded by 86-volt electrons in a horizontal broad thin beam, so that the sheath of ionisation is sufficiently widespread over the hole B. Positive ions the direction of which is defined by the hole and the twin slits of the shield (Fig. 1b) are received by a Faraday cage maintained at -112 volts against the shield. The receiving system can be rotated around the cylinder axis. As the arrangement is of such high cylindrical symmetry, any deviation from a circle of the polar diagram of the current flowing into the Faraday cage indicates the dependence of the probability of ionisation or dissociation upon the molecular orientation.

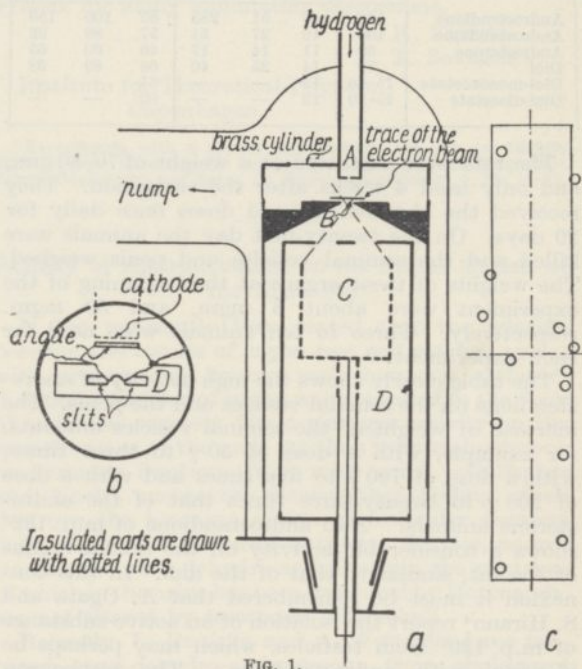


FIG. 1.

Fig. 1c shows the actual diagram obtained, its longer side being parallel to the electron beam. The electrostatic field due to the electron beam and ions² and the possible ionisation inside the shield by the scattered electrons with unequal angular distribution³ are contrary or insufficient to produce the distortion of the diagram observed. Actually, an almost perfect circle was obtained with mercury vapour which filled the ionisation chamber uniformly. Molecular ions simultaneously formed will hit the part between the two slits of the shield. Another type of ionisation: $\text{H}_2 \rightarrow 2\text{H}^+ + 2e$, is much less frequent¹.

A similar investigation of the dissociation process through the state is in progress.

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¹ Bleakney, *Phys. Rev.*, **35**, 1180; 1930. Lozier, *ibid.*, **36**, 1285; 1930.

² Arnot, *Proc. Roy. Soc., A*, **129**, 361; 1930.

³ *idem*, *ibid.*, **A**, **133**, 623; 1931. Brode, *Rev. Mod. Phys.*, **5**, 274; 1933.

Influence of a Magnetic Field on the Viscosity of Para-Azoxyanisol

It is known that a magnetic field has an influence on the orientation of the molecules in anisotropic liquids¹. As it seems probable that the coefficient of viscosity of these substances will depend on whether, and in which direction, the molecules are orientated, a magnetic field may be expected to influence the value of the viscosity coefficient. The first experiments on this subject were made by M. W. Neufeld², who investigated the influence of a magnetic field on the velocity of flow of anisotropic liquids (*p*-azoxyanisol and anizaldazin) through a capillary tube. But, as is well known, in a layer of anisotropic liquid so thin as that in the capillaries used by Neufeld (diameter 0.09 mm.), the action of the field may be impeded by the directive action of the walls. Consequently, Neufeld's experiments cannot be regarded as definitive.

In order to examine the question further, I applied a method in which thicker layers of liquid were in motion, and the surface of friction was a plane, so that it was possible to introduce a magnetic field perpendicular to this plane. This method is somewhat similar to that used by Quincke³ for measurements of the influence of an electric field on the viscosity of liquids.

On one side of the beam of an analytical balance, a glass plate, 48 mm. × 24 mm. × 0.8 mm., was hung in a vertical plane. The plate was immersed in the liquid under investigation, the liquid being in a vessel having two parallel walls 6 mm. apart. The vessel was placed in a thermostat between the poles of an electro-magnet. Thus the plate could oscillate vertically in its own plane. The period of the oscillations was about 5 sec.; the maximum amplitude was 0.5 cm. The damping of such oscillations depends upon the viscosity of the liquid in which the plate is immersed. So far, the influence of the density of the liquid on the damping has been neglected. The apparatus was calibrated with sugar solutions, and then the measurements with *p*-azoxyanisol were made. Its temperature was 125° C. (anisotropic-liquid phase). The damping of the oscillations of the plate was measured without and with the magnetic field (2,400 gauss) perpendicular to the plate. The experiments have shown a rather unexpectedly great influence of the magnetic field on damping. From the values of the logarithmic decrements, the viscosity coefficients were determined, and it has been found that the viscosity in the magnetic field is about 3.5 times greater than without the field. This effect disappears completely after the transition to the isotropic-liquid phase (at a temperature of 135° C).

The experiments are being continued in order to examine how far this effect depends on temperature as well as on the direction of magnetic field. Other substances in their anisotropic-liquid phase are now also under investigation, and the results will be published shortly.

I wish to express my best thanks to Prof. M. Jeżewski for his helpful interest in these experiments.

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¹ See, for example, M. Mięśowicz und M. Jeżewski, *Phys. Z.*, **36**, 107; 1935. M. Trautz und E. Fröschel, *Ann. Phys.*, **22**, 223; 1935.

² M. W. Neufeld, *Phys. Z.*, **14**, 645; 1913.

³ G. Quincke, *Wied. Ann.*, **62**, 1; 1897.

Philosophy and Modern Science

WHEN Dr. Dawes Hicks wrote in his first letter¹ of "that which is sensed", I could not be sure whether he meant an external object, a light wave, or a Russellian sense-datum; but it appears from his further letter² that he meant none of them, but something much more like what I call a sensation. The patch of colour and my awareness of it seem to me to form an inseparable whole; I cannot imagine either without the other, and in any event it is only sensations which we are aware of that can form any basis of knowledge, and therefore that are relevant for my purpose. I do not deny the mental component in a sensation, but I do say that the recognition of physical and mental components in its structure is the result of inference and not a direct observation. Of course I agree fully that discrimination and comparison follow immediately on sensation; their nature is what I am trying to elucidate.

The word "universals" was not introduced by me, but by Dr. Hicks in a definition of "concept" that I do not accept; and the statement that numbers are not existents implies a restriction on the meaning of "existence", about the utility of which there might be a good deal of argument. In Dr. Hicks's sense I am prepared to admit that Neptune may be neither a universal nor a concept; but that does not affect the fact that it is a concept in mine. I never said that an object was a generalisation or an idea of a class of objects; it is a term in a general law or laws that serve to summarise and predict sensations, and such a term is what I have called a concept. I am certainly not the first to use the word in that sense, and I know no other in common use that would express the same meaning.

Perhaps I should explain again that I am not discussing the correctness of any opinion about the nature of the external world or of the mind. I am discussing the nature of the foundations of empirical knowledge, including inference. My objection to most of the theories of science propounded both by physicists and by philosophers is that they postulate from the start a degree of knowledge that cannot possibly be primitive; they begin at the middle or the end instead of the beginning, and thereby fail to come to grips with the fundamental problems.

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¹ NATURE, **135**, 1035, June 22, 1935.

² NATURE, **136**, 183, August 3, 1935.

Phonemes

AT the recent International Congress of Phonetic Sciences, many of the papers contained discussions of 'phonemes' and 'phonology'. There were nearly as many definitions of a phoneme as there were papers, and nobody seemed to have any clear idea of what was meant by the term. The hope was expressed that perhaps the psychologists might be able to discover what a phoneme is. At the Congress dinner, one speaker compared the hunting of the phoneme to the hunting of the snark—with the difference that at least there was a snark. Apparently the phoneme was smiled out of existence. This, however, was not the fault of the phoneme, but of the hunters who failed to find it. The nature of language shows that phonemes do exist, and the successful study of language requires that they shall be found.

Abandoning all speculations concerning what we think we hear and concerning what printed words may be supposed to indicate, we approach the problem as if we had been born deaf and had never learned to read. We first make a collection of tracks of speech on sound films. One after another we find stretches of vibration of more or less homogeneous character. Each one of them was produced by an impulse of the speaker. Such an impulse we term a *speech sound*. The record we have before our eyes is the expression of such speech sounds and it is the only information we have about them. On comparing the records we find that groups of similar speech sounds can be formed. In this way we establish that spoken language consists of a succession of speech sounds, more or less overlapped, and that these speech sounds can be grouped on the principle of similarity. A term is needed to indicate any one of the speech sounds of a group; for this we use the word *phoneme*. A phoneme is not an average of speech sounds; it is one of a group of similar sounds without specification of which one it is. Such a sound can be indicated by a letter. In this way we get a phonetic alphabet that correctly represents spoken language.

Though deaf and unable to read, we can find the phonemes and are able to express them in numbers obtained by measurement. The same procedure might be useful in regard to other problems of language.

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Fibre-Forms in Animal Hairs

THE effect of steam on the fibre-forms of white fox guard hairs reported by Dr. R. O. Hall¹ appears to be an example of a phenomenon, of very general occurrence in wool fibres, which has been described by me in connexion with fibre-forms in merino wool². In the fleece this wool has a waviness which is, to a first approximation, sinusoidal, but the wave form is not entirely stable at ordinary humidities in single fibres withdrawn from the locks, so that in the natural state the fibres must be in a condition of strain, engendered, it may be, during the passage of the potentially curly fibre up the shaft of the follicle, or perhaps due merely to the closeness of packing of the fibres in the locks. The change in the form of a single fibre which proceeds slowly at room humidity is greatly accelerated when the fibre is wetted; it is an elastic deformation, and not a swelling phenomenon, since it is irreversible, and it may be resolved into torsional and flexural changes of which the former are more important. The obvious interpretation of the effect is that in the fleece the fibres have 'cohesive set' which is not relieved naturally because the closeness of packing and greasiness of the fibres in the locks preclude any readjustment under the action of atmospheric moisture.

After reaching an equilibrium form in cold water vapour, the fibre may change its configuration still more if the temperature is raised, and this final change may be compared with the effect obtained by Hall. In view of the fact that the merino wool fibres have existed in a state of strain in the presence of an alkali (the 'suint') the most natural explanation of the temperature changes is that in the fleece the fibres have not only 'cohesive' but also 'temporary'

set^{3,4}, this being stable in cold water but not in hot water or steam. It will be seen that this is also a possible explanation of the flexural changes in steamed fox hairs; in them, of course, any cohesive set would be relieved naturally, since the hairs in the pelt are relatively free from mutual impedance. From this point of view Hall's highly curled hairs are in their normal, unstrained configurations, whilst the fibres in the pelt are temporarily set in straighter forms.

It may be, although this does not seem very probable, that any flexural changes occurring in steamed hairs are due to differential super-contraction following strain in the presence of an alkali; differential super-contraction would also be effective if, as is conceivable, there are structural faults of such a nature that the keratin on one side of the fibre is deficient in those lateral linkages which are responsible for the stability of normal α -keratin in steam. 'Weathering', therefore, must only be regarded as one of a number of possibilities.

The interpretation of effects of this kind is of considerable importance biologically, since the study of fibre-forms can only lead to a knowledge of the mechanism of growth if those factors acting after keratinisation is complete have been taken into account. Whether the cause of Hall's effect is really 'weathering' is, therefore, worth determining; tests on fibres from the pelts of very young foxes would probably throw light on the question.

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¹ NATURE, 136, 28, July 6, 1935.

² Woods, *J. Text. Inst.*, 26, T93; 1935.

³ Woods, NATURE, 132, 709; 1933.

⁴ Astbury and Woods, *Phil. Trans. Roy. Soc., A*, 232, 333; 1933.

Effect of Pressure of Atmosphere on Development of Red Clover

SINCE 1932, studies in this laboratory have investigated the effect of partial pressures of various gases on the nitrogen fixation process in inoculated leguminous plants. The results, which throw considerable light on certain properties of the mechanism employed in this biological process, will be reported in detail in a future publication. In connexion with this research, observations which may be of general interest were made on the effect of growing clover under a fairly wide range of atmospheric pressures. Little work appears to have been reported on this aspect of plant physiology; discussion of the effect of gas pressures in most texts is restricted to the effect of partial pressures of oxygen and carbon dioxide in short-time experiments.

In these studies, red clover plants were grown from two to three months in 10 litre pyrex serum bottles on a sand substrate provided with the required plant nutrients (Crone's solution) and kept under pressures ranging from 0.12 to 1.8 atmospheres. Each bottle was provided with a mercury manometer (with trap) to measure the desired pressure; carbon dioxide was added as required by a method previously described¹. Three times a week all bottles were aerated for 30 minutes and the pressures adjusted, thus preventing an accumulation of oxygen from the carbon dioxide decomposed in photosynthesis.

The most surprising feature of the study was the relatively good growth made by the plants over the entire range of pressures used; differences were noted, but in general, all plants developed even at the extremes of pressure. At pressures greater than atmospheric, nitrogen gas was used to increase the total pressure; the growth of the plants appeared to be quite normal and indistinguishable from plants grown in air. At pressures less than atmospheric and greater than 0.20 atm., a definite stimulation of plant development was noted. The leaves were larger and broader and the plants were slightly greater in size (dry weight) than the control plants kept at normal pressure.

Pressures below 0.20 atm. usually caused some inhibition of growth, probably due to low pressures of oxygen. Previous studies of the effect of pO_2 indicated that plants kept in atmospheres in which the pO_2 becomes less than 0.05 atm. develop typical signs of carbohydrate excess, namely, red stems, yellow leaves and stalky growth habit. Root development under these conditions is characterised by tuberisation. Responses similar to these were observed in plants grown under low total pressure and hence low pressure of oxygen.

Occasionally freak growths were encountered in plants grown under low pressures, including false nodules on the roots, long and pointed leaves and, more rarely, four and five leaves instead of the usual three. Similar studies with other species might be of value in interpretation of types of plant growth at different altitudes.

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¹ E. M. Smyth, *Science*, 80, 294; 1934.

Celluloid Tubes for Sampling Cores of Deep Sea Mud

IN recent years, there has been considerable progress in obtaining long cores of deep sea mud in the course of oceanographical and limnological work. Analysis of the stratification of these cores frequently gives valuable geological, geochronological and palaeoclimatological results. During deep sea investigations it is possible—at least in the U.S.S.R.—to secure cores four to five metres in length. The preservation and subsequent examination of these cores present, however, some difficulties, due to the necessity of pushing out the obtained core from the Ekman tube, the *Meteor* type of sounding tube, and the glass container. This operation is often followed by the secondary deformation of the core, and includes other difficulties of minor importance.

The use of glass containers permits the cores obtained to be kept for a long time in a humid and undisturbed condition. Recently it has been found practicable to remove the cores from metallic tubes in such containers on board ship (Dr. Kuenen¹ on board the *Willebrord Snellius*). This may be ascribed to the fact that the glass container, being placed inside the Ekman or the *Meteor* type tubes, narrows the opening of such a tube, and consequently the length of core is considerably diminished.

Dr. Kuenen's method, however, causes the deformation to be greater, and even doubled.

Instead of glass containers we have used brass ones, with thin walls, that have been placed in tubes of the *Meteor* type or simply adjusted to their stopper. They are not transparent, however, and in using them the process of subsequent withdrawing of cores for their further examination is quite unavoidable. Glass containers, in spite of their transparency and non-oxidisability, have necessarily thick walls and are very fragile and heavy.

In connexion with these difficulties, I venture to suggest that celluloid or some other transparent plastic material be used for the preparation of containers to secure deep sea mud. These containers could have very thin walls (0.2–0.3 mm. or less) and would possess many following advantages: they would be cheap, light, transparent and chemically inactive; moreover, the core could be withdrawn by cutting the container along its length. The thin walls of the suggested containers would make it possible to use them inside the Ekman or *Meteor* type tubes without diminishing the size of the openings. The core included in such a container could be divided into vertical or horizontal sections, even without having to be withdrawn from the container.

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Leningrad, U.S.S.R.

June 21.

¹ Kuenen, H., Die Viermeter-Lotröhre der *Snellius* Expedition. *Ann. der Hydrogr. u. Marit. Meteorol.* H. III, 1932. See also: Stetson, H. C., The Bottom Deposits, Sci. Results of the *Nautilus* Expedition, 1931. Papers in Phys. Oceanogr., etc., vol. 11, No. 3 P.V. 1933. Camb. Mass.

Symbiotic Association between Flies and Nematodes in Galls of Eucalyptus Trees

GALLING of the flower buds of certain trees in Australia, notably *Eucalyptus rostrata* and *E. hemiphloia*, is sometimes so heavy that no flowers appear, and no honey harvest is reaped. The chief causes of galling are agromyzid flies of the genus *Fergusonina*, Malloch.

Inside the galls the fly larvæ are associated with small nematodes, which I have placed in a sub-genus of the plant-parasitic genus *Anguillulina*. The nematodes live in the gall-cavity in contact with the fly larvæ, and ultimately a number of fertilised females enter the body-cavity of the female larvæ of the fly. There eggs are laid, and when the female fly in turn deposits its eggs in young flower buds a number of larval nematodes accompany them. The nematodes at once feed on the plant tissues and give rise to proliferating cells on which the fly larvæ feed, making hollows in which they are associated with the worms.

The symbiosis appears to have arisen as an accidental association between agromyzid leaf-tunnelling larvæ and plant parasitic nematodes.

Goodey¹ has described a parasitic association between the frit-fly of oats and a nematode, which may correspond to one of the steps in the evolutionary series which led to the highly organised association outlined above.

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¹ *Phil. Trans. Roy. Soc.*, B, 218, 315; 1930.

Absorption Spectrum of Methyl Iodide

THE excited state or states, designated by Mulliken as $^1,^3E$, that are concerned in the ultra-violet absorption continuum of methyl iodide, have been compared with the $^1,^3\Pi$ states of the ICl molecule¹. The absence of a band system accompanying the continuum has led to the assumption that the upper state is unstable, whereas a comparison with the $^3\Pi$ states of I₂, IBr and ICl suggests that a 3E state of CH₃I might possibly have a potential curve with a shallow minimum, and that there might exist a band system the convergence limit of which would occur at a wave-length much longer than that of the absorption maximum near λ 2600. The discovery of such a convergence limit would have the additional interest of providing an accurate value of the energy of the C-I bond.

To test this possibility, the absorption spectrum of gaseous methyl iodide at 220 mm. pressure was photographed through an absorption tube 6.6 metres long, the methyl iodide having been fractionated twice immediately before use. No bands were found; but the continuous absorption was found to extend practically to λ 3600, which is some distance beyond the absorption 'limits' of λ 3360 and λ 3100, found by Iredale and Mills² and by Hukumoto³ respectively, using columns of gas 1 metre long. Although the

conditions in the long absorption tube made accurate intensity measurements impossible, it was found that the absorption limits in equivalent columns of gaseous and liquid methyl iodide (6.6 metres at 220 mm. and 0.6 cm. respectively) occurred at about the same wave-length, indicating that the absorption coefficients of liquid and gas in this region are of the same order of magnitude. Since Iredale and Wallace⁴ found that 4 cm. of the liquid absorbed as far as λ 3950, a result that was confirmed in this laboratory, an equivalent column of the gas of the rather impracticable length of 40 metres should absorb at wave-lengths considerably longer than λ 3600, so that the existence of a band system in this region, though improbable, cannot be entirely ruled out.

The experiments also emphasise the fact that the determination of absorption limits by extrapolation from results obtained with short columns of gas may lead to values which are in error by many hundreds of Angstrom units, and that results so obtained have no thermochemical significance. N. S. BAYLISS.

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July 11.

¹ Mulliken, *Phys. Rev.*, **47**, 415; 1935.

² Iredale and Mills, *Proc. Roy. Soc., A*, **133**, 430; 1931.

³ Hukumoto, *J. Chem. Phys.*, **3**, 164; 1935.

⁴ Iredale and Wallace, *Phil. Mag.*, (7), **8**, 1093; 1929.

Points from Foregoing Letters

Prof. G. Beck discusses the forces binding the constituent parts of the nucleus of the atom and inquires into the reasons why two electrons are not emitted simultaneously in radioactive changes; he considers that this would involve the simultaneous occurrence of two neutrinos (neutrino and anti-neutrino).

The half-life periods and the maximum energy of the electrons emitted by a number of artificial radioelements obtained by neutron bombardment are given by Prof. A. I. Alichanow, A. I. Alichanian and B. S. Dželepov. The authors point out that their findings do not agree with Fermi's theory of beta ray decay and do not fit in Sargent's diagram, which connects the maximum energy of emitted electrons with the disintegration constant.

In order to determine the velocity of slow neutrons, Dr. O. R. Frisch and E. T. Sorensen have investigated the effect of passing the neutrons through the marginal part of a rotating wooden disc, and observing the effect of the emerging neutrons upon boron-lined ionisation chambers at two different angles; the results indicate that a large part of the neutrons have velocities of the order of 200 metres per second, and further experiments with cadmium screens show that the main part of those neutrons which are strongly absorbed in cadmium have such thermal velocities.

Dr. E. Tschopp finds that androstendione surpasses other known male hormones in its action upon the growth of the sex organs of the male rat, though, as is the case with the testicular extract, its effect upon the growth of the caapon's comb is inferior to that of androsterone. This and other evidence supports the view that androstendione is a constituent of the male hormone of the testes.

Thin films (mono-molecular) of myosin, a constituent of muscle protein, floating upon water solution, are expanded by potassium lactate at pH 7, and the expansion increases at higher pH (alkaline solutions). A. A. Moss, Jr., Prof. Eric K. Rideal and E. C. Bate Smith consider that these phenomena may throw some light on the changes which take place in the muscle, the lactate helping in the relaxation of the fibrils during recovery.

Hydrogen molecules are more readily dissociated by the impact of electrons moving parallel to the molecular axis, according to Prof. N. Sasaki and T. Nakao. The authors give a diagram of the apparatus used in measuring the angular distribution of the resulting ions.

The influence of a magnetic field upon the viscosity of an anisotropic liquid (*p*-azoxyanisol at 125°C.) has been re-determined by M. Miesowicz, from the damping effect upon an oscillating plate. He finds that the viscosity is increased 3.5 times by a magnetic field of 2,400 gauss.

Clover plants have been grown by Prof. P. W. Wilson in a closed system under pressures of 0.12-1.8 atmospheres. At pressures greater than atmospheric the development of plants appeared to be normal; between 0.20 and 1.00 atmosphere, stimulation of growth was evident. Below 0.20 atmosphere, development was restricted, apparently because of low pressures of oxygen available. At extremely low pressures occasional freak growths were encountered.

N. S. Bayliss describes the ultra-violet absorption spectrum of methyl iodide, photographed through 6.6 metres of the gas. The continuous spectrum was found to extend to at least λ 3600, and although no accompanying band system was found, the possibility of one cannot be entirely dismissed.

Research Items

Excavation in Brittany

IN 1929 Sir Robert Mond was invited to undertake the exploration of the Tressé *allée couverte* by Baron Robert Surcouf, its owner, and entrusted the work of excavation to Miss V. C. C. Collum. This megalithic monument is situated in the Forêt du Mesnil, Ille-et-Vilaine, and had not previously been explored, although it had been reported in 1880 and then scheduled as an ancient monument. Excavation took place in April 1931, and an account of the results then obtained has now been published ("The Tressé Iron-Age Megalithic Monument (Sir Robert Mond's Excavation)". By V. C. C. Collum. Pp. xii+123, with 35 pls. Oxford University Press. 10s. 6d. net). The objective of the investigation was to test the generally accepted view that megalithic monuments in Brittany, such as this, have suffered 'violation' and disturbance in an age long subsequent to that of their erection. Careful and detailed records of excavation and stratification, therefore, were made. A peculiar and characteristic feature of the monument is the occurrence of two double pairs of sculptured human breasts, one double pair on a transverse stone blocking the northern end of the *allée*, the other on the western upright of the alcove beneath the transverse stone. In brief, the results of the investigation indicate that this is a native Gaulish tomb erected in the first century A.D., probably in the reign of Domitian. Fragmentary skeletal remains, not cremated, associated with pottery, both wheel and hand-made, steatite beads, iron which may have been part of a fibula adorned with bronze, and 'nondescript' flint and chert implements, together with the representation of female breasts, point to burial offerings to the mother-goddess or female principle, of which the cult was widespread in Egypt and the East, and at the date suggested as that of the megalith, incorporate in Eastern mysticism. The cult, it is suggested, reached Brittany and Great Britain by way of the Mediterranean, North Africa and the Iberian coast.

Iron Age Pottery in Britain

DR. R. E. MORTIMER WHEELER appends to his report on the excavation in 1934 of Maiden Castle, Dorchester (*Antiquaries J.*, 15, 3), an important, though provisional, amended classification of the Iron Age pottery of Britain. A previous classification, proposed by Mr. Christopher Hawkes, recognises three groups or cultures: *A*—composite, mainly Hallstatt, the type-site being All Cannings Cross; *B*—marsh-village culture of Glastonbury and Meare, pottery with elaborate curvilinear decoration, pre-eminently 'Celtic'; and *C*—Belgic immigrant culture, deficient in artistic expression, but technically well equipped, having the potter's wheel. Geographically, *A* is found over most of middle and southern England, and may be recognised so early as the sixth century B.C., remaining dominant in Oxfordshire, Kent and other south-eastern counties down to the first century B.C. In the west, it is replaced by *B* in the second century B.C., while the Belgic culture enters the south-east in the first half of the first century B.C. *B* occurs primarily in the south-west, but extends,

on one hand, to Northamptonshire and Lincolnshire and, on the other, eastward into Sussex. There is no good evidence for *C* in Wessex before the beginning of the first century A.D. Provisionally, it is proposed to subdivide *A* into three parts: *A1*, 600–400 B.C., marked by finger-tipped ornament especially on high-shouldered *situla* types, and red-coated ('hæmatite') bowls, at first with rilled, and later with cordon decoration; *A2*, 400–200 B.C., absence of above types and presence of poor derivatives of *situla* type, coarse, rough but light fabric, no decoration (well represented at Maiden Castle); *AB*, 200 B.C. to early first century, smaller and simpler types of *A2*, with pottery of *B* types. Class *B*, hitherto regarded as synonymous with Glastonbury, is now seen to be a complex of two or three elements of diverse origin. Decoration is not an adequate criterion. In its place is suggested the bead rim and the counter-sunk handle, neither of which occurs in *A*. The Belgic pottery does not reach Maiden Castle until the eve of the Roman conquest. Reproduction of modified *B* types with the aid of the potter's wheel suggest a composite culture *BC*.

Inbreeding of Swine

VARIOUS experiments on inbreeding of pigs have led to the conclusion that it is injurious to the race. In an experiment which has been continued for eight generations by Mr. R. E. Hodgson (*J. Hered.*, 26, No. 5) at the Experiment Station of the University of Minnesota, he reaches somewhat different conclusions. Brother-sister matings of registered Poland-China swine were made for eight generations without any marked loss of vigour. The strains chosen appear to have been exceptionally free from deleterious recessive characters. The experiments began with six sows, the strain from one being used as an out-bred control. Three of the inbred lines were lost in the first generation and a fourth in the second generation, due to reluctance to mate. In 1926 two new lines were started, one of which is now in the sixth and the other in the eighth inbred generation. The difficulty in securing matings has been less since the fifth generation, and it appears that the strains can now be propagated indefinitely by brother-sister mating. A few anomalies have appeared, and some undesirable characters were segregated, including odd psychological and physiological sexual reactions. Evidence was obtained that differences in disposition, such as super-docity and wildness, are inherited. A substrain with yellow and another with white blotches was segregated from one line. Comparison with the non-inbred strain indicates that no vigour has been lost, but that segregation of vigour has taken place in some cases.

Seasonal Variation in Oogenesis of a Hermit-Crab

M. K. SUBRAMANIAM (*J. Roy. Micr. Soc.*, 55, Pt. 1; 1935) has studied the oogenesis of a hermit crab, *Clibanarius olivaceus*, found in brackish water at the mouth of the Adyar River, near Madras. In January and February, after the heavy rains of the retreating monsoon, the sea-water mixes freely with the river-water, and the bar at the mouth of the river is

open. From the middle of March the level of the water in the river begins to fall, with consequent widening of the bar, and in early April the sea invades the river only at high tide, and even this ceases by mid-April. The crab was found to breed throughout the year but especially in the period from September to March. The ovaries were removed and carefully preserved, and the oocytes examined. In January and February the oocytes showed a voluminous formation of fatty yolk and the occurrence of albuminous yolk. From April to June there was less fatty yolk in the oocytes but more albuminous yolk. The author states that during the period from November to the middle of April, the salinity of the estuarine water is high, but later, as the bar closes, the salinity is suddenly lowered and there is a rise in the pH. The author supposes that the alterations in the condition of life of the crab may have led to a variation in the metabolism which may have affected the constitution of the oocytes.

Diseases of the Iris

A SHORT article by Mr. G. N. Bunyard, in the *Gardeners' Chronicle* for June 29, describes four diseases of Iris plants. Leaf spot, caused by the fungus *Heterosporium gracile*, and Leaf rust, *Puccinia iridis*, are two diseases of the foliage, and may assume serious proportions. Ammoniacal copper carbonate and potassium sulphide do not control either malady, but the simple routine of dividing the rootstock every second year gives healthy produce. Rhizomes and roots are subject to 'scorch' and 'rhizome rot', but no organism has yet been identified as the cause of either disease. Both may be controlled by lifting the rhizomes, cutting away the rotten parts, and then bathing the rest in a bright pink solution of potassium permanganate for twenty minutes. Planting in a 'hospital' bed containing peat and sharp sand further assists the progress of recovery.

Poisoning of Plants by Fluorine

ESCAPE of hydrofluoric acid during chemical operations in which ores rich in fluorides are treated with mineral acid is not easy to prevent, especially when steam is simultaneously liberated, and it may result in damage to the vegetation of the surrounding neighbourhood. An ingenious biochemical method of detecting poisoning of plants by the acid has been devised by Prof. Angelo Contardi in conjunction with Carlo Ravazzoni (*Rend. R. Ist. Lombardo Sci. e Lett.*, 68, parts 6-9). The method is based on the observations (1) that hydrofluoric acid, which attacks the leaves of plants, remains for a long time in the form of soluble compounds capable of inhibiting the enzymic action of the acid phosphatase of rice husk, and (2) that the insoluble fluorides normally present in leaves exert only a very feeble action on this enzyme. The aqueous extract of the leaves under examination is evaporated to dryness, ignited and fused with sodium carbonate, the cold mass being then dissolved in water and the solution filtered. A second solution is prepared similarly from normal, unpoisoned leaves of the same kind of plant, and the effects of the two liquids on the enzymic action are compared.

Respiration of Barley Leaves

THE relation between carbon dioxide production and the concentration of the various carbohydrates during starvation of isolated barley leaves has been

investigated by E. W. Yemm (*Proc. Roy. Soc.*, B, 117, 483-525; 1935) using a combination of iodometric and modified Hagedorn-Jensen methods for the estimation of glucose, fructose, maltose and sucrose. Non-sugar impurities were determined separately after removing all the sugars by yeast fermentation. Carbon dioxide production shows a rise during the 12 hours immediately after isolation, and the subsequent rapid fall is interrupted after about 40 hours by a stage coinciding with the yellowing of the leaves. Finally, the respiration falls rapidly, concurrently with browning and death of the cells. No simple quantitative relation exists between the concentration of any individual carbohydrate and the rate of carbon dioxide production; and, moreover, it is only in the initial stages that all the carbon dioxide arises directly from the available carbohydrate. During the remainder of the time, as much as 75 per cent of the carbon dioxide production arises from some undetermined source other than carbohydrate, and this production is less when the initial sugar content is high, that is, progressive carbohydrate exhaustion increases the production of carbon dioxide from undetermined sources. Determinations of the respiratory quotient suggest that this carbon dioxide arises from protein breakdown. (A similar conclusion was reached by Dastur and Desai with rice seedlings, *Ann. Bot.*, 49, 53; 1935.) It is suggested that rapid sucrose hydrolysis is followed by glycolysis of fructose and accumulation of glucose, which disappears more slowly. Essentially similar results were obtained with bean leaves.

Grass Land Problems in South Africa

ANY traveller in South Africa must be impressed with the wide expanse of country, often comparatively high tableland, which is covered with a grassland dotted throughout with scattered trees, a typical savannah country. Botanically, such country is of the greatest interest as it always raises the question whether such a precarious balance between two types of vegetation will be maintained or whether the trees will close over and subdue the grass or the grass gradually choke out the trees. Economically also the problem is of the utmost importance, this balance of grass and trees being influenced by the head of game or by the amount of stock carried, and by the practice, or lack of regular practice, in seasonal burning of the veldt grasses. It is very fitting therefore that the new *Journal of South African Botany*, issued under the authority of the trustees of the National Botanic Gardens of South Africa and edited by Prof. R. H. Compton, director of the Kirstenbosch Gardens, should include in part 2 of its first volume, a very interesting general discussion of South African grassland problems by Prof. J. Phillips, of the University of the Witwatersrand. Under his direction, problems of grassland ecology are being attacked at the Botanical Research Station of the University at Frankenwald, in the high veld, a preliminary study of the root systems of some of the characteristic high veld grasses, by Messrs. S. M. Murray and P. Glover, carried out at this station, is reported upon in the same journal. This study shows that very fundamental differences may be found in the root systems of pioneering species and other species; whilst Prof. Phillips's paper shows the very wide nature and great economic importance of the problem raised by the study of these grasslands.

Evaporation in India

AN investigation into evaporation in India has been made in the Agricultural Meteorology Branch of the India Meteorological Department by P. K. Raman and V. Satakopan. The work is described in Scientific Notes, 6, No. 61 (Delhi: Manager of Publications). As the authors remark, "our knowledge of evaporation from the soil under natural conditions is practically nil in India", and they have had to content themselves with a study of the evaporating power of the atmosphere with respect to a free water surface, and to calculate this from various meteorological factors such as mean wind velocity, mean relative humidity and mean water vapour pressure, by an empirical formula. The formula chosen was derived from a formula of Carl Rohwer based on laboratory studies made with the view of testing separately the effect of the different factors. In Rohwer's formula, a factor $e_s - e_d$ appears, where e_s is the mean vapour pressure of saturated air at the temperature of the water surface and e_d is the mean vapour pressure of saturated air at the temperature of the dew point. In the absence of data for the temperature of free water surfaces in India, the rather bold assumption has been made that calculation of mean values can be made as though the temperature of the water is the same as that of the air, which is possibly true when one is dealing with averages. In that case, $e_s - e_d$ becomes $(100/h - 1)e$, where h is the relative humidity of the air and e is its vapour pressure. Calculated means of evaporation for a well distributed network of stations for each month are tabulated, together with the mean monthly rainfall. The evaporation is shown cartographically on maps of India, also the annual evaporation and the annual figures for rainfall minus evaporation. As might be expected, the area of greatest evaporation is in the west of India, with its centre in about latitude 20° N.

Activation and Evaporation of Adsorbed Atoms

J. E. LENNARD-JONES and C. Strachan (*Proc. Roy. Soc.*, A, June 1) have made a wave-mechanical calculation of the probability of activation of adsorbed atoms, and Strachan in a second paper extends the calculation to obtain probabilities of evaporation of atoms from surfaces. The atoms adsorbed on a crystal lattice may remain in one place, vibrating about a mean position, they may migrate from place to place or they may be ejected from the surface by the heat motion of the lattice atoms. The vibrations of the atoms about a mean position provide the activated energy states which are considered in this paper. The atoms are assumed to be adsorbed as a simple cubic crystal and the forces holding them are supposed to be of the Morse type in which the potential is given by two exponential terms corresponding to a short-range repulsive field and a long-range attractive field. Formulae are found for the probability of excitation of different excited vibrational states and for the average life of an atom in an excited state. The life of an excited state seems to be of the order of 10^{-12} sec. in a particular case—this time is a few periods of the vibratory atom. The migration of atoms over the surface takes place when the atoms are in an activated state. The evaporation problem involves an extension to the case of transitions to a state in the region of continuous energy distribution. The theory is worked out and applied to the cases of H_2 , HD and D_2 . The surface forces are nearly the same for

these molecules; the different masses lead to different wave functions and the probabilities of evaporation from a surface at low temperature in these molecular species are roughly in the ratio 1, 0.2, 0.05.

A New Power Output Valve

IN the best types of modern broadcasting receivers, the output valve is usually of the triode or three-electrode type, since this enables the most complete freedom from distortion of the acoustic output to be obtained. This valve is, however, relatively insensitive, so that an additional stage of audio-frequency amplification is required, rendering its use uneconomic in the majority of commercial receivers. Such receivers therefore usually employ a pentode output valve, which will give the same output power for about one third of the input voltage required by the corresponding triode. The pentode output valve is very liable to produce distortion due to curvature of its characteristics over a considerable portion of its working range. This defect is claimed to have been removed in a new type of power output valve described by J. H. Owen Harries in the *Wireless World* of August 2. The new valve is of the four electrode type, the cathode and two grids being of normal construction and dimensions; the novelty lies in the fact that the anode is a cylinder of unusually large diameter. It has been found that if the anode of a multi-grid valve is spaced from the outer grid at a certain critical distance, the undesired secondary emission is eliminated, and the consequent necessity for a suppressor grid, as in the pentode, is avoided. Characteristics of the new valves in comparisons with those of typical pentodes illustrate the improvement which has been obtained in linearity and resultant freedom from distortion. The impedances of the new valves are lower than those of the equivalent pentodes, while the mutual conductances are appreciably higher, thus giving about the same overall sensitivity. It is stated that the High Vacuum Valve Co. is now manufacturing these new valves in a two-watt output type, which is considered to be adequate for the average domestic user.

Structure of a Stellar Atmosphere

W. H. CHRISTIE and O. C. Wilson (*Astrophys. J.*, 81, 426) have described an interesting method of examining the structure of a stellar atmosphere in the case of the eclipsing binary ζ Aurigae. This system consists of a giant K -type component with a B -type companion, and the authors have devised a method whereby the effects of the light of the former may be eliminated from the composite spectrum, thus permitting a study of the light from the B star shining through the atmosphere of the K star. A series of spectra taken near the period of eclipse will thus give the relative heights to which various elements extend in the atmosphere of the K star, and also the relative number of atoms existing at different levels above the photosphere. Changes in the total absorption have been measured for nearly 100 lines in spectrograms taken at Mount Wilson during the 1934 eclipse, and the results grouped into the following six classes: neutral metals, Mg, Ti II (two groups), H, and Ca II. Accurate photometric observations are still badly needed to improve the values of essential factors such as the relative diameters of the two components and the inclination of the orbit. It is hoped that these will be forthcoming during the next eclipses in 1937 and 1939.

Tectonic Framework of China

PROF. J. S. LEE delivered a lecture before the Geological Society on June 5 on a subject of which he is the leading authority: "The Structural Pattern of China and its Dynamic Interpretation". Since the time of Suess, it has been generally accepted that the structural framework of eastern Asia consists of a series of arcs with the 'Amphitheatre of Irkusk' as their common centre. Modern researches, however, have shown that each of these arcs embraces features of different tectonic origin. Three main groups of structural elements are now recognised: (a) the Cathaysian geosynclines and their complementary geanticlines; (b) the east-west zones; and (c) the shear-forms. These seem to be fundamentally independent of each other, although they sometimes fall in line and sometimes interfere.

The Palæocathaysian geosyncline existed as an epicontinental trough, more or less parallel with the eastern border of the continent, so far back as late Pre-Cambrian time. A remnant of its borderland still remains in the coastal belt of south-eastern China. Prof. Lee traces its history to Permo-Carboniferous times, when it formed the eastern extension of the Tethys, and on to the Triassic when it formed the Mesocathaysian geosyncline. It was completely filled in during the Lower Jurassic, and since then China has remained continental. Modern features arose from Jurassic-Cretaceous movements and some of them followed the old-established lines, with the result that geosynclines and geanticlines of the Cathaysian type can still be recognised. One of the present-day troughs is occupied by the Sea of Japan and the Yellow Sea; another, farther inland, stretches from the plain of Manchuria to the Central Yangtze Basin and is named the Neocathaysian geosyncline.

The east-west zones, tabulated below, exhibit a rhythmic orogeny that is one of the most striking tectonic phenomena of eastern Asia. It will be noted that the interval between the ranges is 8° of latitude in every case.

The third group of features includes various shear-forms, of which three types predominate. One of these forms consists of a series of nearly parallel folds trending north-east or north-west and is known as the ξ type. These are commonly traversed by faults roughly perpendicular to the axes. Another consists of a frontal arc with a radial backbone, somewhat after the fashion of a bow and arrow, and is called the ε type. The third is a bundle of folds curving round an old massif or mountain mass and is designated the η type.

Orogenic Epochs	Ranges and their latitudes			
	Tannu-Kental 49°-50°N.	Inshan 41°-42°N.	Tsingling 33°-34°N.	Nanling 25°-26°N.
Tertiary	—	×	?	?
Jurassic-Cretaceous	×	×	×	×
Hercynian	?	?	×	×
Caledonian	×	—	?	×
Pre-Sinian	×	×	×	×

Consideration of the mechanics, supported by experimental reproductions, leads Prof. Lee to the belief that the shear-forms imply horizontal shearing movements of the upper layer of the continental mass, directed on one hand against the Tibetan massif or the shattered ends of the east-and-west ranges, and on the other against the border of the continent. The other features also suggest southerly movement of the continental mass, and it is suggested that the driving force might have been supplied by an increased speed of rotation of the earth due, for example, to concentration of mass in the interior or to bodily contraction of the earth as a whole. An attempt is made to test the hypothesis by the distribution in time and place of the marine transgressions of the past, some twenty-one of which (major cycles) are recognisable since the beginning of the Cambrian. For a more extensive summary of the lecture, reference should be made to *Abs. Proc. Geol. Soc. London*, No. 1298, June 17, 1935.

Return of Mineral Elements to the Soil by Plants

IT is not generally known that plants can return to the soil at some stage of their growth, either after the first burst of vegetative activity or after maturation of the fruits, certain of the more important nutrient elements which they have absorbed.

Until recently the evidence was meagre, but a series of papers published in Bucharest by Prof. Deleanu and his colleagues¹⁻³ recording the result of investigations into the function of mineral elements in the life of the plant, has added considerably to our knowledge of this phenomenon.

In 1908 Prof. Deleanu himself⁴ found that there was a reversal of the process of absorption of soil constituents, called by him 'negative migration', which occurred in oat plants after they had reached

maximum growth, the loss being 64 per cent of the ash elements and 47 per cent of nitrogen. In 1919 J. S. Burd⁵ recorded that with barley grown on two different soils, the initial progressively increasing rate of absorption of the soil constituents during the early stages of vegetative development was followed by a period of actual loss, coincident with the development of the heads, and succeeded by renewed absorption at a later period. The absorption and loss were most marked in the elements potassium and nitrogen. In maize the rate of absorption decreased considerably prior to head formation, though no actual loss of soil constituents was found⁶. Plants such as the potato, on the other hand, show no such striking change in the rate of absorption.

In the recent Bucharest investigations, V. G. Bossie², working with wheat, shows that the cycle of absorption and migration is somewhat similar to that of barley, differing only in details. The life period of some seventy days in wheat can be divided into three phases: (1) vegetative, which reaches its maximum by the twenty-sixth day; (2) fruiting, which commences about the thirty-first day and culminates about the sixty-fifth day, and (3) post-maturity. Absorption of all mineral elements in the aerial portions as a whole was rapid and very considerable during phase (1); thereafter the rate of absorption of phosphorus, nitrogen and magnesium was markedly decreased, but none of these was lost, whereas in the case of potassium and calcium actual loss occurred after the first twenty-six days; silica, which amounts to nearly half the total ash, continued to be absorbed more or less regularly until maturity, when some loss of all elements occurred. The amount of the loss was most marked in the case of potassium and calcium, as negative migration of these had started early, but the loss in all other cases was less than 20 per cent. What is happening is that during the stage (2) the developing ear is drawing its supplies of nutrients from the leafy stems, silica only being absorbed directly from the soil; the supply of nitrogen, phosphorus and magnesium is inadequate in the leaves and so a further slight absorption of these elements from the soil takes place; potassium and calcium, however, are in excess of the amount required by the ear, and so can be returned to the soil.

The phenomenon of negative migration occurs in other groups of plants. In tobacco, for example, not only does loss of soil constituents occur when the main stem has reached maturity, but it may also be

succeeded by re-absorption and further negative migration corresponding with the development of axillary shoots³.

It seems obvious, therefore, that the reason for the changes in the rate of absorption by the plant must be sought in the metabolic state of the tissues, and that when actual loss occurs it is probably due to the interaction of the factors causing the metabolic changes and the factors of the soil environment affecting absorption. In this respect it is well to mention that Burd⁵ found that the losses occurred in oats when the constituents of the water extracts of the soil were at or approaching their minima and when the same constituents were moving from the leaves to the ear.

It has been suggested that the elements migrating from the aerial organs are accumulated by the roots. In the paper by Bossie, however, details of the analyses of roots have been included, and bearing in mind the difficulties attending collection of these organs from the soil, the results show that this cannot be the case; for example, from the twenty-sixth day to the thirty-fifth day, the aerial organs of a hundred wheat plants lost 0.187 gm. of potassium, whereas the roots only accumulated 0.001 gm. in the same time; the other 0.186 gm. must therefore have been returned to the soil.

N. L. PENSTON.

¹ Deleanu, N. T., and Bordeianu, C., *Acad. Roma. Mem. Sect. Stiint.*, Ser. 111, Tom. ix, Mem. 10 (1934), "Studiu asupra rolului si functiunii substantelor minerale si organice in viata plantei", No. 11.

² Bossie, V. G., *Lab. de Chim. Anal. Facultatea de Farmacie, ibid.*, No. iv; 1934.

³ Vladescu, I. D., *Lab. de Chimie. Anal. Universitatea din Bucuresti, ibid.*, No. v; 1934.

⁴ Deleanu, N. T., *Trav. de l'Institut de Bot. Geneve*, 1908.

⁵ Burd, J. S., *J. Agric. Res.*, 18; 1919.

⁶ Jones and Huston, *Ind. Expt. Sta. Bull.*, 175; 1914.

Third Imperial Mycological Conference

IN spite of financial stringency, which has cramped the activities of many scientific institutions of recent years, the Imperial Mycological Institute organised a very successful Conference at the Imperial College of Science and Technology in September 1934. Invitations were conveyed to overseas Governments of the British Empire, to certain Government Departments of the United Kingdom, and to the staffs of agricultural and horticultural research stations, university departments, to individual mycologists, and to the representatives of certain firms interested in the manufacture of fungicides. A report of the activities of this Conference has recently appeared (*Imp. Mycol. Inst.*, Kew, Surrey, pp. 32, 2s. net).

Sir Charles Howell Thomas opened the proceedings of the Conference on September 17. In the course of his speech of welcome, he referred to the change in administrative control of the Institute, and praised the work of Lord Buxton in fostering the efficient work of the Institutes of Mycology and Entomology before they were taken over by the Executive Council of the Imperial Agricultural Bureaux. The future finance of the Institute of Mycology gives cause for concern, and was the subject of deliberation by a special sub-committee. It was recommended that

representations be made to the various Governments supporting the Institute for restored or increased financial aid.

The Director (Dr. E. J. Butler), in reviewing the work of the Institute, showed that enormous financial losses are sustained as a result of fungal attack, and stressed the importance of disease surveys in demonstrating such loss. He also discussed the publication of the Institute's periodical *Review of Applied Mycology*.

The deliberations of the Conference naturally covered a wide field. Administrative measures against plant diseases, methods of standardisation of insecticides and fungicides, virus diseases, control methods for small cultivators, foot-rots of cereals, breeding and selection for immunity against disease, and several papers on diseases of particular crops, formed the main topics.

One important activity of the Conference lay in the drafting of a health certificate to be given to consignments of plants made within the Empire. This is not designed to replace any legislation or quarantine regulations, and carries nothing but a hall-mark of freedom from disease. If this practice is adopted extensively, it should mark a very considerable advance in the control of fungus diseases.

Radiation from a Transmitting Aerial

THE transmitting aerial of a broadcasting station designed for local or national service should confine as much as possible of its radiated energy to the horizontal direction, emitting as little as possible in directions making an angle of less than 60° with the vertical. The station will then have a large service area in which little fading is experienced. The demand for information on the design of such an aerial has given rise in recent years to some theoretical and experimental investigations on the general properties of antennae used in radio transmitting stations.

A new and useful contribution to the state of knowledge on this subject has recently been given by Prof. P. O. Pedersen in a booklet published (in English) in Copenhagen ("Radiation from a Vertical Antenna over Flat Perfectly Conducting Earth." Pp. 49+35 figures. G. E. C. Gad: Vimmelskafet 32, Copenhagen. Kr. 6.00). This work comprises a theoretical investigation of the radiation characteristics of a vertical antenna over flat perfectly conducting earth, having for its objective a determination of the most suitable dimensions of the antenna at the new Copenhagen broadcasting station. The theoretical results have been checked by measurements of the distribution of the current in the antenna and of the field intensity at various distances from the station. To facilitate the theoretical analysis, the current distribution in the transmitting antenna

is in the first case assumed to be sinusoidal, although it was known that this is not valid in the practical case. The complete general formulæ for the radiated field for an antenna are obtained, and a most useful series of tables and graphs are provided, from which the radiation resistance and the distribution of the radiated field in the vertical plane may be calculated for antennae of various dimensions.

The author then applies the results to the practical case of the vertical antenna at the Copenhagen station. Measurements of the current and voltage distributions in this antenna have been made to ascertain to what extent they differ from the sinusoidal case. The chief point of difference is that the node of current at the base of the antenna, which is just over half a wavelength high, is replaced by a current minimum only. The formulæ are therefore recalculated to take account of this new distribution, and it is shown that the alteration produced in the radiation distribution diagram for the Copenhagen antenna is almost negligible.

The practical and very satisfactory result of the work described in this paper is, therefore, that for the type of half wave transmitting aerial which is now employed at many broadcasting stations, the radiation characteristics may be calculated with good approximation by the comparatively simple analysis based upon a sinusoidal distribution of current in the antenna.

Work of the Bureau of Standards, Washington

ALTHOUGH owing to the necessity for economy the work of the U.S. Bureau of Standards had to be appreciably curtailed last year, yet the record of the work done as given in the annual report of the Secretary of Commerce (pp. 51-76) is impressive and interesting.

Valuable results were obtained in an experimental research on the transmission utility of the various frequencies used in broadcasting. The effects of ground waves and sky waves were determined. The sky waves were found to play a far more important role in distant daytime reception than was formerly supposed. The results obtained by measurements throughout the year on the height and ionisation of the conducting layers in the upper atmosphere which are responsible for long-distance radio transmission have greatly increased our knowledge of the subject. The relative effects produced by ultra-violet light, electrons and heavy ions have been determined.

Tests show that a new method of assembling watches having monometallic balance wheels and elinvar hairsprings has increased the uniformity of their time-keeping and has practically eliminated the deleterious effects that can be produced by magnetism. In association with the American Dental Association, the Bureau has developed and standardised methods for tarnish tests for dental alloys of low precious metal content. In connexion with criminal work, assistance was given in cases involving

extortion, kidnapping, forgeries, threatening letters, etc.

The temperature of 'freezing' rhodium *in vacuo* has been found to be $1,966^\circ\text{C}$. with a possible inaccuracy of $\pm 3^\circ\text{C}$. The candle-power of tungsten filament lamp standards can now be found from the basic carbon filament standards. The vapour pressures of solid and liquid heavy hydrogen (deuterium) have been measured and from these data its freezing and boiling points and latent heats have been deduced. Interference measurements in the first spectra of several gases have been repeated and extended. Most of the spectral lines have been found reproducible to one part in fifty million and consequently are recommended as standards for spectroscopic and meteorological measurements.

Many useful hints are given amongst the results obtained. For example, tests made under carefully controlled conditions, with lighted cigarettes on grass and forest floor materials, show that the fire risk is greatly decreased when a cigarette paper tip $\frac{3}{4}$ -1 in. long is applied in the course of manufacture over the end that is discarded. The possibility of utilising this result in practice is worth considering. The carpet wear-testing machine developed at the Bureau has been put to good use during the year. It has been found that the durability of a carpet is materially increased by increasing the density or the height of the pile and by the use of underlays.

Colour Inheritance in Silkworms

IMPORTANT results and conclusions regarding the inheritance of cocoon colour in silkworms have recently been published*. In these insects the colour of the silk secreted generally corresponds with that of the h molymp. Breeds with white cocoons have colourless blood, while those with yellow cocoons have yellow blood. In different strains the yellow varies from golden to straw-colour or reddish yellow, and some silkworms with yellow blood may weave a white cocoon, but it is not possible for a silkworm having white blood to produce a yellow cocoon.

It is concluded that migration of pigment takes place from the blood to the silk secretion. In some strains there is a change of colour in the different layers of the cocoon. For example, in the Chinese the outer layer is yellow-gold, becoming gradually paler to pure white in the innermost layer. The cocoon of the Italian strain, however, is colourless outside, becoming deeper coloured towards the interior. The colour is derived from the carotinoid pigments of the mulberry leaf, but its tint and distribution appear to depend on the conditions in which the pigment passes from the blood to the silk.

Two races with white (*W*) cocoons may, when crossed, produce a strain having yellow (*Y*) cocoons if one is white because the blood is unpigmented and the other because of incapacity of the silk gland to extract pigment from the blood. The possibility of migration of blood pigment to the silk is inherited as a dominant Mendelian character, but races differ in the time at which the silk glands show this capacity for taking up pigment. Thus in the Italian strain 'Fossombrone' the cocoon is nearly white in its outer layers, becoming golden yellow within, while in the Chinese yellow the outer layers of the cocoon are yellow. In crosses between them, this difference in 'precocity' of the action of the silk gland gives an intermediate result in the hybrid. Such results account for various discrepancies and the 'maternal inheritance' obtained by earlier investigators.

The colourless blood and white cocoons of the Japanese 'Awojiku' and other recessive whites is believed to be due to absence of capacity for absorbing the carotinoid pigments from the food through the intestinal wall; while in such dominant white strains as 'Baghdad' the colourless blood may be due to the presence of oxidising enzymes. In a green strain the pigment is a flavone derived from the leaf, which is present also in certain other strains. Thus not only are intestinal permeability and glandular permeability independent, but permeability to the flavones and the carotinoids are separate characters. White 'Awojiku' \times 'Green' gives an F_1 with white blood and a 15:1 ratio in F_2 . The explanation of this dihybrid result is not yet clear.

It is found that the pigments can be quantitatively extracted from the cocoons of various types. By these methods it is possible not only to reach a physiological definition of the hereditary factors in terms of cell permeability, but also to investigate the chemicophysiological individuality of the substances the metabolism of which is controlled by these genetic factors.

R. R. G.

Educational Topics and Events

CAMBRIDGE.—The Frank Smart studentship in botany will be vacant on October 1, 1935. Any graduate of the University is eligible for the studentship provided that not more than fourteen complete terms have elapsed after his first term of residence. The value of the studentship is £200 per annum. A candidate must send his name, with a statement of the course of research he proposes to undertake, to Prof. A. C. Seward at the Botany School on or before October 2.

FROM the Kaiser-Wilhelm-Gesellschaft zur F rderung der Wissenschaften we have received two polyglot pamphlets describing the scope of the Society's work, which embraces the maintenance of thirty-four research institutes in Berlin, Heidelberg, Dortmund, Munich, G ttingen, D sseldorf, Breslau, Dresden, the Ruhr and other places in Germany, Austria, Italy, Switzerland and Brazil. An appeal is made for the moral and material support of Germans the world over (in the English version, erroneously, "the widest circles in Germany"). One of the pamphlets relates to "Harnack House" in Berlin, a hostel for foreign visitors engaged in research in subjects germane to those studied in the Society's institutes. Here they have opportunities of intercourse with German savants, for the hostel serves also as a club for members of the Society and the staffs of the Institutes, about 150 of whom take their meals there every day. The House has a library, reading-room with numerous German and foreign periodicals, gymnasium, tennis-courts, bathrooms, lounge, terraces, etc. It is used by various learned societies for lectures and social functions, and is described as having become the centre of intellectual life in Berlin.

UNIVERSITY student housing conditions, past and present, form the subject of two interesting articles by Dr. W. H. Cowley, of Ohio State University, in *School and Society* of December 1 and 8. Nearly all the founders of the American colonial colleges were Oxford and Cambridge graduates or English-educated Americans; but the English college system of bringing together dons and students both for formal individual conferences and for informal social and intellectual intercourse failed to reproduce itself in the United States. College residential conditions were affected not only by the undeveloped state of the country, but also particularly by the bogey of student discipline, responsibility for which rested on the faculty member living in the dormitory, and this led to acute faculty-student antipathies. In the course of the nineteenth century, German university ideals became dominant in America and, as these recognised no obligation on the part of the university to concern itself with the life of the student outside the classroom, dormitories came to suffer from neglect where not dispensed with. Towards the end of the century a reaction began, and though considerably hampered by the recent general economic depression, is still active and promises to become even more important. The Oxford and Cambridge college system has now been adopted more or less at Harvard and Yale, the German point of view still prevails at California and Nebraska, and an American compromise, giving students body shelter and varying degrees of social education, is general.

* Studi di Genetica sui Bachi da Seta. Per Carlo Jucci. I: Il Colore del Bozzolo. *Reale Accad. d'Italia*, Mem. Classe Fis., Matematica e Naturali. Vol. 5, pp. 347-477; 1934.

Science News a Century Ago

Alexander von Humboldt in Paris

IN its column of "Miscellanea", the *Athenaeum* of September 12, 1835, said: "The celebrated Alexander von Humboldt is once more in Paris, and at the meeting of the French Academy of Sciences, on the 17th of August, called the attention of the members to the prints of footsteps, belonging to a quadruped, in the variegated sandstone, or *bunte sandstein* of Hildburghausen. It is an animal of the Plantigrada division, which traversed the rock while soft, and in various directions. A stone containing these impressions, from ten to twelve feet long, and three to four wide, has been sent to the collection of mineralogy at Berlin, of which the Baron submitted a beautiful drawing. There are four or five species of smaller impressions, which cross those of the larger quadruped at right angles, and are remarkable for the unequal dimensions of the fore and hind feet, and all have five toes. The rock is covered with them as with a network, and here and there sinuous serpulac concretions, perhaps of plants on which the animal walked, perhaps some accidental effect of drying. The great importance of this discovery lies in the place occupied by this sandstone in the chronological series of rocks."

Earthquake in Lancashire

ON August 20, 1835, according to the *Annual Register*, "A shock of an earthquake was felt in different parts of Lancashire. . . . It was felt at Downham, Wiswell, Pendleton, Milton, Waddington and all the surrounding villages. At about twenty minutes to four o'clock the inhabitants were disturbed by a violent tremulous motion, and the sensation of heaving or rising and falling of the bed in which they lay, which was followed by a distinct noise resembling distant artillery. It was felt in Liverpool and was violent at Lancaster, where it threw down a chimney in Bridge-street, but without doing serious mischief. . . . The shock was felt very forcibly in Preston at about twenty-seven minutes before four o'clock. The noise produced by the internal thunder was likened to the sound of some heavy piece of artillery being dragged very rapidly over a pavement; and the whole duration of the shock to the latest vibratory motion produced by it was not less than thirty seconds."

Death of Leopoldo Nobili

ON August 23, 1835, the Italian physicist Leopoldo Nobili died. Born in 1784, Nobili was in his youth an artillery officer, but he afterwards became professor of physics in the archducal museum at Florence, the old habitat of the Accademia del Cimento. His principal researches were made in magnetism, electricity and light, on which subjects he left a large number of theoretical works. In some of his latter work he was associated with his distinguished countryman Melloni. Nobile made two valuable contributions to science, the first being his suggestion in 1830 of the astatic combination of the needles by which the sensibility of the galvanometer (Schweigger's invention) is greatly increased, and the second his invention in 1834 of the thermomultiplier or thermo-electric pile, which in the hands of Melloni and J. D. Forbes led to the discovery of many

important facts. At a time when animal electricity was attracting much attention, Nobile demonstrated the passage of a current of electricity from the feet to the spine of a frog, and he was the discoverer of the beautiful coloured transparent films of metal deposited by electro-chemical processes.

Unveiling of Statue of Cuvier

ON August 23, 1835, a statue of Cuvier, who died on May 13, 1832, was unveiled at his birthplace, Montbéliard in the department of Doubs. The statue was by the sculptor Pierre Jean David (1789-1856), and was executed at Belleville, where it had been on view to the public. Deputations from many societies were present and orations were delivered in honour of the occasion. The house in which Cuvier was born was tastefully decorated and on it was placed the inscription—"Ici naquit G. Cuvier, le 23 Août 1769".

Death of John Macculloch, F.R.S.

ON August 21, 1835, Dr. John Macculloch, geologist to the Trigonometrical Survey, died at Penzance through injuries sustained in a carriage accident. Born in Guernsey on October 6, 1773, he attended schools in Penzance and Plymouth; he entered the University of Edinburgh and in 1793 graduated M.D. At first an assistant surgeon in the artillery, he became chemist to the Board of Ordnance, practiced in Blackheath, and in 1814 was appointed lecturer in chemistry and mineralogy to the Royal Military Academy, Woolwich, and geologist to the Trigonometrical Survey. He made several excursions in Scotland, published a "Description of the Western Islands" and prepared a geological map of the country. He was elected a fellow of the Geological Society in 1808, and served as president in 1816-17. In 1820 he was admitted a fellow of the Royal Society: "As an original observer," said Lyell, "he yields to no other observer of our own time and is perhaps unrivalled in the wide range of subjects in which he has displayed great talent and profound knowledge." His portrait by Faulkner is preserved by the Royal Society.

Societies and Academies

CRACOW

Polish Academy of Science and Letters, June 3. A. RAJCHMAN: A complement to the Riesz-Fischer theorem. L. KOZLOWSKI: The movement of fluids accompanying changes of state. S. DOBINSKI: The density of liquid phosphorus. The density of phosphorus has been determined over the range 7°-68° C. The coefficient of expansion is 0.000531. A. JAGIELSKI and I. WESOŁOWSKI: Contributions to the knowledge of the dielectric polarisation of solutions. Determinations of the electric moments of the dipoles of ether, *o*-nitroaniline, *o*-nitrotoluene, *o*- and *p*-nitrochlorbenzene. M. KAMIENSKI: Perturbations in the heliocentric movement of comet Wolf I during the period 1918-25. S. PIOTROWSKI: Several variable stars with eclipses. WLAD. GORCZYNSKI: The mean duration of insolation along the Mediterranean coasts. M. BLUMENTHAL: The mechanisms of the reactions between solid phases and one gaseous phase. B. KAMIENSKI: The influence

of the magnitude, symmetry, ion concentration and dipoles on the electrical potential at the surface of separation of phases: solution and dielectric. B. KAMIENSKI and W. GOSLAWSKI: A simplified dynamical method for measuring the dielectric potentials at the surface of separation of phases: solution and air. B. KAMIENSKI and W. GOSLAWSKI: The influence of the hydrogen ions on the dielectric potential of stereoisomers: quinine and quinidine. F. GAJOWCZYK and J. SUSZKO: Diastereoisomeric compounds: the naphthalene-1, 5-bis-sulphinylaetic acids. J. REYMAN and J. SUSZKO: Study on the hydroiodoquinines and on niquine. J. TOKARSKI: Petrographical studies of the Podolian loess. Petrographical analysis of a Grzybowice profile near Lwow. J. TUR: Embryonic neoplasms obtained experimentally. L. D. LIOSNER and MME. A. WORONZOWA: Continuation of the researches on the mechanism of the perforation of the opercular membrane in the metamorphosis of the batrachians (2). R. TOWARNICKI: The blood vessels in the brain of *Myxine glutinosa*. J. JAROCKI: Studies on the cilia of the fresh-water molluscs.

GENEVA

Society of Physics and Natural History, June 6. C. E. G. STUECKELBERG: The signification of multiple times in the theory of quanta. L. SCHAMES: The field between an α -particle and an atomic nucleus. Transforming a formula previously deduced for the potential between an α -particle and an atomic nucleus, it can be shown that this potential depends only on the ratio of the mass m to the atomic number, Z . For the same ratio, the potential curve divided by Z is the same. L. SCHAMES: The principal difference between the material mass and the magnetic mass. The magnetic masses can be cancelled by transforming into radii whilst for material masses no plausible reason is known at present for such cancellation. Consequently it is only 0.001-0.0005 of the entire mass which can be emitted in stars. This radiation finished, the star is composed only of neutral and material mass of very great density. J. WEIGLE: Molecular fields in the liquid state. The presence of a quasi-crystalline orientation of the molecules of a liquid gives rise to a field of force which opposes the rotation of the molecules. The variation of the mean electric moment of nitrobenzene in different non-polar solvents is attributed to the presence of this field, the magnitude of which can be calculated starting from experimental data. Up to concentrations of 50 per cent, this field depends on the solvent and on the nitrobenzene. But above 50 per cent the molecules of nitrobenzene alone determine it. H. SAINT: The thermal expansion of calcite. Measurements of the expansion of calcite, made between 25° C. and 100° C. by means of X-rays on a specimen coming from Mt. Big Timber, have given the same results, within the limits of the experimental errors, as those obtained macroscopically by J. B. Austin. Earlier measurements made by the X-rays on another specimen had given smaller coefficients. FERNAND CHODAT and M. RAAD: The variation of the buffer coefficient of culture fluids in the course of transmissible lysis. A. MERCIER: The expression of the second principle of relativist thermodynamics by means of Clifford numbers. W. H. SCHOPFER: Researches on the role of vitamin B on the nitrogenous metabolism of the *Phycomyces*. Quantitative researches show that the action of

pure crystallised vitamin B is closely related to that of asparagin. Asparagin and vitamin B may be limiting factors with respect to each other. In the case of *Phycomyces*, it appears that it is especially the nitrogen metabolism which is controlled by vitamin B.

SYDNEY

Royal Society of New South Wales, June 5. EDGAR H. BOOTH: A regional magnetic survey. District: Mittagong-Bowral, New South Wales. This paper presents the corrected observations, over a region of twelve square miles, of a detailed vertical variometer survey. The area is particularly rich in igneous intrusions and flows, and provides a wide variety of both positive and negative anomalies for such detailed study, each isolated phenomenon dropping into place in the regional survey. The work was originally commenced to check whether the micro-syenite intrusion, "The Gib", which rises some 800 ft. between Bowral and Mittagong, was a plug; and developed into a regional survey, when it was found to be an asymmetrical laccolith. Particular attention is given to the examination and discussion of negative anomalies. The instrument employed was a Schmidt type vertical variometer. More than a thousand stations were employed, readings being correct to within 4 γ over areas of slight variation (syenite at depth) where greatest accuracy was required. L. H. BRIGGS, D. A. PEAK and J. L. D. WOOLLOXALL: Constitution of matairesinol. The constitution of matairesinol, C₂₆H₃₂O₈, melting-point 119°, from *Podocarpus spicatus* has been determined, and it is now shown to be $\alpha\beta$ -di-vanillyl- γ -butyrolactone.

VIENNA

Academy of Sciences, June 6. STEFAN MEYER: Calculation of the velocities of α -particles from their ranges, and its relation to the number of ion-pairs produced. FRIEDRICH KOCH and FRITZ RIEDER: Nuclear γ -radiation of beryllium. Investigation of the γ -radiation from α -irradiated beryllium by means of a Wilson chamber in a magnetic field shows that, in the formation of electron-twins, equal distribution of the available energy occurs. The numerical distribution of positrons and photo-electrons for different energies indicates the existence of several γ -lines. WALTER KOSMATH and OTTO GERKE: The radioactive climate and conditions of Badgastein, its bio-climatic and balneological significance. KASIMIR GRAFF: (1) Observations on the brightness, and (2) measurements of the colour, of Nova (1934) Herculis from December 1934 to April 1935. (3) Visual visibility of the Pleiades nebula and of nebula NGC 2237. (4) The diffuse nebulae in the region of Orion. ERICH HAYEK: Formation of mixed crystals with tin monoxide. Mixed crystals of tin monoxide with oxides of other divalent metals—even with those stable as hydroxides under the experimental conditions—are obtained by precipitation from the appropriate salt solutions. The crystals show characteristic colours and their individuality is confirmed by their X-ray diagrams. MAX TOPERCZER: Daily variation of atmospheric dullness at Innsbruck. LEOPOLD VIETORIS: Groups of polydimensional paths. LEOPOLD KOBER: Geological investigations in the Apennines, especially of Calabria. KARL FEDERHOFER: Influence of the axial extension, inertia of rotation and thrust on the frequency of the bending of a circular ring. HUGO RÖSSNER:

Birds collected during the Austrian expedition to Asia Minor in 1934. R. EBNER: Gryllides and tettigoniids from the Anglo-Egyptian Sudan. About twenty species are enumerated and two new species, *Gryllus chopardi* n.sp. and *G. depressiceps* n.sp., are described.

Forthcoming Events

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

Sunday, August 18

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—
M. A. Phillips: "Fossil Mammals".*

Official Publications Received

Great Britain and Ireland

The Federation of British Industries. Survey of Britain's Recent Commercial Policy. Pp. 49. (London: Federation of British Industries.) 1s.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 34: The Influence of Physical and Mechanical Treatment on the Firmness of Butter. By J. Lyons. Pp. 541-558. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), Nos. 22-26: Investigations on the Control of Seedling Diseases of Sugar Beet, by William Hughes; On the Characteristics of *Bacterium violaceum* (Schröter) and some Allied Species of Violet Bacteria, by George Cruess-Callaghan and M. J. Gorman; A Simple Titrimetric Method for the Approximate Determination of Milk Phosphates, by G. T. Pyne; Report of the Irish Radium Committee for the Year 1934; Note on the Effect of Storage on the Colour and on the Free Fatty Acid Content of a Commercial Sample of Veterinary Cod-liver Oil, by E. J. Sheehy. Pp. 205-245. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 3s.

Handbook to the Norman Lockyer Observatory. Compiled by Dr. William J. S. Lockyer. Second edition. Pp. 54. (Sidmouth: Norman Lockyer Observatory.) 6d.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1633 (T. 3563): Reduction of Draughtiness of Open Cockpits. By B. Lockspeiser and A. Graham. Pp. 12+9 plates. 1s. 6d. net. No. 1637 (T. 3188): Aircraft Vibration. By H. Constant. Pp. 30+23 plates. 2s. 6d. net. No. 1642 (T. 3573): Whirling Arm Experiments on Lateral Stability. By Dr. A. S. Halliday and C. H. Burge. Pp. 21+32 plates. 1s. 6d. net. No. 1644 (T. 3587): Effect of Mass Distribution on Spinning Equilibrium. By S. B. Gates and R. H. Francis. Pp. 11+26 plates. 1s. net. (London: H.M. Stationery Office.)

City of Leicester Museum and Art Gallery. Thirty-first Report to the City Council, 1st April 1934 to 31st March 1935. Pp. 28. (Leicester: Leicester Museum and Art Gallery.)

Royal College of Physicians of Edinburgh. Annual Report by the Curator of the Laboratory for the Year 1934. Pp. 25. (Edinburgh: Royal College of Physicians of Edinburgh.)

Proceedings of the Royal Society of Edinburgh, Session 1934-1935. Vol. 55, Part 1, No. 7: The Mathematical Representation of the Energy Levels of the Secondary Spectrum of Hydrogen, II. By Dr. Ian Sandeman. Pp. 72-84. 1s. Vol. 55, Part 1, No. 8: Some Series and Integrals Involving Associated Legendre Functions, regarded as Functions of their Degrees. By Prof. T. M. MacRobert. Pp. 85-90. 6d. Vol. 55, Part 1, No. 9: The Lunar Atmospheric Pressure Inequalities at Glasgow. By R. A. Robb and T. R. Tannahill. Pp. 91-96. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Ministry of Health. Second Report of the Committee on the Standardization and Simplification of the Requirements of Local Authorities. Pp. 36. (London: H.M. Stationery Office.) 6d. net.

Air Raid Precautions. Handbook No. 2: Anti-Gas Precautions and First Aid for Air Raid Casualties. (Issued by the Home Office, Air Raid Precautions Department.) Pp. 110. (London: H.M. Stationery Office.) 6d. net.

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 2, No. 15: An Introduction to the Ecology of Intertidal Rock Surfaces on the Coast of Argyll. By Dr. J. A. Kitching. Pp. 351-374+1 plate. 3s. 6d. Vol. 58, Part 2, No. 16: The Tertiary Geology of Raasay, Inner Hebrides. By Charles F. Davidson. Pp. 375-407+3 plates. 5s. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Other Countries

Publications of the South African Institute for Medical Research. No. 35: Entomological Studies—Studies on Insects of Medical Importance in South Africa. (Part 2). By Dr. Botha De Meillon. Pp. 319-366. No. 36: Silicosis and Tuberculosis—Observations on the Origin and Character of Silicotic Lesions as shown in Cases occurring on the Witwatersrand. By F. W. Simson and Dr. A. Sutherland Strachan. Pp. 367-406+14 plates. (Johannesburg: South African Institute for Medical Research.)

New York Zoological Society. Report of the Director of the Aquarium. Pp. 19. (New York: New York Zoological Society.)

Smithsonian Miscellaneous Collections. Vol. 94, No. 4: A Folsom Complex, Preliminary Report on Investigations at the Lindenmeier Site in Northern Colorado. By Frank H. H. Roberts, Jr. (Publication 3333.) Pp. iii+35+16 plates. Vol. 94, No. 5: Wave Lengths of Radiation in the Visible Spectrum Inhibiting the Germination of Light-sensitive Lettuce Seed. By Lewis H. Flint and E. D. McAllister. (Publication 3334.) Pp. 11. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of the Interior: Office of Education. Pamphlet No. 60: Doctors' Theses in Education; a List of 797 Theses deposited with the Office of Education and available for Loan. Prepared by Ruth A. Gray. Pp. 69. (Washington, D.C.: Government Printing Office.) 10 cents.

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