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Organisation of Agriculture

FEW people, probably, realise the extent of the potential revolution in agriculture foreshadowed in recent legislation in Great Britain, the farmer himself least of all. Here is an intensely individualist industry, still largely traditional and practised over the greater part of the country upon principles which have changed very little in their essentials these two hundred years. All over England, right up to Tudor times, and later than that in many places, farmers were working mainly to feed and to clothe themselves and their families, with very little thought for commercial enterprise except around some of the larger towns and seaports. It was not until the growth of population in the eighteenth century, coinciding as it did with the introduction of new crops and improvement in the technique of cultivation and the breeding of livestock, that agriculture turned definitely from the self-sufficient to the commercial type of organisation.

Even so, the changes introduced were not comparable in any way with those that were to substitute the products of Sheffield for the handicraft of the village blacksmith, and were to remove the weaving industry from the banks of many rivers to concentrate it among the coalfields of Yorkshire. For although the one-man business of fifty acres or so is no longer characteristic, and has given place to holdings where labour and management are no longer combined in the same person, they are still one-man businesses in every other sense. There is no division of the functions of management, no specialisation in production, no openings for men of ability without capital to invest, no organisation for the bulk handling of products, whether for processing and manufacture or for direct sale.

In recent years, much has been said of the need for planning in industry. This is one of those things, like disarmament, upon which all reasonable people are agreed but which none can accomplish, and it is the more striking that agriculture, the most widely diffused, the most disorganised and individual of all industries, should have been selected for the first adventure in national planning. Under the Marketing Acts of 1931 and 1933, powers are accorded to the Ministers of State for the exercise of a degree of control in agriculture which has never been contemplated in Great Britain except by the most advanced political thinkers. The quantity of food imports is no

longer to be dependent upon the capacity of Dominion and foreign producers, but may be subject to regulation by the Ministry of Agriculture and the Board of Trade, and regulation may extend to the point of prohibition. At home, the right of free sale of certain commodities has at one stroke been taken from farmers, and it is apparently only a matter of a short space of time before all the principal food products of the country will follow the lead given by milk, pigs and hops, and the farmer's concern with his business will stop short at production, leaving the marketing boards to handle his produce and give him such prices as they can procure.

Nor is this all, for under the Act of 1933, the State is empowered to control the amount of his production. He may be ordered to withhold that which he seeks to sell; he may be prohibited from increasing his output of that which is profitable to him, in the interests of other farmers less favourably placed or less efficient; he may be forbidden to embark upon new lines of production.

Planning has gone so far, but if this great experiment in State socialism is to have any chance of success, it has only begun. Sir Daniel Hall, in the Alexander Pedler lecture of the British Science Guild entitled "The Organisation of Agriculture", delivered before the Cambridge Philosophical Society on November 6, extracts from which appeared in our issue of November 11, p. 755, indicated some of the work which lies before it. In some ways, the term 'planning' is a misnomer, for in the haste to provide remedies for the sorry plight of many farmers, there has been no time for any serious thought about what a planned agriculture should embrace. No sane person, nowadays, would aim at national self-sufficiency, but should Great Britain contemplate State aid to make profitable any branch of farming upon which the home producers have been engaged? Sir Daniel Hall took the wheat crop by way of illustration, and he might have added sugar beet. Here are crops in the production of which world competition is fierce, while England enjoys no natural advantages. Planning here can only have been based upon the principle of helping arable farming during one of the recurrent crises in its history, and with more time for reflection, Great Britain would probably have been content to leave the production of sugar to the Continental countries and the West Indies, and to let unrestricted competition bring about the rationalisation of wheat-growing by modern methods in those parts of Great Britain suited to them, instead of fostering an extended cultivation of the crop by traditional methods under the stimulus of an artificial price.

Nor should it be regarded as sufficient, on the other hand, for a planned agriculture to leave crops such as these to find their own level in a competitive market, while directing the force of the new organisation towards the development of those perishable and semi-luxury products in the growth of which England enjoys natural advantages. So far, the State has proceeded to the assistance of this or that branch of farming—milk, meat, potatoes, eggs, etc.—by the appointment of reorganisation commissions working at different times and in watertight compartments. There is no co-ordinating commission, no overriding authority reviewing the recommendations of the various product commissions and planning so that the desired development shall be steady and complementary. In this respect, planning, so far, has resembled more the action of a salvage corps, dashing hither and thither to save property in danger of destruction just as the calls have come in, without regard to relative importance or indeed whether some of it were worth saving at all. The substitution of 300,000 acres of sugar beet, in ten years, for other crops, the expansion of 30 per cent in the wheat acreage in two years, the shift from meat production into dairying, are examples of the farmer's quick response to haphazard and unregulated price fixing. It is not in the general interest that agriculture should be swinging about in this direction or in that as one commodity or another catches the artificial sunlight. 'Planning', if the term is to have a scientific status, must envisage the industry as a whole.

Again, it is not clear that sufficient thought has been given to the determination of the principles upon which assistance is to be based. At the present time, sugar beet is encouraged by subsidising from the national Exchequer the manufacture of sugar from home-grown beet. Wheat-growing is fostered by a call upon millers to make a deficiency payment when the average price of English wheat is below a certain figure. Bacon pigs are produced at contract prices varying with the cost of feeding stuffs. Milk is sold compulsorily upon a scale of prices fixed quite arbitrarily and dependent upon the uses to which it is to be put. The price of hops is determined by the appropriate marketing board, and the absorption of the crop by brewers at this figure is secured by

discrimination against imports. The 'salvage corps' is using every sort of weapon, new and old, in its fight with the flames, and its chiefs have not yet taken time to evolve a scientific technique of rescue and prevention.

It may be urged that weaknesses such as those enumerated here are inevitable in any attempt upon a scale so gigantic to re-plan an old industry, and that they will be eliminated as time goes by. Perhaps a more serious difficulty may come from the industry itself. Whatever may be said against unrestricted competition, there is no doubt that it weeded out the inefficient producer ruthlessly. Will the new prosperity, which planning is expected to bring, result merely in organised stagnation? How is it possible to guarantee profits to producers, and at the same time to require of them a high standard of efficiency? As Sir Daniel Hall pointed out, it is by the farmers' answers to these questions that the new organisation of agriculture will be judged.

It is here that science has its part to play, and the powers granted under the Marketing Acts to the commodity marketing boards enable them to set aside sums for the vigorous prosecution of research, which is essential if the whole scheme is not to be found wanting. The leakages, waste and losses arising from faulty organisation, uneconomic utilisation of labour and machinery, the ravages of animal and plant diseases, the uninstructed use of fertilisers and feeding-stuffs, call for continuous investigation and correction, while an immense amount of new work is still awaiting organisation and endowment in order to raise the quality of the food products presented to the public, and to devise better and cheaper methods of transport, processing, storage and distribution. As the result of Sir Daniel Hall's own work at the Ministry of Agriculture in planning so thoroughly the organisation of agricultural scientific and economic research, the equipment is already available and working. It needs nothing more than the active co-operation and support of the new marketing boards to enable the agricultural research institutes to supply all the services needed for this vital branch of the planning scheme. The country, clearly, will have to pay higher prices in the future for its food, and it will not be satisfied unless those who exercise the almost unlimited powers now bestowed upon them show a determination, from the outset, to give the public some definite gain for the higher cost of living imposed upon it.

Linnæana

A Catalogue of the Works of Linnæus (and publications more immediately relating thereto) preserved in the Libraries of the British Museum (Bloomsbury) and the British Museum (Natural History) (South Kensington). Second edition. Pp. 246+68+7 plates. (London: British Museum (Natural History), 1933.) 30*s*.

WHEN the compiler of the above work (the late Mr. B. H. Soulsby) took over the charge of the central library of the Natural History Museum from B. B. Woodward in 1921, he inherited what he must have realised was an unusually difficult task. His predecessor had spent his life in an intensive study of the bibliography of natural history, and his knowledge of it was rivalled only by that of Sherborn himself. He was, moreover, a working naturalist of no mean order. Soulsby possessed neither of these qualifications, and it is not surprising that his transfer from the Director's office at South Kensington to the library was regarded by the friends of that Institution with some misgivings.

It is true that Soulsby's surroundings could not have been more inspiring. The library had been left by Woodward in perfect order, and, as regards the middle and later literature of natural history, it was one of the finest, if not the finest, in the world. On all sides were the superb collections, the study of which was a constant and urgent stimulus to the expansion of the library. Notwithstanding these advantages, there was a real danger that Soulsby would be compelled to accept defeat, and settle down to a literal and uninstructed discharge of his duties. But he was never daunted —indeed he seemed unconscious of his difficulties— and it says much for his determination and powers of adaptation, to say nothing of his enthusiasm, that when he retired in 1930 he had acquired a knowledge of the library, not in fact equal to that of Woodward, which was impossible in the time, but sufficient to earn for him the respect and admiration of his colleagues. Who will say that had he taken off at South Kensington instead of Bloomsbury, he would not have become another "B.B."?

The present work is the second edition of a much smaller and less ambitious catalogue which was compiled by B. B. Woodward and W. R. Wilson. It was published in 1907 as a modest contribution to the celebration of the bicentenary of the birth of Linnæus. It ran to 27 pages only

and included less than 600 entries; in contrast with the 300 pages and nearly 4,000 entries of the work under review, which includes also seven plates—an excellent 'photogravure' of Linnæus in Lapland dress, reproductions of the title pages of four of his works, and two letters.

Soulsby's method, apart from studying the Linnæana at Bloomsbury and South Kensington, was to visit and examine the relevant material at various Scandinavian and other Continental libraries, especially Uppsala, where, as is natural, the most complete collection of Linnæana is to be found. He used to say that South Kensington was second only to Uppsala in this respect, and wanted but a few items to annihilate the difference. He himself contributed largely to this desirable state of affairs, and spent a considerable sum from his private purse in tracking down and purchasing the publications wanted to complete the national collection.

Unhappily, Soulsby did not live to witness the publication of his catalogue, on which he had spared neither labour nor expense in the hope, impossible as all bibliographers will know, of making it a complete and accurate record of Linnæana. However, he saw the whole work through the press, except for the addenda and corrigenda and the short index to the works of Linnæus, which latter was prepared by Dr. Sherborn.

Soulsby's catalogue, of course, is a work of reference pure and simple, the value of which can only be completely realised after extensive use. So far, we have experienced some little difficulty in finding our way about in it. The information is there, but is not readily available in the absence of a good *general* index. For example, when attempting to check the catalogue against the Linnæana in the reviewer's own library, it was not easy to be certain that any sectional omissions which were discovered might not be recorded in some other part of the work. With this reservation we mention the following publications which appear to be omitted: two papers by I. Geoffroy Saint-Hilaire on the nomenclature, classification and method of Linnæus, published in 1841–42; the excellent copper-plate portrait by Feart of 1843; the biography of de Blainville and Maupied of 1845; and Daudin's valuable critical observations on Linnæus's classification of 1926. The proofs of the catalogue have been carefully read and are as free from error as a printed text can be.

The scope of the work is very wide, and the statement quoted by Dr. Tate Regan in the preface that the "Catalogue" is "the most complete review of the writings of or on Linnæus which exists" is one to which we heartily subscribe. It covers all the scientific and other writings of Linnæus, his editorial activities, travels, the theses and orations in which he was more or less concerned, letters, life, portraits, herbarium and collections, lectures, his family, and even the societies, periodicals and places named after him. There is also a list of the bibliographies of Linnæus in chronological order from 1740 to the present day.

A casual inspection only of this scholarly work will reveal how much it owes, and how true it is, to the Woodwardian tradition. In every sense it is a fitting continuation of the seven volumes comprising the general catalogue of the Museum library, which all who have ever used it must admit is the most valuable and learned work of its kind in existence.

British Fresh-Water Copepods

British Fresh-Water Copepoda. By Dr. Robert Gurney. Vol. 3. (Ray Society Volume No. 120 for the Year 1933.) Pp. xxix+384. (London: Dulau and Co., Ltd., 1933.) 37*s.* 6*d.* net.

THE third volume of Dr. Robert Gurney's monograph is now published, completing this excellent and most useful work. It contains the classification of the Cyclopoida and the parasitic forms derived from them. The Cyclopoida are perhaps the best known of all the fresh-water copepods and much work has been done on them, both practical and theoretical. They are, however, particularly difficult to elucidate, being extraordinarily variable, altering much in different localities, and confusion in nomenclature has been great.

The sub-order Poecilostoma of the Cyclopoida includes the semi-parasitic copepods occurring on and in invertebrates, whilst in the order Caligoida are the true parasitic forms, most of which occur on fishes. In the latter group the best known is *Lepeophtheirus salmonis*, the 'fish louse' of the salmon, constantly found on the fish on their return from the sea, and its presence noted by anglers as proof of fresh-run fish. The lice, however, may be carried far up the river and they have been found 85 miles from the sea, the males

surviving longer than the females. This is also found on the sea trout, and on the salmon of the genus *Oncorhynchus* in North America. Another fresh-water fish parasite is *Salmincola salmonea*, the so-called gill maggot belonging to the Lernæopodidæ. This is another salmon parasite, but unlike *Lepeophtheirus*, it apparently breeds only in fresh-water, and the fish are infected only in the rivers. The fish descending the rivers after spawning generally have numbers of these parasites on the gills and their presence on fresh-run salmon may be accepted as proof that the fish has already spawned in a previous year and is returning to spawn again. A new species of *Salmincola*, *S. gordoni*, is described from the trout and grayling.

In the systematic portion the genus *Cyclops* is maintained in a wide sense, containing two sections, Trifida and Bifida of Graeter, based on the modifications of the setæ of the male antennæ and the number of apical setæ on the fifth leg; the two sub-sections of the Trifida being based on the segmentation or otherwise of the fifth leg, segmentation of the female antennule, form and armature of the furcal rami and the form of the nauplius. The structure of the nauplius and copepodid stages of *Cyclops* is taken as typical of the Cyclopoida, and a careful general account is given of the development. In many cases the nauplius of individual species is also described and figured by the author.

In the discussion of the species, a very interesting part is the experimental evidence from the work of Mr. A. G. Lowndes, of Marlborough College, in which it is shown whether certain forms will or will not breed together. Such breeding experiments showed that *Cyclops agilis* and *C. agilis speratus* were mutually infertile, whilst crosses between varieties of *C. agilis* were always successful, and the identity of *Cyclops vernalis* and *C. robustus* is shown; these being fertile when crossed and typical *C. vernalis* forms occurring in the offspring of typical *C. robustus*. Careful tables of comparative measurements are given in many cases.

The notes on bionomics are particularly full and valuable. Some species are adaptable to excessively varied surroundings. To give but one example, *Cyclops fimbriatus* is able to live in the depths of lakes down to 200 metres, in a thin film of water, in running water, underground, or in mountains up to 2,686 metres. It also lives in salt-water pools and in caves or springs. It has been found in the Cheddar caves and associated with *Bathynella* in a quarry at Corsham. It can creep out of the water, pushing a film of water with it.

This volume is well illustrated, like the preceding volumes, with fine outline drawings by the author.

Aspects of Chemical Engineering

Der Chemie-Ingenieur: ein Handbuch der physikalischen Arbeitsmethoden in chemischen und verwandten Industriebetrieben. Herausgegeben von A. Eucken und M. Jakob.

Band 1: *Physikalische Arbeitsprozesse des Betriebes.* Teil 1: *Hydrodynamische Materialbewegung, Wärmeschutz und Wärmeaustausch.* Herausgegeben von M. Jakob. Bearbeitet von M. Jakob und S. Erk. Pp. xix+539. 54 gold marks. Teil 2: *Mechanische Materialtrennung.* Herausgegeben von A. Eucken. Bearbeitet von C. Naske, H. Madel und W. Siegel. Pp. x+385. 38 gold marks.

Band 2: *Physikalische Kontrolle und Regulierung des Betriebes.* Teil 1: *Kontroll- und Regulier-einrichtungen, Allgemeines und Gemeinsames.* Herausgegeben von M. Jakob. Bearbeitet von P. Gmelin und J. Krönert. Pp. ix+208. 18.60 gold marks. Teil 2: *Mengenmessungen im Betriebe.* Herausgegeben von M. Jakob. Bearbeitet von R. Witte und E. Padelt. Pp. ix+274. 27.60 gold marks. Teil 4: *Physikalisch-chemische Analyse im Betriebe.* Herausgegeben von A. Eucken. Bearbeitet von P. Gmelin, H. Grüss, H. Sauer und J. Krönert. Pp. xiii+388. 38 gold marks.

Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.

ACCORDING to the preliminary notices this work will consist of two volumes, each subdivided into four separately bound parts. Like many other books on chemical engineering, it is a composite production, of twenty-six authors under the editorship of Profs. A. Eucken of Göttingen and M. Jakob of Berlin.

The first part of vol. 1 is further subdivided into two sections, the first of which is devoted to hydrodynamics and the flow of fluids. In the opening chapter, Jakob treats the subject theoretically, beginning with the Eulerian equations of movement and proceeding by way of Bernoulli's equation and Poiseuille's law to Stokes's equations of motion and thence to the

consideration of the flow in pipes, either rough or smooth, divergent or convergent, and the application of Bernoulli's theorem to steam and gases flowing under adiabatic and isothermal conditions.

The method of measuring viscosity, and its dependence upon temperature, pressure and chemical composition are discussed in the next chapter, whilst the last chapter of this section, by Erk, deals with the practical applications of the laws of hydrodynamics to the movement of liquids and gases through pipes, bends and coils, as well as the transport of solid materials by pneumatic conveyors.

Heat transmission, an important subject to the chemical engineer, is considered in the second section of this part, in which there are two chapters by Jakob on the fundamental aspects of this subject and problems of fundamental importance. These are followed by two more chapters by Erk, who considers the industrial aspect. Considerable reference is made to the work of Nusselt in the solution of problems relating to heat transmission, and one is pleased to note that in this volume the authors have assumed that the reader has a sound fundamental knowledge of mathematics.

Part 2 of vol. 1 is devoted to the mechanical separation of material, and the first chapter by Naske treats of the plant and methods employed in size reduction. As this subject is at present more an art than a science, the chapter is largely descriptive, but wherever possible a mathematical treatment has been given. On p. 25 there is a diagram described as a *Kegelbrecher* or cone breaker, which clearly indicates that the axis of the inner cone has the motion of a conical pendulum. In Britain such a machine is termed a gyratory crusher, the name cone mill being reserved for a machine in which the axis of the inner cone remains fixed, the size reduction being effected largely by shearing forces.

As a natural sequel to this chapter are others by Madel and Naske on the separation of particles, first according to size and secondly according to composition, and where possible the authors, in addition to describing typical machines for these purposes, have given the fundamental principles upon which the design is based. Siegel in his chapter on filtration begins with a section in which he considers the various geometrical arrangements of spherical particles, and after discussing capillary flow and the equations relating to filtration and the structure of the filter cakes, proceeds to describe types of filters.

The next chapter, by Madel, is on centrifugal machines. After opening with the mathematics relating to a forced vortex, the author proceeds to discuss the machines employing centrifugal force to effect a separation, whilst the separation of dust from gases is carefully discussed in the last chapter.

The first book of the second volume contains only three chapters and is written by Gmelin and Krönert; it deals with the recording of various measurements and the regulation of temperature and flow in industry. After a general review of the subject, the authors consider the types of apparatus which can be used for recording pressure, revolutions, etc., and distance recording. A number of different types of electrical measuring instruments are included in this chapter, which is followed by one on regulators and regulation.

The measurement of quantities of materials on an industrial scale forms the subject of the second part of this volume, and in the first chapter Witte gives a general survey of the quantities and the means by which they can be measured. Padelt then discusses the determination of quantities by weighing and the different types of balances which can be employed. Volumetric measurements, first of liquids, then of solids and lastly gases, and the meters which can be used, are treated in the penultimate chapter, which together with the last, on the distribution of energy in moving fluids and the methods of measuring pressure and pressure drop in such cases, have received careful treatment by Witte.

The fourth part of this volume, on physical and chemical analysis in works, forms an important contribution which is not generally included in books on chemical engineering. The opening chapters by Gmelin give a general review of the subject and the mechanical methods which can be employed for measuring densities, viscosities, etc., and the design and operation of instruments of this type. Gmelin and Grüss in the next chapter consider the thermal methods which can be employed in the separation of particles in a mixture by adsorption, condensation and evaporation, whilst Sauer collaborates with Gmelin on the optical methods involving the use of the visible and ultra-violet rays and the application of the refractometer, interferometer and spectroscope in works control. Electrolytic potential, electrolytic conductivity and the measurement of electrical constants are the basis of the next chapter, by Gmelin and Krönert, and this is followed by a

short chapter dealing with magnetic methods by the first of these authors, who is also responsible for the last chapters, which deal with the effects resulting from chemical reactions.

These five books show that the editors and their collaborators have been working to a carefully prepared scheme. Unfortunately, in some books on chemical engineering the various authors, selected for their intimate knowledge of a particular subject, have been allowed to treat the subject in their own way, with a resulting lack of uniformity in the work as a whole. This is not so in this work, for all the authors deal with the fundamentals of their subject and so far as possible express these in mathematical terms. Many of the diagrams are line drawings specially prepared to illustrate essential points, and no section of the book describes a specific chemical process. One awaits with interest the publication of the remaining books and feels sure that if they follow the scheme underlying those already issued, a very valuable work will be at the disposal of the chemical engineer.

The printing is of a high standard, but one regrets that the price tends to prevent the work coming into the hands of students and the younger members of the profession.

The Jutes in Kent

Pre-Feudal England: The Jutes. By J. E. A. Jolliffe. (Oxford Historical Series.) Pp. x+122. (London: Oxford University Press, 1933.) 7*s*. 6*d*. net.

IN its cultural history, the county of Kent stands apart from the rest of England. For this its geographical position is in some measure responsible. As the main gateway to the south of England from the Continent, it has been peculiarly exposed to outside influence. Its individual character was recognised in Saxon times. The Venerable Bede records the tradition that Kent, with the Isle of Wight and parts of Hampshire, had been settled by the Jutes. Archæologically, the distinction is marked by the development in Saxon times of a rich and characteristic material culture, showing affinities with the Continent. In the northern area, however, a culture more in conformity with that of the rest of Saxon England would seem to afford ground for regarding the popular distinction between "Men of Kent" and "Kentish Men" as the survival of a real tribal or racial difference.

In social organisation, distinctive features of Kentish custom are gavelkind, the custom of partible inheritance, and the manor. The latter differs from the Midland type of manor, which is a concentrated unit, in being something more in the nature of a federation of hamlets, often spatially discrete, and always severally distinguished by accurately defined boundaries. In his study of the Kentish manor, Mr. Jolliffe, by detailed analysis of the evidence, has shown that its anomalous character in a feudal system is due to a maladjustment of the manorial organisation to conditions which must have existed before the Norman conquest. Ninth century documents are, in fact, to be interpreted in that sense. He argues that these conditions belong to a form of social organisation earlier than the manor, the larger organisation of the lathe. Further, he is able to show that this system is not confined to Kent. It can be discerned, sometimes side by side with the Midland type of manor, throughout the area traditionally assigned to Jutish settlement.

In essentials, Mr. Jolliffe holds, the Kentish organisation is a 'provincial' system, based not upon an organisation of the type of the village community, but upon a system of hamlets of landholders in relation with a king.

From this point onward, Mr. Jolliffe's argument is of no little ethnological interest. Not only does he find that the distribution of the system suggests a racial unit, but also he conducts an exhaustive search for similar systems on the Continent at this period, which leads to an interesting suggestion on the difficult question of the origin of the settlers in Kent, the so-called Jutes. No organisation of this type is found anywhere among the early Saxon settlements; but it appears—the resemblances are apparent in some detail—among the Franks of the Rhine valley. It is true that the homogeneity in language of the Saxons and Jutes still presents a difficulty; but it is to be noted that Mr. Jolliffe is in substantial agreement with the evidence of archæology, which points to this part of the Rhine valley as one of the areas with which Kent has close affinities.

Not only has Mr. Jolliffe made a valuable contribution to the discussion of a difficult and obscure question, but he has also demonstrated successfully the possibility of extracting from feudal records the facts of the earlier constitution of the folk upon which feudal institutions were imposed.

Short Reviews

Handbuch der physikalischen und technischen Mechanik. Herausgegeben von Prof. Dr. F. Auerbach und Prof. Dr. W. Hort. Band 5: *Mechanik der Flüssigkeiten, nebst technischen Anwendungsgebieten.* Lief. 1. Pp. ix+472. 45 gold marks. Lief. 2. Pp. vi+473–718. 24 gold marks. Lief. 3. Pp. xxi+719–1152. n.p. Band 5, complete, 120 gold marks. Band 6: *Mechanik der Gase und Dämpfe, nebst technischen Anwendungsgebieten.* Lief. 1. Pp. viii+460. n.p. Lief. 2. Pp. xviii+461–918. n.p. Band 6, complete, 76 gold marks. (Leipzig: Johann Ambrosius Barth, 1927–1928.)

Two further volumes of this remarkable compilation of physical and technical mechanics are now to hand; they are devoted to fluids (liquids in vol. 5—1,152 pages—and gases and vapours in vol. 6—918 pages). Besides the more classical parts of hydromechanics (summarised in about 300 pages by F. Auerbach, who also deals with aeromechanics—175 pages—in vol. 6) the volume on fluids contains articles on particular developments. These include ocean currents (Ekman), tides (Gutenberg), turbulence (Lorenz), fluid friction (Graetz and Stöckl, who also contribute to vol. 6 a valuable article on gaseous friction), heat-transfer in moving liquids and gases (Schmekel), ships (Horn), the integration of the Navier-Stokes differential equations (Noether), lubrication (vom Ende and Duffing), hydraulic machines (Hahn), cavitation (Weinig) and hydraulics (Neményi, Safranez and Weinig). Vol. 6 includes articles on air pumps and vacuum technique (Gaede), atmospheric motions (Exner), technical gas-measurements (Block), explosions and explosion waves (Bollé), solid and liquid bodies in gases (Deutsch), wind mills, steam and gas turbines (Flügel), air forces on moving bodies, aircraft and balloons (Everling, also Fuchs), sails and rotor-funnels (Croseck), pneumatics (Wagner), compression and rarefaction of gases (Seligmann), and energy transformation in steam and internal combustion engines (Hort). The volumes are profusely illustrated by diagrams and photographs. As works of reference they are of great value, though probably few individual workers can afford to purchase them.

A Manual of Practical Inorganic Chemistry: Qualitative Analysis and Inorganic Preparations. By Prof. Dr. E. H. Riesenfeld. Translated by Prof. P. Rây. An authorised translation of the latest German edition of "Anorganisch-chemisches Praktikum", revised in collaboration with Dr. R. Klement. Pp. xxiv+471. (Calcutta: Chuckervertty, Chatterjee and Co., Ltd., 1933.) 6 rupees; 9*s*.

THIS translation has, on the whole, been very well done, although there are one or two minor inaccuracies, such as the translation of *Kohle* by 'coal' instead of 'carbon' on p. 136, and the second footnote on p. 40 is not very clearly worded. A good feature of Riesenfeld's book is the inclusion of a large number of exercises in inorganic preparations, some of which are very simple but many are more elaborate and provide excellent training in manipulation. Some of the preparations are unusual, such as that of nickel carbonyl on p. 207. Theoretical sections, such as an account of Werner's theory, are introduced into appropriate places in the text. The accounts of qualitative tests and separations are good, but it seems doubtful whether a student would find such a book so easy to use in the laboratory, for this part of the work, as a straightforward set of analysis tables. Most of the modern tests and reagents are introduced. The printing, done in Calcutta, is very creditable indeed and the paper is good, but the binding is not quite satisfactory, although the low price of 9*s*. for a book of nearly 500 pages must be considered.

Jahrbuch des Forschungs-Instituts der Allgemeinen Elektricitäts-Gesellschaft. Band 3: *1931–32.* Pp. 205. (Berlin: Julius Springer, 1933.)

THE third year-book of the Research Department of the Allgemeine Elektricitäts Gesellschaft maintains the very high standard both in pure and applied science of its predecessors. This volume contains a report on the work of the Department from January 1931 until April 1933. We notice that the prefatory reviews explaining the present position of the various branches of science discussed have been discontinued. On the other hand, several of the papers which are reprinted have been appreciably altered. The papers are divided into several sections covering acoustics, the winding of sound films, electrotechnics, the physics of electrons and atoms, physical chemistry, the physics of matter, electro-optics, etc. The book is excellently printed, the diagrams being specially clear. It contains a good deal of original matter.

Lehrbuch der Astronomie. Von Prof. Dr. Elis Strömgren und Dr. Bengt Strömgren. Pp. viii+555. (Berlin: Julius Springer, 1933.) 32 gold marks.

THIS textbook covers practically the whole range of astronomy. The object of the authors is to provide a sufficient technical and mathematical introduction to the various departments of astronomical work as will enable the reader to take an intelligent interest in the present rapid developments. The book is partly descriptive and partly mathematical. Clearly, in a book of this size, the mathematical sections can but touch the fringe of the subjects treated; for example, the sections on celestial mechanics form but a bare and very specialised introduction. Altogether, the authors have been very successful in their aim.

The Positive Electron

By PROF. P. M. S. BLACKETT, F.R.S.

THE discovery of the positive electron arose from the study of cosmic radiation by the cloud method[1]. Amongst the tracks of the particles of very great energy, associated with cosmic radiation, were found some which differed from the tracks of negative electrons only by being curved by a magnetic field in the opposite direction. Terrestrial sources of positive electrons of lower energy are now also available, since it has been found that they are produced when hard gamma rays are absorbed by matter, and also in certain cases of nuclear transformation. The production of positive electrons in the laboratory is therefore an easy matter.

The charge and mass of a positive electron can be calculated from the ionisation it produces. For example, Anderson[2] has estimated that the difference between the ionisation due to fast positive and negative electrons with the same curvature in a magnetic field, is not as much as 20 per cent. Since for *very fast* particles the ionisation depends on the square of the charge but scarcely at all on the mass, the charge on a positive electron cannot differ by as much as 10 per cent from that on a negative electron. On the other hand, for *slow* particles with given charge, the ionisation varies as the mass, so the same equality of ionisation indicates that the masses must be within 20 per cent. To obtain further information as to the properties of positive electrons, it is convenient to study in detail the simplest case known of their production; namely, that in which a beam of homogeneous gamma rays is absorbed by heavy elements.

The well-filtered gamma radiation from thorium-C″ is nearly homogeneous and has an energy of $2{\cdot}62 \times 10^6$ volts. It has been found by Anderson and Neddermeyer[3], by Curie and Joliot[4] and by Meitner and Philipp[5] that when such rays fall on a heavy element, positive electrons are ejected.

Positive electrons are also produced when the radiation from beryllium, bombarded by alpha rays, is absorbed[6]. Though this radiation is complex, consisting of neutrons together with gamma rays of rather more than $5{\cdot}0 \times 10^6$ volts energy, Curie and Joliot[6] have shown by absorption experiments that the positive electrons are certainly mainly due to the latter.

The following table, which is derived from the work of Curie and Joliot, Grinberg[7], and some unpublished results of Chadwick, Blackett and Occhialini, gives the numbers of positive electrons ejected in a forward direction from different elements by various radiations, the numbers being expressed as a fraction of the observed number of negative electrons. These percentages give only a rough indication of the frequency of production of positive electrons, since the actual angular distributions are not known, and since the effect of the particular experimental arrangement may be considerable.

Number of Positive Electrons produced when Gamma Rays are Absorbed.

Source	Energy of gamma ray	Absorber		
		U	Pb	Al
Ra	1·0 to 2·2 × 10^6 volts		3%	
ThC″	2·62 × 10^6 volts		10%	very small
Po+Be	5 to 6 × 10^6 volts	more than 40%	40%	5%

The ejected negative electrons comprise two groups, consisting of the photo-electrons with the whole energy of the quanta, that is with $2{\cdot}62 \times 10^6$ volts, and the Compton electrons which have a maximum energy of $2{\cdot}39 \times 10^6$ volts in a forward direction. The table shows that the number of positive electrons increases rapidly with the energy of the quanta and with the atomic number of the absorber.

If from these figures the effective area of a heavy atom for the production of a positive electron by a quantum of 5×10^6 volts is calculated, values are found which are rather larger than the area of cross-section of the nucleus. This fact makes it improbable that the production of the positive electrons is mainly a nuclear phenomenon.

This view is strengthened by consideration of the energies of the particles. The maximum energy of the positive electrons produced by a given radiation appears to be about the same for all absorbers. If the particles had a nuclear origin, a variation with the type of nucleus would be expected.

For the $5{\cdot}0 \times 10^6$ and the $2{\cdot}62 \times 10^6$ volt radiations, the maximum energies of the positive electrons are found to be about 4 and $1{\cdot}6 \times 10^6$ volts respectively, that is, in each case about a million volts less than the energy of the quantum.

If the positive electrons are indeed produced outside the nucleus, many important conclusions follow:

(*a*) Since there is certainly no room, in atomic theory, for the permanent existence of positive electrons well outside a nucleus, then a positive electron that comes from there must be born there, and if born there, an equal negative electron must be born simultaneously in order to conserve electric charge. This is confirmed by the experimental observation that pairs of tracks do occur, which almost certainly are to be interpreted as due to the simultaneous ejection of a positive and a negative electron.

To produce such a pair of electrons with opposite charges requires an expenditure of energy $(m_1+m_2)c^2$. If both particles have the electronic

mass, this energy amounts to $1{\cdot}01 \times 10^6$ volts, so that in the case of the $2{\cdot}62 \times 10^6$ volt radiation, no pair of positive and negative electrons can have more energy than $1{\cdot}61 \times 10^6$ volts energy. Anderson has found this to be the case. Again, the maximum energy of a single positive electron producing an unpaired track should also be $1{\cdot}61 \times 10^6$ volts. An experimental determination of this maximum energy is being made by Chadwick, Blackett and Occhialini, and their preliminary results* give the value of $1{\cdot}58 \pm 0{\cdot}07 \times 10^6$ volts, in excellent agreement with the theory.

(*b*) The positive electron must have a spin of $\frac{1}{2}$ and so obey the Fermi-Dirac statistics. For since energy is observed to be conserved during the birth process, it is to be expected that linear and angular momentum are also conserved. So if a quantum gives rise to a pair of particles, one of which has a spin of $\frac{1}{2}\frac{h}{2\pi}$, the other must have the same spin, since a quantum can only excite changes for which the angular momentum changes by 0 or 1. The argument is still valid even if possible changes in the nuclear spin are taken into account, for these must also be integral.

(*c*) A necessary consequence of the occurrence of the process whereby a quantum interacts with an atom to produce a pair of electrons of opposite sign, is the occurrence of the reverse process, in which a positive electron and a negative electron interact with each other and the field of an atom to produce a single quantum of radiation. Since the conditions for this occurrence cannot be rare, a positive electron cannot be expected to exist for more than a short time in matter at ordinary densities.

These conclusions as to the existence and the properties of positive electrons have been derived from the experimental data by the use of simple physical principles. That Dirac's theory of the electron predicts the existence of particles with just these properties, gives strong reason to believe in the essential correctness of his theory.

Dirac succeeded in formulating the wave equation for an electron moving in a potential field in such a way as to make it relativistically invariant. The solution of this new wave equation not only led, in the case of the hydrogen atom, to a complete explanation of the fine structure of the spectral lines, but also to a rational explanation of the spin and magnetic moment of the electron itself.

However, in addition to the solutions corresponding to the normal electronic levels found experimentally, were others which seemed to correspond to no observed facts. These solutions seemed to predict the existence of states in which the electrons possessed a negative kinetic energy, and therefore did not correspond to particles in any usual sense. These states could not be ignored, because transitions must theoretically occur between them and the normal states corresponding to positive kinetic energy. Dirac suggested that the difficulty might be avoided if it were supposed that all the negative energy states are normally occupied, and further, that the totality of electrons in such states produce no external field.

On this view, only an unoccupied state or 'hole' would correspond to an observed particle. It followed from the theory that such unoccupied states should behave in an external field like particles with the same mass and spin as a negative electron but with a positive charge. The experimental discovery of the positive electron has therefore removed a very serious theoretical difficulty, and by so doing, has greatly extended the field of phenomena over which Dirac's theory may be applied.

Owing to analytical difficulties, the work of applying Dirac's theory to special cases has not progressed far, but Oppenheimer and Plesset[8] have calculated approximately the probability of the production of pairs of electrons of opposite charge when hard gamma rays are absorbed by matter. So far as these theoretical results go, they are in rough agreement with the experimental conclusions, both as regards the order of magnitude of the effect and its dependence on the energy of the quantum and the atomic number of the absorber.

The calculations give for the extra absorption by lead and tin of the $2{\cdot}62 \times 10^6$ volt radiation, due to the production of positive electrons, the values of 25 per cent and 15 per cent of the absorption by the normal scattering and photoelectric processes. These figures are roughly those observed experimentally by Tarrant and Gray. So one may conclude that a large part of the anomalous absorption may be attributed to the production of positive electrons.

One would expect that the absorbed energy would be re-radiated in two ways. An ejected positive electron may disappear by the reverse process to that which produced it, that is, by reacting with a negative electron and a nucleus, to give a single quantum of a million volts energy (see (*c*) above). Or it can disappear, according to Dirac's theory, by another type of process, in which a positive electron reacts with a *free* or *lightly bound* negative electron so that both disappear with the emission of two quanta of half a million volts energy.* It is remarkable that the re-emitted radiation is estimated by Gray and Tarrant to be composed mainly of just these two energies, of one half and one million volts. However, Fermi and Uhlenbeck[9] have found that the

* The mass of the positive electron can be calculated from the equation

$$E_{max.} = h\nu - (m_1 + m_2)c^2$$

Using the values $h\nu = 2{\cdot}62 \times 10^6$ volts, $E_{max.} = 1{\cdot}58 \pm 0{\cdot}07 \times 10^6$ volts. We find $m_2 = (1{\cdot}04 \pm 0{\cdot}14)\, m_1$.

This calculation affords probably the most accurate estimate of the mass of a positive electron yet available.

* Dirac's calculation of this annihilation probability gives a positive electron a life of less than 10^{-9} sec. in water, the life being inversely proportional to the density. If this predicted process is verified experimentally, it will be possible to assume the reverse process, the creation of a pair of electrons of opposite sign by the collision of two quanta of high energy. This latter process would then be the first case known of the 'interference' of quanta; it is conceivable that this process has considerable cosmological importance.

theoretical intensity of the hard component is far smaller than that observed.

This absorption of hard gamma rays by atoms, resulting in the production of pairs of oppositely charged electrons, may be thought of as a photo-electric absorption by the 'virtual' electrons, that is, by electrons with negative kinetic energy, near the nucleus. According to Beck[10], these virtual electrons may be considered to have a binding energy of the order of $2\,mc^2$. Beck also shows that the number of these virtual electrons which are effective for the absorption are proportional to the square of the atomic number and that they amount to about one for each lead atom. The theory also indicates that the birth process takes place within a distance of $h/2\pi mc = 3{\cdot}85 \times 10^{-11}$ cm. of the nucleus, that is, well inside the K ring.

Curie and Joliot[11] have found that positive electrons are produced when *aluminium* and *boron* are bombarded by alpha particles, and that these positive electrons have a higher energy than the accompanying negative electrons. *Silver*, *lithium* and *paraffin*, however, give no positive electrons. Curie and Joliot suggest that the positive electrons originate in the disintegrating nucleus, but it seems possible that they may be produced mainly outside the nucleus by the internal conversion of a gamma ray emitted by the nucleus. To explain the effect in this way, the probability of internal conversion must be nearly unity.* The greater energy of the positives may be explained by the fact that a positive electron gains kinetic energy and a negative electron loses it, on escaping from the field of a nucleus. This resulting difference in kinetic energy will be the larger the nearer to the nucleus that the pair is born, and so should be larger in the case of such an internal conversion process, which depends on a spherical wave, than in the usual case of external absorption, which depends on a plane wave.

Though it was in association with cosmic radiation that positive electrons were first detected, the exact part they play in these complicated phenomena is not yet clear. But certain facts are established[12]. (*i*) Of the fast particles which produce the cosmic ray ionisation at sea-level, about half are positive and half negative electrons. Their energies range from a few million to nearly 10^{10} volts. (*ii*) The same ratio is found in the 'showers'. The showers appear therefore to represent the birth of multiple pairs of positive and negative electrons, as a result of one or more collision processes induced by the primary radiation. Dirac's theory shows that the production of single pairs is of primary importance in the absorption of both gamma rays and particles of high energy[13], but has, as yet, given no hint of the cause of the multiple pairs forming the showers. (*iii*) It has been shown that the majority of the particles incident on the earth's atmosphere are positively charged[14].

Since protons are rarely observed at sea-level, it is probable that the positively charged incident particles are not protons but positive electrons. If this is so, the main part of the flux of cosmic radiation in inter-galactic space must be in the form of positive electrons; and since the total mass of this radiation has been estimated as possibly as large as 1/1,000 part of the mass of all the stars and nebulæ[15], it appears that the positive electron, though rare, because ephemeral, on earth, is an important constituent of the universe as a whole.

* Oppenheimer and Plesset (*loc. cit.*) predict theoretically far smaller values.

[1] Anderson, *Science*, **76**, 238; 1932. Blackett and Occhialini, *Proc. Roy. Soc.*, A, **139**, 699; 1933.
[2] Anderson, *Phys. Rev.*, **43**, 491; 1933. *Phys. Rev.*, **44**, 406; 1933.
[3] Anderson and Neddermeyer, *Phys. Rev.*, **43**, 1034; 1933.
[4] Curie and Joliot, *C.R. Acad. Sci.*, **196**, 1581; 1933.
[5] Meitner and Philipp, *Naturwissenschaften*, **24**, 468; 1933.
[6] Chadwick, Blackett and Occhialini, NATURE, **131**, 473; 1933. Meitner and Philipp, *Naturwissenschaften*, **15**, 286; 1933. Curie and Joliot, *C.R. Acad. Sci.*, **193**, 405; 1933.
[7] Grinberg, *C.R. Acad. Sci.*, **197**, 318; 1933.
[8] Oppenheimer and Plesset, *Phys. Rev.*, **44**, 53; 1933.
[9] Fermi and Uhlenbeck, *Phys. Rev.*, **44**, 510; 1933.
[10] Beck, *Zeit. Phys.*, **83**, 498; 1933.
[11] Curie and Joliot, *C.R. Acad. Sci.*, **196**, 1885; 1933.
[12] Anderson, *Phys. Rev.*, **41**, 405; 1932. Kunze, *Zeit. Phys.*, **80**, 559; 1933. Blackett and Occhialini, *loc. cit.*
[13] Furry and Carlson, *Phys. Rev.*, **44**, 237; 1933.
[14] Johnson, *Phys. Rev.*, **43**, 1059; 1933.
[15] Lemaitre, NATURE, **128**, 704; 1931.

Progress in Non-Ferrous Metallurgy, 1908–1933

THE first meeting of the Institute of Metals was held in Birmingham twenty-five years ago. The autumn meeting was again held in that city this year, on September 18–21, and a review of the progress in those spheres of metallurgical activity with which the Institute is concerned was given by Dr. W. Rosenhain.

Dr. Rosenhain began by pointing out the unsatisfactory state of knowledge of the thermal equilibrium diagrams of metallic systems at the time when the Institute was founded, and the vast improvement in that respect which has since taken place—an improvement for which he and those working under his supervision have been in no small measure responsible. One of the points in regard to which the earlier diagrams were particularly deficient was in the determination of the limits of solid solubility in metals of other metals or their compounds, and the discovery by Wilm of the complex aluminium alloy known as 'duralumin' has emphasised the profound industrial importance of such knowledge. Where the solid solubility is appreciably higher at elevated temperatures than at lower ones, it becomes possible by quenching from an appropriate temperature to retain a super-saturated solution. Such a solution may afterwards undergo decomposition either at room, or some higher, temperature, resulting in what is generally known as 'age-hardening'. The prime importance of this

discovery lies in the fact that, previous to the work of Wilm, steel was the only material which could be hardened by heat treatment. Since the establishment of the fundamental factors controlling the process—many details in the full explanation still require elucidation—an ever increasing number of alloys have become known which are capable of improvement in a similar manner. Apart from the alloys of aluminium itself, perhaps the most interesting example is that of copper alloyed with a small percentage of beryllium, in which a degree of hardness can be induced approaching that of a quenched steel. The range of such alloys is steadily widening and is placing at the disposal of the engineer and other users a whole series of products of a novel and valuable nature.

For some time after the discovery of 'duralumin', age-hardening was confined to wrought alloys. The explanation gradually arrived at concerning the mechanism of the process suggested, however, that cast alloys should be available which were susceptible of similar improvement. This prediction was later confirmed, one of the most commonly employed of such materials being the 'Y' alloy containing 4 per cent of copper, 2 per cent of nickel and 1·5 per cent of magnesium, with the discovery of which Dr. Rosenhain was himself intimately concerned. This alloy and modifications of it, some of which contain small amounts of titanium, possess the further advantage that they will retain their strength as the temperature is raised to an extent which is distinctly better than that of many other aluminium alloys.

Another type of treatment which again is, as yet, almost entirely confined to alloys of aluminium, is the 'modification' of properties which results from the addition of certain materials to the slag under which the alloy is melted. Silicon alloys with about 12 per cent of that element are the most important of this class. The effect is associated with super-cooling phenomena, and 'modification' can be produced in other types of alloy, though not as yet to anything like the same extent. The importance of the discovery lies in the fact that it shows that materials which, in normal circumstances, are brittle to the point of uselessness may, by suitable manipulation during melting, be rendered among the most valuable of the alloys of the particular metal.

Among new materials which are still in course of development, one of the most interesting groups is that of the alloys of beryllium with copper and nickel, to the age-hardening properties of some of which reference has already been made. Other work has concerned itself with the metal itself, research on which is complicated by its remarkable reactivity with almost every element with which it comes in contact. It may be produced in a ductile form with a high degree of strength, a low density and a relatively high melting point. The development of cutting tools consisting of non-ferrous metals is another direction in which considerable progress has been, and still is being, made. 'Stellite' and the sintered products of tungsten carbide with cobalt and other sintering additions are the outstanding examples of such materials and both are being increasingly employed. An application of the sintered tungsten carbide to which Dr. Rosenhain did not refer, but which is already established industrially, is in connexion with dies for the drawing of wire, which, for the finer gauges, are being increasingly employed.

Defects in ingots and castings due to the presence of dissolved gas is another subject which has called for considerable investigation. From aluminium alloys these gases can be removed, at any rate in part, by presolidification, the passage through the melt of nitrogen or the vapours of volatile chlorides such as those of titanium or boron. Such treatment, in addition to rendering the casting free from gas inclusions, may in certain cases have a marked effect on the size of the crystals and thus bear on the whole subject of grain refinement.

In no direction probably has progress been more marked than in the production of the metals themselves in a high state of purity. Zinc, magnesium, aluminium, tungsten, manganese, etc., are now available of a purity and in some cases, therefore, with properties, of a totally different order from that of twenty-five years ago. Some brittle metals are shown to be ductile if the last small traces of impurities are removed, and new uses are opened up for elements which, but a few years ago, were of no more than laboratory interest.

The production by Carpenter and Elam of the first large single crystals of aluminium, and subsequent work on such single crystals of that and other metals, has opened up an avenue for direct experimental research on the reaction of metals to stresses which is gradually throwing a flood of light on factors of immediate importance to the engineer. Through the phenomenon known as 'corrosion-fatigue', a type of failure of parts in service which has only been generally recognised during the last few years, the effects of stress are being linked up with those due to corrosion itself. Not only is our information regarding the underlying causes of corrosion on an altogether surer foundation—though much still remains to be done—but also processes are available for the reduction, or elimination, of the trouble which are now well established. The addition of aluminium to brass condenser tubes, and the use of cupro-nickel alloys afford examples of the adoption of new and superior materials. The surface protection of metallic articles by highly resistant films of oxide, either naturally as in the stainless steels, or artificially on aluminium and certain of its alloys by the anodic oxidation process developed by Bengough and Stuart, are instances of a similar effect produced by an alternative line of approach.

In all these developments the Institute of Metals has itself played a most important if, perhaps, indirect part and can justifiably claim a share of the credit for the progress which has been made.

F. C. T.

The Loch Ness "Monster"

(FROM A CORRESPONDENT)

SINCE early in the past summer, newspaper references have become more frequent and more precise, relating to the presence of an aquatic "monster" in Loch Ness. After its reported occurrence, the writer spent a forenoon in July by and on the Loch without seeing anything unusual, and up to the present the "creature" has been chary of exhibiting its paces to a skilled naturalist. Experience of alleged wonders and the results of investigation—where investigation was possible—lead to deep scepticism concerning reports by inexpert observers describing phenomena with which they are unfamiliar, and in the present case the variations in the descriptions suggest either fertile (if unconscious) imagination, or the observation of different phenomena.

Descriptions vary: several observers have "seen" an eel-like monster with humps upon its back, a few a creature with small head and long neck attached to an enormous body, and others something that looked like an upturned boat. As a rule, it is said to move swiftly through the water, sometimes to the accompaniment of a "flurry" of foam. Guesses at identity have varied even more than descriptions; from possibilities, such as large eel, grampus, porpoise, whale-shark, seal, otter, to improbabilities such as sunfish, crocodile, "some amphibian", and so to impossibilities which include *Plesiosaurus*, "sea-camel" and the sea-serpent of the Middle Ages. Two professional zoologists have ventured identifications: one suggested an unstable mass of drifting peat, the other a white whale or beluga, but for various reasons neither is likely to be correct.

During the last fortnight, the "monster" has become insistent upon attention, mainly through its advocates. The Secretary of State for Scotland, in reply to questions, has written that he has communicated with the Chief Constable of Inverness-shire, who had already stationed five constables at different places on the loch. None has yet seen the monster; but it is guaranteed protection should it appear and be threatened.

In the *Times* of December 8, Lieut.-Commander R. T. Gould, who has taken much trouble to examine the evidence, considers that the creature is a "specimen of one of the rarest and least known of all living creatures", in fact as near as may be a relative of the traditional "sea-serpent", with large body supporting a small head perched upon a long neck, the base of which is fringed with appendages, "possibly gills"—he suggests a giant marine form (hitherto unrecognised by science) of the common newt. To a zoologist, Commander Gould's acceptance and analysis of at any rate some of the evidence appears to be uncritical and even credulous, and his conclusion unjustified.

By far the most important piece of recent evidence has been the publication of a photograph said to be of the "monster". The photograph lay undeveloped for four weeks notwithstanding its possible interest, and its first reproduction in the newspaper in which the writer saw it was cancelled on the following day because the print had been "slightly retouched to throw up the details of the monster and its shadow". A second "wholly untouched reproduction of the photographic print" was produced, and if it is correct, it suggests a creature quite different from the animals it is alleged to represent. But to the writer there still seem to be on the print indications that it is not a direct contact print from an untouched negative, and until he has critically examined the negative, he is not prepared to hazard a suggestion.

So far, one can say that although the evidence is not consistent, and that although much that has been said about the "monster" is, to put it mildly, uncritical, if the evidence is to be believed at all, there may be in Loch Ness a creature, which if not unusual in its own habitat, is unusual in its surroundings in a Highland fresh-water loch.

Obituary

MR. H. M. MARTIN

WE regret to record the death on November 17 of Mr. Harold Medway Martin, who for forty-six years was a member of the editorial staff of *Engineering*, and was widely known not only as an engineering journalist of outstanding ability but also as a mathematical physicist of distinction.

Martin was born at Royston, Hertfordshire, on May 21, 1864, and was one of a large family which included Henry Newell Martin, the biologist who worked with Huxley, and Mary Jane Martin, the first woman to gain first-class honours in the Moral Science Tripos at Cambridge, who became the wife of Prof. James Ward.

Educated at the Northern Congregational School at Silcoats, Wakefield, in 1881, Martin was apprenticed to Messrs. Black, Hawthorn and Co., of Gateshead, and in 1885 obtained a Whitworth scholarship, and a Clothworkers' scholarship at the Central Institution of the City and Guilds of London Institute. Passing out of the Central Institution in 1887, he was recommended by the late Dr. Unwin to Mr. (afterwards Dr.) Maw, and on July 18, 1887, joined the staff of *Engineering*, of which he remained a member until his death.

Martin's contributions to the columns of *Engineering* covered a wide range of subjects, such as lubrication, heat transfer, suspension bridges, the behaviour of gases, the theory of

surface condensers, indeterminate structures and the design of dams. His criticism of the memoir "An Experimental Study of the Stresses in Masonry Dams", published by Prof. Karl Pearson and Prof. A. F. C. Pollard in 1907, led to a controversy which was carried on partly in *Engineering* and partly in our own columns. But the work for which Martin will chiefly be remembered was his original researches in connexion with the theory of the steam turbine and thermodynamics, subjects to which he returned again and again. His earlier series of articles on the steam turbine led to the publication in 1913 of his treatise "The Design and Construction of Steam Turbines". Afterwards he dealt with the proportioning of turbine blading, the strength of rotating discs, nozzle experiments and the reaction of steam jets, his contributions to these and other matters being of the greatest service to the steam turbine industry.

For many years a valued member of the Steam Nozzles Committee of the Institution of Mechanical Engineers and of the British Electrical and Allied Industries Research Association, Martin designed the most successful apparatus used for nozzle research, which has indeed been copied by other workers. With his wide knowledge of engineering theory and practice, he also possessed a thorough acquaintance with modern physics which, combined with his gift for writing, enabled him to produce the reports of scientific lectures which have long been a notable feature in the columns of *Engineering*. "No one but Martin," says Dr. G. Stoney, "could have given the lucid reports of the lectures of Lord Rutherford, Sir J. J. Thomson and others at the Royal Institution."

Never in robust health and somewhat reserved, Martin took but little part in outside affairs, and we believe the only mark of distinction he received from the engineering profession was his election in 1921 as an honorary member of the Junior Institution of Engineers. The indebtedness of the profession to his studies, however, is a great and lasting one.

We regret to announce the following deaths :

Prof. J. Joly, F.R.S., professor of geology and mineralogy in Trinity College, Dublin, on December 7, aged seventy-six years.

Sir Frederic L. Nathan, K.B.E., superintendent of the Royal Gunpowder Factory, in 1900–9, and later power alcohol investigation officer under the Fuel Research Board, Department of Scientific and Industrial Research, on December 10, aged seventy-two years.

Sir William Whitla, formerly professor of materia medica and therapeutics in the Queen's University, Belfast, president of the British Medical Association in 1909–10, on December 11, aged eighty-two years.

News and Views

Aberdeen Meeting of the British Association

The annual meeting of the British Association will be held next year in Aberdeen on September 5–12 under the presidency of Sir William Hardy, Director of Food Investigation in the Department of Scientific and Industrial Research. The following sectional presidents have been appointed : Section A (Mathematical and Physical Sciences), Prof. H. M. Macdonald ; B (Chemistry), Prof. T. M. Lowry ; C (Geology), Prof. W. T. Gordon ; D (Zoology), Dr. E. S. Russell ; E (Geography), Prof. A. G. Ogilvie ; F (Economic Science and Statistics), Prof. H. M. Hallsworth ; G (Engineering), Prof. F. G. Baily ; H (Anthropology), Capt. T. A. Joyce ; I (Physiology), Prof. H. E. Roaf ; J (Psychology), Dr. Shepherd Dawson ; K (Botany), Prof. A. W. Borthwick ; L (Educational Science), Mr. H. T. Tizard ; M (Agriculture), Prof. J. A. S. Watson. The president of the Conference of Delegates of Corresponding Societies will be Sir Henry Lyons.

The 24-Hour System of Time Reckoning

Fifty years ago, the United States adopted zone time, the time in each zone differing by an integral number of hours from Greenwich time. Zone time has been very generally adopted throughout the world, and has resulted, in the long run, in a great deal of convenience to the world, though the choice of the Greenwich meridian rather than that of Washington may then have seemed unnecessary to some Americans. Reform in British methods of public time-keeping, namely, the adoption of a 24-hour clock, and the abolition of the distinction between a.m. and p.m. in railway time-tables and in the Post Office, is again under consideration (see Nature, Dec. 2, p. 835). On December 7 the House of Lords adopted a resolution moved by Lord Newton recommending that the Post Office should adopt the 24-hour day, and that the railways should be invited to use it in their time-tables. The change was recommended so long ago as 1919 by a Home Office Committee. The Government reply was that there is no evidence of a general demand on the part of the public for the 24-hour day. The 24-hour day is, of course, used by astronomers, and also by the Army, Navy, and Air Force. While the present arrangement causes little inconvenience in private life, most people will probably agree with the Astronomer Royal, who is supporting the project, that the adoption of the 24-hour day would be a small but easily made step in the direction of greater ultimate public convenience.

Cinchona and Civilisation

The Pharmaceutical Society awards bi-annually the Harrison Memorial medal, which perpetuates the memory of Colonel E. F. Harrison, a member of the Society who was Director of Chemical Warfare during the later stages of the War and died from the effects of gas poisoning contracted while testing respirators.

He was the designer of the widely used 'Harrison restorer'. The recipient of the medal delivers the Harrison Memorial lecture before the Society, a lecture which need not—and as time passes cannot—deal with Harrison himself or his work. The medal this year has been awarded to Mr. Bernard Howard, a vice-president of the Institute of Chemistry, who took as the subject of his lecture delivered on December 12, "Cinchona and Civilisation". Mr. Howard is a director of one of the largest manufacturers of quinine in Great Britain, whose records go back into the early years of the last century, and he was able to illustrate his discussion, in his presentation of the problem of man's fight against malaria, from the records of his own firm.

WHEN the British army from Bulgaria landed in the Crimea in 1857, the troops were so weak from the effects of malaria that they were scarcely able to carry their equipment. Presumably in 1857, quinine was regularly administered by army doctors to malaria patients, but Mr. Howard maintains that it is almost certain that there was no systematic method of prophylaxis at that time. From an examination of the records of his firm, he finds that the output for 1857 shows an increase of 27 per cent over the 1856 figure, while the post-Crimean War year, 1858, shows a decrease of 22 per cent. He assumes that a good proportion of the 1857 increase must have gone to the army, and that the fact that there was any army at all to be landed in the Crimea was due to the use of quinine. The first cinchona trees known to be grown in Great Britain were in the garden of the Society of Apothecaries in London, maintained to this day as the Chelsea Physic Garden. There is a record in Evelyn's Diary of his seeing cinchona trees there. At a site in Tottenham, which is now an arterial road, the Howard family grew cinchona in the early nineteenth century, and quinine was extracted experimentally from these trees. So early as 1823 it was being manufactured on a large scale in Great Britain, although from imported bark.

Exhibition of Microscopes

MESSRS. W. WATSON AND SONS, LTD., 313 High Holborn, London, W.C.1, have an exhibition of microscopes at the Central Hall, Westminster, London, S.W.1, with the view of popularising the use of the microscope and demonstrating its recreational and educational possibilities. In this connexion, several small microscopes are exhibited, the cost of which is very reasonable. The material set up shows clearly that a great deal of useful teaching work can be done with a comparatively simple instrument. Striking exhibits of differential illumination by means of Rheinberg's disc illustrate the advantages of this method for demonstration and elementary teaching purposes. A very useful instrument exhibited, which should appeal to all microscopists and naturalists who are interested in microscopy in the field, is a small portable microscope. The stand can be folded and the tube lowered so that the whole instrument may be reduced to a size of 7 in. × 3 in. × 3 in. The cost too is very reasonable. Among the demonstrations in photomicrography is one by the Kodak Co., in which experiments with a microscope and an ordinary Brownie 12*s.* 6*d.* box camera, using a super-sensitive panchromatic plate, have produced excellent results. Several new departures for methods in metallurgy and microprojection are being exhibited. A number of useful changes in construction of, and additions to, microscopes for research in biology, crystallography, metallurgy, are also on view; several types of binocular microscope, one with a new inter-pupillary adjustment, being of particular interest. The exhibition, which is open until December 16, is well worth a visit not only by microscopists, who wish to know what can be done with a simple instrument and the recent developments in the finer instruments; but also by those not familiar with microscope work, since there is much of interest to be learned from it.

Racial Elements in India

ON November 17, Dr. J. H. Hutton, the Indian Census Commissioner, gave a lecture, which is now available, before the Royal Society of Arts (*J. Roy. Soc. Arts*, 82, No. 4226). Summarising the results of his work, Dr. Hutton discussed the racial elements in the population of India at length, analysing it into no less than six distinct strains. To a Negrito (Andamanese) sub-stratum must be added a race of Australoid affinities, which is "widely spread" in India. Thirdly, an immigration of Austro-Asiatic speaking peoples can be traced from the Punjab hills to the Bay of Bengal. Fourthly came the Dravidian speaking peoples, described by Dr. Hutton as "Mediterranean" and "Armenoid", from Mesopotamia. Fifthly and sixthly, Dr. Hutton associates Indian brachycephaly with an Aryan speaking stock, described as "Alpine" and said to have preceded the true Aryans. At the conclusion, Mr. K. de B. Codrington pointed out that Dr. Hutton's analysis was based almost entirely on linguistic evidence. No craniometrical evidence can be brought forward in support of the suggested Negrito strain, nor is a widely spread Australoid type discernible. Brachycephaly cannot be seized upon as an isolated fact and labelled Alpine. Furthermore, Harrower's opinion, that there is no support for the identification of the Dravidian and Mediterranean types, should be given serious attention. In putting forward such theories, the canons of biological thought must be obeyed, and due consideration given to current anthropometrical opinion.

Jericho

PROF. JOHN GARSTANG'S survey of the results of his excavations at Jericho in his article in the *Times* of December 6, following on his lecture at the University of Liverpool on November 17, affords a consecutive story of the history of the city which it is possible to accept with assurance in the light of the excavations of last season. Among the more interesting features are the evidence of Babylonian influence in the Early Bronze Age and the conspicuous rarity of Cretan and Mycenæan motives under the eighteenth

dynasty when they might be expected. Four separate and distinct defensive systems have been differentiated, of which the earliest, belonging to the Early Bronze Age (*c.* 2500–2100 B.C.) rested on deposits of a still older period. The period of the city's greatest expansion was in the third phase (Middle Bronze Age II), which is marked by a cultural change. Under the Hyksos at that time, the city walls were much extended; and the character of the Palace and other buildings suggests that Jericho, as the residence of a Hyksos governor, had become a city of more than local importance. This phase comes to an end at about 1600 B.C. when the city was destroyed, presumably by the Pharaohs. It was rebuilt, but restricted within the bounds of the earlier area of occupation. From that time onward its history can be traced by means of scarabs and painted pottery having a range of dates between 1600 and 1400 B.C. At the latter date under Amenophis III the normal life of the city ceases abruptly. All the buildings of the Palace area and the few houses against the city wall bear witness to a great catastrophe—the indications are an earthquake—followed by an intense fire while the rooms were in occupation. Thenceforward until about 900 B.C. the site was practically deserted.

Sixth International Congress for Scientific Management

CONSIDERABLE progress is being made with the organisation of the Sixth International Congress for Scientific Management, which is to be held in London on July 15–18, 1935. A strong council which includes representatives of societies connected with various phases of scientific management has been formed. H.R.H. the Prince of Wales is the patron of the Conference and Government support has been promised. The chairman is Sir George Beharrell, managing director of Dunlops. The chairmen of the various committees are Dr. E. F. Armstrong (Organisation), Sir Henry Fowler (Technical) and Mr. G. R. Freeman (Finance). Mr. H. Ward, formerly general secretary of the National Institute of Industrial Psychology, has been appointed secretary. It is hoped that the Congress will demonstrate that British industry and British technicians are fully alive to the importance of scientific principles in management. Many highly skilled organisations exist, which are using and propagating these principles, but the Congress should help still further to stimulate the national movement in this direction and to create a general appreciation of the applications of management to organised industrial and commercial activity. Among the questions which will be discussed are: concrete examples of the application of scientific management to distribution problems in manufacturing, wholesaling and retailing; methods of controlling production; methods of selection, education and training of personnel suitable for high administrative positions; correct methods of inculcating modern management principles and practices in large-scale, medium and small undertakings, and the rôle of trade or other associations in this field.

Glass-Making

THE Friday evening discourse at the Royal Institution on December 8 was delivered by Major R. M. Weeks, a director of Messrs. Pilkington Brothers, Ltd., on "The Making of a Sheet of Glass". Major Weeks first gave a brief outline of some fundamental scientific considerations, with special reference to composition, the tendency to devitrify, and the resistance of the product to weathering. Melting is carried out by one of two processes, namely, the older method in which the raw materials are placed in pots in a gas-fired furnace, and the modern method by which the raw materials are introduced at one end of a continuous furnace and the molten glass withdrawn at the other. The various processes necessary for the manufacture of sheet and plate-glass were described in detail. Films were shown of the hand-blown and the machine-drawn cylinder sheet glass processes. The latter has been superseded by the flat-drawn process, in which the sheet is drawn in the form of a flat continuous ribbon. To illustrate the manufacture of plate glass, an interesting film of the Bicheroux casting process was shown and reference was made to the latest process of plate glass manufacture, the flow process, in which the molten glass is delivered to rollers which form a continuous ribbon of glass. In the modern continuous grinding and polishing machine the glass plates, laid on a moving bed, pass successively under the grinding and polishing machines. The discourse concluded with a description of two novel forms of flat glass of interest, namely, opaque glass manufactured in black, white and various colours and known as vitrolite; and toughened glass, known as 'armour-plate' or 'triplex toughened', which has a high resistance to fracture combined with the property, if broken, of shattering into small harmless fragments.

India and Displaced German Scientific Workers

ALTHOUGH the creation of special posts and the raising of supplementary funds for research work have alleviated in some degree the difficulties attendant on the absorption of displaced German Jewish teachers and students, these measures have not been adequate to provide for all, or to meet all contingencies. In India, where the appeal on behalf of the displaced workers has met with a sympathetic reception in certain quarters, the posts which might be made available are extremely limited in number, and in the matter of academic and research appointments, India has its own special difficulties which militate against even limited assistance. In each year India produces a relatively large number of men trained in science, including many with qualifications obtained in Europe. In present conditions these find difficulty in obtaining appointments in India. In an interview with Acharya Roy, which appears in the *Amrita Bazar Patrika* of November 14, relating to the appeal on behalf of Jewish men of science, reference is made to the virtual monopoly enjoyed by Europeans in posts for scientific research in India, against which Indian research students have made way only very slowly in the last fifteen years. Acharya Roy points

out that these difficulties would be greatly enhanced if any attempt were made to absorb German men of science, while they might resent being placed in a position of subordination to Indian workers. His attitude towards the employment of Europeans in research in India provides much food for thought, and suggests that the educational situation of the future will call for tactful handling unless Indian education is to suffer. In the course of his interview, however, Acharya Roy does point out a weakness in the position of the European teacher, who, as an exile, looks forward to his return home, and as a foreigner cannot enter intimately into the life of his students.

Classification of *Sinanthropus*

WHEN Dr. Hrdlička was passing through the press the revised edition of "The Skeletal Remains of Early Man" (Smithsonian Miscell. Collect., Vol. 83, 1930) he received a description, accompanied by photographs, of the then recently discovered skull of Peking man. Although it was too late for reference in the text, in an addendum Prof. Hrdlička gave it as his opinion that the skull was neanderthaloid, resembling the Galilee skull, and that "had it been found in Europe or in Asia Minor it would hardly be taken by any expert student . . . as anything else than neanderthaloid". Dr. Hrdlička has now made a careful examination of cranial and endocranial casts of the Peking skull recently received from London, examining them side by side with comparable material in the National Museum collections at Washington. According to a communication issued by the Smithsonian Institution of Washington, Dr. Hrdlička finds that his previous conclusions are fully substantiated. They are in complete agreement with the view recently put forward by Dr. E. Dubois before the Dutch Academy of Sciences, being in effect that Peking man is a somewhat variant member of the widespread Neanderthal race. Though the brain and skull are small, Dr. Hrdlička holds that the former is "thoroughly human", if low in type, while the latter is comparable in capacity with the skulls of prehistoric Peruvians in the Washington collections, of which some thirty in number are less than 1,050 c.c. in cubic capacity. In respect of both characters, Peking man is thus brought well within the range of the human.

Guiding Aeroplanes when about to Land

IN the radio range-beacon system now used on American airways, it is sometimes very difficult to determine the absolute direction of the aeroplane when it is near the radio beacon. The pilot can easily pass from one quadrant to another without knowing it. When once so lost, he may wander many miles from the beacon before he can find out which quadrant he is on. Tests show that the average pilot, when flying under the hood and purposely lost, requires about an hour to find his course. In the *Journal of Research* of the Bureau of Standards for September, Mr. F. W. Dunmore describes aural, visual and combined methods which enable the pilot to identify the quadrant with certainty. In the aural method, directive signals are sent out; a one dot signal in a westerly direction, two dots easterly, three dots north and four dots south. Depending on which set of these signals is the loudest, a pilot can determine his general direction from the beacon. During an interval between the sending of the beacon station identification letter, the one dot and two dot signals are sent out, and during the next interval the three dot and four dot signals are transmitted; which two of the four sets of signals are heard loudest enable the pilot to determine his course. In the visual system, use is made of an indicator the reeds of which are affected by the signals, and their relative amplitudes enable the course to be determined. An advantage of the system for course and quadrant identification is that it can be readily applied to existing beacon stations as it requires no alterations to the antenna structure. Photographs of the devices and full diagrams of the necessary circuit arrangements are given.

Inductive Interference with Telephone Lines

THE working of telephones is often seriously impaired by the noise due to induction from neighbouring power or railway lines. This problem has been closely studied by electrical engineers for the last thirty years. In a paper communicated to the Institution of Electrical Engineers on November 23, Mr. W. G. Radley and Dr. S. Whitehead show that rapid progress has been made in the solution of the problem during the last few years. The amount of the interference in any given case can now be determined quite definitely by mathematics. It is due both to electromagnetic and electrostatic induction and also in some cases to radio effects. The loss in the 'articulation' of a telephone depends on the frequency of the disturbing voltage. For example, to produce the same loss in articulation by means of a note having a frequency of 150 as a note having a frequency of 1050, at which the maximum disturbance occurs, the induced voltage would have to be increased 158 times (22 decibels). The Post Office has now made a 'noise' meter which gives at one reading the magnitude of the interference factor produced by all the induced harmonics. It is a great step in helping the electrical industry to know that interference with existing telephone systems by any projected power or railway scheme can now be predetermined in advance. If it is too great, it can be decreased by a suitable choice of generators, the use of power cables or telephone cables instead of overhead circuits, etc. When there is a short circuit on the power line, and there are large transitory earth currents, there is risk both of electric and acoustic shocks. These may be partly mitigated by protective devices.

Thermodynamic Storage of Energy

THE equalising of the normal daily load of an electricity works with its sudden 'peaks' and deep drop at night is one of the fundamental problems of electrical engineering economics. The suggestions recently made that many of the European power

stations might be linked together so that the peak load might be distributed more evenly, shows how seriously engineers regard the problem. Where Nature makes it possible to collect large quantities of water by the building of dams across valleys and utilising the supplementary energy of hydraulic power stations for yearly storage, the peak demands may be economically covered for months. If the capacity is not sufficient, it can be augmented by using storage pumps to utilise the surplus energy available at night time. In many cases the initial costs of these methods are prohibitive. In the *Escher-Wyss News* for June, published by the Escher-Wyss Engineering Works, Ltd., of Zurich, Dr. Marguerre describes his thermal process for storing surplus energy. The principle may be explained by comparing it to that of a hydraulic pumping storage plant. In this plant, water is pumped from a low to a high level by utilising surplus energy. This energy is then recovered when required by allowing the water to fall to the lower level. In the thermodynamic method, heat is pumped from a low to a high temperature by means of the heat pump (turbo-compressor) and the energy recovered in a steam turbine by a similar temperature drop. The efficiency under average conditions is about 50 per cent. The costs are worked out for practical cases. The method can be used advantageously in connexion with town heating services

Water Heating by Electricity

In order that heating water by electricity may be an economic proposition, it is necessary that electricity be sufficiently cheap. If the price is less than a penny per unit, the method is worth considering. A recent estimate made by the British Electrical Development Association of 2 Savoy Hill, W.C.2, shows that there are already two million houses in Great Britain connected to the supply mains in areas where electricity is offered at the price of $\frac{3}{4}d.$ per unit. The Association issues a pamphlet in which it shows that electricity provides an excellent hot water service and that the supply of hot water reduces very appreciably household drudgery. When hire or hire-purchase terms are available, there is little capital outlay. Prospective users are advised to call at electricity show-rooms and builders are encouraged to make provision for electric hot water systems in new houses. In France, the Société pour le Developpement des Applications de l'Électricité has recently estimated that the number of storage water heating appliances in France exceeds 20,500. There are, however, only 81 with a capacity equal to, or exceeding, 1,000 litres.

Home-Grown Timber in Great Britain

The Inter-Departmental Committee in home-grown timber appointed by the Forestry Commissioners in December 1931 has issued an interim report (Forestry Commission. Interim Report of the Inter-Departmental Home-Grown Timber Committee, 1933. London: H.M. Stationery Office. 4*d.* net). The terms of reference were: "To investigate and submit proposals for improvement in the utilisation of home-grown timber". The report states that the appointment of the committee arose out of the urgent need of redressing to some extent the adverse balance of trade in Great Britain by the increased use of home-grown products. The Committee believes that with adequate organisation and a measure of protection, there should be a greatly increased use of home timber, employing some thousands of men and replacing a part of the imports from foreign countries.

The report now available gives the area which is classified as woodland in Great Britain as nearly 3,000,000 acres (the accepted area before the War), of which some 300,000 acres are under State management, including 230,000 acres of young plantations made by the Forestry Commission since 1920. Approximately 2,700,000 acres are private property. On most private estates, forestry is said to be now at a low ebb, from causes well known and often recapitulated. The marketing of timber forms one of the subjects commented upon by the Committee. The want of any co-ordinated system and the high costs of transport, partly—but only partly—an outcome of the absence of any definite system, have for long been subjects of discussion and complaint. The Committee recognises that if railway rates are to be lowered a guaranteed quantity of traffic is necessary, which in the past has not been forthcoming. The Report states that the immediate problem the Committee has to face is concerned mainly with the utilisation of timber of small size and low quality which will not stand heavy haulage and conversion costs. It is suggested that the smaller estates "should market their timber through a central organisation in touch with various trades using wood, and guarantee a regular supply".

Radio Communication in Mines

The August number of the *Transactions of the Mining and Geological Institute of India* is to hand. Most of the papers in it are of interest mainly to those engaged in mining work in India, but the first paper, by P. I. Keith-Murray on radio communication applied to mines, is of more general interest. The author has devoted considerable attention to the subject of radio communication, and has investigated in some detail the various methods with regard to their applicability to mining purposes, and more especially to mine rescue work. He has come to the definite conclusion that, so far, no place has been found for it in this work, but he also states that in view of the rapid development of all branches it would be unwise to make any definite statement as regards the impossibility of ever employing it in the future. He shows that a great deal of important work has been and is being done, and that new methods are being evolved at a tolerably rapid rate, and appears to hope that within a measurable distance one or other of these methods may be employed for underground work, though he points out fairly enough the very serious obstacles that its application would present.

Reduction of Road Accidents

IN view of the increasing attention which is being directed to road accidents and their causes and prevention, a pamphlet recently issued by the National Institute of Industrial Psychology dealing with practical methods for reducing accidents and transport costs is worthy of general attention. The difficulty of ascertaining accurately the ability of a driver is widely realised, but the way in which his accident record may be misleading and lead to unfair judgments of his ability is less well known. As a result of a considerable amount of research, the Institute has now been able to devise and standardise a group of psychological tests which can be applied to select the best drivers from among a group of applicants for a post. The results of the tests have shown a remarkable concordance with estimates based on close observation of actual driving performance. The tests are equally valuable for selecting the men most suitable for training as drivers and they can also be applied to discover what is lacking in drivers of poor ability in order to remedy deficiencies where possible. A fourth direction of application is of even wider interest as the tests can be used to advise those who intend to learn to drive as to what degree of ability they are likely to develop after adequate tuition and experience. The bearing of such tests on the prevention of road accidents is obvious. The Institute's fee for carrying out such a test is two guineas.

Quarterly Journal of Experimental Physiology

VOL. 23 of the *Quarterly Journal of Experimental Physiology* is dedicated by his past and present assistants to Sir Edward Sharpey-Schafer, in honour of his eighty-third birthday. It contains thirty-one papers, which have been collected and edited by Dr. Argyll Campbell and Sir Leonard Hill, two of his former assistants. The list of those who have participated in the production of the volume contains twenty-nine names, covering a period of nearly fifty years. It is unnecessary to mention the great advances made by physiology in this time, advances to which Sir Edward Sharpey-Schafer has himself in no small degree contributed. In the present volume, the original contributions cover many different aspects of physiological science, from the effects of posture on heart-rate and blood pressure and the discomfort of close rooms caused by infra-red rays, to studies on arginase, the effect of formaldehyde on vitamin B_1 and variations of the anterior pituitary hormone in the blood in pregnancy, to mention only a few. Examination of the volume gives a good idea of the branches of physiology in which interest is being taken at the present time and indicates that this science is rapidly adding to our store of knowledge.

A 'Sun-Path Demonstrator'

TEACHERS who have difficulty in explaining geographical and astronomical phenomena which involve motion in three dimensions may find that a model illustrating the phenomenon is much more intelligible to the pupil than is any blackboard drawing intended to represent three dimensions. Messrs. Philip and Son, Ltd., 32, Fleet Street, London, E.C.4, have sent to NATURE office a model called the 'Sun-Path Demonstrator" (price 15*s*.) the use of which is to demonstrate the sun's apparent motion, hour by hour, at the equinox and solstices, as it appears to an observer in any latitude. The latitude can be set by one protractor and the sun's altitude read off on another protractor. The device may be helpful in demonstrating the particular point, but why the sun should behave in this way is left quite unexplained. Nevertheless, a wide acquaintance with such a device would tend to lessen the number of otherwise intelligent pupils who find particular difficulty with problems of this nature.

Early Man in Nevada

FURTHER evidence of the presence of early man in the United States, which is regarded as "highly suggestive if not absolutely convincing", is reported by Dr. George Gaylord, of the American Museum of Natural History, to have been found in Nevada, according to a statement issued by Science Service, Washington, D.C. This is a flake of obsidian found by a field party led by Mr. Fenley Hunter while quarrying for the bones of fossil animals. It was enclosed in an undisturbed matrix in a horizon in which were the remains of camel, horse and deer, and belonging to Pleistocene or post-Pleistocene times. The flake bears marks of chipping, as for the preparation of a blade. Obsidian has not been found in the region of the discovery, this fact strengthening the view that the flake is of human origin. Charcoal is stated also to have been found in three well-defined areas, and is presumed to be the remains of ancient hearths.

Index Veterinarius

WE have received the first number of the *Index Veterinarius* (vol. 1, No. 1. April 1933), the proposed publication of which by the Imperial Bureau of Animal Health has been mentioned in these columns, and covers the first quarter of this year. It is a volume, produced by duplicator, of 304 pages, preceded by 36 pages of explanatory introduction and the list of journals and reports indexed, with key to the abbreviations adopted. The *Index* will be issued quarterly, and each volume will be a single complete alphabetical index of veterinary publications, authors' names and subjects being given their appropriate places in the same series ; references are fully cross-indexed under subject headings. The publication should be of great service to the veterinary profession and to research workers on veterinary subjects. The annual subscription is £4, which should be forwarded to the Bureau, Weybridge, Surrey, England.

Irritating References

DR. F. A. BATHER recently complained (NATURE, July 15) of the irritation and loss of time caused by the custom of not indicating the page number of a new chapter. Mr. C. A. Silberrad, 2 Forrest Side, Epping, Essex, writes to say that a far greater source of irritation and loss of time is the habit of many

authors of giving a reference as "loc. cit. p.——", with no indication as to where the previous reference has been given—often several pages previously. He adds: "Surely it should be generally recognised that 'loc. cit.' is not to be used unless the previous reference is on the *same* page as the second reference."

Medical Uses of Radium

UNDER this title, the Medical Research Council has issued a summary of reports from radium research centres for 1932 (Special Rep. Series, No. 186. H.M. Stationery Office. 1*s*. net). Brief details of the results obtained during the year are given, as well as a statistical analysis of data relating to the after-histories of patients treated in earlier years. The treatment of cancer of the rectum by irradiation, hitherto disappointing, appears now to have a more favourable future as a result of better understanding of the dosage.

Victorian Bush Nursing Association

THE Bush Nursing Hospitals, Victoria, Australia, of which we have received the annual report to June 1933, are apparently furnishing the solution to the problem of medical attendance in the country. They are owned and controlled by the centres, and are available to all who need them at fixed rates. They enable cases of illness to be dealt with which otherwise would have to be sent many miles for treatment.

The Leonids, 1933

BAD weather in mid-November seems to have precluded most of the English observers from watching for the return of the Leonid shower this year. Mr. A. King, of Scunthorpe, Lincs, however, was able to maintain a lookout on November 16 (the probable night of maximum), from 9h. 55m. to 15h. 55m. (G.M.A.T.). There was frequent interruption from cloud and rain, the total time spent in actual watching being 2h. 34m. There were some very clear intervals, and it was evident from the scarcity of meteors that no great shower was in play; indeed, Leonids were not so numerous nor so bright as on November 16, 1931. The following radiant of Leonids was determined:

Nov. $16^{d}\cdot6$ $151°\cdot8 + 21°\cdot8$ 7 paths

Mr. M. A. R. Khan, at Hyderabad, India, notes: "This year's Leonids were a poor show." He observed as under:

Date	Time (G.M.A.T.) h. m. h. m.	No. of Leonids
Nov. 11	9.30 to 10.30	3
„ 12	Do.	
„ 13	9.30 to 11.30	8
„ 14	9.0 to 10.15	7
„ 15	9.15 to 10.30	6
„ 16	8.45 to 10.15	19

The sky was generally hazy.

Mr. Arthur Renshaw, Manchester, writes that at 4.30 a.m. of November 13 he noticed that "in an E.S.E. direction the sky was illuminated by what at first I took to be rockets. . . . A group of people waiting for the first workmen's tramcars were gazing in wonderment. Stars were shooting from left to right and vice versa; in most cases there was a streak of light . . . hanging in the sky, which lasted for several minutes." This account, as regards both the direction in which the meteors were seen and their character, is strangely suggestive of a display of Leonids. If this can be substantiated, it means that the maximum of the shower happened this year at least four days before the usual date—an unprecedented occurrence.

Announcements

MR. H. B. WATERS, deputy director of agriculture, Gold Coast, has been appointed director of agriculture, Kenya.

THE twenty-fourth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on January 9–11, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7. The leading manufacturers of scientific instruments will be exhibiting their latest products in the Trade Section. The Research and Experimental Section will contain contributions from most of the important research laboratories in Great Britain, and there will be a special sub-section devoted to experiments of educational interest. The following discourses will be delivered in the evenings at 8 p.m.: January 9, R. S. Whipple, "The Evolution of the Galvanometer"; January 10, J. Guild, "The Instrumental Side of Colorimetry"; January 11, Sir J. Ambrose Fleming, "The History and Development of the Thermionic Valve". Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, S.W.7. No ticket is necessary on January 11.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in chemistry at the Polytechnic, 309, Regent Street, London, W.1—The Director of Education (Dec. 18). A principal of the Maclagan Engineering College, Moghalpura, Lahore, India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Dec. 29). A woman inspector of agricultural education—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, London, S.W.1 (Jan. 4). A head of the Mechanical Engineering Department in the Liverpool Central Municipal Technical School—The Director of Education, 14 Sir Thomas Street, Liverpool (Jan. 5). An engineering inspector to the Ministry of Health—The Director of Establishments, Ministry of Health, Whitehall, S.W.1 (Jan. 8). A principal of the Yorkshire Training College of Housecraft—The Director of Education, Education Offices, Calverley Street, Leeds (Jan. 12). A bacteriologist or zoologist to investigate foul brood disease in bees at the Rothamsted Experimental Station—The Secretary, Rothamsted Experimental Station, Harpenden, Herts (Jan. 16). A student assistant in the Economics Department of the Harper Adams Agricultural College, Newport, Shropshire—The Advisory Economist.

Letters to the Editor

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

The Dispersion Formula for an Ionised Medium

IN two letters in NATURE recently[1], Dr. L. Tonks has expressed disagreement with the use of the Lorentz formula

$$\mu^2 = 1 + \frac{\sigma}{1 - \frac{1}{3}\sigma}, \left(\sigma = -\frac{4\pi Ne^2}{mp^2}\right),$$

relating the ionisation density N and refractive index μ of an ionised medium for waves of frequency $p/2\pi$. In the second of these letters, he refers to some work of mine[2] in which this formula was derived *ab initio* (not by Lorentz's method as he suggests, but by a method which avoids some of the difficulties of applying Lorentz's argument directly to an ionised medium), and he suggests that this derivation is in error on account of the omission of a contribution to the field acting on an electron of the medium, and further that the inclusion of the omitted contribution reduces the dispersion formula to the Sellmeyer form $\mu^2 = 1 + \sigma$.

While I realise that the question of this contribution is not so simple as I thought at the time that the work was done, and agree with Dr. Tonks that some modification may be required, I do not think it can be established by the rather superficial arguments given in his letter, which depend on an assumption which seems quite as unjustified as the tacit assumption in my work which he questions. I propose, by an argument which seems to me at least equally plausible, to derive the direct contrary to Dr. Tonks's conclusions. This, of course, does not mean that his conclusion is erroneous, but that a much more careful and critical investigation is necessary before the question can be answered with certainty.

The refracting medium considered consists of discrete charges, namely positive ions and electrons. To avoid complicating the discussion by the interaction of the free electrons with bound electrons, I will take the positive ions as protons. The point at issue is the expression for the average, over all electrons, of the electric field acting on an electron, in terms of the electric field of the incident wave and the scattering coefficient σ of the medium. If we consider any one electron, the field acting on it can be thought of as the sum of contributions from the other electrons, and contributions from the protons. So far as the contributions from the other electrons are concerned, Dr. Tonks and I seem to be in agreement; it is in the contribution from the positive charges, which I omitted, that we differ.

The amplitude of the motion of the protons in the radiation field is m/M times that for an electron, and can be neglected, so the protons can be considered at rest and so give no contribution to the radiation field at a fixed point in space. But the field E_+ of the positive charges is not homogeneous, so that when a free electron is displaced to a point P, at displacement r from its mean position P_0, there is an effective 'restoring force' $(r.\nabla)E_+$ on it due to the difference of the contributions of the positive charges to the field at P_0 and P. The question is as to the average value of this quantity.

I omitted it on the ground (expressed in my paper) that it is usual in dispersion theory to neglect all terms of the form $(r.\nabla)E$ arising from the difference between the fields at the instantaneous and mean positions of the oscillating electron (if such terms are included, the equations of propagation may become non-linear). Dr. Tonks rightly points out that, for a bound electron, we do *not* neglect this difference in writing down the force exerted on the electron by the rest of the atom to which it belongs, but attempt to include it by introducing an 'elastic restoring force' $-\alpha r$ in the total force acting on the electron, and he suggests that for a free electron we must replace this by the Coulomb forces of the ions. It should be pointed out, however, that this argument is not altogether satisfactory as a basis for his further calculations, as the 'elastic restoring force' is essentially *not* a classical contribution to $(r.\nabla)E$ from the Coulomb field of the rest of the atom, but is a formal way of putting into classical electromagnetism the essentially non-classical reaction of the atom to incident radiation; and this might suggest a doubt whether for a free electron the effect of the positive ions could be calculated by so purely classical an argument, in terms of Coulomb forces, as Dr. Tonks uses.

Apart from this doubt, however, there is another, and I think more serious, objection to Dr. Tonks's argument as it stands. He calculates the average Coulomb force on the electron due to the positive charges "by supposing the positive ion to be distributed uniformly throughout a sphere of volume $1/N$". Now this supposition, which is introduced casually and without any justification, really begs the whole question, but it is by no means obvious that it is valid; the non-zero contribution to the field from the smoothed-out distribution of positive charge, which in Dr. Tonks's presentation leads to Sellmeyer's formula, by cancelling the 'Lorentz term' $-\frac{1}{3}\sigma E$ arising in the expression for the contribution to the field from the other electrons, arises from the non-zero volume density of the distribution *at the point where the electron concerned is located*, and it is not at all obvious whether the effect of the positive charges in the immediate neighbourhood of the electron *can* be represented by such a smoothed-out distribution.

Classically it is uncertain whether any meaning can be given to an electron being coincident with a proton, and wave-mechanically, if we have a point charge at $r = 0$, then the behaviour of the wave function of an electron very near $r = 0$ is, from Schrödinger's equation, independent of whether the charge at $r = 0$ is positive or negative. So in place of Dr. Tonks's supposition, it seems at least equally plausible to suppose that the positive charges in the neighbourhood of the electron considered should either be treated, on the same basis as the electrons, as discrete charges *no* one of which is coincident with the electron considered, or smoothed out into a continuous distribution over a region of space surrounding, but *not* including, the points occupied by the electron. In either case, the average of $(r.\nabla)E$ is zero, and we have the Lorentz dispersion formula for an ionised medium.

This, I must emphasise, is not put forward as a conclusive argument for the Lorentz formula, but only to show that it can be supported by arguments superficially just as plausible as those used by

Dr. Tonks to condemn it. I admit an unjustified assumption in my own earlier derivation of the Lorentz formula for this case; but the remedy for it is not another equally unjustified assumption, but a more careful and critical study of the problem.

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Nov. 10.

[1] L. Tonks, NATURE, **132**, 101, July 15, and 710, Nov. 4, 1933.
[2] D. R. Hartree, *Proc. Camb. Phil. Soc.*, **25**, 97; 1929: **27**, 143; 1931.

Reactivity of the Sulphur Linkage in Wool

ASTBURY and Woods[1] have suggested that the action of steam in imparting a permanent set to strained fibres takes place in two stages—a primary breakdown of linkages between the long peptide chains, followed by the rebuilding of new linkages. Breakdown of side linkages is recognised from the fact that fibres steamed for 2 minutes at 50 per cent extension are then able to contract in steam to a length one-third less than the original. Supercontraction of this type may be produced in several ways[2], but all methods appear to involve the sulphur linkage in wool. For example, fibres immersed in 0·0325 *N* sodium sulphide solution contract 6 per cent in about 60 minutes[2], in spite of the pronounced increase in length which is the ultimate result of attack by sodium sulphide. Secondly, silver sulphate solution is known[3] to react with cystine according to the equation:

$$3\ R\text{–}S\text{–}S\text{–}R + 3H_2O = R\text{–}SO_3H + 5R\text{–}SH;$$

fibres boiled with saturated silver sulphate solution contract 28 per cent in 5 hours. In addition, sodium sulphite reacts with cystine as follows[4]:

$$R\text{–}S\text{–}S\text{–}R + Na_2SO_3 = R\text{–}SNa + R\text{–}S\text{–}SO_3Na.$$

Similarly, fibres boiled with 5 per cent sodium bisulphite solution contract 24 per cent in 30 minutes.

From these and other reactions it has become apparent that the phenomenon of supercontraction is associated with the breakdown of disulphide linkages in wool, so that when strained fibres are exposed to the action of steam, the first reaction which occurs[5] is as follows:

$$R\text{–}S\text{–}S\text{–}R + H_2O \rightleftarrows R\text{–}SH + R\text{–}S\text{–}OH.$$

That such a reaction is possible receives support from the observation, made in conjunction with C. A. Cooper, that wool heated with water in presence of mercury vapour, is rapidly contaminated with mercuric sulphide at a temperature as low as 55° C.

As regards the chemical mechanism of the rebuilding of new linkages, I have already shown that the free amino groups of lysine and arginine play a fundamental part in the reaction[6]. It is now evident that the amino groups must react with the products of the reaction between disulphide groups and water. Although salt formation between sulphydryl and amino groups is possible, this does not appear to be the mechanism of permanent set because although contraction of set fibres is always possible in caustic soda solution[2], contraction is not accompanied by the reversion of β- to α-keratin. In consequence, it seems reasonable to assume that the rebuilding of new linkages takes place according to the equation:

$$R\text{–}S\text{–}OH + R\text{–}NH_2 = R\text{–}S\text{–}NH\text{–}R + H_2O.$$

Support for this view is afforded by the fact that when fibres are treated with saturated silver sulphate solution for 17 hours in the cold, to convert the disulphide group to $R\text{–}SO_3H$, their ability to assume a permanent set is considerably reduced, as shown by the following data. The latter express the rates of contraction in steam of treated and untreated fibres, which had been steamed for 30 minutes at 40 per cent extension.

Time (Minutes)	Percentage Extension Untreated	Treated
0	40·2	39·9
2	24·4	6·3
15	13·8	1·1
30	10·4	− 0·5
60	8·0	− 3·7

Reactions such as the preceding, besides serving to reveal the chemical mechanism of permanent set, emphasise the reactivity of the sulphur linkage in wool. Of particular interest in this connexion is the reaction with barium hydroxide. Prolonged treatment with baryta water is known to remove the sulphur from wool, but it now appears that so deep-seated a change is preceded by the formation of an addition compound. Its formation is responsible for the inability of fibres treated with saturated baryta water for only 1½ hours in the cold to contract when boiled for 1 hour with 5 per cent sodium bisulphite solution. In addition, such fibres possess no power of assuming a permanent set.

The industrial significance of these and other reactions of the sulphur linkage in wool will receive discussion in another place.

J. B. SPEAKMAN.

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University, Leeds.
Nov. 18.

[1] Astbury and Woods, *Phil. Trans.* (in the press). H. J. Woods, NATURE, **132**, 709, Nov. 24, 1933.
[2] Speakman, NATURE, **124**, 948, Dec. 21, 1929. *J. Soc. Chem. Ind.*, **50**, 1 T, 1931.
[3] Vickery and Leavenworth, *J. Biol. Chem.*, **86**, 129; 1930.
[4] Clarke, *J. Biol. Chem.*, **97**, 235; 1932.
[5] Cf. Marriott, *J. Soc. Leather Trades' Chemists*, **12**, 347; 1928.
[6] Speakman, *J. Soc Leather Trades' Chemists*, 1933. Conference on the Swelling of Proteins, *J. Soc. Dyers and Colourists*, **49**, 180; 1933.

Constitution of Neodymium, Samarium, Europium, Gadolinium and Terbium

AFTER a long and troublesome series of investigations, I have obtained settings of the apparatus for accelerated anode rays good enough to admit of a provisional analysis of the rare earth elements. Since the beams of rays are still very faint, these results could only be obtained by increasing the aperture of the slits to the limit allowing resolution. In consequence, only the roughest estimates of relative abundance can be made when the mass numbers differ by unity.

Three isotopes, 142, 144, 146, of neodymium (60) had already been identified by the first mass-spectrograph. These are now found to be definitely in descending order of abundance and 143 and 145 also shown to be present.

Samarium (62) gives a strong pair 152, 154 and a triplet 147, 148, 149.

Europium (63), as expected from its chemical atomic weight (152·0), contains the two odd mass numbers 151, 153 in roughly equal abundance.

Gadolinium (64) appears to consist of 155, 156,

157, 158 and 160. Faint effects at 152, 154 are probably due to the presence of samarium in the sample used.

Terbium (65) shows only one line, 159. Search was made for a possible heavier constituent suggested by its atomic weight, 159·2, but none could be detected.

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Catalysed Reaction of Hydrogen with Water and the Nature of Over-voltage

IN the electrolytic formation of hydrogen from water an inertia is present, which has to be overcome by a certain amount of over-voltage. The nature of this inertia is still under discussion. It may either be ascribed to the process of the transition of the hydrogen ions from the water into the state of atoms adsorbed on the electrode, or to the process of formation of hydrogen molecules from the adsorbed atoms.

Our observations on the spontaneous transition of hydrogen from platinum into water[1] seem to settle this question for the case of a platinum electrode. It appears that the rate at which the hydrogen is ionised strongly depends on the composition of the aqueous solution with which the platinum is in contact. This influence can scarcely be explained if one attributes the inertia of the process to the reaction of hydrogen with platinum, whereas its presence is easily understood if the inertia is attributed to the transition of the hydrogen atoms into the solution.

The rate of ionisation of hydrogen on platinum black was found to be highest in pure water. Taking the rate in pure water as unity, the approximate rates in different solutions are as follows: in $N/1$ HCl 0·7; in $N/1$ H_2SO_4 0·2; in $N/4$ KOH 0·4; in ethyl alcohol + 2 per cent water 0·4; in ethyl alcohol + 2 per cent water + $N/4$ KOH $<0·02$.

From the last figure we see that the interchange of hydrogen atoms adsorbed on platinum with the hydrogen atoms of undissociated ethyl alcohol molecules is an imperceptibly slow process.

J. HORIUTI.
M. POLANYI.

Victoria University,
Manchester. Dec. 1.

[1] NATURE, 132, 819, Nov. 25, 1933.

Theory of Supraconductivity

IN a recent paper[1] I discussed the transition of a metal in an external magnetic field to the supraconductive state on the usual thermodynamical methods. The chief results of that paper may be summarised as follows:

(1) Simple phenomena and sharp transitions can only be expected if we have to do with a long-shaped or very flat body, orientated parallel to the field.

(2) The experimental data permit us to consider only the transitions between the normal state and those supraconductive states where the induction B equals 0 (B has been called G).

(3) A relation has been derived in analogy to Clapeyron's equation, which was verified for tin[2] in low external fields (Rutgers' equation).

(4) From the validity of Rutgers' equation the conclusion may be drawn that, within the limits of accuracy, $dQ/T = dS$, is true for the transition.

(5) If the body has not the shape of a very oblong or very flat body parallel to the field, supra-conductivity will vanish gradually[3], when the field or the temperature is raised. Supraconductivity will then be disturbed in some parts of the body, while it can persist in other parts, the persisting parts being long-shaped or very flat regions ('needles' or 'razor blades') parallel to the field.

A few weeks ago, Meissner and Ochsenfeld[4] published a series of very interesting observations on the establishment of supraconductivity in a constant external field. Their results seem to indicate that in a supraconductor B always equals 0.

This last assumption throws new light upon my results (2) and (4). It appears that the condition $B = 0$, made in the thermodynamical treatment, does not cause loss of generality, since supraconductive states with $B \neq 0$ do not exist. If hysteresis may be neglected for a moment, the transition to the supraconductive state and back again is literally reversible (in spite of the 'persisting currents') so that it is obvious that $dQ/T = dS$.

One further remark must be made about the (usually small) magnetic and thermal hysteresis, which has been observed. This hysteresis can perhaps be attributed to the fact that a transition (in an external field or if the measuring current is not switched off) will cause a sudden change in the distribution of the magnetic field, and so will be accompanied by eddy currents in other conductors in the neighbourhood and in non-supraconductive parts of the body itself. These currents represent a certain amount of energy, which will be wasted, when the currents will die out in course of time; this energy might be identified with the hysteresis loss ($\int Hd\sigma$ or $\int TdS$ in a magnetic or in a thermal cyclical process). It may be expected that the transition *to* the supraconductive state especially will be retarded by the necessity of starting the eddy currents.

The remarkable fact, that the condition $B = 0$ does not seem to be fulfilled in Meissner's experiments inside a hollow leaden tube may be brought into relation with my result (5). It seems highly probable that parts of the tube were not supraconductive; this allowed the lines of induction to pass (it may be remembered that at first only supraconductive 'needles' or 'blades' parallel to the field will be formed).

So it seems quite possible to complete, on the basis of Meissner's new results, my previous considerations, with the assumption that in the supraconductive state not only $E = 0$, but also $B = 0$. Though general agreement with the observed facts seems to exist, perhaps new difficulties may arise when theory and experiment are considered together more closely (especially if bodies of complicated shapes are considered). Perhaps the formation of supraconductive rings in the body might account for such complications.

I wish to express my thanks to Prof. Fokker, Prof. de Haas, Prof. Keesom and Dr. Casimir for valuable discussions.

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Nov. 22.

[1] *Archives du Musée Teyler*, 7, 378; 1933.
[2] Making use of Keesom and Kok's results on the discontinuity in the specific heat. *Comm. Leiden*, 221e; 1932.
[3] For example, W. J. de Haas and J. Voogd, *Comm. Leiden*, 212c and 214c; 1931. W. J. de Haas, *Leiziger Vorträge*, 59; 1933.
[4] *Naturwiss.*, 21, 787; 1933.

Distortion of the Tropopause due to Meridional Movements in the Sub-Stratosphere

In the neighbourhood of the equator, the height of the tropopause is about 17 gkm. and at latitude 70° N. about 10 gkm. The rate at which the height of the tropopause changes with latitude is, however, not uniform, the change being very rapid between 45° and 20° in winter, and between 50° and 30° in summer. The ring of cold air which collects near the tropopause over tropical latitudes will tend to spread out with a slight downward component towards higher latitudes. To compensate this movement, we may expect that there will be at lower levels a movement towards lower latitudes.

At the latitude of Agra (27° N.) in winter, the meridional variation of temperature is least at about 12 gkm., while at higher levels the temperature increases towards the pole and at lower levels towards the equator. The lower boundary of the spreading equatorial cold air will lie in the neighbourhood of 12 gkm. It is also known from pressure data that

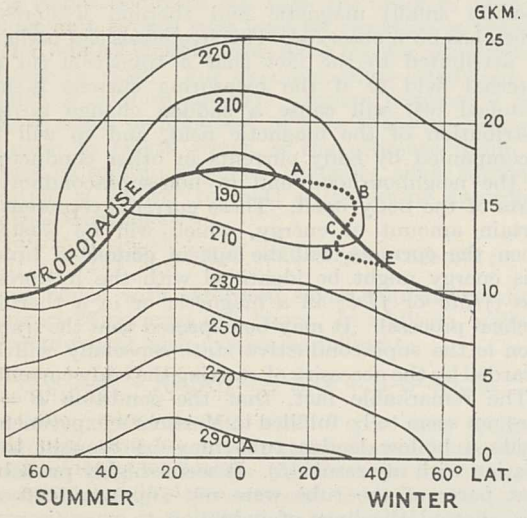

FIG. 1. Meridional distribution of temperature in the atmosphere over the northern hemisphere showing the tropopause and its distortion.

the westerly winds of the season in sub-tropical latitudes have their maximum strength at a height of 10–12 km. As an interesting consequence, it will follow that in the region of latitudes where there is a rapid variation of the height of the tropopause, it will often have a folded structure such as is represented by the dotted line in Fig. 1.

At Agra, in winter, the type of tropopause which occurs most frequently is one in which the transition from the troposphere to the stratosphere occurs in two stages, the lower one being at a height of 12–13 gkm., with the lapse-rate suddenly changing from a high to a low value, often reaching zero above the transition, and the second transition at a height of about 17 gkm., this being invariably an inversion. Immediately below the upper inversion, there is frequently a layer of positive lapse-rate with a mean value of 5° C. per km. of about 2 km. thickness.

This thermal structure is what one would expect if the lower transition corresponds to the tropopause of higher latitudes and the upper inversion transition to the tropopause of lower latitudes. Between these two, the air will be partly stratospheric air from higher latitudes and partly tropospheric air from lower latitudes. In summer, with the movement of the hump in the level of the tropopause towards higher latitudes, this folded structure of the tropopause is either absent at Agra, or if present, the difference of level between the transitions is very small.

At the latitude of Poona (18° N.), the double transitions are much less conspicuous than at Agra, though one can often notice them in winter and early summer. When present, the difference of level between the two transitions is smaller than at Agra, the lower one being at a height of about 14 gkm. and the upper at 16–17 gkm.

On the other hand, many of the temperature-height curves of places like Avalon (lat. 33° N.), Groesbeck (31° N.) and Fort Omaha (41° N.) in the United States[1] in summer show the double transition distinctly.

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[1] *Mon. Weather Rev.*, U.S.A., July 1914, May 1916, and June 1919; *Bulletin, Mount Weather Observatory*, 4, part 4, 1911.

An Ultracentrifugal Study of Crystalline Pepsin

We have examined in the ultracentrifuge crystalline pepsin, prepared by a method closely resembling that of Northrop[1], using both the velocity and the equilibrium methods[2]. The velocity method gave a sedimentation constant of $3{\cdot}3 \times 10^{-13}$, as a mean of seven determinations having an estimated standard deviation of $0{\cdot}15 \times 10^{-13}$. The equilibrium method gave a molecular weight of 35,500 as a mean of two determinations, the individual figures being 34,400 and 36,600. Comparison of the molecular weight with the sedimentation constant shows that the molecule is spherical. Although, owing to the small number of determinations, these figures are only provisional, they lead to the same conclusion as Northrop's osmotic and diffusion data, namely, that as regards molecular weight and shape, Northrop's crystalline pepsin belongs to the same class of proteins as ovalbumin, Bence Jones protein and insulin. This conclusion is independent of whether the peptic activity is a property of the protein molecule or of an active group adsorbed on its surface.

The ultracentrifuge also yielded information as to the homogeneity of the preparations studied. The figures quoted above were obtained from preparations the absorption of which at 250–290 mμ was almost entirely due to particles of a single size. Some well-crystallised preparations, however, even after thorough washing, contained appreciable quantities of other particles, some slightly smaller than the main group and some so small as to be non-centrifugible. The material with which we started (Parke-Davis pepsin 1 : 10,000) contained much of both types of impurity. This disappeared to a large extent in the first stage of purification (precipitation with magnesium sulphate) as was shown by the rise in the mean value of the sedimentation constant of the centrifugible part from $1{\cdot}7 \times 10^{-13}$ to $2{\cdot}5 \times 10^{-13}$, by the decrease in the non-centrifugible part and by the increase in sharpness of the sedimentation boundary. Using these criteria, it was found that

magnesium sulphate was a more selective precipitant than ammonium sulphate, and that its selectivity increased with dilution, doubtless owing to the greatly diminished yield of precipitate. The next two stages (precipitation with sulphuric acid and crystallisation by cooling from 45° C.) raised the sedimentation constant to $3{\cdot}0$–$3{\cdot}3 \times 10^{-13}$, and further improved the sharpness of the boundary.

The best two preparations studied appeared to be quite homogeneous. They were both obtained from crystals, one by precipitation by dialysis at 5° C., and the other by precipitation with magnesium sulphate and recrystallising at room temperature. A higher temperature was avoided since pepsin is slowly converted in solution to particles resembling, at least in size, those which it was desired to remove. The peptic activity of the recrystallised preparation was determined by the non-protein nitrogen method, using casein as substrate, and was found to equal that of Northrop's crystals.

In all the above experiments the *p*H was kept at 4–5 during centrifuging, by dilute acetate buffers; *N*/5 sodium chloride was added to suppress the Donnan effect. A few tests were also done to find the effect of other *p*H conditions. An exposure of ten minutes to normal hydrochloric acid, followed by two and a half hours with *N*/10 hydrochloric acid and *N*/10 sodium chloride, at a temperature rising to 36° C., only changed the mean sedimentation constant of the centrifugible part from $3{\cdot}3 \times 10^{-13}$ to $3{\cdot}2 \times 10^{-13}$, though it became less homogeneous and the absorption of light due to the non-centrifugible particles increased from 3 to 18 per cent. This suggests that a *p*H of a little above zero has no instantaneous effect on the molecular weight, but only produces slow acid hydrolysis. In this respect the pepsin protein is unique. An exposure of ten minutes to *p*H 9, followed by *p*H 3·6, caused, on the other hand, the formation of about 50 per cent of an aggregate having a sedimentation constant of about 12, while the rest became very inhomogeneous. The latter treatment corresponds to the instantaneous alkaline inactivation which Northrop[3] and others have shown to be partly reversible.

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Nov. 11.

[1] Northrop, *J. Gen. Physiol.*, **13**, 739; 1930.
[2] Compare, NATURE, **123**, 871, June 8, 1929. **127**, 438, March 21, 1931. **130**, 434, Sept. 17, 1932.
[3] Northrop, *J. Gen. Physiol.*, **14**, 713; 1931.

Rotation Period of the Planet Venus

ACCORDING to my observations, this planet seems to have a very slow rotation, round an axis almost perpendicular to the plane of the orbit. Thus, a dusky spot remained fixed with regard to the terminator for three or four hours on the same dates, as well as on the following days. The behaviour of other spots was analogous; and the interposition of Cytheræan cloud would occasionally render them invisible. The southern regions appeared persistently dusky, while a similar, though smaller, dusky area would, now and then, be seen near the north limb.

These real markings were revealed by the great light-gathering power of the 33-inch telescope, which shows faint half-tones beyond the reach of medium sized instruments; and they are radically different from the contrast effects seen by Schiaparelli, or from the spots described by others. The equatorial and temperate zones of Venus are more cloud-covered than latitudes beyond ±45°.

Cosmogonical speculation must naturally be considered with the most guarded diffidence. Yet these results seem to support the conclusions reached by Kirkwood in 1864; and as the tidal brake of the sun on the rotation of Venus is now only slightly more effective than the combined brakes of the moon and sun on the rotation of the earth, it seems probable that the rotation of Venus was originally retarded by solar action, when that planet was in a nebulous state, as so ably suggested by Sir George Darwin.

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Nov. 25.

Dynamics and Mechanism of Aliphatic Substitutions

A SHORT time ago we showed in conjunction with Dr. C. S. Patel[1] that the known facts concerning reactions of the type of the hydrolysis of ammonium cations ('Reaction *B*') could be accommodated by the assumption of a dual mechanism: the reaction could be either bimolecular (*B* 2), or unimolecular (*B* 1); for example:

$$\mathrm{Alk.NR_3^+ + OH^- \rightarrow Alk.OH + NR_3} \quad . \; . \quad (B\,2)$$

$$\left.\begin{array}{l}\mathrm{Alk.NR_3^+ \rightarrow Alk^+ + NR_3} \text{ followed by} \\ \mathrm{Alk^+ + OH^- \rightarrow Alk.OH} \text{ (instantaneous)}\end{array}\right\} \; . \quad (B\,1)$$

For a given organic cation, mechanism *B* 1 was expected to be favoured by a low nucleophilic activity in the reagent-anion, as for example towards the right-hand end of the anion series:

$$(B\,2) \; . \; . \; \mathrm{OEt^-, OH^-, OPh^-, OAc^-, Br^-} \; . \; . \; (B\,1)$$

On the other hand, for a given reagent-anion, mechanism *B* 1 should be favoured by constitutional changes in the organic cation, which confer upon the group 'Alk' a greater tendency to pass into the cationic state, for example changes corresponding to passage towards the right in the aralphyl series,

$$(B\,2) \; . \; . \; \mathrm{CH_3, CH_2Ph, CHPh_2, CPh_3} \quad . \; . \quad (B\,1)$$

or in the alphyl series,

$$(B\,2) \; . \; . \; \mathrm{CH_3, CH_2Me, CHMe_2, CMe_3} \quad . \; . \quad (B\,1)$$

At the time of our paper, very little direct dynamical evidence in support of these views was available, but we are now able to furnish dynamical observations relating to each of the three series mentioned above. First, concerning the anion series, we have found in conjunction with Mr. J. L. Gleave, that the anticipated change from bimolecular to unimolecular dynamics can be realised in the example of triethylsulphonium compounds[2]. Secondly, with reference to the aralphyl series, we have observed the required change of mechanism in the case of aralphyltrimethylammonium hydroxides[3]. Thirdly, in relation to the alphyl series, in which the previous indication was merely that methyl and *tert.*-butyl alcohols are more readily eliminated than primary and secondary alcohols from ammonium hydroxides, we are now able to show that, whereas methyl and ethyl alcohols are eliminated by a bimolecular mechanism, *tert.*-butyl alcohol is eliminated by a unimolecular mechanism, in the decomposition of trialphyl-sulphonium hydroxides.

In our theoretical paper we stated that the general dynamical relations which we then foresaw and have since confirmed, would apply not only to the decompositions of organic cations but also to the analogous reactions of neutral molecules; for example, the hydrolysis (reagent OH^-), alcoholysis (reagent $OAlk^-$), phenolysis (reagent OPh^-), aminolysis (reagent NR_3), etc., of alkyl halides. In hydrolysis, for example,

$$AlkCl + OH^- \rightarrow Alk.OH + Cl^- \quad . \quad . \quad . \quad . \quad (B\,2)$$

$$\left.\begin{array}{l} AlkCl \rightarrow Alk^+ + Cl^- \text{ followed by} \\ Alk^+ + OH^- \rightarrow Alk.OH \text{ (instantaneous)} \end{array}\right\} . \quad (B\,1)$$

the changes of mechanism, $B\,2 \rightarrow B\,1$, characteristic of the above aralphyl and alphyl series should again appear. That this is true for the aralphyl series has become clear from a comparison of Grant and Hinshelwood's recent work on ethyl chloride[4] with the earlier work of Ward[5] and of Norris and Morton[6] on benzhydryl chloride. Concerning the alphyl series, the indication that methyl and tertiary alkyl halides are more reactive than primary and secondary alkyl halides has long been available[7], and one of us has now proved that, in contrast to the bimolecular hydrolysis of ethyl chloride[8], the hydrolysis of *tert.*-butyl chloride is unimolecular, the velocity being the same in alkaline and in acid solution. In accordance with mechanism *B* 1, these experiments are regarded as measuring the velocity of ionisation of *tert.*-butyl chloride.

Other analogous reactions (phenolysis, aminolysis, etc.) are being examined, and in view of the interest attached to critical energies of ionisation, the attempt is being made to trace their dependence on the nature and existence of the solvent through study of such unimolecular reactions as have been illustrated.

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Nov. 20.

[1] *J. Chem. Soc.*, 526; 1933.
[2] Cf. von Halban, *Z. physikal. Chem.*, **67**, 129; 1909.
[3] *J. Chem. Soc.*, 69, 75; 1933.
[4] *ibid.*, 258; 1933.
[5] *ibid.*, 2285; 1927.
[6] *J. Amer. Chem. Soc.*, **50**, 1795; 1928.
[7] Compare especially Segaller's experiments on phenolysis, *J. Chem. Soc.*, **103**, 1154, 1421; 1913.
[8] Grant and Hinshelwood, *loc. cit.*

Biological Races in *Psyllia mali*, Schmidberger

THE apple-sucker, a serious pest of orchards, has long been known to breed on species of *Pyrus*, chiefly *P. malus*, and has been reported to occur on hawthorn, though definite record of its breeding on this plant is lacking. My observations on the biology of Scottish Psyllidæ (Hemiptera-Homoptera) have shown that in south-east Scotland *Psyllia mali* regularly breeds on various species of *Crutaegus* and is, in fact, identical with, and only a seasonal form of, *Psyllia peregrina*, Först, recorded from hawthorn. The nymphs of these insects on hawthorn, however, differ slightly from those of the apple-sucker, and this fact, coupled with their habit of being confined to different host genera, has been probably responsible for the two specific names under which they have been so far known.

Careful examination of adult psyllids from hawthorn and apple has shown them to be morphologically indistinguishable, except as regards inconstant differences of size, the hawthorn insect being often less robust than the apple one, so that the case for segregating them as two species disappears unless differences of host plants and immature stages (to a slight degree) may be considered sufficient criteria of specific separation. It is worthy of note, in this connexion, that Sulc[1] at least regarded *P. mali* and *P. peregrina* as synonymous. At the same time, these insects do not mate with each other, nor can they be induced to oviposit on each other's host plants. I have, therefore, felt justified in calling them two biological races of the apple-sucker: *P. mali* race *crataegi* bred on hawthorn and *P. mali* race *mali* bred on apple.

An interesting fact, in this connexion, is that while the hawthorn race is attacked by many Chalcidoid and Proctotrypoid parasites, the apple race is free from them. The only parasite common to both is a new species of *Endopsylla*[2] (Cecidomyidæ-Diptera) which oviposits on the wings of the adults, the larvæ burrowing into the abdomen of the host. The incidence of parasitism is much greater in the hawthorn race than in the apple-sucker. Fuller accounts of the question of biological races in *Psyllia mali* and of the biology of its Cecidomyid parasite will be published shortly.

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[1] Vide his synonymy of *P. mali*, cited by Speyer, W., in "Der Apfelblattsauger", 1929. Berlin.
[2] This species, which was reared by me, is being described by Dr. H. F. Barnes of the Rothamsted Experimental Station.

Quantity of Meteoric Accretion

IN ordinary circumstances, about three meteors are visible per hour at a given place. Such average meteors are visible at a distance of at least 100 km., and their mass seems to be in the neighbourhood of 6×10^{-3} gm.[1]. Thus the mass falling per hour on an area of order 3×10^{14} cm.^{2} is about 2×10^{-2} gm.; or 6×10^{-17} gm. per square centimetre. Taking the density as 3, we find that the rate of accumulation is 2×10^{-17} cm. thickness per hour or 2×10^{-5} cm. in 100 million years.

This result seems surprisingly small, but Lindemann and Dobson's result and the estimate of distance can scarcely be seriously out. It will be increased in the meteoric showers, but they do not occupy enough of the time more than to double the estimate. It follows that the amount of meteoric accumulation is so small as to be imperceptible even over periods comparable with the age of the earth.

As there are occasional published references to meteoric dust found in snow in the Alps and in polar regions, I have consulted a number of observers, who are all inclined to think that the dust found is of terrestrial origin and has been transported by wind. The smallness of meteoric accumulation would explain why the bright streaks on the moon, which are too shallow to cast a shadow, have failed to become buried and rendered invisible.

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[1] Lindemann and Dobson, *Proc. Roy. Soc.*, A, **102**, 419; 1922.

Research Items

Problems of Colour Vision. Colour vision and colour blindness are of much importance in connexion with signal and traffic lights and navigation, as well as being of general interest. Between the colour 'normal' and the actual colour-blind, many intermediate states exist, and a review of literature dealing with colour discrimination by Mr. W. O'D. Pierce has recently been issued by the Medical Research Council (Special Rep. Series, No. 181. London: H.M. Stationery Office). The Committee on the Physiology of Vision of this Council has also undertaken at the request of the Admiralty investigations on the subject which are now published in another report (Special Rep. Series, No. 185. London: H.M. Stationery Office). A surprising number of colour-sense defectives may be found even among men who have been selected after passing colour-vision tests now in general use, and in some of these cases the defect may be present in such degree as to impair efficiency. Thus, in harbour the colour of moving navigation lights may be correctly interpreted by colour-defectives by contrast with known fixed 'key' lights, while moving lights at sea are misnamed. Coloured lights of high intensity may be correctly named when the same lights of low intensity cannot be recognised. The red end of the spectrum may be visually shortened compared with the normal—a dangerous defect—and so on. The report lays down the requirements for an effective system of tests, and recommends those for the Navy, namely, the Ishihara card test first, followed by a lantern test, preferably with the Board of Trade lantern. No single test is infallible.

Stimulus to Colour Change in Fishes. The sensitiveness of response of colour-change in fishes to visual stimulus has been tested by Ellinor Helene Behre with coloured lights the wave-lengths of which were known (*Copeia*, 1933, p. 49). She has found that certain species of fishes can distinguish between lights of different wave-length and between these and daylight or complete darkness, and can record their perception by changing colours. Two species, at least, can record equally well when one eye is obscured, but no response occurs when both eyes are obscured. The six light filters used seemed to affect all fishes in much the same order. Daylight was the extreme darkening factor and absence of light the extreme fading factor. More particularly, the colours fall into line with minus blue, red, minus green, minus red, green and blue, leading towards complete absence of light as fading factors. Apparently the red end of the spectrum, or long wave-lengths, is responsible for darkening, and in combination the short wave-lengths counteract this effect.

Ecology of Japanese Stickleback. J. Kobayashi records observations (*J. Sci. Hiroshima Univ.*, ser. B., div. 1, vol. 2, 1933) on the ecology of a stickleback, *Pungitius sinensis* var. *kaibaræ*, which occurs in brooks. The coloration of the sexes becomes different when the fish are about 2·4 cm. long, about 80 or 90 days after hatching, and the fighting qualities of the male begin to appear about this time. As the spawning period is reached the male becomes dark bluish-black. Spawning occurs between late January and late June. In the shelter of aquatic plants the male makes the almost spherical nest, composed of pieces of soft material and mucus (secreted from the kidneys) and having at first two openings, one at the back and one in front, but finally only one—the front opening. When the nest is completed the male swims around a female, raising his spines and spreading his fins and oscillating his caudal fin, and endeavours to induce her to enter the nest and lay eggs. As soon as the female has left the nest by breaking through the back wall the male enters and deposits the milt on the eggs, and repeats this after each female has laid eggs. From three to ten females are so induced to lay eggs and then the male assumes protection of the eggs, which hatch about ten days after they have been laid. The fry issue from the nest ten days later, swim in shoals, and three days later leave the care of the male, who conceals himself in the aquatic plants, weakens and dies. Many of the females die after depositing two batches of eggs at intervals of 50 days, but some lay three times.

Observations on *Hydractinia*. Dr. P. L. Kramp (*Vidensk. Medd. Dansk. naturh. Foren.*, Bd. 94, 1933) records observations on the hydroid *Hydractinia echinata*. On examining large poles of fir used in building a new mole on the Skagerrak coast, he observed they had been more or less attacked by the shipworm (*Teredo*) and on several poles he found enormous colonies of *Hydractinia* which seemed to have played a part in stopping the attack of *Teredo*, for on removing the encrusting colonies he observed several small openings leading into short tubes bored by *Teredo*. These *Teredo* had met an early death because their connexion with the water had been cut off by the growing colonies of *Hydractinia*, and several small mussels (*Mytilus*) attached to the same poles were also more or less overgrown by the *Hydractinia*. In another place on the same coast where the perpendicular walls of the moles are covered with creosoted planks of beech-wood, Dr. Kramp found extensive areas covered with a carpet of *Hydractinia* separated from the wood by a thin layer of creosote. Wood when not covered in this way exudes creosote which is washed away, but where the carpet of *Hydractinia* was present it had prevented the escape of the creosote.

Genetical Classification of Roses. A paper in the *Gardeners' Chronicle* of November 4, 1933 ("Origin of Species in Rosa, Linn.", by Dr. C. C. Hirst, pp. 347–348) shows how recent advances in genetics can be used to clear up difficulties in the classification of roses. Of the tribe *Roseæ*, there are six genera, containing ten diploid species and possibly eighty-one polyploid species (that is, species with more than one contribution from each parent—3*n*, 4*n*, 5*n* chromosomes and so on, instead of the normal 2*n*). Of the possible eighty-one polyploids, only forty-one have so far been identified, but the author shows how a new pentaploid variety, which may be designated *ABCDD* and is apparently *Rosa farinosa*, Bech., appeared on Limepit Hill, in Cambridgeshire. Its parents must have been the pentaploid *R. Eglanteria* (*ABBCD*), pollinated by the tetraploid *R. mollis* (*CDDE*). The former produces female gametes *ABCD*, and the latter male gametes of constitution *D*, therefore giving the desired combination. The reciprocal cross would result in a sterile hybrid, but *R. farinosa* produces germ cells which are similar in constitution to those of its original parents, and

therefore breeds true from seed. It is, indeed, spreading quickly in the district under study, and bids fair to be a successful rival to *R. mollis*, its male parent.

Fungi Imperfecti. The presidential address of Mr. John Ramsbottom to the Quekett Microscopical Club deals with the "Fungi Imperfecti" (*J. Quekett Micro. Club*, Ser. 2, 16, No. 99, 261–276, Oct. 1933). Several ways in which the conidial stages of members of the Phycomycetes, Ascomycetes and Basidiomycetes can be classified as separate fungi are discussed. An ingenious suggestion is that many of the Fungi Imperfecti are mutants from one sex of certain heterothallic fungi, which cannot unite with mycelium of the opposite sex, owing to the mutation, and are therefore propagated only by vegetative means. Various systems of classification are described, including those of Saccardo, von Hoehnel and Vuillemin.

Structure of Timber in Relation to its Use. A paper of great interest to scientific users of timber has recently been published by Mr. F. W. Jane (*J. Quekett Micro. Club*, 16, No. 99, 277–300, Oct. 1933). The various ways in which medullary rays are found to occur in microscopic section are shown to have a very definite bearing upon the beauty of 'figuring' in the sawn timber. Parenchyma round the vessels can also account for figuring. Examination of a section under the microscope should make it possible to determine the best way of sawing to obtain the maximum beauty. Strength, resilience, uniformity of structure and other characters are all discussed from the point of view of microscopic structure. Special interest is attached to the presence or absence of thyloses in the wood vessels, in rendering a wood either porous or impermeable. Microscopic structure will not, of course, explain all the characters of a timber, but Mr. Jane's paper represents a definite contribution to the application of science to the art of wood-working.

Grass Treading and Grazing by Poultry. Up to the present, very little information has been available as to the capacity of different grasses to withstand the treading and grazing of poultry. Experience gained in management of pastures grazed by cattle, sheep and horses is not necessarily applicable to poultry runs, as in the latter case treading is of a different nature and also more intensive. Further, no rotational grazing is practised and the droppings are relatively rich in nitrogen, both of which are factors influencing the nature of the sward. Results of preliminary experiments, however, recently described by D. H. Robinson (*J. Minis. Agric.*, 4, 510), show that the state of the turf in poultry runs is of more importance than has hitherto been realised, for it seems to be associated with egg-laying capacity. In trial pens, set up at the National Institute of Poultry Husbandry, sown with single species of grasses, crested dogstail and the meadow poas gave the most satisfactory results, the rye grasses proving less persistent and fiorin quite unsuitable. As regards non-graminaceous plants, yarrow, or yarrow in conjunction with rib grass (plantain), seemed particularly promising. Interesting points of contrast arose if ducks or geese were kept in the place of hens. The peculiar flat tread of the duck brought about a complete destruction of the grass species in the turf, leaving broad-leaved plantain and mayweed as the dominant species, but on replacing the ducks by hens the plantain and mayweed disappeared and the grasses regained their dominant position. Geese also exerted an entirely characteristic effect on the turf, both on account of their specially vigorous grazing habits and also because of the different chemical composition of their excreta. Relationships suggestive of a correlation between the state of the turf and egg production, and between the type of feeding and the demands made by the poultry upon the grass were also obtained. The confirmation and extension of these results will be awaited with interest.

Extinct Waterways of the Fens. Certain raised banks of laminated silt which meander over the peat lands of the Fens have been identified by Major G. Fowler and called by him roddons. In a lecture to the Royal Geographical Society on November 13, he explained their formation and discussed the courses of some of these ancient waterways. Their present raised position is due to differential shrinkage or wastage as between the deposited silt of the stream and the deep peat through which it flowed. In some cases shell marl takes the place of silt. Another type is a deep and steep-sided channel in the clay which is filled with peat. The silt of many roddons contains marine or brackish water foraminifera which show that they were once tidal waterways. The roddon that marks the original course of the Little Ouse is shown to go back as far as Mesolithic times. The Fenland Research Committee has investigated the chronology of the fens in the area near King's Lynn. The floor of the Fenland basin there appears to be eroded Kimmeridge clay which was a land surface 60 ft. above sea-level in Mesolithic times. A later subsidence associated with the formation of the North Sea led to bad drainage and peat formation and afterwards brackish lagoons. Then after a deposition of silt a slight re-elevation or cessation of subsidence led to a second period of peat formation, and so on until four distinct peat beds had been formed, or further inland only two. Through these peat beds the old waterways can often be traced and so the ancient topography reconstructed.

Rainfall of the Dutch East Indies. In *Verhandelingen* No. 24 of the Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia, under the heading "Regenval in Nederlandsch-Indie", Prof. Dr. J. Boerema continues his account of the rainfall of the Dutch East Indies by a cartographical study of the mean rainfall over Borneo for each month of the year and for the whole year. The monthly distribution is shown by shading, with steps of 50 mm. up to 200 mm., and above that in steps of 100 mm., and the annual distribution by steps of 500 mm. to 3,000 mm., the interval then becoming 1,000 mm. These maps illustrate well the persistently wet climate of an island through which the equator passes almost centrally, and the large influence of elevation in condensing the moisture carried by the north-east and south-east trade winds, which here cross the equator in the winter and summer respectively of the northern hemisphere, but they do not bring out very clearly the different types of seasonal rainfall to which different parts of the island are subject: for example, it is not easily seen that a part of the island shares the Indian type of distribution and gets most rain from south-east trades that have crossed the equator and become the south-west monsoon. It is seen from the annual map that a part of the central region, lying slightly north of the equator, receives on an average more than 4,000 mm. of rain (London

receives about 600 mm.), and that it is only in the north that the figure falls below 1,500 mm. In judging of the extent of the service to climatology of studies of this kind, it is necessary to bear in mind the trying tropical conditions under which the work of maintaining uniformity of method of observation and of handling the accumulated material has always to be carried on.

Magnetisation by Rotation. In part 8 of the thirteenth volume of *Physica*, Prof. S. J. Barnett, of the University of California, gives an account of the various gyromagnetic effects and the experiments which have been carried out to detect and measure them. In the June issue of the *Proceedings of the American Academy* he describes his most recent experiments to detect the axial magnetisation of a rod of magnetic material, due to the rotation about its axis of a transverse magnetic field. The rods used were of compressed iron and permalloy dust 25 cm. long and 1·4 cm. in diameter with their axes running horizontally magnetic east and west. They were magnetised transversely by flat coils with their planes horizontal and vertical respectively, through which alternating currents in quadrature of frequencies 14,000 and 21,000 per sec. were sent and produced a rotating field of about 15 gauss. The axial field was measured by an astatic magnetometer, a rod being placed on each side of it. The results for both materials are about a fiftieth of those calculated on the supposition that the magnetic elements rotate with the field, and the author concludes that they do not rotate but have their moments periodically reversed by the rotating field.

Protection of Magnesium Alloys. The employment of magnesium alloys for engineering purposes is in many cases restricted on account of their liability to corrode and of the serious effects of corrosion on their mechanical properties. In particular it is found that localised corrosion may set up a pronounced notch effect, and this factor, in a group of materials already markedly susceptible to stress-concentration effects, has naturally hampered their development where corrosive conditions have to be met. The problem has recently been attacked by the development of protective films as bases for the usual painting processes, and several methods of producing such films by chemical immersion have been devised. Owing to the high reactivity of magnesium, it is comparatively easy to produce films on these alloys, but it has required much patient investigation to arrive at really successful processes. In a paper read before the Institution of Chemical Engineers on December 8, Bengough and Whitby described the successful application of their selenium process for the protection of magnesium alloys against marine corrosion. Specimens were immersed for 5–15 minutes in a solution containing 10 per cent selenious acid and 0·5 per cent sodium chloride, at ordinary temperature, and were then subjected to four months' exposure to sea-water spray, applied thrice daily, without suffering appreciable attack. The success of the process is attributed largely to the self-healing properties of the film, which are thought to depend upon the following reactions. The magnesium surface becomes coated with a thin layer of magnesium selenide, which is decomposed by water penetrating through pores in the selenium layer. The hydrogen selenide thus formed reacts with oxygen to give selenium, which seals the pores through which the water penetrated.

Structure of Glasses. In an extension of their previous work, J. T. Randall and H. P. Rooksby have described (*J. Soc. Glass Technology*, September) experiments on the diffraction of X-rays by vitreous bodies (NATURE, 130, 473 ; 1932), including cadmium pyrophosphate, selenium, lithium metaborate, antimony and bismuth sesquioxides, lead metasilicate and a number of common glasses. In agreement with the previous work, it is concluded that the diffraction bands can, in general, be explained on the basis of the idea of minute crystals or groups of atoms regularly arranged over very small volumes in the glassy solid. In more complex commercial glasses, the regular groups of atoms may not be so definite in composition or size as in the case of the simpler glasses. The complex glasses might, from the results, be either assemblages of SiO_4 groups joined and cemented together by the large Na and Ca ions, or mixtures of silicates such as $CaSiO_3$ and $Na_2Si_2O_5$. Although crystals of, for example, $CaSiO_3$, separate on annealing, it does not follow that these silicates are present as such before devitrification commences, since at temperatures near the annealing range, motion of ions such as Na and Ca may occur so as to destroy existing complexes and form new ones. The general question of the state of affairs favourable for the formation of a glass is considered, and it is suggested that the probability of the formation of a glass is high for those substances in the normal crystalline forms of which the forces binding the atoms together are either strongly directional or localised in character. The authors point out that the average widths of X-ray diffraction bands for liquids are about the same as those of the glasses, and hence conclude that similar groups of atoms or molecules are present. A suggested mechanism for the fusion of solids is sketched in the paper.

Chemistry of Tobacco Curing. The importance of the chemical changes which occur in the tobacco leaf during the process of curing has led to a detailed investigation by H. B. Vickery, G. W. Pucher, A. J. Wakeman, and C. S. Leavenworth (Carnegie Institution of Washington, Publication 445). Tobacco leaves from one picking were either subjected to the curing process or placed with their bases in distilled water, random samples being selected for chemical analyses at frequent intervals. The changes in water and solids and various leaf constituents, the distribution of nitrogen, the synthesis of nitrate and various other factors were examined in both sets of leaves. Generally speaking, the reactions in both cases were very similar, but there was a marked difference in the time relationships, as most processes were hastened in the cured leaves compared with those in which turgor had been maintained as long as possible. Full comparisons of results were made and inferences drawn from the slope of the graph curves with regard to the chemical reactions that proceed in intact tobacco leaves. Loss of organic solids due to the formation of volatile products is a continuous process, but apparently reducing carbohydrates play a relatively small part in the reaction. Digestion of protein to amino acids occurs slowly in cured leaves, as the full efficiency of the protein-digesting mechanism is not called into play under these conditions. The relevant data are set out in tabular form, and details are given as to methods used in the work for the determination of carbohydrates in tobacco leaf extracts.

Condensation of Water in the Atmosphere

AT the meeting of the British Association in Leicester a number of papers were read on September 12 in Section A† (Department of Cosmical Physics) relating to different aspects of the problem of condensation of water in the atmosphere. Dr. G. C. Simpson, in his opening remarks, dealt mainly with the question of the size-distribution of droplets in cloud, fog and rain. A number of workers, notably Defant, Köhler and Niederdorfer, claim to have shown that the volume of droplets in the atmosphere are most frequently integral multiples of some standard minimum size. Köhler also states that the chloride concentrations of samples of cloud or rain water are all integral multiples of the smallest concentration ever found in such water.

If this is true, then first, the original nuclei must all have masses related to one another in the same series as the final drops; secondly, after the drops reach a certain specified size, condensation on them ceases and thereafter they may only grow by collision; thirdly, only drops of the same size may unite; and fourthly, only drops with the same salt concentration may unite. It is obviously difficult to see how all these conditions can be satisfied simultaneously and on all occasions, though mechanisms have been suggested to account for some of the processes involved. For example, Schmidt has explained the tendency for drops of the same size to unite by the fact that they would fall through the air at the same rate. Two equal drops may therefore find themselves side by side for a sufficient time for the hydrodynamic attraction between them to result in their union. It should be noted, however, that the different experiments do not agree as to the fundamental size from which it is supposed the bigger drops are built up; and that there is an element of doubt in the physical interpretation of the statistical analysis of the data. In these circumstances, the final conclusions should be regarded as suspect, until further information is available.

Mr. H. L. Green dealt with the problem of measuring the size and number of particles in the atmosphere. Both the size and number may vary over enormous ranges; the size from 10^{-8} cm. in the case of ions to 10^{-3} cm. in the case of gross atmospheric pollution particles; and the number from one or two per cubic centimetre in certain mists to several millions per cubic centimetre in some smokes. Further, the particles may be solid or liquid. It is not surprising therefore that many different methods of measurement have been developed to deal with different parts of the range and that few are efficient except for the job for which they were designed. For example, the Owens jet dust counter has an efficiency of more than 80 per cent for atmospheric pollution particles between 10^{-5} cm. and 10^{-4} cm. radius, but it only counts about 40 per cent of mineral dust particles of radius between 10^{-4} cm. and 10^{-3} cm. On the other hand, the circular konimeter and the Greenburg-Smith impinger is more efficient for dust than for ordinary atmospheric pollution.

Workers have been handicapped by the absence of means for testing the efficiencies of their instruments, but with the advent of the ultramicroscope and sedimentation methods, this difficulty should disappear. One would like to know how reliable were the various methods used for measuring the droplets discussed by Dr. Simpson.

Some experiments were described by Prof. J. J. Nolan showing the behaviour of a drop of water in an intense electric field, such as exists in a thunder cloud. The drop becomes pulled out and, at a certain value of the field, begins to discharge, the ions produced attaching themselves to nuclei (if any are present), thus becoming large. The critical field is given by $F\sqrt{r}=3600$ (F, the field, in volts/cm., and r the radius). A similar law has been found for bubbles. In pure air, free from nuclei, no large ions are detectable, even if the field is made so intense that the drop is broken up. It therefore seems that the low mobility ions required by C. T. R. Wilson's theory of thunderstorm electrification are not directly produced by discharge from raindrops.

Meteorologists, both in Germany and England, have found that when a hair hydrograph is sent up into the air, the hair frequently elongates beyond the 100 per cent relative humidity mark. One has been reluctant to infer from this that the atmosphere was, on these occasions, supersaturated, particularly as the phenomenon often occurs inside a cloud. Mr. L. H. G. Dines reported to the meeting many cases of this apparent supersaturation, many of them occurring above the freezing point. Further, he has observed a small momentary superelongation of a hair in the laboratory, when it was subjected to (presumed) supersaturation in a type of Wilson expansion chamber. It is therefore becoming increasingly difficult to explain the experimental results in any other way than by supersaturation.

An occasion of apparent supercooling (as implied by a temperature record) seems to support the view that the atmosphere can be so clean as to permit both supercooling and supersaturation; but, as Dr. Simpson pointed out, we know so little about the behaviour of a hair in varying circumstances, and, in the case of the temperature record, it is so difficult to believe that supercooled water could have existed on the thermograph, that we must await further evidence before making up our minds definitely on this point. M. G. B.

New Science Laboratories at Bedford School

THE new science laboratories at Bedford School, which were visited by the Prince of Wales on November 8, were designed by Mr. Oswald P. Milne, who is an old boy of the school. A detailed account of the architectural features of the building is given in the *Architect and Building News* for November 17.

The Physics Department is on the ground floor and consists of a senior laboratory (28 ft. × 25 ft.), two junior laboratories (44 ft. × 24 ft.), two lecture rooms (25 ft. × 25 ft.), dark room, electrical control room, preparation room, book room and offices. The corridors run approximately magnetic north and south. The laboratories have been designed so that all students' tables may be moved into any desired position. This has been made possible by fitting a shelf about a foot wide at table height all round the room except where there are store cupboards, sinks, or doors. All pipes, cables, etc., are fitted below the

shelf, the underneath shelf space being available for cupboards, which are fitted at the front with sliding doors. Gas taps, and terminal and plug boxes are fixed above the shelf, and balances may be accommodated at suitable intervals along it.

Above the shelf, and mounted rigidly at about six inches from the walls, there are horizontal rigid bars mounted at suitable heights. These are provided with slots and holes so that drawing boards, pulleys, pendulums, etc., may be mounted on bars for experimental work in mechanics.

Two large sinks are fitted in each laboratory and are provided with draining boards, draining pegs, burette and pipette racks, and hot and cold water. The space below the draining boards is made up into racks for drawing boards.

The junior laboratories are each fitted with a demonstration table provided with hot and cold water, gas and electricity (A.C. and D.C. at various voltages).

All lecture rooms and laboratories are fitted with a screen, lantern plugs, dark blinds and demonstration tables. A bell push underneath the demonstration table establishes communication with the preparation room. A service lift works between this preparation room and the one above.

The electrical control room contains a motor-generator set, working off the local A.C. power supply, a bank of large accumulators and a rectifier. Various D.C. voltages (high and low) are distributed to students' benches and demonstration tables from a system of bus bars in the control room. Each circuit is provided with automatic overload trip switches. Each bench and table is also supplied with A.C. at 6 and 12 volts obtained from transformers in each laboratory. A plug is provided on each bench and table for connecting to the A.C. lighting supply. The motor-generator set also provides the current for the sound motion-picture apparatus in the Great Hall of the School.

On the upper chemistry floor there are three laboratories, two large and a smaller one for more advanced work. These correspond in size with those on the ground floor. Each of them possesses large fume cupboards, the draft being produced by electric fans; a generous supply of cupboards with glass doors fitted with an excellent arrangement of adjustable shelving; modern devices for supplying both hot and distilled water, and a battery of hot water ovens. Owing to the more than usually large window space, the laboratories are bright by day, and the electric lighting by night is all that can be desired.

In addition to the three laboratories there are two lecture theatres, both fitted with demonstration benches, shelving, and cupboards for chemicals and apparatus. The larger of these theatres seats 150 people. This room can be darkened very efficiently and quickly; and as it possesses an epidiascope and lantern, it lends itself to purposes other than chemical. Hidden behind a large blackboard, the surface of which, as in the other rooms in this building, is glass, there is a large bench. This room is ventilated by a separate system of fans. Leading to the large lecture theatre is the preparation room. All the benches in the three laboratories are supplied with electricity, in addition to the usual water and gas.

An outside staircase gives access to the upper floor from the outside. The hot water system is provided with a pump to accelerate the circulation. There are two electrically worked clocks, one outside and the other on the inside of the building.

Between the ceiling of the upper floor and the roof of the building, a store room, reached by a ladder, runs the whole length of the building. This plan much relieves the pressure on the smaller store rooms situated on the chemistry and physics floors themselves.

Fishery Research in Newfoundland

THE annual report for 1932 of the Newfoundland Fishery Research Commission (vol. 2, No. 1, 1933) is now published. A large part is concerned with technical investigations, but in addition there are the results of the hydrographical and biological work, including important researches on fishes and plankton. Much has been done to advance the dried-cod industry and work on the artificial drying of cod and squid and on fish meal production has progressed. The cod liver oil investigations, however, are perhaps the most interesting and it is shown that the younger the fish the less colour there is in the oil, the liver from the young fishes giving an almost colourless oil, that from the old fishes being a deep red or yellow. The depth of colour seems to go with the abundance of vitamin A, so the richly pigmented dark oil is the strongest in vitamin content (see also NATURE of July 1, p. 26).

Considerable progress has been made in correlating the movements of cod and salmon with changing conditions of temperature. The year 1932 was superior for the fisheries to 1931, owing to the greater influx of arctic waters in the Newfoundland area, with simultaneously a stronger and opposite influx of salter water from the Atlantic occurring in the deeper water layer over the Banks. These two strong inflows of water of opposite types, in opposite directions, led to the production of a large body of mixed water (Bank Water) suitable for the multiplication of marine forms of life, so that the season on the Banks and on the coasts sharing Bank conditions was a good one for the fishery. The plankton investigations clearly show much richer hauls in 1932 than in 1931, the general average ratio being 2 : 1 in favour of 1932.

Special groups were worked up in detail, notably the Copelata (*Oikopleura* and *Fritillaria*), and maps of the distribution made. This group shows a preponderance of arctic and cold-temperature (arctic and boreo-arctic) forms in 1932 and of boreal (warm-temperate) forms in 1931. There was no evidence that cod-fry and haddock-fry were more plentiful in 1932; rather the reverse was the case. The richness of the plankton in 1932 is correlated with the abundance of squid, *Illex illecebrosa*, inshore which were full of food, whilst in 1931 far more were feeding in the deep waters outside. These squid probably approach the Banks and Newfoundland coast in the deeper water layers along with the influx of comparatively warm saline Atlantic water. Dr. Harold Thompson (director) and his staff are to be congratulated on the amount of good work done in so short a time.

Annual Congress of the British Institute of Radiology

THE annual congress of the British Institute of Radiology and an exhibition of X-ray apparatus were held at the Central Hall, Westminster, on December 6–8.

Although the apparatus shown was mainly of the type used in medical work, either for diagnosis or treatment, a number of exhibits were of general scientific interest. Nearly all the X-ray tubes shown were of types which not only carry their own protection against stray X-rays, but also are so constructed as to eliminate the danger of electric shock. In certain cases earthed metal sleeves are made integral with the tubes, whilst in other cases sleeves of insulating material with earthed metal coatings are employed for this purpose.

A new high-voltage tube, exhibited for the first time, has, in addition to the normal anode and cathode, a third open electrode corresponding somewhat to the grid of a triode. This grid, which is given a definite potential with respect to the filament, tends to suppress the tube current except at the peak of the voltage wave, and thus considerably increases the efficiency of the tube when operated by pulsating voltages. The output of an ordinary two-electrode tube excited by constant voltage is about twice as great as that of the same tube when operated by a pulsating voltage under similar conditions of peak voltage and tube current, but it is claimed that the three-electrode tube gives the same output under pulsating voltage excitation as a normal tube of similar type under corresponding constant voltage excitation.

Among high-tension rectifying valves was one of the mercury vapour type having an impregnated filament consuming only seven watts. This valve, which is capable of suppressing an inverse voltage of 120 k.v., comprises several low voltage elements in series, electrical balance being maintained by the use of small condensers integral with the valve. The most important property of the new valve is that it can pass high currents (up to 1 ampere or more) with a voltage drop of only about 40 volts, the voltage drop being practically independent of the current.

Another interesting exhibit was a high-tension voltmeter for the measurement of peak voltages up to about 250 k.v., comprising a potential divider so arranged that a convenient small fraction of the total voltage can be rectified and caused to charge up a condenser. The voltage across this condenser is measured by means of an electrostatic voltmeter of the normal low-voltage type.

High-frequency diathermy for both medical and surgical work has been in use for some time but a development of this form of high-frequency treatment using electric currents at frequencies corresponding to wave-lengths of 30 metres and less was shown for the first time. Owing to the very high frequency, it is sufficient to apply the current by insulated electrodes, which together with the intervening tissue, constitute a condenser. The heating effect in the tissue treated, which behaves like a dielectric with very high losses, is considerable, and temperatures up to 120° F. are very easily obtained. It is also claimed that this form of treatment is very satisfactory for septic conditions. Apart from the heating effect, it is claimed that very high-frequency currents, corresponding to wave-lengths of 3–12 metres, have a marked effect on tissue, some workers holding that they break up malignant cells.

For his Silvanus Thompson Memorial lecture, Dr. A. Bouwers took as his subject "Modern X-ray Developments". He discussed the possible applications of X-rays generated at very high voltages to the treatment of malignant disease, with special reference to the design of suitable generators, and made passing reference to the possibility of generating and using neutrons in medical work. In connexion with diagnostic radiology, he showed a complete X-ray generator in the shape of a cylinder, only a few inches long and a few inches in diameter, which incorporated a high-tension transformer developing 43 k.v., an X-ray tube and a time switch.

Among the physical and technical papers read at the Congress were contributions dealing with ionisation by high-voltage X-rays and gamma rays, with a new type of X-ray tube and new types of generators.

W. V. Mayneord and J. E. Roberts described experiments dealing with the measurement of high-voltage X-rays and gamma rays in rontgens, showing especially the difficulties encountered in making suitable ionisation chambers free from serious errors. The results of this work seem to show that the gamma ray dose per milligram hour at a distance of 1 cm. from a radium source is about 8·7 rontgens.

T. E. Allibone and his collaborators described a high-tension generator with demountable rectifiers designed for operating a demountable X-ray tube. The equipment, which has been in use for some time in X-ray treatment work at a hospital, employs oil vapour diffusion pumps, which are so interlocked with the various electrical circuits that the process of evacuation is entirely automatic. The various vacuum joints are made by means of flanges ground and lapped so as to be flat to within three or four wave-lengths of sodium light. The X-ray tube is of a type having its anode at earth potential, so that highly efficient cooling may be effected by making use of water from the high pressure mains. Since the cooling of the anode is good, a gold target is used in preference to the customary tungsten target. Adequate protection against stray radiation is afforded by lead sheet about 4 mm. thick applied to the anode end of the tube except for the necessary window to afford egress for the X-rays.

G. C. Osment gave an account of a method of obtaining high voltage of 400 k.v. and above by means of a cascade arrangement of rectifiers and condensers somewhat similar to that employed by Cockcroft and Walton, of the Cavendish Laboratory, Cambridge. The equipment makes use of the mercury vapour valves already mentioned, so that the loss in output voltage due to voltage drop in the rectifiers is very small. Current for heating the filaments of the valves is provided by small generators driven by a suitable motor through an insulating drive. A generator of this type is very compact, one giving 600 k.v. only occupying a floor space of about 8 ft. × 3 ft., and having a height of about 8 ft.

L. Levy and his collaborators gave an account of some of the difficulties encountered in making fluorazure (zinc sulphide) intensifying screens for radiography. Earlier screens of the type exhibited marked afterglow and also a form of latent 'afterglow' which manifested itself as an increase of sensitivity of the screen after exposure to X-rays. By employing suitable technique, these difficulties are stated to have been overcome.

Minerals Causing Silicosis

PRACTICALLY all types of dust fibrosis of the lungs are now known to be manifestations of the presence of silicon, though in the older textbooks several forms of pneumoconiosis are described according to the different dusts which were supposed to have produced them. Usually the element is present in the form of the oxide silica, and it is generally held that, with the exception of the silicate asbestos, the more complex compounds of silicon are incapable of producing the disease.

There is evidence that this view of the question is perhaps too limited, and in a recent paper Dr. W. R. Jones ("Silicotic Lungs: The Minerals they Contain", *J. Hygiene*, 33, No. 3, 307; 1933) even goes so far as to suggest that a silicate, sericite, plays a far greater part in the production of silicosis than silica itself. He finds that in the rocks and materials exploited in the industries in which silicosis is a recognised hazard, silica is combined with a fibrous silicate, sericite, the hydrous silicate of aluminium and potassium. On the other hand, there is no sericite in the gold-bearing quartz of the Kolar goldfield, India, or in the sandstone of certain Scottish collieries, and in these mines silicosis is said not to occur.

Further, Dr. Jones finds that the bulk of the mineral residue obtained from silicotic lungs consists of sericite; quartz particles also occur in these lungs, but they are nothing like so numerous as the minute sericite particles. There would seem to be no doubt that quartz is capable of producing fibrosis of the lungs—recent experimental work alone shows this—but Dr. Jones suggests that in the majority of cases sericite plays by far the more important part.

In South Africa, where Dr. Jones has recently described his theory, his views may perhaps have only academic interest; but in Great Britain, where industrial conditions are more complex, they may, if substantiated, be of great practical importance, and it is clear that they must receive serious consideration.

University and Educational Intelligence

CAMBRIDGE.—H. E. Tunnicliffe, of Gonville and Caius College, has been elected University lecturer and G. A. Millikan University demonstrator in the Department of Physiology.

The General Board recommends that there shall be established a Shield readership of pharmacology, the stipend of which shall be £1,100 a year.

The Managers of the Benn W. Levy Fund have appointed J. Yudkin, Hackney Downs School and Christ's College, to the studentship for research in biochemistry.

C. H. Waddington, of Sidney Sussex College, has been elected to a research fellowship at Christ's College.

LONDON.—The Middlesex County Council has made a building grant of £100,000, payable over ten years, to the University towards the cost of erecting new University buildings on the Bloomsbury site. The grant is subject to certain conditions, one of which is that the new building for the University Central Library shall be associated with the name of the County of Middlesex. Grants have also been made by three more of the City Companies, namely, the Cordwainers, the Innholders and the Farriers, towards the Hall.

OXFORD.—At his installation as Chancellor of the University on December 7, Lord Irwin took occasion to recall the eminence of his predecessor, Lord Grey of Falloden, as a field naturalist. With an apposite adaptation of a line from the Odyssey, the Chancellor went on to say that Lord Grey's intimate knowledge of the habits, movements and song of beasts, fishes and birds respectively, suggested that Nature herself had inspired him with the quintessence of her own wisdom.

In the annual report, just issued, of the Curators of the Bodleian Library, mention is made of the approaching completion of the extension of the Science Library. The new building will ultimately provide 120 additional seats for readers. More space is available for the storage of scientific books than will be required for some years; and meanwhile the building will be able to accommodate temporarily the overflow from other parts of the Library.

THE annual meeting of the Mathematical Association will be held at the Institute of Education, Southampton Row, London, W.C.1, on January 4–5, under the presidency of Prof. G. N. Watson. On January 4, Prof. Watson will deliver the presidential address, entitled "Scraps from some Mathematical Notebooks". On January 5 a discussion on "Mathematics in Central Schools" will be opened by Mr. G. T. Clark and one on "Teaching of Differentials" by Prof. G. Temple. Further information can be obtained from Mr. C. Pendlebury, 39 Burlington Road, Chiswick, London, W.4.

EDUCATIONAL films stand to gain largely in the volume and extent of their influence through the results of a conference held on the invitation of the League of Nations at Geneva on October 5–11, 1933, for facilitating the international circulation of films of an educational character. A convention was drawn up providing for the exemption from Customs duties of films having "eminently international educational aims". In the machinery prescribed for giving effect to the convention, an important rôle is to be played by the International Educational Cinematographic Institute, represented at the conference by its director, Dr. Luciano de Feo. Every film (including 'talkies') for which exemption from customs duties is to be claimed, will have to be submitted for certification to the Institute, although the actual grant of exemption will be accorded in each case by the competent national authority. The Institute will publish catalogues of certificated films and the parties to the convention will encourage the circulation of the catalogues. The convention has already been signed by plenipotentiaries on behalf of Great Britain, India, Italy and seven other countries. The conference further recommended the reduction or abolition of charges for the transport of such films and the extension of Customs facilities to the posters advertising them. It is noteworthy that the preamble to the convention specifies the "encouragement of moral disarmament" as a principal benefit to be looked for as the result of its operation.

Calendar of Nature Topics

Daylight and Animal Activity

The significance for the activities of animals of the reduction of daylight during the winter months is indicated by the experiments carried out at Harper Adams Agricultural College in connexion with the artificial lighting of poultry. Artificial lighting to control egg production is not a common practice in Great Britain, although it is recognised that scarcity and dearness of eggs throughout the year correspond generally with the falling off of natural daylight. When this is supplemented by artificial light, arranged so that morning and evening lighting is extended to make a uniform 12- or 14-hour day throughout the winter, food consumption and egg-laying both show a marked increase (Bull. No. 6, National Institute of Poultry Husbandry, 1931). In an uncontrolled pen, food consumption reached its lowest during December; in a lighted pen the amount consumed remained much more uniform throughout the year, and each bird used about 4 lb. more in 48 weeks. The final results show that, allowing for the additional cost of food and lighting, a reasonable profit may be made by thus artificially stimulating metabolism, since lighting causes increased winter production when eggs are dear. For the winter months, the 120 pullets under lights laid 950 more eggs than an equal number of pullets without lights, and for 48 weeks the lighted pen yielded 1,086 more eggs. The price received per dozen was 17·34*d.*, the food cost per dozen 5·26*d.*, the margin per dozen 12·08*d.*, and the margin of profit over food and lighting costs per dozen was 11·58*d.*

American Ducks in Europe

Winter wildfowling has revealed many records of rare species, notably the occurrences in British and Continental waters of typical North American duck otherwise difficult to obtain. The first European record of the American hooded merganser (*Lophodites*, or *Mergus*, *cucullatus*) was an immature female shot at Yarmouth in the winter of 1829 (Selby, *Trans. Nat. Hist. Northumb.*, 1, 292); others were afterwards recorded in the Menai Straits, off Sussex, Suffolk, Caithness, Co. Meath, Sheerness, etc., but no record appears to have been made on the Continent.

The American widgeon (*Mareca americana*) was first recorded in Britain by Blyth (*Naturalist*, 111, 417) from a male bought in Leadenhall Market, London, in 1837–38, but a male bird in the British Museum was shot in the Outer Hebrides in 1807. The species breeds from Alaska east to the Hudson, migrating in autumn as far south as the West Indies, Central America and Mexico. The North American surf scoter (*Œdemia perspicillata*) has occurred off the Irish coast and the western coasts of England and Scotland, more frequently in the Orkneys and very exceptionally off the east and south coasts of England, though a pair were seen off Southend Pier about 1880. Martin (*Naturalist*, 83, 1853) recorded the surf scoter from the Firth of Forth in 1852, though the first record has been mentioned as 1838. Donovan recorded the buffel-headed duck (*Bucephalus albeola*) in Britain in 1819; others have been noted from Yorkshire, Aberdeenshire, Orkney, Yarmouth and Norfolk. The harlequin duck (*Histrionicus histrionicus*), a North American nester, resident in Iceland but almost unknown elsewhere in Europe, was first recorded by Montagu (1802) from the Isle of Lewes. Several records have since been proved of other species, and a drake was shot at Crossens, Lancashire, so recently as 1916 (Check List, Lancs. and Cheshire Fauna Committee, 1930).

Salmon Spawning in Progress

In the tributaries and small streams which feed the salmon rivers of the British Isles, spawning is now actively taking place and will continue until about mid-January. What determines the salmon's choice of a spawning stream has not been discovered, but the oxygen content of the water seems to be one factor, and others certainly are the presence of a suitable current and suitable gravel in which the eggs may be laid, fertilised and concealed. It is generally supposed that the spawning adults are always fish returned from a sojourn in the sea, about four or five years old, but recent evidence from Ireland suggests that sometimes salmon may spawn before they go to the sea. In the Shannon, R. Southern, while investigating the age and growth of parr and smolts, found that a number of large male salmon parr had enlarged testes, and a number of these had upon their scales the marks of wear and tear which indicate that they had passed through a spawning season (*Field*, June 10, 1933, p. 1336).

Most of the salmon smolts in the Shannon make for the sea after one or two years in fresh water, so that parr like the Killaloe specimen, 10·4 inches long, four years old, with two spawning marks on its scales, must be very rare. But precocious male salmon with fully developed testes are common in the Liffey, and one of these, 5·8 inches long, had one full spawning mark and traces of the formation of another, at the end of its third year. The milt from such individuals has been found to be capable of fertilising salmon ova, and it now remains to observe and record the natural process in respect of these precocious males.

Lime and Grassland

Liming is a winter job and will now be in progress on numerous farms. On grassland, the effects are in general slower and less spectacular than they are on arable land. In fact, at the outset, the result of liming pasture is often more apparent to the live-stock than it is to the farmer. Thomas Hale, in the "Compleat Body of Husbandry" (1758), says: "The first year I used chalk on my pasture grounds I was afraid I had thrown away my labour. . . . I perceived that the grass was not a whit the taller or fuller for it and therefore I thought it did no good, but I soon found from my cattle and in my dairy that chalk gives a body or richness and sweetness to the grass though it does not increase the quantity." This effect, well known to graziers on lime deficient soils, is no doubt associated with the increased calcium content of the herbage and the gradual incursion of clovers that enrich the grazing both in protein and in lime.

Farmers of the early days had little guide apart from local observation whether lime was needed for their soils, and disappointment must have been frequent. The matter is now on a more precise footing, thanks to laboratory methods for determining the quantity and intensity of acidity. In the case of grassland, such methods assist in deciding if the basic phosphates usually applied will suffice to improve the herbage or whether the greater expense associated with liming must be undertaken.

Societies and Academies

LONDON

Physical Society, November 3. MARY D. WALLER: Vibrating properties of metals at different temperatures. Since the damping of the vibrations is mainly due to internal friction or solid viscosity, it is greatly altered either by previous heat or mechanical treatment and by impurities. On account of the large variations of the vibrating properties with temperature, it will be possible to obtain, by observation of irregularities in these variations, much interesting information regarding the state of metals and alloys at different temperatures. MARY D. WALLER: Production of sounds from heated metals by contact with ice and other substances. The conditions are described under which soft notes may be produced from heated metal bars brought into contact with ice and a number of other substances. These substances must either sublime or boil or decompose with the evolution of gas, at temperatures for which the metal to be excited still retains adequate vibrating properties. P. C. MAHANTI: The band spectrum of barium oxide. New measurements of the bands of barium oxide have been made from moderate-dispersion and high-dispersion spectrograms. The band-head data of the early investigations have been extended in the red region as far as λ 8000. The bands lying between λ 8000 and λ 4300 have been assigned to a single system. F. W. G. WHITE: Diurnal variation of the intensity of wireless waves reflected from the ionosphere. An account is given of the diurnal variation of the relative intensity of waves returned from the ionised regions of the upper atmosphere as observed over the early morning period from about 2 a.m. until about 9 a.m. The relative intensity is taken as the ratio of the intensity of the downcoming wave to that of the ground wave. The influence on the intensity of electron-limitation and of absorption limitation is discussed, in the light of theoretical ionisation curves given by Chapman. The experimental observations described show that the magneto-ionic doubling of the echo, which has been observed by Appleton and Builder for the *F* region, occurs also for the *E* region. J. A. RATCLIFFE and E. L. C. WHITE: Automatic records of wireless waves reflected from the ionosphere. The records extend over a period of fourteen months. They indicate that the region below the *F* region may be triply stratified and consist of the intermediate region (effective height approximately 120–180 km.), the *E* region (effective height approximately 100–120 km.), and the *e* region with an effective height which is always nearly 105 km., within ± 5 km. The *e* region is intermittent in its occurrence, and is identified with the 'nocturnal *E* region' mentioned in previous papers. The temporal variations of the ionisation in these three regions is discussed.

PARIS

Academy of Sciences, October 30 (*C.R.*, **197**, 953–1008). The president announced the deaths of Paul Painlevé and Albert Calmette. E. MATHIAS: The reality of the remains of spherical lightning. Proofs that spherical lightning leaves behind a material body, possessing form, volume and mass. E. J. GUMBEL: The smallest value amongst the greatest and the greatest value amongst the smallest. J. SCHREIER and S. ULAM: The continued transformations of Euclidian spheres. LUIGI FANTAPPIÉ: The integration by quadrature of the general parabolic equation with constant coefficients on the characteristics. J. LE ROUX: The characteristics of partial differential equations of the first order. J. REY PASTOR: The application of Borel's method to series which have zero terms. PIERRE COPEL: The propagation of a plane wave associated with the movement of a corpuscle. MME. G. CAMILLE FLAMMARION and F. QUÉNISSET: The observation and photography of the meteors of October 9, 1933. This fall was characterised by the large number of meteorites observed and by the persistence of the trails, one lasting at least twenty minutes. On one photographic plate, in spite of unfavourable atmospheric conditions, twenty-seven trails were recorded. EMILE SEVIN: The nature of waves and corpuscles. H. SPINDLER and R. COUSTAL: The prediction of the photoelectric power of certain bodies starting with a structural number related to the formulæ of these bodies. One of the authors has constructed a table of the elements in which the elements have an integral atomic index (not the atomic number). On this as a basis, it was predicted that cuprous chloride, bromide and iodide would not possess the same photoelectric properties, but that the bromide could be used in photoelectric cells. This conclusion was verified experimentally, the cuprous bromide cell giving a sensibility of the order of three-fifths of a good cuprous oxide cell. JEAN AMIEL: The slow combustion of benzene. The reaction velocity. The results of experiments on the slow combustion of benzene at temperatures between 420° C. and 500° C. are shown graphically, and a formula is given for the velocity as a function of the temperature. R. ETIENNE: The displacement of equilibrium at constant volume. MLLE. M. L. JOSIEN: The action of aqueous iodine solutions on silver nitrate; a kinetic study. As in the case of the reaction between silver nitrate and chlorine water previously described, there is an immediate precipitation of half the iodine as silver iodide, with a second reaction in which the hypoiodous acid is converted into hydriodic and iodic acids. The latter reaction is much more rapid than the corresponding change of hypochlorous acid. The effects of temperature and dilution were studied. E. AUBERT DE LA RÜE: Contribution to the geological study of the western Cordillera of the Colombian Andes. MAURICE COLLIGNON: The lower marine Trias of the north of Madagascar and its cephalopod fauna. The Barabanja strata constitute, in the southern hemisphere, a striking replica of the deposits of the Himalaya, of Salt Range and of Idaho, characterised by the genera *Flemingites*, *Hedenstrœmia* and *Pseudosageceras*. J. P. AREND: The composition and structure of the sedimentary layers as a function of the orogenic equilibria. A. DAUVILLIER: Observation of the polar aurora at Scoresby Sound during the polar year. The results of observations carried out by twelve members of the French expedition every three hours throughout the day. Visual, photographic and spectrographic observations were made and the results are discussed statistically. The results are not in accord with theories attributing the auroral and magnetic phenomena to the emission of ultra-violet rays by the sun. AD. DAVY DE VIRVILLE: The flora and physical conditions of the seashore pools of the Atlantic Ocean and the English Channel. Studies of the changes in the *p*H of these pools and the effects of these changes on the plant growth. J. MILLOT and R. JONNART: On the presence of a substance with a free phenolic function in the blood of spiders.

POLACK: Colour vision and its anomalies. The author concludes that the Young-Helmholtz trichromatic theory does not accord with the facts. Normal colour vision cannot be reduced to three fundamental colours. Colour vision is characterised by two physiological factors, the position of the luminous maximum in the spectrum and the extent of the unitonal regions. R. GRAIN: The electrical treatment of chronic catarrhal laryngitis. Details of a method of fixing iodine ions on the tissues by faradisation.

CRACOW

Academy of Sciences and Letters, October 2. R. MALACHOWSKI and T. WANCZURA: The catalytic hydrogenation of dehydracetic acid. By the action of hydrogen upon dehydracetic acid in the presence of platinum oxide, the principal product was 6-methyl-3-ethylpyronone. MLLE. T. GRADOWSKA, A. KRYNICKI and R. MALACHOWSKI: The unsaturated polybasic acids. Derivatives of ethylene-tricarboxylic acid. The methyl and ethyl esters of this acid were prepared, but, owing to reactions occurring on saponification, the free acid could not be obtained. K. DZIEWONSKI, ST. PIZON and MLLE. M. MAZURKIEWICZOWNA: Symmetrical αβ-dinaphtho-γ-pyrone. K. DZIEWONSKI and ST. PIZON: Two isomers, compounds of the type of symmetrical αβ-dinaphthopyrane. W. SZYMANOWSKI: The lethal time for animals submitted to the action of short electric waves of different wave-lengths. Contrary to the results obtained by other workers on the same subject, the author finds no maximum lethal effect for a given frequency. The lethal time follows fairly closely the laws of heating of electrolytes produced by the action of high-frequency electric fields. The conclusion is drawn that the death of the animals is due to the heat effects produced. B. PAWLOWSKI: Studies on the delphiniums of Central Europe belonging to the Elatopsis section. J. WISZNIEWSKI: The males of the psammic rotifers. MLLE. I. TUROWSKA: Studies on the sulphur bacteria (2). The Cyanophyceæ accompanying the sulphur bacteria (3). The intimate structure of the cell of the sulphur bacteria. Attempt at the establishment of their phylogenesis. Discussion of the relations between the white sulphur bacteria and the Cyanophyceæ. J. JAROCKI: Two new ciliates of the family Hypocomidæ. *Heterocineta janickii* and *H. lwoffi*, ectoparasites of *Physa fontinalis* and of *Viviparus fasciatus*. MLLE. M. WIERZBICKA: The results of crossing certain forms of *Cyclops strenuus*. Z. GRODZINSKI: The development and the comparative anatomy of the axial vessels of the anterior extremities of the vertebrates. J. STACH: Two new species of the genus *Onychiurus* in Poland.

Forthcoming Events

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

Monday, December 18

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—J. R. Rymill: "The Tugtilit (Lake Fjord) Country, East Greenland".

Tuesday, December 19

EUGENICS SOCIETY, at 5.30—(in the rooms of the Linnean Society, Burlington House, London, W.1).—Discussion on "Family Allowances".*

Wednesday, December 20

ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. J. Glasspoole and W. L. Andrew: "The Exceptional Summer of 1933".

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 15: Contributions to the Life-History of *Fitzroya*. By J. Doyle and W. T. Saxton. Pp. 191–217+plates 11–12. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

Imperial Bureaux of Plant Genetics: Herbage Plants. Bulletin No. 12: Lucerne, its Ecological Position and Distribution in the World. By Dr. M. Klinkowski. Translated by G. M. Roseveare. Pp. 62. 3*s*. 6*d*. Bulletin No. 13: Plant Breeding in the Soviet Union; Achievements, Organization and Future Programme of the Institute of Plant Industry. Pp. 58. 3*s*. 6*d*. (Aberystwyth: Agricultural Buildings.)

Report of the Departmental Committee on Thames Flood Prevention. (Cmd. 4452.) Pp. 24. (London: H.M. Stationery Office.) 6*d*. net.

Transactions and Proceedings of the Botanical Society of Edinburgh. Vol. 31, Part 2, Session 1932–33. Pp. ix–xv+245–322+plates 3–8. (Edinburgh.)

Proceedings of the Linnean Society of London, Session 1932–33. Part 4: Hooker Lecture—Some Aspects of the Bearing of Cytology on Taxonomy. By Sir William Wright Smith. Pp. 151–182. (London: Linnean Society.) 1*s*.

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 6 (New Series), No. 10, October. Abstracts Nos. 1654–1844. Pp. 325–360. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Agreements concluded at the International Conference for the Protection of the Fauna and Flora of Africa, London, November 8, 1933. (Cmd. 4453.) Pp. 61. (London: H.M. Stationery Office.) 1*s*. net.

Proceedings of the Royal Irish Academy. Vol. 41, Section A, Nos. 13, 14: The Resolving Power with a Microphotometer, by R. W. Ditchburn and E. J. Power-Steele; The Method of Focal Isolation, by R. W. Ditchburn. Pp. 137–155. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 1*s*.

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Forestry Society. Vol. 47, Part 2, October. Pp. xviii+93–214+23–30. (Edinburgh: Douglas and Foulis.) 7*s*. 6*d*.

Board of Education. Report of the Consultative Committee on Infant and Nursery Schools. Pp. xxvi+282+6 plates. (London: H.M. Stationery Office.) 2*s*. 6*d* net.

OTHER COUNTRIES

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 44: The Chemistry of Australian Timbers. Part 3: The Chemical Composition of Four Pale-Coloured Woods of the Genus *Eucalyptus*:—*E. gigantea*, *E. obliqua*, *E. regnans*, *E. sieberiana*. By W. E. Cohen, A. G. Charles and A. B. Jamieson. (Division of Forest Products, Technical Paper No. 9.) Pp. 22. Bulletin No. 76: A Soil Survey of the Hundreds of Laffer and Willalokka, South Australia. Edited by J. K. Taylor. (Report of the Division of Soils.) Pp. 41. (Melbourne: Government Printer.)

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