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Pipe Lines and Progress.

SLOWLY but surely the day of the individual, of the private firm, and of the small community is passing or has already passed. The individual has parted with his liberties to the community, rationalisation is putting the private firm out of business, whilst the small town must participate in larger schemes if it is to supply such public utilities as water, gas, and electricity at satisfactory prices. Thus we have a scheme for the national supply of electricity from super-power stations already in being, and there is much talk of the long-distance transmission of gas by trunk lines. These would in the first place serve to interconnect all the existing gas producers in a given area of country, with the result that in time the main load would be supplied from the more economical plants, the others serving as a standby for conditions of peak load. At the same time, the available productive capacity of the whole area would be greater than before, without any additional capital expenditure being required for new plant beyond that of the cost of the trunk lines. All these considerations and advantages closely parallel those which it is hoped to attain in the electrical industry.

It is surprising that a small country like Britain, in which distances are relatively so short, has not taken the lead in these matters: it affords yet another proof, if such be required, of the inborn nature of British individuality. The passage of our kin across the Atlantic, coupled more likely with the necessity for the co-operative spirit in the development of the vast areas of a new and virgin country, has had the effect of making them super-enthusiastic in developing large projects, and the very existence of distances has been seemingly accepted as a challenge to bridge and to make them as naught.

The newest example of this spirit is exemplified in what is happening in regard to natural gas, which, though it can alas have no parallel in Great Britain, is well worth attention and study. The great American oil industry to-day has a capital of two thousand million pounds. It has constructed in the United States some 100,000 miles of pipe line for the gathering and conveyance of the oil from the fields to the refineries and to the coast; the said lines contain at all times a quantity of oil estimated at 18 million barrels of 42 gallons each; they involve a very large annual expense for their maintenance and repair.

At first the natural hydrocarbon gas produced

at the wells was largely wasted; part of it was burnt near at hand as a source of heat; part of it converted, by processes which are none too efficient, into carbon black, which is an important ingredient of the rubber tyre.

When the advantages of the gas as an industrial fuel became realised, distance was regarded as no objection in running a pipe line to bring it to a potential large consumer. Already some 60,000 miles of pipe line for natural gas are in existence and a very extensive programme of new construction is in hand. The existing state of affairs is well shown in a large map of the natural gas pipe lines of the United States, which is published by and can be obtained from the Department of Commerce.

As showing the magnitude of the engineering problem involved, and incidentally its beneficial effect on the steel industry, it may be mentioned that in the line from Northern Louisiana to St. Louis, a total of 526 miles of 20-in. and 22-in. high pressure pipe were laid, involving a weight of 115,000 tons of steel. Much greater lengths than this are projected, and natural gas is already beginning to reach the holders and distribution mains of the gas companies in the large cities of the East. The natural gas has a calorific value of some 1000 B.T.U., or roughly twice as high as that normally distributed by the gas industry; problems therefore arise in regard to its dilution if it is to be burned efficiently in the existing domestic apparatus.

It is claimed that already 75 per cent of the total gas burned in America is natural gas. Questions naturally arise as to the permanence of any one source of supply as the wells become exhausted and the economic wisdom of the large capital sunk in the construction of the pipe: it is the custom to write these off very rapidly. The optimism of the American rises superior to any question of exhaustion—at the worst, gas made from coal at super gas works astride the collieries can be pumped in the reverse direction through the mains, is his answer.

Indeed, in the case of oil, reversing the pipe-line flow has already begun. The original Pennsylvania field is largely exhausted, so that the oil formerly sent from it by pipe line to be refined on the eastern seaboard has been replaced in the coast refinery by oil brought in from the Pacific Coast or Gulf of Mexico by ship; such oil is being sent back along the pipe to be refined at Pittsburg and elsewhere. Much more startling is the innovation to send finished petrol, or gasoline as the Americans call it, along a 371-mile pipe from the coast to Western Pennsylvania: it is said that this will cost some 35 to 50 per cent less than the usual transport in tank waggons by rail.

Naturally all sorts of problems have arisen in connexion with pipe lines, the solution of which has been due to prompt and whole-hearted co-operation with scientific workers. Soil corrosion is a most important matter; even the aeroplane has been brought in to assist in making the first survey for the path of the line through rough country. But for the production of better pipe and the development of welding methods which enable higher pressures to be used, the transport of the natural gas such distances would not have been possible.

The natural gas is obviously of very little value at the well, so that its cost delivered into the holder of a city gas company, even after full allowance has been made for the cost of pumping and the depreciation of the pipe, is less than that at which gas of equivalent heating value can be manufactured from coal at the gas works. This is of no disadvantage to the gas companies, the co-operation of which is essential to the success of any scheme for the introduction of natural gas, seeing that one of the main items in the cost of gas to the actual consumer is that of the distribution from the point of manufacture.

The lower the price at which gas can be supplied the more chance there is of its universal adoption as a source of heat: its use, whether by the householder or in industry, saves the worry connected with the purchase and storage of fuel, to say nothing of the labour of stoking and the removal of clinker and ashes. Most beneficial of all to the community will be the freedom from smoke in the cities.

In Britain this last factor should appeal to us most of all, but we have no natural gas and must therefore search in what other ways the price of the therm can be reduced. There is every indication that the desirability of this is realised by the gas industry, which apart from technical progress in the manufacture of gas in horizontal and vertical retorts, is studying the use of gas from coke ovens, from low temperature carbonisation and from oil refineries and cracking plants. It would take us too far now to deal with the somewhat vexed question of the production of oil from coal in Britain—it has been achieved technically on the large scale, though perhaps still a problem from the economic point of view. Scotch shale, cannel coal, and the like, will all eventually give their quota of oil and gas.

On the continent of Europe the supply of gas

in bulk from coke oven plants in the Ruhr district over considerable distances has already made much headway, though it is understood that the original schemes to take gas as far as Berlin have been deferred. Plans are also on foot to bring coke oven gas into Paris from a considerable distance.

The problem in Britain is not altogether so simple as might appear. The question of the cost of wayleaves for pipes and the assessment of these for rates by rural districts impose burdens which the consumer should not be asked to sustain if the nation has the production of cheap fuel and the lowering of costs in industry really at heart. The proposal to locate super gas stations at the colliery also requires very careful examination; not every seam is suitable for gas-making, whilst the ready marketing and cheap transport of the subsidiary products of the industry to the small consumer are factors of paramount importance.

An Everflowing Stream.

The Danube in Prehistory. By Prof. V. Gordon Childe. Pp. xx+479+57 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1929.) 42*s.* net.

A BOOK of this kind has been long needed. As Prof. Childe notes in his preface, British archæologists, in addition to their own local antiquities, have found in the first cultures of the Mediterranean and the Near East happy hunting-grounds and rich rewards. There are historical reasons for that, and also for the comparative neglect of Central and even of Northen Europe. Yet readers of Schliemann's works must have been impressed with the great mass of detailed work which had been done in these regions fifty years ago, however little they may have been convinced by his comparisons of this material with his own finds at Troy. It must be admitted, however, that until recently the very abundance and perplexing variety of the data retarded the appearance of any such compendious handbook as Peet's "Stone and Bronze Ages in Italy". Even Hoernes' "Urgeschichte der bildenden Kunst in Europa", before its recent transformation by his pupil Menghin, was essentially a history of art (and particularly of iconic art), not of civilisation. Latterly, the marked growth of popular interest in 'origins', as well as the necessity for some clue to such a labyrinth, even for specialists, has elicited summaries like Schuchhardt's "Alt-Europa", Tyler's "New Stone Age in Europe", and Prof. Childe's own "Dawn of European Civilisation". But in so far as these attempted to cover the ground of Europe, and not stray far beyond it, they necessarily lacked scientific and historical, as well as literary unity. What "The Danube in Prehistory" gives us is a series of intimate studies of a family, instead of a snapshot at a crowd. The great valley now is no longer a corridor but a portrait gallery.

Prof. Childe is well equipped for his adventure. His intimate acquaintance with museum collections and recent field work all over Europe, his command of the rather numerous languages in which the literature is scattered, and his previous surveys of the ground in his "Dawn" (already mentioned) and his "Aryans", give him advantages which he has here used to the full. Above all, bulky as this book is, he has managed not to say too much; his characterisations of each phase of culture are graphic, and detach the really significant features from the bewildering details; and the comparisons, and inferences as to their meaning, which he has drawn, are so concisely stated, that it is only when one begins to know the book well that one discovers how much has been put into it.

Very properly, an attempt to rationalise a microcosm of this sort, begins with a profession of faith; and there are few, if any, shorter and weightier statements of an antiquary's creed and code than the preface here. Properly also, wild Nature frames the pageant of man's achievement: the physique, and the principal external relations of the Danube basin with adjacent regions. It would not have occupied more than a few additional pages, to indicate, still more concisely, what lies beyond the watersheds, even without anticipating by more than a phrase the peculiarities of the human contributions of each to Danubian cultures. Without this, the significance of successive references to horse-bones, for example, will not be obvious to everyone.

On the difficult problems of historical climate, and the sequence of plant-regimes, what is said is cautious and trustworthy, but it would have been helpful to emphasise the contrasts between forest-regimes north and south of the valley, and still more between the vegetations that replace them respectively when drought sets in. Beside the conspicuous contrast between superincumbent loess and older components of the structure, the petrological differences between different strata may seem slight; but there are phrases here and there which show that the author is aware of the marked peculiarities of 'karst' country, and the prevalence of this and other soluble rocks might have been

indicated, as well as the profound results of this, in the distribution of the types of plant-covering already mentioned. It is difficult, for example, to believe that the passes between Morava and Ægean were so long and so completely closed to mankind, as is represented here and hereafter, in view of the predominance of limestone country there; and this hypothesis is fundamental to the view taken in Chap. iii. of the course of the propagators of the culture known as 'Vinča I'.

So little has been observed, hitherto, of the traces of palæolithic man in the Danube valley, that even the data collected in Chap. ii. (the extent of which will be a surprise to many) do not justify more than the most general inferences. It is clear, however, that there was rather early admixture of brachycephalic types (p. 14), so far back as Aurignacian deposits, and that consequently "the round heads of Ofnet do not necessarily betoken a fresh racial intrusion" (p. 18). But in view of the general distribution of brachycephaly in Eurasia, Central European examples of it are surely intrusive, not aboriginal, whatever their date. On the affinities of the long-headed stock which seems to predominate on the loess-land in early neolithic times, Prof. Childe expresses no opinion, after recording several (p. 45). His presentations of other folk's views are throughout commendably objective. Only occasionally, even in descriptions, does a word of regret escape him; for example (p. 58), on the French reluctance to take potsherds seriously, and (pp. 166, 169) on delays in publication.

The first neolithic culture, represented by the lower levels of the great *tell* at Vinča, has admittedly well-marked resemblances with that of Anatolia. Is it not, however, necessary to distinguish between neolithic Crete, for example, and the mainland sites, in view of Cretan and even Cycladic resemblances with early Sicily, Malta, and even Sardinia, and of the Egyptian glimpses of an indigenous neolithic culture in Libya. Are 'East Mediterranean' and 'Anatolian' really convertible terms? Or is a good deal of the similarity among local cultures around the Ægean due to interpenetration of two distinct archetypes, one (in broad terms) indigenous to the north-east, the other to the south-west, of a line from Alexandria to Rhodes? How that line is to be prolonged beyond the latter is gradually being revealed by recent work in Lesbos, in Macedonia, and south of the Corinthian Isthmus; and conclusions here may confirm or modify our interpretation of the course of events north of the Ægean.

If Prof. Childe is right in supposing that those who introduced 'Vinča I' culture into the Middle Danube came up the waterway, he may have to face the question whether such navigators came only from the Marmara shores, or from ports farther south. To derive 'Vinča I' from fisher-folk does less than justice to its emphatically agricultural character. Whether the overland routes from the Marmara to the Middle Danube were really so impassable has been already doubted; and only further exploration in Thrace and Bulgaria can decide this point. It must be admitted, however, that, on present evidence, early settlements seem to spread *up* the Morava, rather than downstream. Jablanica—excavated too early to be quoted with confidence—seems to belong essentially to 'Vinča II', but it is noted (p. 68) that Vinča itself may have remained conservative. But on p. 67 the possibility is after all admitted, that the beginnings of 'Danubian Ia' culture—more distant still to the north-west—may be due to immigrants through Serbia; and the clay women nursing infants, in Danubian II, are "taken over from Thessaly and the Ægean" (p. 70).

In the two 'Danubian' phases, outstanding controversies are as to the relations of 'Danubian I' with neighbouring cultures to the north-west, in the Rhine valley and beyond, and of 'Danubian II' with the nascent civilisations of the Ægean, and especially of Thessaly. The rich but inaccessible material from Butmir is put in a new perspective, as the work of an 'industrial centre', 'quite eccentric', and not 'originative', though it ran its own idiosyncrasies rather hard. The recent Sumerian evidence for very early spirals in the south-east is naturally emphasised; yet it looks as if spirals, which originate in several ways, may also have originated in several places: but Asia Minor is still almost unexplored, for early cultures.

On the eastern margin of the 'Danubian' culture-areas lie the secluded 'painted-ware' settlements around Erösd with their perplexing resemblances to those of Ukraine, Bukowina, and Thessaly, and their 'poor cousins' injected into 'Danubian' surroundings so far off as the upper Tisza, on the frontier of Slovakia. Here Prof. Childe elaborates his earlier suggestion that these 'painted wares' are due to emissaries of the 'painted ware' culture of Sumeria. But "frankly, many steps have to be interpolated", even if the queer "incineration necropolis" at Surghal in Babylonia be as closely like the *ploshchadki* sites of Kiev (which are neither cemeteries nor incinerated) as has been stated. Once again, Asia Minor is unexplored; there have been surface-finds of early painted ware, but

Hissarlik eschewed painted ornament, and in Cyprus it is quite secondary. On the other hand, the 'painted-ware' regime at its widest included Baluchistan and Mongolia, as Sir Aurel Stein and Dr. Andersen have found; and the lower Volga is almost as unexplored as the Halys. Meanwhile, is it certain that (p. 110) 'Minyan ware' occurs at Cucuteni? One swallow does not make a summer, nor are all smooth iron-grey potsherds 'Minyan'.

A whole group of intrusive cultures along the north side of the Danube basin owes its common characters to the interpenetration of two extraneous elements, the 'megalithic' culture of the Atlantic and Baltic frontage, and the pastoral regime of the 'battle-axe-folk' generally now derived from the Russian steppe. As these cultures belong to the 'sub-boreal' climatic phase, their spread was rapid, for the forests were now discontinuous, and grazing-ground extensive. Among the numerous controversies, Prof. Childe picks his way discreetly, clarifying and supplementing; he has coined one term, 'Danordic' (for cultures superimposed by Nordic intruders on Danubian aboriginals), which is likely to persist; and he offers one ingenious suggestion: that the 'globular-amphora' folk navigated the north German rivers, and in this way travelled far without losing characteristic 'megalithic' traits.

These are only illustrations, all from the first half of this important book, of the kind of problem which the subject-matter presents, and the lines on which a solution is attempted. The author's candour and open mind are illustrated by his criticism of his own earlier views about the 'Pile-dwellers' (p. 171). Naturally many difficulties have to be confessed and left unsurmounted, until fresh evidence comes—a conspicuous example is in the chapter on the 'Corded-ware' people—but those who have most to contribute will be the last to complain of that frankness; and the systematic arrangement, and clear distinction between facts and theories, secure to the book a permanent place, as a ground plan on which to lay out one's own superstructure, as time goes on. We could have wished for even more illustrations, and especially for more of the quite excellent line-drawings: pot-fabrics are very hard to photograph, and impossible to represent fairly except by a series of examples. And how comfortable it is to have all the line-drawings from the same competent hand, whatever their ultimate source! The correlation-diagram facing p. 418 looks like a cross-word puzzle, but is easier to read when you know how. The maps, though uniform in principle, and in the picturesque style of execution which finds favour now with the Clarendon Press, are not all equally eloquent; partly because some include too many kinds of data, partly because the symbols are not sufficiently contrasted. But "The Danube in Prehistory" is a masterpiece in this kind of work. J. L. M.

A Chemical Dictionary.

A Chemical Dictionary: containing the Words generally used in Chemistry, and many of the Terms used in the related Sciences of Physics, Astrophysics, Mineralogy, Pharmacy, and Biology, with their Pronunciations; based on recent Chemical Literature. By Prof. Ingo W. D. Hackh. Pp. viii + 790. (London: J. and A. Churchill; Philadelphia: P. Blakiston's Son and Co., Inc., 1930.) 42*s*.

THE present day intensely rapid development in all branches of natural science necessarily involves a growing terminology with which even the specialists find difficulties in keeping pace. Particularly is this the case in chemistry, the encyclopædic nature of which scarcely needs remarking. Apart from its laws and theories, chemistry has to deal with the elements, naturally occurring compounds, and with reactions, processes, and methods for obtaining the thousands of compounds continually being added to and produced as useful materials or as illustrative substances or as addenda of the science. To treat of all of these is an enormous task by itself; if, in addition, a chemical dictionary attempts to make clear the interdependence of chemistry and the other branches of natural science—physics, biology, crystallography, and geology—and the arts of medicine and pharmacy, and also makes reference to those associated with the development of chemistry and the cognate sciences, it must attain a very considerable size and be frequently brought up-to-date if its usefulness is to be maintained.

The production of a one-volume chemical dictionary is, therefore, a great achievement, and Prof. Hackh has rendered an important service to chemists and chemistry. The volume is not too bulky to be handled conveniently and, for the most part, the information given is reasonably accurate and, in many cases, surprisingly detailed. It is almost a super-dictionary, the author being rarely content to give a mere definition or description.

It must be allowed that no dictionary will ever be found fully satisfactory in all details to all who may consult it. The specialist in any one subject cannot expect to be satisfied with the necessarily

brief account given in a dictionary of those portions of the subject of which he can claim to be an authority. It would not be surprising, for example, if even " The Oxford Dictionary " fails on occasion to satisfy the critical faculty of those cross-word puzzle enthusiasts who are also readers of the *Times*.

To illustrate the excellent features of Prof. Hackh's dictionary would be impossible in a review of reasonable length, and reference can only be made to one or two. Under ' hydrogen-ion ', there are, apart from the definition, a table of hydrogen-ion concentrations, references to and illustrations of hydrogen-ion determinations by the electrometric and colorimetric methods together with a cross reference to ' indicator ', where rather more than 2½ pages are devoted to tables showing various indicators and the hydrogen-ion concentration corresponding to the colour change in the cases of some 74. After the description of Paul Ehrlich as a German biochemist and the founder of modern chemotherapy, there is an outline covering 1½ pages of Ehrlich's side chain theory and of other outstanding features of his work. It would be interesting to discover how many organic chemists will familiarise themselves with the three pages of abbreviated structure formulæ of typical organic compounds, but this method of representation has saved many pages.

Many ' articles ' are illustrated by diagrams ; for example, the triple-point diagram for water is given under ' triple point ', and the equilibrium diagram of the ternary system, lead-bismuth-tin, occurs under ' alloy '. It would scarcely be reasonable to expect, but it would be useful to many readers to have, some explanation, however brief, of such diagrams, even if this could only be given by omitting illustrations of familiar apparatus such as an Erlenmeyer flask, a tripod, a burette stand, or even the photographs of chemists and physicists. There is an adequate reference to ' parachor ', even if the mathematical expression is inaccurate owing, possibly, to a printer's error. The description of acetophenone in two places as ' benzoyl hydride ' needs revision, and perhaps the author would have been well advised to omit at this stage the structural formula given to strychnine.

The dictionary refers to the leading chemical societies, of which our own takes precedence on account of its date of foundation. It also aims at being something in the nature of a chemical biography and, so far as living chemists are concerned, the present writer has gained the impression that the majority appear to be American. Prof. Armstrong is mentioned, but it may be regretted that his photograph does not appear on the opposite page to that of Arrhenius ! We are tempted to wonder why there is no mention of H. B. Baker, W. H. Perkin, junr., R. Robinson, J. F. Thorpe, R. Willstätter, and H. Wieland among chemists, and why J. J. Thomson and Eddington find no place in the gallery which includes Aston, Bohr, Einstein, Moseley, Rutherford, and C. T. R. Wilson.

There are, however, so many good points about the dictionary that one becomes perhaps unduly impressed by the relatively few defects, from whatever cause they have arisen, but which can easily be remedied in a future edition.

C. S. GIBSON.

The Oligochæta.

The Oligochæta. By Dr. J. Stephenson. Pp. xvi + 978. (Oxford : Clarendon Press ; London : Oxford University Press, 1930.) 60*s*. net.

THIRTY-FIVE years ago the Clarendon Press published Beddard's well-known " Monograph of the Order Oligochæta ", but in the interval numerous investigations have been made on the structure, embryology, and physiology of these animals, and much more has been learnt of their ecology and distribution. The time was ripe for a new monograph, and zoologists are grateful to Dr. Stephenson for undertaking its preparation. With the exception of Prof. Michaelsen of Hamburg, it is doubtful if any other author could have successfully surveyed the whole order. Dr. Stephenson brought to the preparation of this work a thorough practical mastery of the structure and classification of the Oligochæta, an extensive knowledge of the literature, and a flair for conciseness and clearness in presenting facts and conclusions, and he has produced a monograph of exceptional merit.

The book consists of twenty chapters, a bibliography, a subject index, and a systematic index. The first ten chapters give a systematic account of the external characters and of the structure, histology, and physiology of the various tissues and systems of organs—alimentary, vascular, excretory, nervous, and reproductive. That on the alimentary canal includes consideration of the chromophil cells, the peptonephridia, and the calciferous glands which are produced by folding of the œsophageal epithelium, and are therefore not of mesodermal origin as some authors have suggested. The chapter on the vascular system opens with an account of the arrangement of the blood vessels in *Lumbricus*, followed by a comparative consideration of each group of vessels in the Oligochæta and of their histology, concluding with a brief discussion of the

evolution of the vascular system in which the views of Lang (the trophocœl theory) and of Vejdovsky are set forth. The following chapter on respiration gives a clear account of the mechanisms of respiratory interchange through the body-wall—in which there may or may not be networks or loops of blood-vessels—or by the agency of gills which are present in half a dozen genera, and of intestinal respiration which is met with in certain aquatic Oligochæta and to which the author devoted considerable attention some years ago.

A description of the anatomy and histology of the Lumbricid nephridium prefaces the account of the half-dozen main types of nephridia found in Oligochæta. A systematic survey of the nephridia in the several families, a résumé of the processes of excretion, and a brief note on the evolution of the nephridial system within the order complete a masterly exposition of a difficult subject.

In the chapters on the nervous system the author has described the various neurones and their relations to one another and the remarkable giant nerve-cells and fibres, has discussed the physiology of the nervous system in relation to the various types of locomotion, and has added a short note on the psychology of earthworms.

The tenth chapter (115 pp.), the longest in the anatomical part, is by far the best comparative account available of the gonads, their ducts and associated glands, the spermathecæ, the spermatophores, the modified genital setæ and the clitellum. The three following chapters deal with spermatogenesis, oogenesis, fertilisation, copulation, oviposition, embryology, and asexual reproduction.

In the fourteenth and fifteenth chapters are recorded the chief anomalies of structure and malformations, for example, bifurcation of one or both ends, and the principal results of investigations on regeneration and transplantation for which earthworms have been extensively employed.

The following chapter on the ecology and manner of life of the Oligochæta contains a selection of the most interesting observations on these subjects from the literature of the last thirty-five years; for example, reference is made to the very small oxygen requirements of certain aquatic forms—a species of *Limnodrilus* occurs in Peoria Lake (near Chicago) where the dissolved oxygen was found to be less than one part in a million—and to the number of earthworms in the soil, which appears to be considerably greater than was stated by Darwin. The highest numbers recorded are for a meadow near Zurich, in which 700 Lumbricidæ and 8000 Enchytræids per square metre were found.

The excellent chapter on geographical distribution deals clearly among other subjects with the views of Michaelsen and of Benham regarding the value of the evidence afforded by the distribution of Acanthodriline worms concerning the former existence of a more extensive antarctic continent. The author adds his own careful conclusions on the bearing of the known facts of geographical distribution on the former existence of Indo-Australian and other land-bridges.

The discussion of the phylogeny and affinities of the Oligochæta includes interesting observations on convergence and on polyphyly.

In the concluding chapter, the author adopts a scheme of classification of the Oligochæta into fourteen families. The Acanthobdellidæ are not included; they are regarded as leeches. For each family a concise definition, a note of its distribution, and comments on the chief structural characters and on ecology are given. The further systematic consideration is restricted to the genera—about 120—under each of which is a definition, reference to its distribution and a note of the number of species, with comments on special features. The author states that the number of species of Oligochæta now known is about 2400, twice as many as were known in 1900, the revision of which would be a formidable task. He makes a strong plea in the preface for the careful identification of specimens used in research and for the avoidance of such meaningless expressions as 'the earthworm' or 'the common earthworm', and points out that the phrase "the common earthworm, *Lumbricus terrestris*" is for many parts of the country fallacious, this worm being often less common than one or two species of *Allolobophora*.

The bibliography of more than 1000 papers includes the most important works down to October 1928 and a few more recently issued. Only about 80 bear date previous to 1895, the author rightly considering that the papers of an earlier date had been dealt with by Beddard or that the subjects of which they treat had been reinvestigated by newer methods.

The illustrations have been carefully chosen, nearly all from recent memoirs. A miscalculation of the number of earthworms per square metre from the figures per acre is the only mistake the reviewer has noticed, and the book appears to be entirely free from misprints. The author is to be most heartily congratulated on his masterly monograph, which will undoubtedly be for many years the authoritative work of reference on the Oligochæta.

J. H. A.

Our Bookshelf.

Die Technologie der Fermente. Herausgegeben von Prof. Carl Oppenheimer. Halbband 2: *Fermente in der Fettindustrie, Milchwirtschaft, Lederindustrie, Gelatine- und Leimindustrie, Pharmaz. Industrie, Malzextraktindustrie, Textilindustrie, Nahrungsmittelindustrie.* Pp. xi + 370. (Leipzig: Georg Thieme, 1929.) 42 gold marks.

THE work before us forms the completion of the fourth volume of Prof. Oppenheimer's great treatise "Die Fermente und ihre Wirkungen". The fourth volume is entitled "Die Technologie der Fermente", the first half-volume of which was compiled by Dr. Albert Hesse of Munich. The subject matter it dealt with may be gathered from its title, "Enzymatische Technologie der Gährungsindustrien". The second half-volume, which is now under review, is concerned with the subjects given above under the sub-title.

The hydrolysis of fats on an industrial scale by the lipases is dealt with by Dr. Emil Hoyer, whose article contains 17 illustrations. Dr. W. Grummer's short article on enzymes in the milk industry is concerned with the technology of rennet. A comprehensive monograph of 116 pages on the leather industry includes 21 illustrations and is contributed by Dr. Otto Gerngross, following which is a short article of four pages by the same author on gelatin and glue. The article by Drs. P. Bergell and H. Carls on enzymes in pharmacology covers 102 pages and contains five illustrations. The concluding three articles are by Dr. A. Hesse, the subject matter being commercial malt extract, the significance of enzymes in the textile industries, and industries concerned with foods. They occupy 13, 79, and 69 pages of text respectively.

Throughout the work citations are made to scientific papers as well as to patent specifications.

Prof. Oppenheimer may be congratulated in having, with the help of his collaborators, produced an exceedingly valuable treatise on a department of science of ever-increasing industrial importance.

A. R. L.

Vorkommen und Geochemie der mineralischen Rohstoffe: Einführung in die Geochemie und Lagerstättenlehre; besonders für Chemiker und Studierende der allgemeinen Naturwissenschaften. Von Prof. Dr. Georg Berg. Pp. x + 414. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1929.) 28 gold marks.

IN accordance with the modern tendency, Dr. Berg regards the study of mineral deposits as 'applied geochemistry'. His book, moreover, does not deal exclusively with ore deposits in the strict sense but includes deposits of all the useful minerals. It is divided into two parts. Part 1 consists of an introduction to geochemistry, and treats of the general factors underlying the distribution and migration of elements within the crust and interior of the earth, and the particular factors upon which their local enrichment to workable bodies depends. In this part is given a good summary of all modern work on the subject.

In Part 2 the elements are considered individually, although there is a primary grouping into certain classes, and in certain cases two closely related elements may be treated together. The various mineral species are dealt with, and in every case the actual mode of occurrence is regarded as a function of all the geochemical characters of the element in question. By this means the genetic relationships are made clear and the paragenesis of both elements and minerals takes on a new significance. In a book of this nature it is quite impossible to describe every known deposit of each element: nevertheless, the author has selected representative examples of the important types from world sources. The text is illustrated throughout with numerous diagrams and sections.

Travels in the Congo. By André Gide. Translated from the French by Dorothy Bussy. Pp. ix + 375 + 16 plates. (New York and London: Alfred A. Knopf, 1930.) 15*s.* net.

THIS volume, which is a translation of "Voyage au Congo" and "Le Retour du Tchad", published in 1927 and 1928, is the embodiment of an ambition realised after thirty-six years. It is appropriately dedicated to Joseph Conrad. André Gide, the distinguished French man of letters, has here recorded the day-to-day events and the impressions stored up in a journey by road and river, in boat and car, but mostly on foot, through the Belgian and French Congo to Lake Chad. The reader should feel no disappointment at finding this no scientific record: beyond an amateur interest in the more remarkable fauna of the tropics, and to some greater extent in the lepidoptera and flora, the author had not the equipment for systematic observation. But nevertheless, as a vivid impressionistic picture of life and travel in tropical Africa, it has a value. Native life and character stand out in the round against a background of the forest. Though the author started, as he himself confesses, with little interest in the native and his relations with the white inhabitants and the administration, this soon became the main interest of the journey. It is beyond question that his intervention brought to the notice of the administration many abuses in treatment of the natives by the commercial companies to whom concessions had been granted.

Experimental Physical Chemistry. By Prof. F. Daniels, Prof. J. Howard Mathews, and Prof. J. W. Williams. (International Chemical Series.) Pp. xvi + 475. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1929.) 17*s.* 6*d.* net.

ALTHOUGH there is no lack of good English textbooks on practical physical chemistry, the present volume forms a welcome addition to the literature of the subject. It covers the range of experiments usually done by students in Great Britain, and gives in addition a number of alternative experiments of a more advanced character which will make the book useful to those beginning research. There are useful references to literature. The book should be available in every physico-chemical laboratory.

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 Parachor and Molecular Volume.

DR. SUGDEN has put physical chemistry very much in his debt by his introduction of the concept of the parachor. Simply defined as this is in terms of Macleod's fundamental discovery that the surface tension of a liquid at any temperature is in a constant ratio to the fourth power of the difference of the orthobaric densities of liquid and vapour measured at the same temperature, the parachor has proved, as a weapon of attack on the problems of chemical constitution, much more powerful than the molecular volume.

If we write Macleod's law in the form

$$\gamma^{1/4} = K(D - d),$$

the parachor P is simply the constant K multiplied by the molecular weight; putting, therefore,

$$P = M\gamma^{1/4}/(D - d),$$

it follows, as Dr. Sugden rightly points out, that, if d is negligible in comparison with D, a comparison of the parachors of two substances is a comparison of two molecular volumes at temperatures such that the surface tensions are equal. But the step from this argument to the assumption that a parachor (Sugden, *Jour. Chem. Soc.*, **125**, 1177, 1924; and T. M. Lowry, NATURE, Mar. 8, p. 364) "is in fact a molecular volume which . . . is . . . independent of the temperatures at which it is measured", and which "therefore replaces, with greatly enhanced efficiency, the old molecular volumes" is quite unjustifiable.

It is true that two speeds may be compared by comparing the lengths covered in equal times, but this does not provide the slightest justification for asserting that a length *is* a velocity. Just as much, or as little, is a parachor a molecular volume, and one is not forwarding the use of this valuable concept by calling on it to play a rôle for which it is by no means fitted. The parachor, as parachor, has assisted in the elucidation of a number of constitutional problems—there is nothing to be gained, and much to be lost, by rechristening it a molecular volume.

The dangers attendant on this attitude are well illustrated by a study of a table drawn up by Dr. Sugden. He remarks (*Jour. Chem. Soc.*, **125**, 1177, 1924) that if the parachor "is a true measure of the molecular volume it should bear an approximately constant ratio to the critical volume"; and he gives a table, reproduced in extended form on p. 31 of his interesting volume "The Parachor" which shows that the relation $P = 0{\cdot}78\ V_c$ can be used to predict the molecular critical volume to within about 3 per cent. Now, whatever we may think of the rational basis of Dr. Sugden's hypothetical syllogism, we have good ground for assuming that the ratio P/V_c is *not* a constant. Some little time ago, I showed (*Trans. Far. Soc.*, 1923) that Macleod's constant C in the equation

$$\gamma = C(D - d)^4$$

may be expressed in terms of the molecular weight and critical constants of the liquid by

$$C = \Delta\theta_c/M^{2/3}\rho_c^{10/3}$$

where Δ is a 'universal' constant. If we replace ρ_c by the critical molecular volume V_c and remember that the parachor P is equal to $MC^{1/4}$, we easily find that

$$P = \Delta_1\theta^{1/4}V_c^{5/6}.$$

Hence it is not P/V_c which we should expect to be constant, but Δ_1, where

$$\Delta_1 = P/V_c^{5/6}\theta_c^{1/4} \text{ or } (P/V_c) \times (V_c^{1/6}/\theta_c^{1/4}).$$

I reproduce here Dr. Sugden's table with one or two additional columns, and if the columns headed P/V_c and Δ_1 respectively be compared, it will be seen that the constancy of the numbers in the column last mentioned is very considerably improved.

Substance.	P.	V_c.	θ_c.	P/V_c.	$\Delta_1 = P/V_c^{5/6}\theta_c^{1/4}$.
Hydrogen .	35·1	[46·9]	33·1	[0·75]	0·440
Methyl formate	138·6	172·0	487·1	0·81	0·406
Methyl acetate	177·0	227·8	506·8	0·78	0·405
Benzene .	206·3	256·1	561·6	0·81	0·417
Carbon tetrachloride	219·9	276·1	556·3	0·80	0·418
Diethyl ether	211·7	281·9	466·9	0·75	0·414
Methyl propionate	215·0	282·0	530·5	0·76	0·407
Propyl formate	216·1	284·8	538·0	0·76	0·404
Ethyl acetate	217·1	286·3	523·2	0·76	0·407
Chloro-benzene	244·5	307·8	632·3	0·80	0·412
Methyl isobutyrate	253·3	338·9	540·7	0·75	0·409
Methyl butyrate	254·2	340·1	554·4	0·75	0·408
Ethyl propionate	254·8	344·3	546·0	0·74	0·405
Propyl acetate	256·1	345·3	549·3	0·74	0·406

The numbers for hydrogen are a little difficult to follow. Dr. Sugden gives the critical molecular volume of hydrogen as 46·9. Landolt-Bornstein and the "International Critical Tables" agree in giving as the most probable value, Kamerlingh Onnes' figure of 0·03102 for the critical density. This gives 64·5 as the critical molecular volume. If now we take Dr. Sugden's value of 46·9, the ratio P/V_c is about 0·75, but the value of Δ_1 is very far from the mean value 0·409. On the other hand, the accepted value of 64·5 makes the ratio of P/V_c equal to 0·53, but the constant of the last column is now 0·44, as close to the mean as one would expect with a substance such as hydrogen.

There is very little doubt that it is preferable to treat the parachor as a parachor, and to discuss the problem of molecular volumes on an entirely independent basis. As Prof. Lowry remarks (in rather stronger terms than is justifiable) Kopp's attempt to regularise the values of molecular volumes by measuring them at the boiling points of the liquids concerned was not an unqualified success. One has to remember, however, that boiling points are only very approximately corresponding temperatures. The ratio of boiling point to critical temperature varies, for example, in a perfectly regular manner for the homologous series of normal paraffins.

It is possible—if indeed the attempt has not already been made—that a number of these irregularities would be removed if molecular volume determinations were carried out at exactly corresponding temperatures. I have recently developed an equation showing the variation of the orthobaric density (ρ)

of an unassociated liquid with reduced temperature m, which takes the form

$$\rho = 2\rho_c[A(1-m)^{0\cdot3} + (1-m/2)],$$

where A is a constant which to a first approximation may be taken as unity. With the exception of a few degrees in the neighbourhood of the critical temperature, this equation represents the behaviour of an unassociated liquid with an accuracy equal to that of experiment. The equation shows that, if comparisons be made at *strictly* corresponding temperatures, a comparison of molecular volumes reduces to a comparison of critical molecular volumes, and it is possible that regularities may emerge from a search made in this direction. However that may be, it is certain that a parachor is not a molecular volume. The parachor is a healthy infant, strong enough to fight its own battles in its own name, and its friends will be well-advised to treat it as an independent concept.

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Parasitism a Stimulus to Pupation: *Alysia manducator* in Relation to the Host *Lucilia sericata*.

CONSIDERABLE diversity of opinion has been expressed regarding the stage in which hibernation of the 'blow fly', *Lucilia sericata* Meigen, takes place. Records are given variously as:

(*a*) Mainly in the pupal, but also in the larval stage.[1]

(*b*) Both in pupal and larval.[2]

(*c*) In the larval stage.[3]

In investigations in progress for the Australian Council for Scientific and Industrial Research, on the biological agencies which play a part in limiting the numbers of this fly, the question of hibernation has been brought into close apposition with that of parasitism by the Braconid, *Alysia manducator* Panzer.

Originally it appeared that hibernation of the host might take place in more than one stage, for both larvæ and puparia were recovered from the soil surrounding baits exposed in the autumn and examined towards the end of the season, five weeks later. The mean daily temperature from the time the larvæ had reached a stage of development normally leading to pupation, and for three weeks prior to examination, had been 8·5° C. As the daily range in temperature was small and the weather dull, the mean air temperature was no doubt a reasonable approximation to that of the soil to which most of the larvæ had migrated. Of the larvæ collected, some pupated a day or two after being brought to the laboratory, while others did not; the latter have undergone a tardy pupation on encountering higher temperatures, and the larval life of some of them at an average temperature of 15° C. was prolonged to three months.

The mean temperatures obtaining in the field at the time the material from the bait was collected were such as are usually associated with hibernation. Thus it seemed highly improbable that the puparia taken from the field were those which would complete their development and produce flies before the winter. In other words, it appeared that hibernation might be possible in both larval and pupal stages. The parasitism records, however, have yielded some interesting results, which necessitate a different interpretation of the facts. From larvæ which had not pupated within eight days of being brought from the field the percentage parasitism has been negligible: practically all the parasitism records have been obtained from puparia or larvæ which pupated soon after collection, as will be seen from the following table:

TABLE I.

Batch.	Stage.	Number.	Parasitised.	Parasitism.
1	Larvæ . . .	198	1	0·5%
	Puparia (plus larvæ pupated within 8 days of collection)	198	173	87·4%
2	Larvæ . . .	70	6	8·6%
	Puparia (plus larvæ pupated within 8 days of collection)	128	119	92·2%

It appeared then, since practically all the parasitism was associated with those forms which had passed into the pupal stage, while those which remained as larvæ were unparasitised, that there might be some relation between host pupation and parasitism.

Of several thousand larvæ removed from the field a month earlier which had completed their development under cool conditions indoors, a proportion also had pupated, though the majority had remained in the larval stage. If, then, the relation which appeared to exist between parasitism and host pupation were a fact, it seemed reasonable to expect that confirmation might be obtained from those forms collected a month earlier, which, under cool conditions, were apparently hibernating in part as larvæ and in part as puparia. One hundred of each stage were therefore dissected and the results were as follows. (One hundred larvæ left under the same conditions have continued to hibernate without pupation.)

TABLE II.

Stage.	Number.	Parasitism.
Larva . . .	100	0 per cent.
Puparium . . .	100	88 per cent.

As there was a possibility that the presence of parasites, more especially in the egg stage, may have escaped detection in the host larvæ, an additional hundred larvæ were put to pupate. (The parasite is present as a reasonably well-developed larva after the host has pupated and its detection is therefore assured.) Of these, 87 pupated and 13 died. All were dissected. A further 100 puparia were also placed aside to emerge for confirmation of the species of parasite. The results from these extra larvæ and puparia confirm those already given.

TABLE III.

Stage.	Number.	Parasitism.
Larva . . .	100	0 per cent.
Puparium . . .	100	89 per cent.

It appears, then, that the retardation by low temperatures of the physiological events normally leading to pupation may be overcome by a stimulus contributed by parasitism.

Of the parasites obtained from the four groups of puparia given in the foregoing tables, *Alysia manducator* has predominated to the extent of 93·6, 99·1, 96·6, and 98·9 per cent respectively. The remaining parasitism was by *Aphœreta minuta* Nees, which appears to produce an effect similar to that caused by *Alysia*.

Altson [4] was of the opinion that 'successful para-

sitism ' by *Alysia manducator* caused the host larvæ to burrow, although he does not record any experiments on the point. As most of his observational and experimental work was done on *Calliphora erythrocephala*, it was no doubt this species to which he referred. One hesitates to accept the idea that ' successful parasitism ' by *Alysia manducator*, if this means the actual presence of an egg capable of development within the host, is the cause of stimulated pupation in *Lucilia sericata*. It may be that the real cause is the secretion injected at the time of oviposition and which causes temporary paralysis of the host larva. If this were the case it would probably account for some host pupation as a result of the injection without the deposition of the egg, and explain why in the foregoing tables all puparia did not yield parasites. Interruptions in the oviposition act are common enough and due to a variety of causes. Experimental work on this point is in progress.

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[1] Graham-Smith, G. S., *Parasitol.*, **8**, 4, 440-544; 1916.
[2] Kisluik, M., *Ohio Jl. Sci.*, **17**, 8, 285-294; 1917.
[3] Davies, W. M., NATURE, **123**, 759-760; 1929.
[4] Altson, A. M., *Proc. Zool. Soc. Lond.*, **15**, 195-243; 1920.

Penetration of Methylene Blue into Living Cells.

IN NATURE of June 16, 1928 (vol. 121, p. 939), Irwin has commented adversely on certain quotations of my results on the penetration of methylene blue into living cells. It seems important, therefore, to direct the attention of readers of NATURE to subsequent findings made by me.

In these new experiments (M. M. Brooks, *Protoplasma*, **7**, No. 1, 46; 1929) it was found that differences between Irwin's methods and those used by me were responsible for differences in the results. Irwin's experiments were done with a very much higher *p*H value of the external solution; a much more concentrated solution of dye in the external medium (from 3 to 25 times as concentrated); and a more impure dye; and in darkness rather than in diffuse daylight.

Experiments done according to methods used by me again showed that methylene blue penetrates living cells as such and not as one of its lower homologs. When Irwin's methods of experimentation were used, trimethylthionine was found in the sap, showing without doubt that her results were due either to high *p*H value which alters the dye, to the impurity or high concentration of dye which she used in the external solution, to the difference in illumination, or to some combination of these factors. It is also important to consider what part is played by injury; plants placed under the adverse conditions of Irwin's experiments are undoubtedly more abnormal than those subjected to such mild treatment as that used by me.

There is no reason to doubt the validity of the spectrophotometric analyses made for Irwin by W. C. Holmes and K. S. Gibson of the Bureau of Standards, Washington, D.C. The error lies in the solution which was submitted to them for measurement.

It is apparent that the purer the methylene blue, and the less abnormal the experimental conditions, the more nearly will methylene blue be found uncontaminated in living cells.

Discussion of contradictory results obtained by different workers will scarcely advance our knowledge of cellular biology unless due consideration is given to possible differences in experimental methods. It is a simple matter to confirm the observation that methylene blue as such penetrates normal living cells, provided proper methods are used.

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Photo-Decomposition of Molecules having Diffuse Band Spectra.

THE products of photo-decomposition of molecules showing diffuse discontinuous band absorption spectra (predissociation spectra) where, according to Bonhoeffer and Farkas (*Z. physik. Chem.*, **134**, 337; 1928), the light produces dissociation by internal energy exchange, without collision, can be studied readily in the case of ammonia.

If ammonia at a few millimetres pressure be introduced into a quartz tube containing the yellow tungstic oxide and the gas be illuminated with a hot mercury vapour arc, reduction to the blue oxide of tungsten occurs with a few minutes exposure. This ready reduction points to the presence of atomic hydrogen in the decomposition products. The result is not unequivocal, since there might be (Bates and Taylor, *J. Am. Chem. Soc.*, **49**, 2438; 1927) hydrazine formed in a stepwise decomposition of the ammonia, and it is known that hydrazine reduces tungstic oxide at room temperature.

The formation of atomic hydrogen is, however, indicated by the following experiment. Mixtures of ammonia gas, hydrogen, and carbon monoxide when streamed through a quartz tube illuminated by the mercury arc produce marked quantities of formaldehyde and also a considerable deposit upon the sides of the tube of a white solid, soluble in water, which appears to be hexamethylene tetramine. This reaction definitely points to a dissociation of ammonia yielding atomic hydrogen, since the activity of this latter in producing formaldehyde from hydrogen and carbon monoxide is well known (Taylor and Marshall, *J. Phys. Chem.*, **29**, 1140; 1925). This method of producing atomic hydrogen in controlled amounts by regulating the intensity of illumination of ammonia and other molecules showing diffuse spectra is well adapted to the study of reactions induced by introducing atomic hydrogen in various gas mixtures. Such studies are in progress here.

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Intensities in the Atmospheric Oxygen (Intercombination) Bands.

WE have made exact intensity measurements of the *A* group of the absorption bands of oxygen at λ7600 A. with the aid of the ' raster ' method of Frerichs,[1] using a 6·4 metre concave grating, infra-red sensitive plates, and three different lengths of light path, respectively 14, 33, and 60 metres. It was found that the exponential absorption law $J = J_0 e^{-kd}$ holds for these absorption lines; for the 33 metre light path, assuming that the peaks of our photograms can be identified with the true absorption co-efficient, we find for the strongest line an absorption $\frac{J_0 - J}{J_0}$ of 27 per cent.

Knowing the temperature of the absorbing gas (air, room temperature) and the true energies of the

rotational levels[2] it is possible to compute the transition probabilities of the rotational levels, since the Boltzmann factor is exactly known. According to Mulliken, these bands are a $^1\Sigma - {}^3\Sigma$ combination, the ground level of the molecule being the $^3\Sigma$ state. The lines obey the following relations:

$$P_2(j) = F'(j) - F_2''(j+1); \quad R_2(j) = F'(j) - F_2''(j-1)$$
$$P_3(j) = F'(j) - F_3''(j); \quad R_1(j) = F'(j) - F_1''(j)$$

The intensity relations (not hitherto known for intercombination bands of this type) which are found to hold are as follows (omitting the Boltzmann factor $e^{-E/kT}$)

Intensity of $P_2(j) = \frac{1}{2}(j+2)$ $\quad R_2(j) = \frac{1}{2}(j-1)$
$P_3(j) = \frac{1}{2}(j+1)$ $\quad R_1(j) = \frac{1}{2}(j)$

For small values of j, there are small deviations which we believe to be real and which are proportional to reciprocal values of j. The summation rule $P_2(j) + P_3(j) + R_2(j) + R_1(j) = 2j + 1$ is therefore obeyed only for the higher values of j. The mean error of the measurements, of which a full account will be given later in the *Zeits. f. Phys.*, is about 3-4 per cent.

W. H. J. CHILDS.
R. MECKE.

Physikalisches Institut d. Univ.,
Bonn, Feb. 20.

[1] R. Frerichs, *Zeits. f. Phys.*, **31**, 305; 1925.
[2] R. M. Badger u. R. Mecke, *Zeits. f. Phys.*, **60**, 59; 1930.

The Hybridity of *Drosophila melanogaster*.

I AM very much attracted by Prof. Jeffrey's remarks in NATURE of Mar. 15 on the hybridity of *Drosophila melanogaster*, partly because I also think hybridisation (internal or external) of great evolutionary importance. But the tangle of genetical and cytological literature has obscured so many of the issues involved that I feel Prof. Jeffrey would do us a great service in elaborating some of his ideas and defining others.

What, for example, is a hybrid? How are we to define it and how are we to recognise it? These are questions that Prof. Jeffrey with his clear-cut ideas will be able to answer directly. The working geneticist and cytologist cannot deal with them so easily. He cannot see the wood for the trees.

One would like to know also in simple terms how variation is connected with hybridity in, say, *Drosophila melanogaster* and *Œnothera Lamarckiana*? Is it what Mendelians call 'segregation'? Or is it due to crossing over? Or can we perhaps ascribe it to an irritability of the germ plasm induced by the hybrid condition? If we knew these things we might be able to make some notable generalisations.

Again, with regard to the pairing of chromosomes, I agree with Prof. Jeffrey in attaching great importance to failure of pairing, but I hesitate to give it a general cause. Does it happen for the same reason in *Drosophila*, *Œnothera*, *Drosera*, and *Tradescantia*? Perhaps Prof. Jeffrey can show that it is always due to hybridity, and that will be a great help in understanding meiosis. Perhaps he can show, also, that lagging chromosomes are always due to the same condition.

Finally the student would like to know what Prof. Jeffrey thinks of the criticisms of *Drosophila* workers, such as Metz, Bělař, Huettner, Guyénot and Naville, and Zuitin. Are their suggestions, that Prof. Jeffrey's lagging chromosomes in *Drosophila* are really cytoplasmic bodies, to be taken seriously, or are they merely irrelevant?

C. D. DARLINGTON.

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Raman Effect in Water.

IN a previous communication (NATURE, Nov. 16, 1929) the peculiar changes in the Raman bands for water in solutions of nitric acid were mentioned. Work with many other strong electrolytes, acids, bases, and salts, has confirmed this behaviour. Study of the bands with ice and with water at higher temperatures has revealed interesting features connected with this. Pure water gives three bands corresponding to infra-red wave-lengths of about 3·12, 2·93, and 2·79 μ, which are diffuse and merge into one another. In electrolytic solutions, however, these three bands become sharper with increasing concentration of the electrolyte. The band corresponding to 3·12 μ gradually diminishes in intensity until, in very concentrated solutions, it entirely disappears. On the other hand, the band corresponding to 2·79 μ, which is the weakest of the three in pure water, becomes stronger in intensity with increasing proportion of the electrolyte, until, in very strong solutions, it becomes equal in intensity to the central band, which is the most intense of the three in pure water.

A study of the variation with temperature of the distribution of the intensities of these three bands has shown a similar behaviour, the band corresponding to 3·12 μ diminishing in intensity with increasing temperature, while that for 2·79 μ increases. Crystalline ice has shown an entirely different behaviour. The intensity of the central band is the same as in water. But the band corresponding to 3·12 μ is stronger in intensity than in water, the band for 2·79 μ being weaker still in ice. Thus the behaviour of water in electrolytic solutions, instead of being similar to that in crystalline ice, is exactly opposite to it. It behaves more like water at higher temperatures. This is a surprising result, being contrary to existing ideas regarding the nature of water in solutions.

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Dipole Moment of some Organic Halides.

IN a note published in NATURE (Mar. 16, 1929), Prof. P. N. Ghosh pointed out from the results of Mahanti and Das Gupta (*Ind. Jour. Phys.*, **3**, 467; 1929) that the OH-radical is mainly responsible for producing the dipole moment in the case of the saturated normal alcohols, whether the carbon chain is open or closed, long or short. Recently (in a paper communicated to *Phys. Zeit.*) Mahanti has shown that the dipole moment is sensibly constant for a homologous series and its magnitude depends on the nature of the polar group, radical, or atom in the corresponding homologues. According to his view, all the alkyl chlorides should have a dipole moment of the order of 2×10^{-18} e.s.u. and the bromides of the order of $1{\cdot}79 \times 10^{-18}$ e.s.u. I have determined the dipole moments of a few organic halides by a heterodyne method and they agree well with the views and results of Mahanti. They are:

	$\mu \times 10^{18}$
Propyl chloride . . .	2·07
Allyl chloride	1·99
Propyl bromide . . .	1·78

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Earth Movements in the Delta of the Rhone.

By R. D. Oldham, F.R.S.

DELTAS are essentially areas of instability. The very existence of a large delta is dependent on changes of level of the land, and not merely a general subsidence, but a special local sinking of the deltaic region in comparison with the surrounding land. Nor is this all, for there can be few deltas, if any, in which the general movement in a downward direction has not been interrupted at intervals by one in the opposite direction, and in which more or less extensive areas of upraised alluvium cannot be found. To this rule the delta of the Rhone is no exception, but there is no other instance in which the amount of this change can be measured, or the date fixed at which it took place, with so close a degree of accuracy as can be done for some of the changes which have taken place at the mouth of the Rhone.

Readers of Nature may remember that this subject was referred to in articles on "Problems of the Rhone Delta", which appeared in the issues of July 4, 11, and 18, 1925. It was there pointed out that the geological work of M. G. Denizot had demonstrated an uplift of the land in the prehistoric past, by which the original alluvial deposit of the delta was raised to a level at which further accretion was brought to an end and an undulating land surface developed by denudation, a surface on which the Romans built their homes and monuments, and of which large areas are still in evidence, though a larger part has been buried under fresh deposits of alluvium formed at a later date. It was also pointed out that there was evidence of a subsidence of the land, amounting to about 5 metres, having taken place between the beginning of the eighth and the end of the ninth centuries. Since those articles were written, I have been able to collect a much larger volume of evidence bearing on the problems indicated in the earlier articles, and an epitome of the results, as they affect this question, of past changes of level, will probably be of interest.

The position of the mouth of the Rhone in Roman times can be fixed with certainty and a fairly close approach to precision from the maritime itinerary, first compiled in the first or second century of our era. It lay sixteen Roman miles from the port of Fossae Marianae, now represented by the seaside resort of Fos-sur-Mer, and this would bring it to the locality where is now the Grau de la Dent at the mouth of the Vieux Rhône, or channel occupied by the river during the seventeenth century, the existing sea coast being at this point almost coincident with the ancient shore line of pre-Roman and early Roman times. At Arles the channel of the Roman Rhone seems to have followed very closely the course of that in which it now flows, and local conditions preclude any wide departure from it. At about ten kilometres below Arles the channel can again be fixed within narrow limits; a spur of the gravels of the Crau puts an absolute bar on any course lying east of the present one, and within less than 3 kilometres to the west comes a spread of the old pre-Roman land surface carved out of the upraised alluvium. Within these narrow limits the Roman Rhone must have flowed, but below this there is no certainty, except that it never flowed past Passon or by any of the channels below that point, which have been followed at various times from the twelfth century to the present day. The most likely interpretation is that it followed the general course of the present Aube de Bouic to near the shore of the Étang de Vaccarès, thence southwards to the east of Fiélouse and the ruins of the Abbey of St. Ulmet, and then to the same general course as was followed by the last 8 or 10 kilometres of the seventeenth century channel, which is still known as the Vieux Rhône. Measured along this course, the thirty Roman miles given in the itinerary as the distance by river from the mouth to Arles, would correspond very closely with the actual length of channel.

With the end of the Roman dominion the records become scanty and fragmentary, until the close of the twelfth century, when we find an entirely different state of things. The seaport of Fossae had disappeared, the entrance to the main channel of navigation was at the mouth of what is now the Étang de Galéjon, on the western shore of which there is a group of low hills, then known as Odor, and later as La Roque. Passing this a broad stretch of inland lagoons was traversed to the neighbourhood of Passon, where further progress was only possible along a single channel, narrow and barely deep enough to admit even those vessels of small tonnage by which the bulk of the sea traffic of those days was carried. This channel, known as the Grau de Passon, led into a wider and more open one coming down from Arles, and was the cause of constant anxiety to the council of that city, for fear that it might become blocked by obstacles to navigation. Though called a 'grau', which at the present day would suggest the mouth of a river, the condition in the twelfth century was different; it is clear from later history that the real river did not flow this way, and did not reach the so-called grau until after the thirteenth century had run its course. The channel was a passage between two lagoons, through which little or no current flowed, and the question arises of how it could have originated. It is certain that nothing of the sort existed in Roman times and that the track of vessels bound for Arles did not then run up the Étang de Galéjon, and through that channel which is crossed by the railway from Arles to Port St. Louis, immediately south of the station of La Porcelette. Here a small irrigation canal, deriving from the river, is all that remains to mark what was once the main channel of navigation from Arles to the sea, then for a while of the river itself, continuing ultimately as a distributory until it was artificially closed, somewhere about 1640, and ultimately converted into an irrigation canal. There is but one way in which a narrow channel lying, as this did, between broader

spreads of water could have originated, and that is a general subsidence of the country and submergence of the lower levels ; the narrow passage was across the strip of higher ground, known as the Plan du Bourg, which may be described as the backbone of the country east of the Rhone. Besides the Grau de Passon, at least one other channel was opened across this barrier, but neither it nor any other, if such there were, was as deep or convenient for navigation.

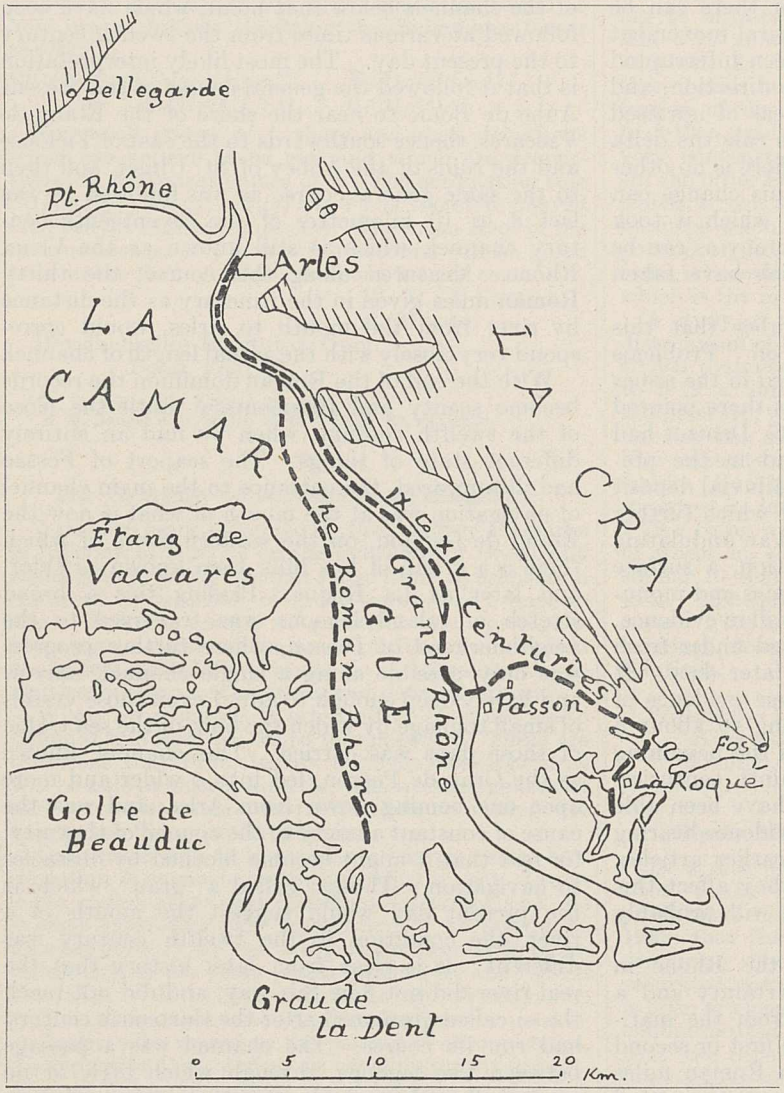

FIG. 1.—Map of the eastern delta showing the main channel of navigation between Arles and the sea in Roman and in early medieval times. The change from one to the other took place in the eighth century A.D.; the eastern channel became blocked by the advance of the river about the end of the fourteenth century. The course of the Roman Rhone across the Camargue has not yet been worked out in detail; that shown on the map is merely approximate.

Here, then, we have a definite means of measuring the amount of subsidence which took place. In Roman times the ground level of the bed of this channel must have stood above the flood level of the Rhone, and at the present day the flood waters of the Rhone near Passon reach a height of about 2·75 metres, from which we may conclude that the bottom of the channel must originally have been about 3 metres above the mean sea-level of Roman times. The depth of the channel at some time not later than the end of the fourteenth century was such that the bottom stood at about 2·75 metres below mean sea-level, and in the twelfth century would probably have been somewhat, though not materially, below this. Adding these two together, we have proof of a change of level amounting to nearly 6 metres in all, for, taking the shallowest part of the channel, where the solid land rose to its highest level along the depression, we find that a spot which up to the fifth century had stood about 3 metres above sea-level, in the twelfth lay about the same height below it, and this could only come about through a change in the relative height of land and sea, which may be described as a sinking of the land, or a rise of the sea, level, according to the point of view. Four years ago this figure seemed excessive for the town of Arles, where remains of Roman structures on the banks of the Rhone show that here also there has been a change of level, which appeared to have amounted to about 5 metres, but not more than that. In October last, however, when visiting Arles, I found the river standing at an unusually low level, and was able to examine the remains on the western bank more thoroughly than had previously been possible, with the result that the amount of change since Roman days must be raised to a figure of quite 6 metres, or possibly more. From this must be deducted an allowance for subsidence which took place in the eighteenth century of from a half to a whole metre, so that the evidence at Arles and at Passon confirm each other in showing that the eastern delta along the present course of the Rhone stood somewhere about 6 metres lower in the twelfth than it did in the earlier centuries of our era. Subsidence of this amount, in a region of such low-lying land and such low relief, must have had one result, that large areas of the lower levels would permanently sink below the level of the sea, and, as a further consequence, there would come into being a large area of shallow waters through which the river could extend its new delta with great rapidity. These new lands so formed gave rise to a number of disputes over their ownership, and from the evidence recorded and the maps which were made to illustrate the claims of one party or another, it has been possible to reconstruct the main outlines, and in some cases even the details, of the geography

of the country as it stood after the subsidence was complete, but before the river had re-established itself in its former territory. The result, however, has only been attained after a considerable search among the ancient records; made possible by the care which is taken in France of their archives and the unfailing courtesy of the archivists in charge.

The date at which this subsidence took place is as important and interesting as the amount, and so far as the eastern delta no new evidence has appeared beyond that referred to in the earlier article. At the beginning of the eighth century the port of Fossae Marianae—which by this time had dropped the second word of its title—was still a mart of importance, a port of destination for sea-borne commerce and, presumably, of transhipment into river-going craft. Its character was still the same as in Roman times, and we may conclude that the subsidence had either not yet commenced or, at any rate, had not gone far enough to affect the status of Fossae. From the middle of the ninth century we find the Passon channel in full use, and nothing more is heard of Fossae as a seaport, for it had been superseded by Arles, which had become a port of destination for the overseas commerce of those times. The bulk, if not the whole, of the change of level must have taken place between the commencement of the eighth and the latter half of the ninth century, and in the eastern delta the limit cannot be more closely drawn, but if we turn to the western delta we find that it also underwent a change of level comparable in amount with that which affected the eastern, and a charter of the year 788, conveying a grant of land to the Abbey of Psalmodi, shows that the subsidence, if not complete, was at any rate far advanced at that date. As the grant out of the customs of Fossae, made to the Abbey of Corbie in 716, shows that the subsidence had not yet made much progress, the two together put the bulk of the movement as having taken place within the limits of the eighth century, though doubtless overlapping it at either end, and this brief period of rapid change of level came between two much longer periods of little or no change.

Interesting as this would be in itself, it is by no means the whole story, for the maps of the eighteenth century make it clear that the latter part of that period saw a renewal of downward displacement of the level of the land, of shorter duration in time than that of the eighth century, and smaller in amount; the total change of level having been no more than a metre in all, and possibly less. More interesting, however, than this, is the distinct suggestion of a change of level, not very different in amount from that of the eighth century, having taken place somewhere about a thousand years before our era. The "Ora maritima" of Avienus, after describing the course of the Rhone from its source in the mountains, says that it enters a great marsh and mere, known in ancient times as Accion, and then, resuming its character as a river, gives off a branch towards the west. On this follows immediately the mention of the bifurcation of the river and of Arles, from which it is easy to fix the position of the lake Accion. Hereabouts it is known that there was a great spread of water in the Middle Ages which has largely been silted up, disappearing finally when the canal from Aiguesmortes to Beaucaire was constructed. This drained away the permanent standing water, and all that is left to preserve the memory of a lake which had been important enough to be shown on a portolan map of Petrus Vesconte, is a tract of marshy ground, lying east of Bellegarde. Though occupying the same position, this medieval lake cannot be accepted as a continuation, but must rather be regarded as a successor of that mentioned by Avienus, though not by the Roman geographers of the first century or by later writers, even those contemporaneous with Avienus himself. In this there is nothing either of contradiction or inconsistency, for the "Ora maritima", though composed in the fifth century, was avowedly based on an ancient record, which modern scholarship has recognised as a Greek 'periplus' of about 600 B.C., revised in part and at intervals of later date. It is to this period that the lake Accion must be referred, which

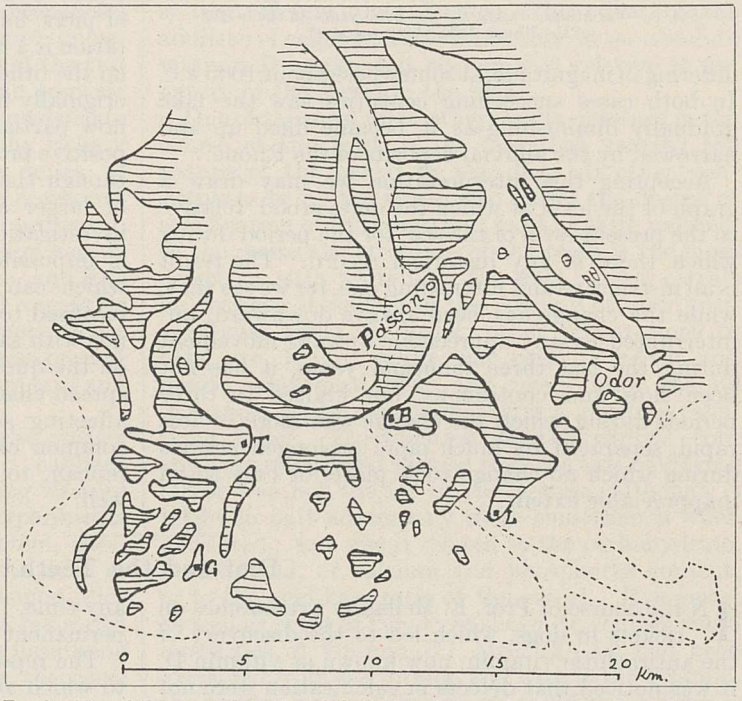

FIG. 2.—Map of the seaward portion of the eastern delta, as it was from the ninth to the thirteenth century. The representation is necessarily approximate and somewhat diagrammatic; the actual outline must have been more intricate, and many small islands, not shown, must have existed, but nothing is represented for which there is not some authority, and nothing of material importance is likely to be missing. *B*, *T*, *G*, *L*, sites of the Tours de Bolovard (1469), Timpan (1606), St. Genest (1656), and St. Louis (1736), built by the town of Arles to guard the channels successively adopted by the Rhone.

had dwindled, in later Roman times, to a condition not unlike that of the marshes of Bellegarde before they were drained in the eighteenth century. History, in fact, seems to have repeated itself twice in this period, and the great spread of water which may be inferred as having been originated by the eighth-century subsidence, was preceded by a similar one, resulting from a subsidence, not greatly

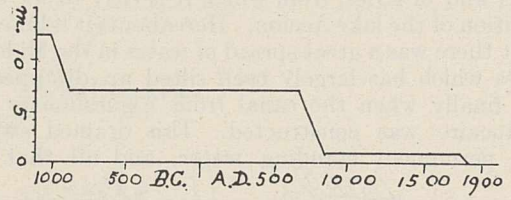

FIG. 3.—Variations, during the last 3000 years, in the height of the Rhone delta above sea-level.

differing in magnitude, at somewhere about 1000 B.C. In both cases succeeding centuries saw the lake gradually diminishing as it became filled up and narrowed by the alluvial deposits of the Rhone.

Accepting this interpretation we may draw a graph of the level at which the delta stood, relative to the present level of the sea, for the period during which there is any historical record. The result is an instructive and interesting one, for we see that, while the change has been always downward, uninterrupted by any appreciable upward movement during the last three thousand years, it has not been slow and continuous, but limited to three periods during which the change was more or less rapid, separated by much more prolonged periods during which no change took place, or only to an inappreciable extent.

It is natural to inquire whether these changes were localised in the delta of the Rhone, or formed part of a widespread change in the level of the Mediterranean. It is scarcely possible that a change of 20 feet at Passon would not have extended so far as Fos, only ten miles away, and this may well be the explanation of the fact that an important and prosperous town, such as was Fossae Marianae in its prime, has left no remains of buildings adequate to its former importance, the site of the docks, warehouses, and public buildings having sunk beneath the sea. Farther afield, however, the evidence becomes contradictory and unconvincing; on one hand there is the existence, at several places along the coast, of Roman constructions, which archæologists have described as the remains of piers, harbours, and fish-stews, but the interpretation is a matter of opinion and open to argument; on the other hand, there are structures which must originally have been built above sea-level, and are now partially submerged, but none of these gives positive proof of more than a very few feet of change, though they are not inconsistent with movement of larger amount. The question calls for fuller investigation, and until this has been carried out it is impossible to assert that the changes of level which can be recognised in the deltas were not localised to that region; for the present they cannot with safety be regarded as having any bearing on the question of whether there has been a widespread change in the relative level of land and sea, affecting simultaneously and as the result of a common cause any large fraction of the Mediterranean, to say nothing of the Atlantic Ocean as well.

Diet and the Teeth.[1]

IN the course of Prof. E. Mellanby's researches on rickets in dogs, which led to the discovery of the antirachitic vitamin, now known as vitamin D, it was noticed that defects in calcification were not confined to the long bones, but occurred also in the jaws and teeth of animals maintained on defective diets. Mrs. Mellanby followed up this point, and during the last decade has published numerous papers upon the influence of the diet upon the teeth, and also upon the relationship between dental structure and disease. A detailed account of this work is in preparation, and is being published in three parts: the present volume is the first of the series and is being followed by Part II., upon dental structure in other animals than the dog, and upon the production of dental disease, and by Part III., upon the structure of human teeth and the relationship between structure and caries.

The dog was selected as the experimental animal of choice, since wide variations of dental structure can be readily produced: it is, moreover, omnivorous, like man, and can be readily kept in health under strict laboratory conditions; it is easy to handle, and its teeth can be readily examined at any time. Like man also it shows a deciduous and permanent dentition.

The report describes in detail the various points to which attention was paid in each of the experimental animals; notes were made of the general health as well as of the condition of the mouth; macroscopic examination of the teeth and radiographs of the jaws and teeth during life were followed by microscopic examination of the teeth and related structures post-mortem, special attention being directed to the large carnassials in the upper and lower jaws. The various grades of calcification are best studied in photomicrographs of ground sections of the teeth, of which numerous excellent reproductions are included in the report; at the same time enlarged photographs of the crowns readily show up deficiencies in calcification of the enamel.

The standard basal diet used throughout had the following composition: cooked cereal 100-200 gm., separated milk powder 10-30 gm., raw 'lean' meat 10-20 gm., oil or fat 10 c.c., orange juice 3-5 c.c., brewer's yeast 5-10 gm., and sodium chloride 1-4 gm. If 3 c.c. of the oil consists of cod-liver oil, perfect health and perfect dental structure are observed, indicating that the diet is now adequate. Small quantities of fat-soluble vitamin occur in the milk

[1] Medical Research Council. Special Report Series No. 140: Diet and the Teeth, an Experimental Study. Part 1: Dental Structure in Dogs. By May Mellanby. Pp. 308+109 plates. (London: H.M. Stationery Office, 1929.) 17s. 6d. net.

powder and in the fat remaining between the fibres of the lean meat, but not sufficient to prevent the development of marked rickets and gross defects in dental structure when the fat used contains little or none of this factor.

The following influence the structure of the teeth: the diet, especially its vitamin D, calcium and phosphorus and cereal content; the rate of growth and previous dietetic history of the animal or its mother and certain environmental conditions. Of these the most important is the vitamin D intake.

When this work was begun, vitamin D had not been differentiated from vitamin A; many experiments were carried out to determine the distribution amongst foodstuffs of the calcifying factor; in general it was found in foods which were known also to be sources of vitamin A, but certain discrepancies were observed, which in the light of later knowledge are readily explained by the fact that the two vitamins are different entities. In some respects the tooth of the dog appears to form a more delicate test for the calcifying vitamin than the rickety rat, differences in potency among a series of vegetable oils being readily observed; thus coconut oil contains a fair quantity, and it is also present in some samples of arachis oil; rapeseed, palm kernel, and cottonseed oils contain little or none, and it is absent from olive and linseed oils and vegetable margarines. Certain animal fats form much richer sources, most notably cod-liver oil; it is also present in beef-suet and butter, but is absent from lard and hydrogenated animal fats.

Calcification of the teeth and jaws is also greatly improved by whole milk and egg-yolk; cabbage may have a slight effect, but no calcifying vitamin was detected in carrot; and extensive experiments showed that protein, such as meat protein, caseinogen, eggwhite or legumes, carbohydrate, such as glucose or a diastatic digest of a cereal, lemon-juice (as a rich source of vitamin C) and yeast (as a rich source of vitamin B) had no influence in improving the structure of the teeth of puppies on the basal diet.

Mammalian liver-fat, which contains abundant vitamin A, had little effect on calcification; complementary to this result is the more recent finding that irradiated ergosterol, a source of vitamin D unmixed with vitamin A, exerts an extremely powerful influence upon the calcification of the teeth.

Vitamin D was found to be destroyed by prolonged exposure to heat with simultaneous oxygenation of the fat containing it, the actual conditions necessary depending on the fat treated; at the same time some evidence was obtained that harmful products were actually produced by this treatment in cod-liver oil and butter. Methylation of cod-liver oil also resulted in considerable destruction.

Since the hardness of bones and teeth is due to their content of calcium and phosphorus deposited as inorganic salts in the original organic matrix, it is clear that the diet must contain both these elements if calcification is to proceed normally. The experiments of Mrs. Mellanby have indicated, however, that the amount of each present in the diet and the Ca : P ratio are of little significance in promoting or hindering calcification as compared with the intake of vitamin D. In the rat, on the other hand, rickets cannot be produced unless the Ca : P ratio is high. In puppies, when vitamin D is abundant in the diet, perfect calcification of the teeth occurs even when the calcium intake is very low; on the other hand, when the vitamin D intake is moderate or low, addition of a calcium salt, such as the carbonate or phosphate, results in definite improvement of calcification. Thus butter containing moderate amounts of vitamin D is more effective as a calcifying agent when separated milk is added to the diet, the latter acting as a source of calcium, and butterfat which contains no calcium is less efficient than butter. The effect of the addition of calcium depends not only on the absolute vitamin D intake, but also on that relative to the nature of the cereal in the diet.

One of the most interesting results obtained in the course of the work is the fact that varying the nature of the cereal in the diet, all other constituents being the same, also varies the degree of calcification of the bones and teeth. With oatmeal as the cereal the structure of the teeth is the most defective, with white flour the least; other cereals lie between these two in the potency of their anti-calcifying effect, in order, other preparations of oats, rye, barley, maize, the germ of wheat and maize, wholemeal flour and rice; bran has no influence, whilst rye germ exerts a positive calcifying effect. Examination of the various constituents of oatmeal showed that the anti-calcifying factor was not the fat or the protein, although it might in part accompany these constituents when extracted; nor was it related to the carbohydrate, nucleic acid, or calcium and phosphorus content, or to the acid-base ratio of the cereal. Rye germ, as well as ergot of rye, were shown to contain small quantities of vitamin D; after the fat had been extracted from the former, and with it the vitamin, the residue had a definite anti-calcifying influence. Destruction of this factor occurred on heating the cereal with 1 per cent hydrochloric acid or caustic soda for $1\frac{1}{2}$ hours; heating alone had little effect. Malting also resulted in some destruction, provided the germinated cereal was allowed to stand for a few days before consumption.

Since the cereal forms the chief energy producing constituent of the diet, varying its amount in the diet varies also the number of calories available, and within limits, the growth rate of the puppy. On the same diet more rapidly growing animals have worse calcified teeth than those growing more slowly; hence, to obtain comparable results, it is necessary to limit the food consumption of a series of animals to that of the one with the smallest appetite.

Experiments on the influence of environment on tooth calcification indicated that confinement played no part; the important factor in this connexion is exposure to sunshine. Similarly, irradiation of the animal by a mercury-vapour lamp resulted in improved calcification, but under the

conditions used was not so effective as adding cod-liver oil to the diet; irradiation of various food materials also improved their calcifying action: for example, olive oil, butterfat, oatmeal, and maize germ, due to the production of vitamin D from the ergosterol present in them; as was to be expected, even small amounts of irradiated ergosterol can give nearly perfect calcification.

Vitamin D can be stored in the body; hence offspring from a mother well supplied with it show greater resistance to an imperfect diet than young from a mother kept herself on this diet; evidence was obtained that the mother supplies the young from her own stores when her intake is deficient. The structure of a tooth is permanent, so that variations in the diet at different periods will be reflected in variations in its structure; in contradistinction, imperfectly calcified bone will be reabsorbed when the diet is improved. Improvement of a bad diet will be reflected immediately in improved calcification of the later-formed dentine; but a change from a good to a bad diet will have little immediate effect, owing to the availability of the body's stores of vitamin D.

The work here presented proves convincingly that the structure of the teeth of puppies depends almost entirely upon the intake of vitamin D. Even although the diet given was soft and pappy, perfectly formed teeth and well-developed jaws were produced, provided a sufficiency of the vitamin was given. Exercise of the jaws appears to depend upon the general health; giving an animal something hard to gnaw will not produce well-developed jaws when the vitamin intake is low.

The application of these results to man and the relationship of structure to dental disease will form the subjects of Parts II. and III. of Mrs. Mellanby's reports. Considering that rickets occurs in both man and the dog, it might be expected that diet would have an influence upon the structure of human teeth. Caries of the teeth, however, does not occur in the latter, so that a relationship between this disease and structure must be determined in other animals or in man himself. Some evidence of such a relationship has already been published (see, for example, the *British Dental Journal*, 1928; July 15); the final reports will be awaited with interest, owing to the importance of such a conclusion for the prevention of human dental disease.

Obituary.

PROF. AUGUSTINE HENRY.

AUGUSTINE HENRY was born on July 2, 1857, coming of an old Derry family, and possessing to the full the delightful characteristics of the Irish race. He was educated at Queen's College, Galway and Belfast, and was trained as a medical man, being L.R.C.P., Edinburgh. He began his career as an attached medical officer of the Chinese Imperial Customs at Shanghai. In 1882 he was appointed in this capacity to the Customs Station at Ichang on the Yangtze, where he remained for seven years. Here he commenced to interest himself in the flora, following in the footsteps of earlier medical officers in India, such as Wallich, Falconer, Cleghorn, Hooker, etc. As with these officers, it was doubtless the medicinal possibilities of the many unknown plants which aroused Henry's interest at the outset. Even more than in India, China is the home of the *materia medica*, the great therapeutic value of many bulbs, roots, and leaves of common plants being known to the Chinese. The legendary Emperor, Chennung, was, so tradition has it, a great exponent of the medicinal values of plants. So keen was this interest that it is said that Chennung had a glass window fitted into the wall of his stomach in order to study the reactions of different plants on the alimentary system! Henry will be remembered in horticultural circles as the introducer of the beautiful *Lilium Henryi* and many other Chinese plants.

It was during his sojourn at Ichang that Henry commenced his explorations and investigations into the flora, and thus became the first of a select band of adventurous spirits who investigated the flora of central and western China. One predecessor there had been, Robert Fortune, who first went to China in 1842 to collect plants for the Royal Horticultural Society, and afterwards, in 1848, on behalf of the East India Company, introduced the tea plant into India. But Fortune's work was carried on in other parts of China. Henry's collections were chiefly of dried plants, and he wisely sent those first made to Kew, where they were received by Thiselton-Dyer with high appreciation: for their examination soon showed that a new flora was being tapped. For example, the collections from Hupeh (made in 1888), a botanically unexplored country, were found to contain 500 new species of plants and 20 new genera. It was here that Henry came across the flowering tree *Davidia*. This is now well known in Great Britain, but the seed was not sent home by Henry. Veitch, of Chelsea, sent out E. H. Wilson, who afterwards became famous for his collecting work, and the latter obtained the seed.

After a year's leave at home, where Henry found himself eagerly welcomed in botanical circles, he returned to Shanghai, and was soon transferred to Formosa (which had not then been made over to Japan). During three years spent there he collected assiduously and greatly enriched our knowledge of Formosan plants, publishing later a first account of the flora of Formosa. Henry had for some time previously ceased to practise medicine. In 1896, Sir Robert Hart transferred him to Mengtse in southern Yunnan. In this region he collected extensively, and sent home large collections containing many new species. He discovered the wild tea plant whilst exploring the virgin forests in the mountains south of the Red River in south-east Yunnan. This plant had not previously been discovered out of Assam. He was afterwards stationed at Szemao, where his

inexhaustible energy resulted in collections of equally rare and interesting plants.

During his numerous explorations Henry's interest had been aroused in trees and in the forests. When he finally returned home in 1900, after having accomplished what would have satisfied many men as a life's work, he therefore determined to study forestry. For this purpose, being then forty-five years old, he joined the French Forestry School at Nancy, where he passed nearly two years, 1902–3. It was in the latter year that, being on furlough, I accompanied the senior class of that school on a tour of the Vosges and first met Henry, who formed one of the class. To those who knew that delightful personality, it will be unnecessary to say that Henry was the life and soul of the party, and his quaint Irishisms and anecdotes, rendered into French with a rich Irish brogue, were an unfailing source of merriment.

In connexion with his forest work, Henry will be chiefly remembered for his collaboration with the late H. J. Elwes in producing the great standard work on "The Trees of Great Britain and Ireland", which was published in parts between 1906 and 1913.

It was whilst engaged on this work that Henry was appointed to the first readership in forestry founded in 1907 in the new School of Forestry at Cambridge. From that appointment he started a second life's work. At Cambridge he was chiefly interested in carrying out breeding experiments connected with trees, chiefly elms, on Mendelian lines—a piece of research work which, for some purposes, may have practical results. In 1913, Henry was appointed professor of forestry in the College of Science, Dublin, the chair being afterwards absorbed (in 1926) in the Irish National University. In addition to the "Trees of Great Britain" he published "Forests and Trees in Relation to Hygiene", and many papers in the *Kew Bulletin* and other scientific publications. His travels, apart from China, in the forests of North America and a considerable portion of Europe, gave him an intimate knowledge of the species of trees of many types, a knowledge which was ever at the disposal of all.

Henry had a wide circle of friends in many walks of life, and many will remember the kindly face, great energy, and ever ready humour which rendered so many excursions of the Royal Arboricultural Societies the more enjoyable for his company.

E. P. STEBBING.

PROF. F. V. THEOBALD.

FREDERICK VINCENT THEOBALD died on Thursday, Mar. 6, at his residence, Wye Court, Wye, Kent, at sixty-one years of age. Though a comparatively young man, he had not had good health for some time, being very susceptible to chills. Last Easter he made a marvellous recovery from pneumonia, but it undoubtedly left its mark in the form of a weakened heart. Some six weeks ago, when about to leave the house for a much-needed change, he became ill and was ordered to bed. He seemed to be progressing satisfactorily when bronchitis set in, and this in his weakened state led to his death.

The son of the late J. P. Theobald of Kingston-upon-Thames, Theobald's early days were passed at his home and at St. Leonards. He then went to St. John's College, Cambridge. From a very early age he was attracted to all forms of Nature study, and at the early age of eight, with childish enthusiasm, he set himself the task of writing the "Fauna of Sussex". The pages in a boyish handwriting showed such promise that his parents deemed them worthy of binding, and they form an interesting first volume to his many subsequent works.

Of Theobald's later entomological work much could be written. After taking his degree he became an extension lecturer in economic zoology for the University of Cambridge, but on the opening of the South-Eastern Agricultural College in 1894 he gave this up, taking up the post of lecturer in agricultural zoology at Wye.

Besides the many reports of economic entomology which have appeared from Theobald's pen, he published "Agricultural Zoology", a standard text-book, and "Insect Pests of Fruit", a large reference work which soon found favour amongst the fruit-growers not only of Kent but also of Britain generally. About this time he was also engaged upon work on mosquitoes, and having completed his "Monograph of the Mosquitoes of the World", he turned his attention to the Aphidiæ. This was some twenty years ago, and although the third and last volume of his monograph on the "Plant Lice or Aphidæ of Great Britain" appeared a year ago, he was still at work upon the group at the time of his death.

Among the numerous scientific distinctions which came Theobald's way were the election to honorary membership of the Société nationale d'Acclimatation de France, from which he received the Grande Médaille Isidore Geoffroy Saint-Hilaire; Société pour l'Étude Agriculturale Zoologique de Bordeaux; Société de Médicine tropicale de Paris; Association of Economic Entomologists of the United States, and the Royal Horticultural Society of Britain, etc. He was made an Officer of the Imperial Ottoman Order of the Osmanieh; he was also a Mary Kingsley medallist (University of Liverpool) and a fellow of the Entomological Society of London; only a few years ago he was presented with the Victoria gold medal of honour of the Royal Horticultural Society. He was also an early president of the Society of Economic Biologists; and at one time was vice-principal of the South-Eastern Agricultural College.

From 1900 to 1904 Theobald was entrusted with the arrangement of the economic zoology collection at the British Museum and resigned his agricultural zoology professorship in the University of London. In 1920 he ceased to hold the post of lecturer at Wye College, devoting his time to advisory and research work under the Ministry of Agriculture, and though this work was primarily for the south-eastern province of England, he had much correspondence from other parts of the world.

Theobald was not a collector in the ordinary sense of the word, and was always against the formation of mere collections of dried insects; he got together, however, what is probably the finest collection in existence of insects of economic importance, showing the various stages and damage done by these pests. In his work he may at times have appeared too hasty in his summing up of obscure matters and so opened himself to criticism, but in time his critics were usually compelled to come round to his way of thinking.

Of a kindly and genial nature, Theobald was always more than ready to help with advice those who came to him for assistance, and the present writer, who had the privilege of being in close touch with him for nineteen years, will always be grateful to him for his ever-ready help. He was buried in Wye Churchyard on Monday, Mar. 10, being borne from the house by colleagues and students of the College to which he had given so much of his time. C. A. W. D.

WE regret to announce the death in his sixty-second year of Prof. Robert Franz Pschorr, which occurred quite unexpectedly on Feb. 23 in Munich. Prof. Pschorr occupied the chair of organic chemistry at the Technical High School in Charlottenburg. From the *Chemiker-Zeitung* we learn the following particulars of his career. Born and educated in Munich, he began the study of chemistry there under Adolph von Baeyer. Part of his student course was also spent with Bamberger at Zurich and with Knorr at Jena, where he graduated in 1893. Attracted to Berlin by Emil Fischer, he began there his well-known work on the synthesis of derivatives of phenanthrene, which at once established his reputation. Thereafter Pschorr's chief interest lay in the investigation of the constitution of the alkaloids derived from phenanthrene. Shortly after his arrival in Berlin, Pschorr was appointed to a responsible position in the University Chemical Institute, and in 1914 he was elected to succeed Liebermann at Charlottenburg. During his later years he devoted considerable attention to the investigation of coal-tar. He interested himself greatly in the student-life of Berlin, and became the first president of the students' hostel at Charlottenburg. He was the recipient of many academic honours, and was one of the editors of the *Berichte der deutschen chemischen Gesellschaft*.

WE regret to announce the following deaths:

Prof. G. A. Gibson, emeritus professor of mathematics in the University of Glasgow, aged seventy-one years.

M. Armand Solvay, president of the Société Solvay, and honorary member of the Society of Chemical Industry, who was the son of Ernest Solvay, the pioneer of the ammonia soda process, on Feb. 2, aged sixty-three years.

Dr. J. W. L. Spence, who was associated with Röntgen in his early investigation of X-rays, and was one of the founders of the Radiological Department of Edinburgh Infirmary, on Mar. 15.

Sir David Wilson, Bart., honorary treasurer and formerly chairman of directors and convener of the science committee of the Highland and Agricultural Society of Scotland, on Mar. 8, aged seventy-four years.

News and Views.

MR. RICHARD INWARDS, pioneer in mining and related operations in various parts of the world, celebrates his ninetieth birthday on April 22, an event the more auspicious in view of his maintenance of personal vigour. Born at Houghton Regis and educated at Soulbury, Mr. Inwards early engaged in and afterwards adopted as a career mining prospection work, allied also with managerial duties. He has reported on mining enterprises in Great Britain, Norway, Portugal, Austria, South America, and Mexico; indeed we think he has an even wider range of countries to his credit. Elected president of the Royal Meteorological Society in 1894, Mr. Inwards served for two years; his presidential addresses were entitled respectively, "Some Phenomena of the Upper Air", and "Weather Fallacies". He was also author of an interesting paper "Turner's Representations of Lightning", showing that the artist's representations might be placed side by side with photographs of lightning, and would be found to convey faithfully to the mind all that the highest powers of sight can perceive in the phenomena. Mr. Inwards once wrote regarding popular weather prophets: "The stock-in-trade of a prophet is of a slender and cheap description. He must have an inventive mind, a store of self-confidence, a keen memory for successes, and a prompt forgetfulness of failures." Mr. Inwards has been a fellow of the Royal Astronomical Society for many years.

CLASSICAL education, as a contribution to general culture of the mind, is by no means to be held in small repute by those whose training has directed them into scientific channels of thought. We sympathise with the view that everyone, including the scientific worker, has much to learn from the classics, and here we evidently have the support of the Archbishop of York, who discussed the matter in his presidential address to the Classical Association on "The Distinctive Excellencies of Greek and Latin". To look back on to a past age, to examine and to assimilate something of the spirit of the sources of our present-day civilisation, is a delight and a profitable recreation such as we could wish all members of the scientific professions to enjoy, for the distinctive excellencies of Greek and Latin are unquestionable. In so far as there are schools whence youth passes out into the world primed with scientific facts and figures but ignorant almost of the very existence of ancient civilisations, we would support the claims of the humanities—literature, history, philosophy—to recognition, but we would also remind Dr. Temple that there are places where neither the plea nor the support is necessary, where it is the

scientific spirit that is being stifled in a stuffy atmosphere heavy with the odours of the past. Dr. Temple goes further than we can follow when he expresses alarm at the non-classical educational trend of Great Britain. There is nothing to get alarmed about in the spread of an honest search for knowledge ; indeed, our feeling of alarm is reserved for the consequences of forgetting that the need of a scientific age is a scientific education.

IT is all very well to say that except for those who are to be specialists in the study or application of the natural sciences it is more important to know about European civilisation than to know about the solar system ; but the inference that the advance of civilisation is not very closely dependent on the progress of science is one which few students of mankind will admit. It is no doubt also very true to say that the most important of any human being's relationships are those between himself and his God, and those between himself and his neighbours. There is, however, no prohibition of the use of a more strictly theological term to express the scientific worker's 'ultimate cause', no monopoly of a sense of the wonder and power of which no one is more acutely aware than the student of science ; whilst as for a man's relations with his neighbours, what better apprenticeship could he serve than that which demands of him exceptional patience and the strictest integrity, and encourages him to regard his fellows as members of an international fraternity ? Does he think too highly of his ability, an hour's study of astronomy will convince him of his impotence. Is he unaware of the powers that are at his command, chemistry, medicine, engineering will teach him more than will Greek and Latin. Let him first learn his own language, learn to love it and learn to use it ; then let him turn to foreign tongues, to such foreign tongues as are used to disclose man's mind to-day. Above all, let him remember that the quest of truth will outlast himself, his generation, even his civilisation ; that his dreams, his arts and his literature, however beautiful, may be forgotten a thousand years hence when men are still building on the scientific foundations he has laid to-day.

NOT very long ago the public, or at least that part of it which has any care for the beauties of the countryside, was shocked at the ravages of quarrying operations at Malvern. A project of a similar nature but even more serious in its consequences is contemplated in Northumberland. It will affect five miles of the finest stretch of Hadrian's Wall. A company is to be formed to quarry the whinsill dyke in the neighbourhood of Shields-on-the-Wall, Pell Crag, and Housesteads. The site of the projected quarries includes the finest and most characteristic of the Wall scenery. About 200,000 tons of material will be removed annually, and eventually, it is estimated, 100,000,000 tons of whinstone will be taken away. Although it is difficult to forecast the ultimate effect of its removal on the land surface, it is certain that the landscape will be completely transformed and the meaning of the Wall utterly obscured. The relation to the surrounding country, which determined the siting of the Wall as a defensive work, will vanish with inestimable loss to the study of Roman culture and military science in Britain. The Wall will be left on the edge of a high cliff and be quite inaccessible from the south, for in some places quarrying may proceed to a depth of as much as 400 ft. The beautiful scenery thus to be obliterated includes land around the fort at Housesteads, the Borcovicus of Roman times, lately presented to the National Trust by Mr. J. M. Clayton.

A VIGOROUS resolution of protest has been framed by the Council of the Society of Antiquaries of Newcastle-on-Tyne ; but the proposal is a calamity which calls for nothing less than a national protest. The Wall, like Stonehenge, is essentially a characteristic element in the history of British culture. The magnitude of the financial interests involved should not be allowed to stand in the way of its safety and it should be saved as Stonehenge was saved in similar circumstances. Hadrian's Wall has been scheduled as an 'ancient monument' ; but the existing law does not allow the surrounding countryside to be protected in this manner. In a clash of historical and economic interests of this magnitude, pressure should come from the nation as a whole to secure that commercial considerations should give way and the law be amended to make it possible not only for the country adjoining the Wall and forming an integral part of the ancient line of defence to be declared a national park, but also that legal provisions should be so framed as to make any similar situation impossible in the future.

As we have already announced, an exhibition of objects illustrating the culture of Zimbabwe opened in the Assyrian Basement of the British Museum on April 7. Among the chief contributors are the British Museum, the South African Museum of Cape Town, the Rhodesian Museum, Bulawayo, and the Queen Victoria Memorial Museum, Salisbury. The recent excavations of Miss Caton Thompson at Zimbabwe and of Mr. A. L. Armstrong at Bambata, preparatory to the visit of the British Association to South Africa, are well represented. It is intended that the exhibition should afford material for comparison with objects of a similar character from other parts of Africa. Among the most interesting objects shown are those of carved soapstone. These include examples of the birds of prey, about two feet high, which originally formed the end ornaments of the perpendicular beams crowning the walls of the elliptical temple. Four of these are shown with the stone pedestals of others which are decorated with various linear patterns—herring bone, basketry, chevrons, and lozenges. A short soapstone cylinder decorated with 'rosettes' is thought by some to be a symbol of fertility. Most remarkable for their decoration are the large flat soapstone trays, almost all of them broken in fragments. On the exterior of the raised rims is carving in medium relief. Sometimes this imitates the appearance of plaited grass trays of similar shape, sometimes it shows scenes of animal life, especially long-horned cattle. One of the most remarkable is a hunting scene in which the hunter and his dog, baboons, a bird, and zebra appear. This was published in the *Times* of April 7, accompanying an article by Prof. J. L. Myres, in which he summarised the results

of Miss Caton Thompson's work in their bearing on the problem of the origin and date of Zimbabwe.

THE Minister of Health, Mr. Arthur Greenwood, announced in the House of Commons on April 9 that the committee on post-graduate medical education, composed of fourteen leading physicians and surgeons appointed by his predecessor, Mr. Neville Chamberlain, in July 1925, has issued a report recommending the establishment of a British Post-Graduate Hospital and Medical School. The possibility of converting the West London Hospital, which does not possess a medical school, had first been considered by the committee, but it was found that the capital cost of conversion and equipment would not be less than £400,000, while the cost of maintenance would be at least £100,000 a year exclusive of the medical school. Moreover, the site, covering only 2½ acres, did not allow of any further expansion. The hospital finally chosen was the Hammersmith Hospital in Ducane Road, built in 1905, containing 400 beds in modern wards, which was transferred from the now extinct Boards of Guardians to the London County Council on April 1. The hospital will continue to be supported by the rates, and the Government has decided to contribute from the public funds a sum of £250,000 for building and equipping a medical school as well as to provide grants for its maintenance through the University of London. An appeal will shortly be made to the public for funds to establish a residential hostel in the centre of London for the use of students of both sexes, not only in medicine but also in other arts and sciences, from the Dominions and Colonies. The Committee's report has been published by His Majesty's Stationery Office as a White Paper (9*d*. net).

THE Radium Commission has issued a statement on the progress of the national organisation which it is engaged in setting up. The cardinal feature of the Commission's policy has been the concentration of national radium at a limited number of centres in England, Scotland, and Wales, where there are medical schools with complete clinical courses, and where treatment of patients can be combined with education in approved methods of radium therapy. Of these centres 12 have already been nominated, and will be recognised as 'National Radium Centres' as soon as they have complied with the requirements of the Commission. They are as follows :—Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Sheffield, Aberdeen, Dundee, Edinburgh, Glasgow, and Cardiff. In every instance the channel of communication between the Commission and the centre is the medical faculty of the local university, and loans of radium are being restricted in each area to one hospital selected by the faculty. By these means it should prove possible to avoid the dangers and futilities of splitting up the limited national stock of radium into small quantities, which would not only give ineffective results, but also contribute little, if anything, to a national controlled and co-ordinated study and practice of radium therapy.

LONDON has been treated as a separate and special problem, in view of its position as the metropolis of the whole country. Here no centre of the normal type is being set up, but steps have been taken to organise two centres to carry out special work of general and national importance. One of these, the Westminster Hospital, has been experimenting, on behalf of the Commission, for several months past with a 'bomb' (containing 4 gm. of radium), in order to determine the value of long-distance radium therapy. The other London centre which is being organised by the Commission is one for the development of post-graduate teaching in radium therapy—a prime and urgent need—and the facilities which will be provided will be available for the benefit of qualified medical practitioners from any part of Great Britain. This centre will be located at the Radium Institute and the Mount Vernon Hospital (Northwood), which institutes for these purposes are being reorganised as a joint teaching centre styled the "Mount Vernon and Radium Institute", under a single control, so far as medical services, teaching, and research are concerned.

MR. HENRY TWITCHIN, who died at Nice on Mar. 19, has left the whole of his property, with the exception of certain minor legacies, to the Eugenics Society. The bequest is accompanied by no conditions, except that the capital is to remain intact. Mr. Twitchin, who came of an English farming family, settled in Western Australia, and came to own two large stations. His attention was attracted to eugenics by his own personal experiences as a pastoralist, and probably by a belief that he himself suffered in health from hereditary defects. He was, therefore, above all things anxious that eugenists should be practical in their aims, fully believing that we now know enough to advance safely in many directions. He had for many years subscribed generously to the Eugenics Society, but insisted on remaining strictly anonymous. His aim was to benefit mankind, without winning any notoriety for himself. The value of the bequest is not yet known, but it will probably be not very far short of £100,000.

AN important contribution to the proposals which have recently been made for the reform of the British patent system is furnished in a memorandum issued by a joint chemical committee representing the Association of British Chemical Manufacturers, the Chemical Society, the Faraday Society, the Federal Council for Chemistry, the Institute of Chemistry, the Institution of Chemical Engineers, the Society of Chemical Industry and the Society of Dyers and Colourists. The memorandum, like other similar documents of the past year or two, is based upon the report of the Patent Law Reform Committee of the British Science Guild, and is admirably drawn up. The proposals are classified into 'major', 'minor', and 'controversial', the latter class comprising those in which the committee differs from the conclusions reached by the British Science Guild. A valuable feature of the memorandum lies in the concrete suggestions which it puts forward for the amendment of various sections of the Patents Acts; it is distinctly advantageous to have a definite form of words

as a basis for discussion on such subjects. Further, the memorandum supplements the Guild's proposals in respect of some matters, of special interest to chemists, which were somewhat overlooked in the parent report.

AMONG the more important of the Joint Chemical Committee's recommendations the following may be mentioned: (1) Extension of the Patent Office search to cover a wider field than at present; (2) restriction on the granting of 'selection patents'; (3) extension of the Comptroller's judicial powers, by the introduction of a new ground of opposition ('no manner of manufacture'); (4) restrictions on 'user patents' and on unduly wide claims. The memorandum does not favour the suggested introduction of 'short term patents' (*Gebrauchsmuster*), on the ground that these would hamper rather than encourage manufacturers. The most interesting part of the memorandum, however, is that which deals with medical patents. At present, medical ethics precludes the patenting of drugs and biochemical products which are of use in medicine, with the result that foreign patentees are able to exploit British discoveries to their own advantage, while British manufacturers may be deprived of the assurance of such reasonable return on their outlay as would enable them to put new products of high quality on the market at moderate prices. The memorandum puts forward in considerable detail a scheme whereby medical patents may be dedicated to the State and administered by a 'Medical Patents Trustee' acting under the guidance of a suitably constituted advisory committee.

SEVERAL reports have appeared in the press recently of a communication made on April 9 by Prof. W. B. Harkins to the American Chemical Society, on the effect of collisions between α-particles and nitrogen atoms. It is not clear from these whether Prof. Harkins has been describing new work, or whether he has merely given an account of the earlier researches made on this subject by him, some details of which have already been published. In these, the cracks of α-particles in nitrogen are observed by the cloud method of Prof. C. T. R. Wilson. A very small proportion of the collisions between the nuclei of helium and of nitrogen result in the appearance of a new fast proton, and the formation of a fresh, heavy nucleus which is almost certainly that of an isotope of oxygen, since the α-particle disappears. Excellent photographs of this effect were obtained several years ago by Mr. Blackett in the Cavendish Laboratory, and many investigations of it have been made during the last decade by other methods by Sir Ernest Rutherford and Dr. Chadwick and others. The advantage of the cloud method is that it gives fairly complete information about the fate of all the interacting particles in any particular collision. Its great disadvantage is that it is extremely tedious, since reorganisation of the nitrogen nucleus happens so rarely that only about ten cases in which this has occurred have as yet been photographed, although of course many thousands of the protons ejected have been recorded by the method of scintillations and by the use of electrical counters. The theory of the effect is now receiving the attention of physicists on the basis of the wave mechanics, and also, whereas it was thought at one time that oxygen was a pure element, it is now known from the evidence of band spectra that it does actually possess isotopes.

AN inquiry into the teaching of Empire geography in schools is the subject of a report by the Board of Education (Educational Pamphlets, No. 79). The inquiry showed that this aspect of geography is not being neglected in elementary and other schools visited. It is stated that there is little evidence of that widespread ignorance in schools in Great Britain of the geography of the British Empire which has been alleged to exist, although there is room for improvement and progress. There can be no doubt that most children on leaving school have a reasonable knowledge of the topography of the Empire, and the conditions of life in its different parts. They also have some knowledge of the sources of authoritative information and some ability to interpret and apply that information. The inquiry has suggested a doubt as to whether too much is not expected of the average child, and it is clear that the time available makes it impossible to give a detailed knowledge of particular parts of the Empire. It is noted that the demand for specialists to teach the subject is increasing.

THE annual report for the fiscal year ending June 30, 1929, of the Director of the Bureau of Standards (*Miscellaneous Publication*, No. 102; Washington, D.C.: Government Printing Office, 10 cents) is interesting and instructive. During the past year there has been much correspondence and discussion relative to the question of defining the yard in terms of wave-lengths of light. The International Conference on Weights and Measures has agreed that the length of the metre is equivalent to 1553164·13 wave-lengths of the red radiation from cadmium when produced under standard conditions. The Bureau is anxious that the yard should be accepted as equal to 0·9144 metre or, which is the same thing, that the inch should be taken as exactly equal to 2·54 millimetres. At the same time, it is highly desirable that industrial measures of length should have their nominal dimensions correct at a temperature of 68° F. (20° C.). If this were done, then, in the opinion of the Bureau, the problem of the international interchangeability of parts would be completely and satisfactorily solved. The search for a source of homogeneous radiation has been renewed. Since Michelson compared in 1893 the wave-length of the red radiation of cadmium with the length of the international metre, no serious competitor to the red cadmium line has been forthcoming. A line of krypton which was very narrow was tried, but proved unsatisfactory, as it lacked intensity and was subject to reversal. Certain lines of krypton and xenon might usefully be employed as auxiliary standards, but they compare unfavourably with cadmium red. Photo-electric cells with a Riefler clock have proved useful for obtaining accurate time signals. The signals for distribution to the Bureau's laboratories are correct to about 0·0001 sec.

IT is stated in the annual report that the total expenditure of the United States Bureau of Standards for the year 1928–29 was £460,000, about 7 per cent less than the average of the two previous years. Salaries amount to £117,000, cost of testing structural materials £45,000, of industrial research £32,000, of commercial aircraft research £25,000, and of research on the standardisation of mechanical appliances £33,000. The fee value of the commercial tests carried out for the State departments and for industry was £109,000. The staff consists of 365 regular members and about a hundred research associate members. The average salary is £480. The *Journal of Research* published by the Bureau has now nearly six thousand subscribers.

THE Right Hon. Sir Samuel Hoare, Secretary of State for Air, 1922–29, has accepted nomination as president of the British Science Guild in succession to the Right Hon. Lord Melchett.

THE twentieth annual May lecture of the Institute of Metals will be given on Wednesday, May 7, by Major F. A. Freeth, who will take as his subject "The Influence of Technique on Research".

AT the annual meeting of the Société Nationale d'Acclimatation de France in Paris on April 6, Dr. C. Tate Regan, F.R.S., Director of the British Museum (Natural History), received the Isidore Geoffroy Saint-Hilaire medal for 1929.

AT the meeting of the London Mathematical Society on May 15, at 5 P.M., at Burlington House, Prof. G. I. Taylor will deliver a lecture on "Recent Work on the Flow of Compressible Fluids". Members of other scientific societies who are interested are invited to attend.

A 'FREDERICK G. DONNAN FELLOWSHIP' in Chemistry, open to graduates of the universities of Great Britain and Northern Ireland, has been founded at Johns Hopkins University, Baltimore, in honour of Prof. Donnan, professor of general chemistry in the University of London. Prof. Donnan last year had the honorary degree of LL.D. conferred upon him by the Johns Hopkins University, and also the honorary degree of D.Sc. by Princeton University and Oberlin College. He is to receive the honorary degree of D.Sc. from the University of Durham in June, and has this year been elected a foreign member of the Royal Society of Sciences, Uppsala.

AT the annual meeting on Feb. 3 of the Asiatic Society of Bengal, the Barclay Memorial Medal, which is awarded each alternate year to that person who, in the opinion of the Council, has made conspicuously important contributions to medical or biological science with reference to India, was awarded to Mr. Albert Howard, director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India. The Joy Gobind Law Memorial Medal, which was instituted last year and is to be awarded every three years to that person who, in the opinion of the Council, has made conspicuously important contributions to our knowledge of zoology in Asia, was awarded to Prof. Max. Weber, emeritus professor of zoology in the University of Amsterdam, for his contributions to our knowledge of the fauna of Asia as director of the *Siboga* Expedition to the Malay Archipelago, and for his work on Indo-Malayan fishes.

A PRELIMINARY programme has been issued of the Portsmouth Congress of the Royal Institute of Public Health to be held on June 4–9. The presidents of the five sections and the subjects of their respective addresses are as follow: Prof. H. R. Kenwood, the reduction of preventable diseases (Section I., State medicine and municipal hygiene); Surgeon Rear-Admiral H. C. Whiteside, problems of the sea-faring doctor (Section II., naval, military and air, including tropical diseases); Sir Thomas Oliver, the health of the modern worker (Section III., industrial hygiene); Lady Keyes, the voluntary worker in public health service (Section IV., women and children and the public health); Sir Henry Gauvain, sun treatment in England (Section V., tuberculosis). Several discussions have been arranged and numerous papers are promised. Particulars of the Congress can be obtained from the secretary of the Institute, 37 Russell Square, London, W.C.1.

WITH reference to the classified list of Nobel Prize Awards, published in NATURE of April 5, Prof. M. W. Beyerinck, writing from Gorssel, Deventer, Holland, recalls that during the period of Prof. van 't Hoff's prime contributions in connexion with the discovery of the laws of chemical dynamics and osmotic pressure in solutions, for which he was awarded the Nobel Prize in Chemistry for 1901 (the first allocated in the section), he was a professor in Amsterdam, and not in Berlin. Van 't Hoff was at the University of Amsterdam from 1878 until 1896, and his collected "Études de dynamique chimique" appeared in 1884, and the celebrated paper on "The Laws of Chemical Equilibrium in the Dilute, Gaseous or Dissolved State of Matter" in 1886. He removed to Berlin in 1896, and passed the remainder of his life in Germany: hence Germany was his "working domicile . . . at the time of allotment of the prize", although, of course, Holland was the scene of the fundamental researches for which the prize was awarded. It is desirable also to correct here a mistake in classifying under France the award of the Physics Prize for 1909 to Prof. Ferdinand Braun (Strasbourg). Dr. von Auwers, Berlin-Siemenstadt, writes to point out that in 1909, Strasbourg and its university were German and not French. Prof. Braun's name should, therefore, have appeared with the prize awards under Germany.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in geology at University College, Grahamstown, South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (April 25). Full-time teachers at the Technical College and Junior Technical School, Horwich, one mainly for science or mathematics in the Junior Technical School for Engineering Subjects in the College; and one for wood and metal work, and mechanical drawing in day and evening classes—The Secretary, Railway Mechanics' Institute, Horwich (April 26). A research student at St. Mary's Hospital, Institute of Pathology and Research—The Secretary, Institute of Pathology and Research, St. Mary's Hospital, Paddington, W.2

(April 28). A senior lecturer in applied mathematics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (April 30). A first assistant in the clinical laboratory of the Manchester Royal Infirmary—The General Superintendent and Secretary, Royal Infirmary, Manchester (April 30). A full-time assistant master in the Junior Technical School and Evening Technical Classes of the Worsley Technical School, near Manchester—The Secretary for Higher Education, Town Hall, Walkden (May 1). Readers, (*a*) economics, with special reference to banking and currency; (*b*) economics, with special reference to industrial organisation; and (*c*) international history, at the London School of Economics—The Academic Registrar, University of London, S.W.7 (May 1). A technical assistant in the department of the Chief Officer of the London Fire Brigade for inspectorial and advisory duties connected with fire and safety matters in buildings licensed by the London County Council for public entertainment—The Clerk of the London County Council, The County Hall, Westminster Bridge, S.E.1 (May 5). A woman demonstrator in pathology at the London (Royal Free Hospital) School of Medicine for Women and Royal Free Hospital—The Warden and Secretary, 8 Hunter Street, W.C.1, or the Secretary, Royal Free Hospital, W.C.1 (May 6). An assistant medical secretary of the British Medical Association—The Medical Secretary, British Medical Association, Tavistock Square, W.C.1 (May 12). A soil chemist in the department of agriculture, Kenya—The Private Secretary (Appointments), Colonial Office, 2 Richmond Terrace, Whitehall, S.W.1 (May 15). A professor of mechanical engineering at the Bengal Engineering College, Sibpur, Bengal—The Secretary to the High Commissioner for India, General Department, India House, Aldwych, W.C.2 (May 19). A laboratory assistant for the medical department of Kenya Colony—The Crown Agents for the Colonies, 4 Millbank, S.W.1 (quoting M/2117).

Our Astronomical Column.

Recent Magnetic Disturbances.—A magnetic disturbance with a range in declination of 30′ was registered at Greenwich between April 6 and 9. There was no definite commencement, which may be taken as occurring about 18^h on April 6. The greatest range in declination was registered on April 7–8. This is the third member of a sequence of three small storms which have taken place at intervals of about a solar synodic rotation. The dates of the two preceding storms are Mar. 11–18 (commencement Mar. 11·6) and Feb. 12–16 (commencement Feb. 12·9). No unusual solar disturbance was observed on any of the above dates, but cloudy weather in England rendered observing impossible on most days just before and during each magnetic storm. It may be noted, however, that a fair-sized sunspot in latitude 17° N. crossed the sun's central meridian on April 7·1.

Distance of the Trans-Neptunian Planet.—Prof. G. Armellini, Capitol Observatory, Rome, writing with reference to the distance of the Trans-Neptunian planet, reminds us that in 1918 he published in *Scientia* (vol. 24) a simple relation between the distances of the planets from the sun. This relation is given by the formula: $D = 1{\cdot}53^n$, where $n = -2$ for Mercury, -1 for Venus, 0 for the earth, 1 for Mars, etc. For the Trans-Neptunian planet, $D = 1{\cdot}53^9 = 45{\cdot}6$. The distance calculated by Bode's law is 77·2; and by Bélot's law (*Comptes rendus*, II. p. 937; 1905) is 61. Prof. Armellini regards the true distance as probably between 45 and 48, and his value agrees with this estimate. We do not, however, know the distance of the new planet yet. Assuming a circular orbit, the distance comes out close to 40; but it is probably an ellipse, and a much longer interval is required to determine its elements.

Photo-electric Observations at Neubabelsberg.—*Astr. Nach.*, No. 5683, contains a paper on these observations by Margarete Güssow. The most interesting of the stars the light-changes of which were investigated is Boss 46. This is one of the very massive stars, of type *O*, the radial velocities of which have been studied at the Victoria Observatory. It was found by Prof. Guthnick in 1919 that the star has a small variation of light; the full period of variation is 3·52 days; but this contains two unequal maxima and two minima. A paper by J. A. Pearce in vol. 3 of the Victoria publications discussed both the photometric and spectroscopic data; he showed that the system consisted of two enormous stars, the diameters of which are 23·8 and 15·5 times that of the sun, their masses being 36·3 and 33·8 times the sun's. They revolve nearly in contact with each other, and their shapes differ sensibly from spheres in consequence of tidal distortion; the eclipses are only small partial ones, and would scarcely have been detected without the photo-electric cell, the light range being 0·17 mag. Their detection enables accurate deductions to be made of the masses, diameters, and relative surface brightness of the components. These deductions are of use in making probable assumptions regarding the elements of the Plaskett star, B.D. +6° 1309. This is still more massive, but no eclipses have so far been detected. The light-curve of Boss 46 appears to show progressive change since 1919, the two maxima having become more nearly equal; this might be explained by a motion of the line of apsides, which would undoubtedly be present. ζ Geminorum is another of the stars discussed in the paper; the light-range is more than 0·6 mag., the period being 10·15 days; the colour index is found to change by 0·2 mag. in the same period, being 0·47 mag. at light maximum, and 0·66 mag. about a day before light minimum. α Canum Ven. was also examined; the observations in 1927 showed a regular light-variation in the spectroscopic period of 5·47 days; the light range is less then 0·05 mag.; the variation is less clearly shown in the observations of 1928, 1929.

Annuaire Astronomique et Meteorologique Camille Flammarion pour 1930.—This publication (printed by Jouve et Cie, Paris; published by Juvisy Observatory, Seine et Oise. 12 francs) contains all the usual almanac matter relating to the positions of sun, moon, planets, etc., with several other features likely to help amateur observers. There is a very full table of the elements of the periodic comets prepared by M. F. Baldet; also tables of double stars, variable stars, stars of large proper motion, etc. There are also sections on magnetism and meteorology; a table for the date of Easter up to the year 2200 is of course based on the assumption that no change will be made in the method of computation. The hints on choice of a telescope and methods of observing should be helpful to beginners. The work is edited by M. Ernest Flammarion.

Research Items.

White Immigrants in Polynesian Tradition.—Mr. W. Ivens, in *Man* for March, discusses a number of traditions relating to white beings which occur in various parts of the Pacific. Malekula, New Hebrides, is said once to have been inhabited by a race called Ambat, who were white, and when Europeans first arrived on the island, they were believed to belong to that race and called by the same name. The Maoris believed in the existence of a white race of *atua*, and on Motu Island, Banks group, Bishop Selwyn and Bishop Patteson were taken for Kwat, the legendary hero, the origin of the association possibly being that he may have been supposed to be white. On North Mala, Solomon Islands, immigrants, white in colour, are said to have arrived in outrigger canoes at a place called Suuna Rii. They wore clothes and coverings to conceal their hair. Their hair was red, but for anyone to see it meant death at their hands. No name is given them, but they are accredited with the introduction of fighting, of magic, and of food plants, including the areca nut. They are worshipped on North Mala as *agalo i mae*, ghosts of war. The head covering of the *agalo i mae* survives in the pigtail of the statues of south-east Solomons, and the carved figures on Vanua Leva, Banks Islands, have a decided pigtail. In the Paumotus and Tahiti there are traditions of red-headed women who rose up from the floor of the lagoon. If, as seems possible, any connexion is to be seen between all these legends, the people to whom they relate may represent a movement into the Pacific at a very early date.

Neolithic Camps.—In *Antiquity* for March, Mr. E. Cecil Curwen, writing on neolithic camps, points out that while the popular attribution of prehistoric hill-forts either to the Stone age or the Roman occupation is usually erroneous, progress in prehistoric research in Britain during the last two decades has justified the popular belief in the existence of neolithic camps though not in the specific instances expected. Among the neolithic camps described, special importance attaches to the account of Windmill Hill, near Avebury, which is based upon material supplied by Mr. Keiller, by whom the site has been explored annually since 1925, though his own reports are not yet published. The camp consisted of three rings of not quite concentric ditches, in most cases accompanied by ramparts on the inner sides. All these ditches are interrupted by numerous causeways. The outstanding value of this site lies in the stratification of the finds. British neolithic camps have certain very definite features, not all, however, exclusive to that period. Most obvious is the tendency for the ditches to be interrupted by causeways. It is suggested that these may have been intended to enable the defenders to sally forth at frequent points along the line of defence. There is also a tendency to concentric lines of defence with neutral ground between—not exclusively neolithic, but if one of the outer rings is fragmentary the presumption is strengthened. In some cases the defences are deficient altogether where the hill falls away steeply. The ground plan varies, but if one is more common than any it is the oval unrelated to the contour of the ground. The situation varies, the majority being on hill-tops—but low-lying sites occur as at Abingdon. Of the hill forts some, curiously, are situated on a saddle between two eminences. In the consideration of the pottery, it is suggested that in the so-called Windmill Hill class two sources of influence are to be discerned, one from Portugal and Brittany, and one from Sweden and Norway.

Mammals of Uruguay.—The report on the collection made by the Captain Marshall Field Expedition during four months in 1926 and 1927 is made the basis of a complete list of Uruguayan land mammals by Colin C. Sanborn (*Field Mus. Nat. Hist.*, Publ. 265, 1929). The introduction mentions that the expedition collected 345 mammals, representing thirty species, but it does not even mention the total number of forms now recorded from Uruguay (they appear to be 53 or 54), and says not a word about the relationship of the mammalian fauna as a whole. We note, however, that three introduced European animals, the house mouse, the Norway rat, and the common hare, have become amongst the commonest and most destructive rodents in Uruguay—another lesson, if one be needed, on the danger of unconsidered importations.

Genetics of Interspecific Hybrid Birds.—Although many interspecific, intergeneric, and interfamilial crosses can be made between gallinaceous birds, such as turkey and guinea-fowl, common fowl and guinea-fowl, *Gallus bankiva* and *G. varius* and various pheasants, yet the frequent complete sterility of the F_1 prevents further breeding experiments which would determine their genetic composition. Serebrovsky (*Jour. Genetics*, vol. 21, No. 3) shows that it is possible nevertheless to draw important conclusions regarding the genotypic constitution of various species, from a study of the characters shown by the F_1 hybrids in crosses with different breeds of domestic fowls having various dominant or recessive characters which have probably arisen by mutation. From a study of such hybrid specimens in the museums at Hamburg and Berlin, he finds that such factors as bare-neck, dominant white, melanism, and leg-feathering, which are dominant in crosses between different breeds of fowls, are also dominant in the hybrids between fowls and various other genera of wild Gallinaceæ, Phasianidæ, and Tetraidæ. By the use of this method it should be possible to arrive at definite conclusions concerning the part played by mutations in the process of specific differentiation among these birds.

Dragon-Flies of the Family Cordulegasteridæ.—Owing to post-War difficulties attending the publication of the well-known series of memoirs entitled "Collections Zoologiques du Baron Edm. de Selys Longchamps", the issue of further fascicles of that work has had to remain in abeyance. The parts dealing with the dragon-flies were never completed and Lieut-Col. F. C. Fraser has aimed at their continuation. In *Memoirs of the Indian Museum*, vol. 9, part 3, 1929, pp. 69-167, he has contributed an important revisional monograph of the family Cordulegasteridæ. This paper forms Part 1 of a general revision of the whole group of the Fissilabioidea: its two remaining families, the Petaluridæ and Petaliidæ, it is mentioned, will form the subject of a subsequent contribution by Dr. R. J. Tillyard. The Zoological Survey of India is to be congratulated on having undertaken the work of publication, as a considerable part of the fauna dealt with occurs within the limits of the Indian Empire. The family under consideration comprises four genera and forty-five species and subspecies. These are fully described and figured in the present memoir, which forms a useful and complete account of the insects concerned.

Nutrition of the *Grantia* Amphiblastula.—Prof. J. B. Gatenby and Dr. S. D. King (*Jour. R. Micr. Soc.*,

Dec. 1929) state that in well-fixed preparations of *Grantia compressa* with amphiblastula larvæ there are near the larva a number of wandering cells, apparently amœbocytes. In a later stage these cells become more numerous either by division or by the wandering in of others, and still later these cells form a wall round the amphiblastula. Sometimes the wall or sheath is complete, but in other cases there are gaps. The cells of this sheath are of two kinds—non-granular cells which abut against the flagellated layer of the amphiblastula and granular cells against the posterior granular cells of the larva. These latter cells contain osmiophile granules and " there can be no doubt that these membranes form a sort of placenta between the mother sponge and the larvæ ".

Polychæta of Lake Baikal.—B. Dybowski (*Bull. Internat. Acad. Polon. Sci. Lettres.* Ser. B 2, Oct.–Dec. 1929) criticises the memoir of Zenkewitsch (1925) on the fresh-water Polychætes of Lake Baikal and dissents from the latter author's view that the fauna is to be regarded as a primitive fresh-water fauna. The generic characters of the fresh-water polychætes *Manayunkia* Leidy, *Haplobranchus* Bourne, and *Dybowscella* Nusbaum are reviewed and two new genera established—*Trichosobranchella* and *Garjaiewella*. The last four of these genera are represented each by a single species in Lake Baikal. To merge these genera with Manayunkia is undesirable. The author recalls with justifiable satisfaction his finding in April 1870 of the trochophore larvæ for the first time in Lake Baikal and adds a few other details of historical interest.

Manurial Experiments on Fruit Trees.—Mr. T. Wallace continues the description of these valuable experiments in the *Journal of Pomology*, vol. 8, part 1, January 1930. The trees are grown in pots in sand cultures and their behaviour in complete nutrient solutions compared with their behaviour when the nutrient supplied is deficient in either potassium, magnesium, or calcium. In this present paper, very full ash analyses of the pruned shoots over a period of three years are given. Characteristic effects were produced by the omission of each element. Potassium deficiency led to increased shoot growth, leaf scorch, and defoliation of shoots from tip to base. Calcium and magnesium omission both led to reduction of shoot growth after the first season and to severe breakdown of leaf tissue. The results of magnesium deficiency were especially severe and were reflected in a much lower percentage of dry matter on fresh weight, and thus possibly to a high percentage of ash on dry matter ; the calcium and potassium omission series showed a reverse effect—a relatively high dry weight, and low ash content on dry weight. Mr. Wallace directs attention to the wide variations in the ash constituents in the bark and wood of shoots and main stems. The ash is relatively uniform in the bark from both shoot and main stems, but the percentage of ash in the one-year shoots is approximately twice as high as in the wood of the four-year-old stems.

Arctic Ice in 1929.—The Danish Meteorological Institute has issued the report on the state of the ice in the Arctic seas in 1929. In many respects the distribution was abnormal. In the Barents Sea the pack ice was unusually far south in spring, and during April its edge was only 86 miles from the North Cape. A few icebergs were close to the Murman coast in May, and throughout the summer, icebergs were seen in the Barents Sea. On the west of Spitsbergen there was much ice in May and June. In July it decreased, but in August some still remained. The east coast was blocked throughout the summer. The Spitsbergen ice had a more southern connexion with the east Greenland ice than is usual. Along the east coast of Greenland, however, the pack ice formed only a narrow belt; though it extended to Iceland in July and August, there was exceptionally little on the south-east coast. In Davis Strait and Baffin Bay there was much less ice than usual. The Kara Sea was open in August, September, and October. The White Sea was blocked with heavy ice until the end of May. On the Siberian coast and among the islands of the Canadian Archipelago the conditions were about normal. Wrangel Island was accessible in September. The report is illustrated with the usual charts and is written in English.

Soil Erosion in Tanganyika Territory.—Dr. E. O. Teale describes the soil and agricultural development of parts of Northern Kigoma and Southern Bukoba Provinces in *Short Paper* No. 4 of the Geological Survey of Tanganyika Territory. The questions of soil erosion and conditions for re-afforestation are particularly emphasised, for they seriously affect the future prosperity of an otherwise well-favoured district. The whole of the Kasulu Highlands were formerly covered with forest, but now there are widespread areas of wind-swept, torrent-cut, and eroded slopes due to the combined application of the axe and annual firing. All that was needed to start the rapid disappearance of soil was deforestation. Moreover, the custom of farming an area for a few seasons and then deserting it for a new block of virgin land favours the waste that is going on. Hillside terracing such as is effectively adopted in southern Europe is not a practicable solution, for there is no local stone and the population is thin. Dr. Teale shows that, if the future is to be safeguarded, afforestation should be started and maintained by protecting certain selected areas from fire, and headward erosion of streams should be delayed by planting bamboos and native figs at the heads of runnels and gutters which threaten the still unbroken ground of the gentle slopes above them. The geological features of the areas considered are described in the paper.

Seismic Waves and the Sedimentary Layer.—According to T. Matuzawa (*Bull. Earthquake Research Inst.*, Tokyo, Sept. 1929, p. 257) the crust in the Kwanto district of Japan is made up of three layers : (*a*) The upper or granite layer : 20 km. thick ; $Pg = 5{\cdot}0$ km./sec. ; $Sg = 3{\cdot}15$ km./sec. ; (*b*) The second or 'intermediate' layer : 30 km. thick ; $P^* = 6{\cdot}2$; $S^* = 3{\cdot}7$; (*c*) The layer immediately below (*b*), 50 km. from surface : $P = 7{\cdot}5$; $S = 4{\cdot}5$. A. Imamura, F. Kishinouye, and T. Kodaira have begun the investigation of the effects of a surface layer of sedimentary rocks overlying the 'granite' layer, basing their work on records of 21 of the 65 moderate shocks that affected the Kwanto district during 1927 (*Bull. Earthquake Research Inst.*, Tokyo, Dec. 1929, p. 485). Adopting the above data by Matuzawa, they find the sedimentary layer to have a thickness of the order 10 km. It is not clear, however, that the latter was not already tacitly included in Matuzawa's 'granitic' layer, and until this ambiguity is cleared up the Japanese results remain difficult to interpret.

Spectrum of Sodium Hydride.—We have received from Prof. Takeo Hori, Port Arthur College of Engineering, South Manchuria, a letter describing a band spectrum of sodium hydride which he has obtained in absorption by passing the light from a lamp through sodium vapour heated to 750° C. in hydrogen at atmospheric pressure. The spectrum between 3680 A. and 4450 A. was examined in the second order of a

concave grating two metres in radius, and bears a superficial resemblance to the secondary spectrum of hydrogen. In spite of its complexity it has, however, been almost completely analysed into seventeen bands, each of which consists of a P branch and an R branch degraded to the red. The type of electronic transition involved is $^1\Sigma \rightarrow {}^1\Sigma$. An anomaly occurs in the energy of the upper $^1\Sigma$ state similar to that found by Nakamura with lithium hydride. The moment of inertia of the molecule in the normal state is $5{\cdot}6_5 \times 10^{-40}$ gm. cm.^{2}, and the other molecular constants, with the usual notation, $\omega_e'' = 1133$, $B_e'' = 4{\cdot}89_9$, $D_e'' = 3{\cdot}3 \times 10^{-4}$, and $r_e'' = 1{\cdot}9 \times 10^{-8}$ cm.

The Nature of Positive Electricity.—The first March number of the *Physical Review* contains a letter from J. R. Oppenheimer, criticising Dr. Dirac's theory of positive electricity (see NATURE, Feb. 1, p. 182). Two difficulties occur in connexion with the interaction between radiation and matter: applied to this, the theory necessitates the presence of an infinite density of positive electricity, and also predicts that protons and electrons should be equally efficient in scattering soft radiation, whereas it is probable that scattering by protons is relatively unimportant. A third difficulty is that, according to Mr. Oppenheimer's calculations, the rate of destruction of protons by electrons is far too great. The approximate formula for the mean free life (T) of an electron is an enclosure in which there are n free protons per unit volume is $T = m^2c^3e^{-4}n^{-1}$, where e and m are the charge and mass of an electron, and c the velocity of light, which gives a mean free life for ordinary matter of the order of 10^{-10} sec. A way of avoiding these difficulties is suggested, but it involves the rejection of the fundamental similarity of positive and negative electricity, which was perhaps the most attractive feature of Dr. Dirac's theory, and a return to the hypothesis of two types of independent elementary particles, dissimilar in mass and with opposite charges.

Technical Sound Problems.—An introductory address on this subject given by Dr. E. Lübcke of Berlin at the Brunswick Technical School in February, is reproduced in the issue of *Die Naturwissenschaften* for Mar. 14. It deals mainly with the use of sound at sea, and in flight, and with the methods suitable for diminishing its propagation in buildings. A receiver of the Riegger and Wente type has been used in air, but in water one of the carbon microphone or the condenser type is used. The sounds sent out by several types of ship are analysed, and sound spectra are given of a motor boat with its engine making 420 and 600 revolutions per minute, of a tug boat and of a vessel driven by electric motors of high speed. The records of an under-water explosion are also reproduced, and the method of echoes as used in sounding at sea or from an airship explained. In dwellings the oscillations due to traffic are of frequencies 10-25 per second and increase in amplitude from the ground floor upwards to about four times in the first storey and about sixteen times in the second storey that in the ground floor. An amplitude of 0·03 mm. is already disagreeable, and if due to resonance is reduced by stiffening the floor or wall which is affected. In order to prevent sound from penetrating walls, it has been found necessary to use materials weighing at least 150 kgm. per square metre of wall.

Wireless Defects.—In an address to the Institution of Professional Civil Servants, published in the March issue of *State Service*, entitled "What is wrong with Wireless", Mr. R. A. Watson Watt put very clearly before his audience the difficulties which confront broadcast radiotelephony at the present time. He considers that the loud speaker, in failing to reproduce in proper proportion the whole of the notes of the musical scale, is the principal offender, the last valve in the average receiver the next, followed by the microphone with its favourite frequencies and its tendency to produce 'blasting' noises during *forte* passages, then the difficulty of spacing out the wavelengths sufficiently when 1000 stations have to be accommodated between wave-lengths 100 metres and 2000 metres. Lastly, he blames the fading out of signals due to the interference between the direct waves, and those which arrive by reflection in a conducting layer of the atmosphere between 60 miles and 150 miles above the surface of the earth. Mr. Watt looks forward to the time when these defects will be remedied, but he sees in atmospherics the ultimate limitation on wireless signalling.

Building Material and Heat Insulation.—Two of the papers read to the International Heating and Ventilating Exhibition at Washington, which are abstracted in a recent *Daily Science News Bulletin* issued by Science Service, Washington, D.C., illustrate the advantage of building houses with materials the thermal conductivity of which is low. It was found by experiment that a breeze blowing at seven miles per hour and one degree colder than the surface of the building on which it is blowing will carry away by convection three British thermal units of heat from each square foot of surface per hour. When the wind is blowing at thirty miles per hour, under the same condition it will carry away eight heat units per hour. We may say, roughly, that the heat carried away by convection varies as the square root of the velocity of the wind. This law is well known to electricians in connexion with the heating of overhead electric wires. The experiments were carried out at the University of Minnesota. Further experiments were made on the heating of surfaces by direct radiation from the sun. It was found that on an ordinarily bright day in the smoky city of Pittsburg, a piece of black oil-cloth ten feet square would receive energy from the sun at the rate of about 45 British thermal units per minute. This is equivalent to the oil-cloth receiving energy from the sun at the rate of one horse-power. If the house is to be kept cool, this shows the necessity of using building materials which are good thermal insulators.

Pyrophoric Iron.—It has long been known that finely divided iron reacts with incandescence with atmospheric oxygen at room temperature, and several theories have been proposed for the phenomenon. In the January number of the *Journal of the American Chemical Society*, T. G. Finzel describes the preparation of the material, chiefly with the view of investigating the effect of the initial substances used and of various gases on the pyrophoric properties of the iron. The iron becomes inactive when heated for some time. It was found that the best iron was obtained by the reduction of ferric oxide, precipitated from ferric nitrate, in hydrogen at 500°. Chlorides are to be avoided, as they destroy the pyrophoric property of the iron. Inactivation depends not only on the temperature and time of heating but also on the gaseous medium. One sample became inactive after heating at 600° for 2·5-3 hours in hydrogen, but only after 156 hours in helium, Inactivation appears to be due to decrease in total surface. Iron was pyrophoric in dry air and also in air cooled to −78°. The adsorption of gases by the material was very irregular; adsorption of carbon dioxide was no criterion for pyrophoric activity. Iron prepared from colloidal oxide obtained by hydrolysing ferric nitrate and dialysing was worthless as an ammonia catalyst.

High Frequency Fatigue.[1]

MESSRS. G. F. Jenkin and G. D. Lehmann have prepared an important report on the subject of high frequency fatigue. These researches, the object of which was to determine the effect of the frequency of alternation of stress on the fatigue limits of various metals, were carried out in the Engineering Laboratories of the University of Oxford, and tests were made on rolled, normalised, and hardened steel; rolled aluminium, annealed copper, and normalised armco iron. The ordinary frequency employed in fatigue tests is 50 periods per second, though in 1924 Jenkin[2] carried out work up to 2000 periods per second, and in the research described in this paper frequencies up to 20,000 periods per second were used. In all the higher frequency tests the specimen consisted of a bar supported at the nodes, and vibrating freely.

Jenkin had previously used an electromagnetic method to produce the vibrations, but this will not work for very high frequencies and a new method had to be designed. On the experiments now described fluctuations of air pressure acting directly on the specimens were used to make them vibrate. The apparatus was essentially two blowers, each blower consisting of a small adjustable resonating chamber, into which air was admitted by a throttle valve in the back, while the front was closed by one face of the specimen. The position of the specimen was so arranged that as it vibrated to and fro it alternately released the air pressure or allowed it to mount up in the chamber.

The strains were calculated on the assumption that the bar vibrated freely and the only measurement necessary was the amplitude of vibration at the centre of the bar. Lord Rayleigh has shown how the strains may be calculated for a long, thin vibrating bar, but using the method of vibrating by air, the bars had to have a moderate width and, for the highest speeds, had to be short, with the result that Lord Rayleigh's theory was no longer sufficiently accurate. Prof. Love, however, has explained how the theory could be applied to bars of moderate width, such as were used in this apparatus.

The results obtained are of very great interest. In Jenkin's earlier experiments the largest increase of the fatigue limit observed was only 15 per cent, but, as he pointed out, much larger rises were to be expected at higher frequencies. In the present tests, the fatigue limit in all cases increases as the frequency of vibration is raised, and increases of fatigue limit up to 60 per cent have been recorded. It has also been found that the fatigue limit does not increase indefinitely with the frequency, but apparently reaches a maximum value at a certain critical frequency. In some tests it was actually shown to fall at the highest frequencies, the greatest drop obtained beyond the maximum fatigue limit being about 9 per cent of the maximum. This fall would probably have occurred for the other metals also, if they had been tested at still higher frequencies. The results obtained are summarised in the following table:

Material.	Critical Frequency (Approx.).	Maximum Fatigue Limit (Tons/sq. in.).	Ratio Maximum F.L. to Ultimate Tensile Stress.	Ratio F.L. at 50 ~ to Ultimate Tensile Stress.	Maximum Increase above F.L. at 50 ~ (Per cent).
Normalised 0·11 per cent carbon steel	20,000	>17·99	>0·799	0·631	>26·7
Rolled 0·11 per cent carbon steel .	>20,000	>25·25	>0·588	0·528	>11·5
Annealed copper .	10,000	5·59	0·385	0·324	18·8
Rolled aluminium	20,000	5·02	0·785	0·586	33·9
Normalised armco iron	10,000	18·1	0·903	0·685	31·6
Hardened 0·86 per cent carbon steel	10,000	32·4	0·658	0·400	62

[1] Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1222 (M. 62): High Frequency Fatigue. By G. F. Jenkin and G. D. Lehmann. (E.F. 219.) Pp. 34. (London: H.M. Stationery Office, 1930.) 1*s.* 6*d.* net.

[2] *Proc. Roy. Soc.*, A, vol. 109; 1925.

South African Vegetation.

DURING the recent meeting of the British Association in South Africa, the South African Association for the Advancement of Science may be said to have acted as scientific hosts to their visitors, and in that capacity they certainly spared no effort to provide information as to South African scientific activities which would interest their visitors from the northern hemisphere. As a result, the number of the *South African Journal of Science* issued in December 1929, which contains some of the papers read at the 1929 meeting, provides an exceptionally favourable means of gaining a comprehensive impression of South African science. The president, Dr. Jan H. Hofmeyr, in an eloquent address pointed out that, since the first visit of the British Association in 1905, there has been a great increase in the facilities for higher education throughout South Africa, and the 27 graduates of 1905 had increased to 314 in 1928. There has naturally, therefore, been a great amount of valuable scientific work carried out throughout the country since 1905, and Dr. Hofmeyr emphasises, as the outstanding feature of this period, that the bulk of this work is due to the activities of South Africans. Scientific data are no longer the result of the sporadic activity of visitors from older communities with a longer academic history; they result from the continuous labours of a number of South African investigators, many of whom have received their training in South Africa.

Biologically, South Africa is the product of its climate, its sunshine, its clear dry air, and its dependence upon rainfall. The remarkable vegetation of this great continent is very much influenced by the very characteristic physical and climatic features of the country, and this report, describing pioneer work in many fields, naturally has to give great space to the tentative generalisations that emerge as to the natural vegetation of the country and as to economic possibilities in agriculture and forestry. Prof. J. H. Wellington points out, however, that the three characteristic South African regions, as determined by seasonal precipitation, are equally important in determining human activities. These regions are:

(1) The western part of Cape Province, with a winter rainfall associated with westerly and north-westerly winds from the South Atlantic anticyclone. The visiting botanists obtained a slight impression of the possibilities of this type of weather on the occasion of their excursion to the Kirstenbosch Botanic Garden.

(2) The vast central and eastern area of the sub-

continent, with a summer rainfall, carried to it by the east and north-east winds from the anticyclone over the South Indian Ocean.

(3) The intermediate region, mainly a coastal strip, on the south and east, where, as a result of its intermediate position, the rains are fairly evenly distributed throughout the year.

The high tableland that fills the interior of the continent means that the rain-laden winds usually lose their moisture at the mountain barriers near the coast. As a result, over a great part of the interior of the continent the rainfall is very scanty, and the deficient moisture supply is the dominant factor determining both natural vegetation and possibilities of cultivation.

In the south-west of the Cape Province, with its adequate winter rainfall, cultivation is of the type associated with the Mediterranean seaboard. Provided there is enough potash, vines may be grown on the alluvial soil, and many visitors will have grateful recollections of the local vintages and the local liqueur Van der Hum. The olive, apparently, cannot compete with European conditions for economic rather than climatic reasons. But if cultivation problems are somewhat the same, the natural vegetation of the Cape Province is entirely different, for reasons that Dr. Marloth makes clear. We have in the Cape flora a remarkably diversified vegetation which, in an area about one-tenth of the country south of the Orange River, contains as many species as in the remaining nine-tenths. The bulk of these species are so remarkable in form and so new to the visitor that even the non-botanist is led to wonder and admire. Dr. Marloth lists 64 genera, containing 615 Cape species, which between them include only 19 species that are found outside the Cape region. These plants form part of the characteristic southern, sub-Antarctic flora, with affinities rather with other Antarctic land masses, and which has remained isolated and distinct by reason of the 'physiological isolation' imposed upon it by the arid tableland that intervenes between it and more northern floras, so that such invasion as does occur takes place either along the more richly endowed coastal strip, or by sea. Most of the familiar plants that the visitor first notices, the oaks, the weeds, etc., result from the long history of the Cape as a port of call upon the ocean route to India, before the making of the Suez Canal.

Most of the northern immigrants are also unfamiliar to British visitors, being elements identical with, or related to, the main African flora, Acanths, Asclepiads, Euphorbias, etc., and most of the native forest trees; comparatively few familiar northern genera, *Anemone*, *Rubus*, *Hieracium*, etc., are to be seen. As a result, the botanist from the northern hemisphere is at first swept off his feet by the vast assembly of striking forms of plants that are new to him; even in the Cape winter the Ericas and Proteas provide him with a wonderful array of flowers; in the spring, the numerous bulbous monocotyledons give sheets of colour on the hillside, and all the year round the flora is full of interest. The extraordinarily pronounced development of ericoid vegetation forms at the Cape also strikes the visitor; 21·4 per cent of the flora of French Hoek have ericoid leaves, according to Dr. E. P. Phillips; many of these plants being characteristic of an acid, if not a peaty, soil.

Northwards of the Cape, on the high inland plateaux, over many miles of ground, stretches the Karroo, with a rainfall averaging between 3 and 12 inches annually. This Karroo vegetation varies greatly in type: on the east with a summer rainfall we have a scanty grass veld, merging westwards into the 'Composite' Karroo, grazed by Persian black-faced sheep and goats; on the west, with a winter rainfall, the paradise of the succulents, where the more arborescent types predominate until the flora merges into the scrub areas of the coastal belt.

Prof. R. H. Compton has a brief note on this interesting vegetation. He points out that it is recruited from north and south. From the Cape come the leaf succulent Mesembryanths and Crassulas; from the north, stem succulent Euphorbias, Asclepiads, etc., and from the south, geophilous bulbous Monocotyledons, unpalatable Composites, the staple shrubs of the Composite Karroo, and from the igneous outcrops of the Transvaal and Rhodesia come curious plants with 'resurrectionist' habit, etc.

Where rainfall is slightly more favourable, the bush savannah or the high veld stretches over many miles of the Transvaal and Rhodesia. Dr. E. P. Phillips describes this interesting vegetation in the environs of Pretoria, where high veld and bush veld meet. He points out that the tropical element is conspicuous in the bush veld, which shows close affinities with the Kalahari flora.

South African Forestry.

Dr. H. M. Steven has written his impressions of the high forests of South Africa, gained during the British Association tour in 1929, in *Forestry*, vol. 3, 1929. The natural high forest in the region of Knysna and George, where rainfall may be expected throughout the year, is a mixed, temperate rain forest type, which in the past has been exploited regardless of the future. It is now under the care of a scientific forest service which studies its natural regeneration, but probably no skill could make this natural forest, with its superabundance of hardwood species, and relatively slow increment growth, an economic asset. It remains a national asset, and is well worth the care it receives, but South Africa is concerned with the fact that it exports its fruit in boxes made of imported timber and is rapidly introducing exotic softwoods to meet the needs of the industries of the Union. Messrs. G. A. Zahn and E. J. Neethling give an account of progress to date along these lines. *Pinus pinaster* has been planted most extensively in the past, but *P. insignis* and *P. canariensis* now stand higher in favour and are being planted very extensively. The yield of wood is already sufficient to enable Mr. M. H. Scott to give some preliminary notes upon the behaviour of the timber of such exotic conifers, whilst the high moisture contents recorded by Mr. Nils B. Eckbo (for example, 474 per cent on dry weight in the sapwood of *Cryptomeria japonica*) are a reminder that these studies deal as yet with very young-grown timber.

A new industry of considerable importance has sprung up around the cultivation of the introduced black wattle, *Acacia mollissima*, from which bark and tannin extract are exported annually to the value of about one million pounds. Mr. A. J. O'Connor and Dr. I. J. Craib deal with its sylviculture, whilst it would appear, from Mr. E. F. English's account, that most preliminary experiments on paper pulp production from South African hardwoods have been carried out upon the wood of the black wattle. With the tree grown especially for bark, a use for the timber is obviously an urgent economic problem.

It is interesting to note, with the distribution of the natural forest, and in the problem of plantation management, the dominant external factor in South African conditions is again the water supply. Indeed, Dr. I. J. Craib argues, on the basis of his experience gained at the Yale Forestry School, that the moisture content of the soil is in general of more importance than light in forest growth and in controlling the succession of events beneath the forest canopy, that go so far to determine the stability of forest conditions.

Dr. Craib's discussion of this problem has very general biological interest, as, indeed, do many of the contributions in this issue of *Forestry*, which seem primarily of economic interest.

Another very interesting ecological problem is the way in which the diversified native flora is sometimes superseded, as the result of fire or over-grazing, by almost pure stands of some particular plant. Mrs. Levyns gives a brief account of her extensive observations upon one such case, the extensive spread of the rhenoster bush, *Elytropappus rhinocerotis*, which has displaced pasture on the veld under such conditions. She shows that the seedlings of this plant flourish when germinating in completely exposed sites where many competitors wither and die, and that germination of the seeds may be better after exposure to a fire—observations which may explain the spread of this plant, which is useless as pasture. Sometimes the plants that oust the varied native flora are aliens, as several species of *Hakea* that cover the slopes of Table Mountain after fires.

GRASSLANDS.

South Africa is now grazed much more closely by the stock of the settlers than was previously the case, when wild game alone roamed in the veld. For many miles, in the dry South African winter, the only fruiting grass haulms seen from the railway will lie inside the wire fence that protects the rail track from the stock. Outside this fence, every palatable plant is grazed ruthlessly down to soil level, and only plants with conspicuous powers of regeneration are able to survive the onslaught. The control of grazing so that future resources are not needlessly impoverished, is probably the line of surest advance in many agricultural problems, and the doyen of American agrostologists, Prof. A. S. Hitchcock, of the Smithsonian Institution, has a brief paper upon the relation of grasses to man, which, whilst it emphasises the great importance of these plants, is full of wise counsel as to the conservation of grazing land based upon the experience of the United States, where over-grazing with the consequent depletion of the range has been a pressing problem, as indeed it has always been in the history of stock raising on open grassland since the days of Abraham.

The paper by Messrs. R. R. Staples and A. J. Taylor upon pasture management shows that South Africa is already attacking its own problems in this field. They show that frequent clipping on the veld, to simulate close grazing, materially affects the normal grass flora, both the dominant species, *Themeda triandra*, and the coarse pioneer grass, *Eragrostis alba*, succumbing very early under such treatment, whilst an introduced pasture grass, *Paspalum dilatatum*, survived the treatment much better. One of the most important results so far obtained in grassland management is undoubtedly the dominant significance of phosphate deficiency in most South African soils. Dr. I. de V. Malherbe states that phosphate treatment of arable soils practically always gives a large increase in yield, and Dr. P. J. du Toit emphasises the fact that phosphate manuring of grasslands in the form of bone meal has revolutionised the cattle industry in certain parts of South Africa. He suggests that, with a small daily ration of the missing mineral, it should be possible to raise improved breeds of cattle on the veld. A number of other very interesting contributions, dealing with both the native fauna, the stock and the economically important pests of the cultivator, are also included in this "Report of the 27th Annual Meeting of the South African Association"; in this review it has been possible to mention only very cursorily some of the many contributions that deal mainly with South African vegetation under both natural and cultivated conditions.

Weather and Climate of the Sahara.

OUTSIDE the polar regions there is no extensive area of land the weather and climate of which has been so little studied as that of the Sahara, with the possible exception of Central Asia. A certain romantic glamour seems to attach itself in the minds of most of us to that vast and little-known desert region, and this gives additional interest to a memoir published by the Meteorological Office, Air Ministry (Geophysical Memoir No. 48), which discusses in detail the meteorological observations made by Mr. Francis Rennell Rodd in 1922 and 1927 in various parts of the Southern Sahara ranging from Timbuktu in the west nearly to Lake Chad in the east, and in latitude from about 12° N. to 20° N.

This is a region that owes its rainfall to a brief monsoonal incursion of south-westerly winds from the southern Atlantic during the late summer. These winds penetrate underneath the prevailing easterly or north-easterly winds, probably to a height of about 1 kilometre, and the rainfall appears to be generally of a vigorous convectional type; the convection apparently mixes the opposing wind currents and often leaves the easterly wind in temporary occupation of even the lowest layers. Occasionally this process gives rise to 'tornadoes' of the African type, which are of the nature of line squalls, not destructive vortices like American tornadoes; they give severe gales of short duration. The rainy season appears to be a complicated affair, interrupted by various breaks. There was an important autumnal part until about fifteen years ago according to the natives, and Mr. Rodd experienced a cloudy spell in late November and early December that yielded a few drops of rain and lent colour to the local tradition. He was not of the opinion that any important general desiccation of this part of Africa has been in progress either recently or during past ages.

As in many other parts of Africa, the more mountainous districts tend to get abundant rain, while the relatively low-lying plains not only have, on an average, a very small annual fall, amounting locally to less than five inches, but also one that is capricious, and in large areas a scanty desert vegetation is only precariously maintained.

It is not in regard to rainfall, however, that the interior regions of the Sahara yield the most interesting weather, but in the matter of low relative humidity and the temperature contrasts that arise from it. Unfortunately, the degree of dryness experienced when easterly or north-easterly winds hold sway is too great for trustworthy treatment by normal hygrometry, and it would be necessary to make special direct absolute determinations to measure accurately the minute fraction of possible water-vapour pressure contained by the air on those days when temperature rises to 114°, as happened in June 1922 and September 1927. Some idea was obtained by assuming that the vapour pressure remained constant between the cool early morning, when measurements by ordinary means could be relied on, and the time of greatest heat at 3 P.M., so that the relative humidity was governed by air temperature alone. There was reason for believing such an assumption to be nearly true; more than one calculation

indicated a relative humidity of only five per cent, with a probability that two per cent may be attained at times.

The diurnal range of temperature is so great that, in spite of the very high day temperatures, frost is not unknown. On Dec. 14, 1922, the air temperature measured on a march by sling thermometer was 92° at 2.30 P.M., and during the ensuing night in camp the minimum was 31°.

University and Educational Intelligence.

LONDON.—A Bayliss-Starling Memorial Scholarship has been founded by old students, friends, and admirers in commemoration of the late Sir William Bayliss and Prof. E. H. Starling. The annual value of the scholarship is about £120, with exemption from tuition fees, and it is tenable at University College. The Scholar will be required to follow a course of study approved by the Jodrell professor of physiology, involving a training in the principles of, and methods of research in, physiology and biochemistry. Candidates must send their applications to the Secretary of University College not later than Wednesday, May 14.

AN election of junior Beit fellows for medical research will take place in July next. The yearly value of each fellowship will be £400, and the tenure, ordinarily, three years. Forms of application (returnable on or before June 1) may be obtained by letter only, addressed to: Sir James K. Fowler, Honorary Secretary, Beit Memorial Fellowships for Medical Research, 35 Clarges Street, W.1.

APPLICATIONS are invited from British subjects by the L.C.C. for two Robert Blair fellowships in applied science and technology, each of the value of £450 and tenable for one year in the Dominions, the United States, or other places abroad. Particulars and application forms (T3/300) are to be had on application to the Education Officer (T. 3), The County Hall, S.E.1. The latest date for the return of forms is June 18.

UNIVERSITY COLLEGE, LONDON, has just issued its report for the year ending February 1930, with statistics for 1928–29 showing a total enrolment of 3249 students, including 2399 whose homes were in the British Isles, 311 from the rest of the Empire, 52 from the United States of America, and 487 from other parts of the world. 1466 were in the different stages of degree courses, 523 were graduate and research students, 441 evening and 266 vacation students. In addition, free public lectures, among them seven by visiting professors from the continent—Dutch (2), Belgian, German (2), Swedish, and Danish universities—were attended by more than 14,450 persons, the aggregate number of attendances at the 67 lectures being 29,590. Among academic developments during the year was the establishment of a chair of American history for which the Commonwealth Fund of New York gave 214,500 dollars. The Centenary Fund, inaugurated three years ago to provide £500,000 for the completion of buildings and equipment and for endowment, amounted on Jan. 31, 1930, to £223,860. The office of Provost of the College, held for twenty-five years by Sir Gregory Foster, on whom the honour of a baronetcy was conferred last New Year's Day, passed, as from the same date, to Mr. Allen Mawer, formerly Baines professor of the English language in the University of Liverpool.

Historic Natural Events.

April 20, 1897. Aurora Australis.—A remarkable display of aurora was observed in the South Indian Ocean in lat. 47½° S. It began at 6.30 P.M. with a diffused light; horizontal flashes soon spread and flared in every direction, increasing in length and brilliancy, until at 7.30 P.M. they were shooting across the sky to within 30° of the northern horizon. Cones and circles of light travelled rapidly over the whole sky, flashing beams of intense brilliancy from one to the other. This continued until 8.30 P.M., when an arch of bright green light fading off into yellow formed over the southern horizon, rose rapidly to a high altitude, and was followed by similar arches in regular sequence, until there were six distinct arches, their apices being from 10° above the southern horizon to 60° above the northern horizon. They were formed of narrow vertical bands of light from 5° to 20° deep, bright green and yellow at their upper edges, and of a rosy hue at their bases. At 9 P.M. a brilliant circle formed round the zenith, composed of narrow bands of light, pendant overhead and having a rotary motion, producing the effect of the vertex of an electrical cyclone. The display lasted until 9.45 P.M.

April 22–25, 1547. Red Sun.—In the whole of Germany, France, and England the sun appeared reddish and dull, like a ball with spots, so that the stars were visible (especially on April 24, during the battle of Mühlberg).

April 22, 1884. Colchester Earthquake.—No British earthquake has resulted in so much damage to property as this shock. Within an area of 10 sq. miles to the south and east of Colchester, 1213 buildings and 31 churches had to be repaired. In Colchester more than 400 buildings were injured, while at three villages—Abberton, Peldon, and Wivenhoe—about 70 per cent of the chimneys were thrown down. The Colchester earthquake is one of the few British earthquakes that have been felt on the Continent, as at Boulogne and Ostend.

April 24, 1579. Snow.—Holinshed records that snow fell in London between 4 A.M. and 9 A.M. to the depth of a foot. This is the more remarkable because, according to the present calendar, the date would have been early in May.

April 25–26, 1908. Great Snowfall.—This was one of the greatest spring snowfalls on record in the Midlands and southern England. About six inches of snow fell near London on April 24, but the heaviest fall occurred on April 25, accompanied by a strong gale in the English Channel. At Southampton, work at the docks was brought to a standstill, and throughout Oxfordshire, Berkshire, and the north of Hampshire all traffic by road was held up and communication by rail was maintained only with the greatest difficulty. The thaw caused a severe flood in the Thames.

April 25, 1926. Floods.—Owing to a rapid thaw of the heavy snows of the preceding winter, the rivers of Russia were in flood, all the low-lying parts of Leningrad, Moscow, and many other towns being under water. The damage was accentuated by blocks of drifting ice.

April 26–28, 1867. Gale and Floods in Brisbane.—Rain commenced to fall on April 26 and continued throughout April 27, becoming torrential on April 28. On this day the wind rose to gale force, doing much damage. The river rose rapidly to an abnormally high level, and the banks were covered by debris from the valley. The lower parts of Brisbane were flooded.

April 26, 1902. Green Flash.—Mr. C. T. Whittmell records in the Journal of the British Astronomical

Association that: "In the belfry of the Wesleyan Chapel, on the west side of Woodhouse Moor, there are narrow, horizontal openings through which the setting sun can send his rays. . . . On Saturday, 26th April, between 7.15 and 7.30 P.M. I was so exceptionally fortunate as to observe, through the openings, no fewer than three green and red flashes. The red ones were seen just as the base of the sun successively revealed itself below each of the upper edges of three openings. The green ones were seen just as the top of the sun disappeared behind each of the lower edges of the openings. Moving aside afterwards, in order to watch the actual sunset on the true horizon, distant some three miles, I observed a beautiful bluish green flash just as the sun's top sank out of sight at 7h. 23m. The sky was singularly clear, and there was a cool fresh breeze from north-east."

April 26–29, 1928. Dust Fall.—A great fall of dust took place in eastern Europe, travelling in a west-north-west direction from the coast near the Sea of Azov, as far as the upper Weichsel. The darkness was so great that artificial light was in use all day, and in southern Russia the fallen dust formed heaps like snow drifts a foot or more in depth, but farther to the north-west the depth was less than a sixth of an inch. The origin of the dust is unknown, but it occurred with an easterly wind, and was heaviest where this wind reached the coast from the open sea.

Societies and Academies.

London.

Linnean Society, Mar. 20.—C. Tate Regan: A new Ceratioid fish (*Caulophryne* sp.), female with male, from off Madeira. The fish represents a new species of the genus *Caulophryne*, distinguished from *C. jordani* Goode and Bean by the greater number of dorsal and anal rays and by the filaments on the stem of the illicium. Although distended by a recently-swallowed fish larger than itself, it took a bait, and was caught on a long line off Madeira. The specimen is a female, 210 (145 + 65) mm. long, with a dwarfed and parasitic male 21 (16 + 5) mm. long attached to its abdomen.—Lieut.-Colonel J. Stephenson: On an Oligochæte worm parasitic in frogs of the genus *Phrynomerus*. A specimen of a Nigerian frog, *Phrynomerus microps*, recently examined had a number of small worms hanging out in a cluster of about a dozen from the anterior angle of each eye and from under the neighbouring part of the lower lid. The worms belonged to a new species of the genus *Nais* of the freshwater family Naididæ. In a second species of the genus *Phrynomerus* (*bifasciatus*), from Beira, Portuguese East Africa, the Harderian (lacrymal) glands were found to be distended and transformed into a sac containing a number of small worms; these belonged to the same species as the preceding. This discovery prompted the stripping of the mucous membrane from the roof of the mouth of the first frog, from Nigeria, when it was discovered that in it also the Harderian glands contained a number of the worms. Oligochæta are rare as external, and still rarer as internal parasites.

Society of Public Analysts, April 2.—Ella M. Collin: The separation of cadmium and copper in spelter and zinc ores by internal electrolysis. The most satisfactory method is to deposit the copper first from a sulphate solution containing a small excess of sulphuric acid, to dissolve the copper in excess of nitric acid, and to electrolyse the solution at 70°. The original sulphate solution is readjusted with ammonia, sulphuric acid, and sodium acetate, and the cadmium electrolytically deposited. The anodes are of zinc, and a 5 per cent solution of zinc sulphate acidified with sulphuric acid is used in the anode compartments. —A. F. Lerrigo: Routine detection of nitrates in milk. A modification of the diphenylamine test is capable of detecting the addition of 5 per cent of a water containing about 0·5 part of nitric nitrogen per 100,000. The test is regularly applied in Birmingham to all samples of milk containing less than 8·5 per cent of solids-not-fat.—J. C. Ghosh: The determination of titanium as phosphate. The prepared ore or clay is fused with sodium carbonate, and the mass treated with boiling water, which dissolves aluminium and silica as sodium salts, leaving sodium titanate in the residue. This is hydrolysed and is then dissolved in either sulphuric or hydrochloric acid, and when boiled yields a precipitate of meta-titanic acid. This is dissolved, the solution just neutralised with ammonia, and the titanium precipitated and weighed as phosphate.

Leeds.

Philosophical and Literary Society, Mar. 4.—J. E. Roberts: Note on the critical potentials of the hydrogen molecule. The observed critical potentials of the hydrogen molecule are considered in the light of the potential energy curves for the various states and the Franck-Condon principle. The most probable energy change requires 12·8 volts, though this is not, strictly speaking, a critical potential, the latter being in the region of 12 volts. A further potential between 8 and 9 volts reported by Jones and Whiddington is probably due to the excitation of the triplet states with consequent dissociation of the molecule and emission of the continuous spectrum. —J. E. Roberts and R. Whiddington: The passage of electrons through argon. Excitation potentials of argon have been investigated experimentally by the magnetic spectrum method already described. The three sharp loss lines have been examined photometrically, and found to be much narrower than the corresponding loss lines in the case of certain diatomic molecules. In order of intensity, the losses in volts of the lines are 11·6; 14·1; 13·0, and this is the descending order of their intensities.—E. C. Stoner: (1) Free electrons and ferromagnetism. The question is considered as to whether ferromagnetism may be due to 'free electrons', that is, electrons forming an 'electron gas' as in Sommerfield's theory of conductivity. For spontaneous magnetisation to occur, the change in the interaction energy associated with magnetisation must exceed the increase in the kinetic energy of the electrons. On this basis, it is shown that the Curie temperature θ would have a minimum value depending on the saturation intensity I_0. To a sufficient approximation $\theta > 6{\cdot}74 \times 10^2 \times I_0^{2/3}$. This gives $\theta > 43{,}160°$ for nickel (observed 640°) and correspondingly large values for other ferromagnetics. It is concluded that ferromagnetism is not due to free electrons, but to interchange interaction electrons as in Hasenberg's theory. If the 'magnetic' electrons are the same as the conduction electrons, as Dorfmann's thermo-electric measurements indicate, it follows that conductivity may be due to interchange electrons. The bearing of this on the theory of the magnetic and electric properties of metals is indicated. (2) The interchange interaction theory of ferromagnetism. Considering the atoms in a crystal as separate systems interacting with neighbouring atoms, a very simple treatment of the interchange interaction theory of ferromagnetism is given. The method differs from that of Heisenberg, who considers the whole crystal as a single system. The terms which make the original formulæ unsatisfactory

as a representation of the experimental results do not appear. The final expressions of the magnetisation energy are formally equivalent to those given by the Weiss theory, if the classical assumption of continuous orientations of the carriers is appropriately modified. The agreement with the observations on ferromagnetics is very satisfactory.—**H. Burton**: Mobile anion tautomerism (Pt. 5): γ-phenyl-α-*p*-dimethyl-aminophenylallyl alcohol. Attempts to prepare the above alcohol have resulted in the formation of a mixture of products, which on treatment with hydrochloric acid furnishes a crimson coloration. The cause of the colour is discussed.—**E. Cockerham**: Some observations on cambial activity and seasonal changes in starch content of sycamore (*Acer Pseudoplatanus*). The activity of the cambium in producing both xylem and phloem has been followed throughout the year in all parts of the stem and root of *Acer Pseudoplatanus*. Cambial activity is found to initiate in the buds in the spring, and from thence to work basipetally downwards on to the main roots. In the distal region in the root this seasonal activity is thus superimposed upon a very slow cambial activity which seems to be practically continuous in this region of the root. Fluctuations in starch content are discussed in relation to these data.—**H. L. Newby** and **W. H. Pearsall**: Observations on nitrogen metabolism in the leaves of *Vitis* and *Rheum*. Ratio of protein to soluble nitrogen changes with the age of the leaf, and increases when the water content of the leaf is caused to fall. The diurnal fluctuations in this ratio are correlated with changes in acidity, increases in acidity being associated with increases of the proportion of protein.—**Rosa M. Tupper-Carey**: Observations on the anatomical changes in tissue bridges across rings through the phloem in trees. In a zigzag bridge of phloem left across a ring upon a tree, the new xylem and phloem in the horizontal portion of the bridge is eventually formed with its elements extended in a horizontal direction. The developmental changes in the cambium are followed in detail, which bring about this alteration in direction of the elements which differentiate from the cambium.—**R. G. S. Hudson**: The age of the *Lithostrotion arachnoideum* fauna of the Craven Lowlands. The recorded horizons of the various species of the *L. arachnoideum* fauna are noted, and the faunal assemblage is considered to be of S_2 age. The bearing of this determination on the age of the Clitheroe-Pendle succession is discussed. Various Lithostrotions are also re-described.

PARIS.

Academy of Sciences, Mar. 10.—The president announced the death of Camille Viguier, *Correspondant* for the Section of Anatomy and Zoology.—**A. Cotton** and **G. Dupouy**: Measurements of magnetic double refraction with the large Bellevue electromagnet. Details of the methods employed for determining the field strength, and of the apparatus used in the optical measurements.—**Lucien Daniel** was elected *Correspondant* for the Section of Botany.—**Paul Lévy**: The probability and the asymptotic frequency of the different values of the complete and incomplete quotients of a continued fraction.—**Elie Cartan**: The linear representations of the group of rotations of the sphere.—**Georges Giraud**: Certain problems at the limits concerning equations of the elliptic type.—**Paul Flamant**: The reduction and the independence of the conditions imposed on families of abstract vectors.—**Georges Valiron**: Integral functions defined by a class of Dirichlet series.—**P. Dupin** and **M. Teissié-Solier**: The distribution of the pressures round an immersed cylinder. An experimental study of the distribution of the pressures on a cylinder immersed in a current of water, the results in non-turbulent flow being compared with those obtained with turbulent flow.—**Alex. Véronnet**: The displacement of the poles and the deviation of the continents.—**Corps**: The interpretation of the Sagnac and Michelson experiments.—**Henri Mineur**: The field of gravitation of a variable mass.—**F. Joliot**: The electrical properties and the structure of the metallic films obtained by thermal and cathodic projection. A study of the causes of the resistance changes in these films: the presence of occluded gas, slowing down the recrystallisation of the metal, would appear to be the principal cause of the diminution of electrical resistance.—**H. Pélabon**: The copper oxide rectifier. The results are given of a study by metallographic methods of a copper oxide–copper rectifier.—**D. Chalonge** and **Ny Tsi Zé**: The variations of the continuous spectrum of the hydrogen molecule with the conditions of excitation.—**G. Déjardin** and **R. Ricard**: The first spark spectrum of mercury (Hg II).—**A. Smits** and **Mlle. C. H. Macgillavry**: Remarks on the note of Mlle. Maracineanu. The authors have not verified the results of Mlle. Maracineanu in all respects, but only so far as concerns the measurements relating to the radioactivity of lead from the roof of the Paris Observatory. Details of a very sensitive method for detecting traces of mercury in lead are given.—**H. Deslandres**: Remarks on the preceding communication.—**Pierre Poulenc**: The alkaline bromo salts of rhodium.—**Marcel Godchot** and **Mlle. G. Cauquil**: The methylcycloheptanols. Details of the properties of three alcohols obtained by the reduction of the two methyl-cycloheptanones described in an earlier communication.—**R. Cornubert** and **R. Humeau**: An ultimate property of the carbonyl group. It has been shown that the ketone γ-methyl-αα′-tetrapropylcyclohexanone gives neither an oxime, phenylhydrazone, nor tertiary alcohol with magnesium methyl iodide, and can only be characterised by reduction to the secondary alcohol and transformation into the acetate. Another ketone, β-methyl-αα′-tetrapropylcyclohexanone, has now been found to possess similar abnormal properties, but this also can be converted by reduction into the secondary alcohol.—**Léon Piaux**: Some quaternary iodides derived from phenylaminoacetic acid and the corresponding betaines.—**O. Munerati**: Observations on the duration of the cycle of the beet-root.—**H. Bierry**: Glycogen, glucidic reserves, in the starving animal.—**Mlle. G. Cousin**: The diapause of *Lucilia sericata*. Experiments on *L. sericata* have given results at variance with the views of Roubaud. The diapause (arrest of larval evolution) can always be traced to external conditions.—**H. Colin** and **E. Guéguen**: The sugar of the Floridæ. The sugar of the marine Floridæ is a compound of α-galactose and has nothing in common with trehalose.—**M. Javillier** and **Mlle. L. Emerique**: The vitamin activity of carotene. Crude carotene, arising from leaves of spinach, has the physiological property of vitamin A. It is active in very small doses, less than 0·01 mgm. per day. The activity of carotene remains high after keeping for forty years. It still remains an open question whether the physiological effects of carotene are due to the substance itself or to some adsorbed substance.—**A. Leulier** and **L. Revol**: The distribution of cholesterol and its esters in the suprarenal capsules.—**J. Nicolas**: Ulcerated X-ray epithelioma cured by diathermocoagulation.

PRAGUE.

Czech (Bohemian) Academy of Sciences and Arts (Second Class, Natural Science and Medicine), Jan. 10.—**J. Milbauer**: Studies in the preparation of vege-

table charcoal (1). The action of calcium chloride as activator. The decolorising power of charcoal depends on the tissue of the initial material and the temperature and duration of burning. The best material is that with a great content of celulose.—M. Mikan: Cremona correspondence in quadridimensional space given by four correlations.—V. Spaček: Complex swings of the magnetic declination needle.—E. Votoček and F. Valentin: Studies in the series of rhodeose (*d*-galacto-methylose).—E. Votoček and V. Kučerenko: Studies in the series of fucose (*l*-galacto-methylose). In both the above communications the optical rotation of the derivatives of rhodeose, epirhodeose, fucose, epifucose are studied and an entire agreement is found with the Hudson's rule; this confirms Hudson's rule also in the series of methyl-pentoses.—V. Pospíšil: Experimental studies on the pressure effect of light upon microscopic particles.—O. Michal: The *K*-absorption and the satellites of the ferromagnetic elements. The wave-length of the *K*-absorption edge is negligibly affected, when varying the crystalline diffraction grating.—J. Klíma: The construction of flecnoidal lines on the skew planes of fourth order.—F. Herles: The significance of the segment RT and of the wave T in the electrocardiogram for the diagnosis of pathological changes in the myocardium.

WASHINGTON, D.C.

National Academy of Sciences (Proc., Vol. 15, No. 12, Dec. 15, 1929).—Chas. W. Metz and M. Louise Schmuck: (1) Unisexual progenies and the sex chromosome mechanism in *Sciara*. It has been shown previously that sex of individual depends on the sperm, but the types of sperm functioning depend on the zygotic constitution of the female. Both characteristics are determined by the sex chromosomes, of which there appear to be three kinds.—(2) Further studies on the chromosome mechanism responsible for unisexual progenies in unisexual progenies in *Sciara*. Tests of 'exceptional' males. Such individuals, to be expected on the hypothesis put forward above, were found.—M. Demerec: Changes in the rate of mutability of the mutable miniature gene of *Drosophila virilis*. The lines of mutable miniature are described and the rate of change from one to the other determined.—L. J. Stadler: Chromosome number and the mutation rate in *Avena* and *Triticum*. Cultivated oats and wheat are polyploid forms and treatment with X-rays produces very few mutants, as judged by seedling characters, in contrast with cultivated barley (normal chromosome content) in which many mutants are produced. This appears to be connected with reduplication of chromosomes in polyploid species.—Donald A. Johansen: A proposed phylogeny of the Onagraceæ based primarily on number of chromosomes.—Delmer C. Cooper: The chromosomes of *Buginvillaæ*.—Robert F. Weill: New results from the study of cœlenterate nematocysts (preliminary note). A comprehensive study of nematocysts from 109 species has been made; the nematocysts are of taxonomic value.—Harold Osterberg: An interferometer method of observing the vibrations of an oscillating quartz plate. One mirror of the interferometer is replaced by the crystal, which is mounted so that reflection occurs at the surface to be examined.—Jenny F. Rosenthal and F. A. Jenkins: Perturbations in band spectra (2). Perturbations in the Angström bands of carbon monoxide are discussed.—Marie J. Weiss: On groups defined by $A^q=1$, $B^{-1}AB=A^x$, $B^q=A^e$.—Tracy Yerkes Thomas: On the existence of integrals of Einstein's gravitational equations for free space and their extension to n variables.

Official Publications Received.

BRITISH.

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, Grenada, for the Period 1926 to 1928. Pp. ii+12. (Trinidad.) 6*d*.

Board of Education. Educational Pamphlets, No. 79: Report of an Inquiry into the Teaching of the Geography of the British Empire in certain types of Schools. Pp. 29. (London: H.M. Stationery Office.) 4*d*. net.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, No. 26: Experiments on the Establishment of Rice Grass (*Spartina Townsendii*) in the Estuary of the Lee. By Prof. H. A. Cummins. Pp. 419-421+plate 28. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Report of the Marlborough College Natural History Society for the Year ending Christmas 1929. (No. 78.) Pp. 120+5 plates. (Marlborough.) To Members, 3*s*.; non-Members, 5*s*.

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 2, No. 19: Chromosome Linkage and Syndesis in Œnothera. By David G. Catheside. Pp. 467-484+3 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3*s*. 6*d*.

Government of India: Department of Industries and Labour. Note on the Functions, Organisation and Present Developments of the Indian Meteorological Department. Pp. 12. (Delhi: Government of India Press.)

The Mining Institute of Scotland. Fifty-second Annual Report of the Council, 1929-1930. Pp. 4. (Glasgow.)

Asiatic Society of Bengal. Presidential Address, 1930. By U. N. Brahmachari. Pp. 12. Annual Report for 1929. Pp. 30. (Calcutta.)

Journal of the Chemical Society. March. Pp. iv + 321-569 + xii. (London.)

Department of Agriculture, Madras. Bulletin No. 89: The Conduct of Field Experiments. By R. O. Iliffe and B. Viswa Nath. Pp. vii+51. (Madras: Government Press.)

Transactions of the Geological Society of South Africa. Vol. 32, containing the Papers read during 1929. Pp. iv+190+9 plates. 42*s*. Proceedings of the Geological Society of South Africa: containing the Minutes of Meetings and the Discussions on Papers read during 1929; to accompany Vol. 32 of the Transactions, January-December 1929. Pp. iii+lx. (Johannesburg.)

The Indian Forest Records. Silviculture Series, Vol. 15, Part 1: Classification of Thinnings. Pp. vii+8 plates. (Calcutta: Government of India Central Publication Branch.) 14 annas; 1*s*. 6*d*.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, March. Pp. 105-203. (London.)

Clifton College Scientific Society. Report for the Years 1926-29. Pp. 24. (Bristol.)

Souvenir, Henry Hill Hickman Centenary Exhibition 1830-1930 at the Wellcome Historical Medical Museum, 54 Wigmore Street, London, W.1. Pp. 85. (London: The Wellcome Foundation, Ltd.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 5: A Comparison of some Methods of Testing the Breaking Strength of Single Cotton Fibres. By Harirao Navkal and K. R. Sen. Pp. 10. (Bombay.)

Ministry of Health. Eighth Report of the Advisory Committee on the Welfare of the Blind to the Minister of Health, 1928-29. Pp. 34. (London: H.M. Stationery Office.) 6*d*. net.

Ministry of Health. Final Report of the Departmental Committee on Ethyl Petrol. Pp. 91. (London: H.M. Stationery Office.) 1*s*. net.

Proceedings of the Royal Society. Series A, Vol. 127, No. A804, April 1. Pp. 240. (London: Harrison and Sons, Ltd.) 8*s*.

Tanganyika Territory: Department of Agriculture. Annual Report 1928-29. Part 1: Agricultural Administration and Progress. Pp. 46. 2*s*. Part 2: Agricultural Investigation. Pp. 36. 2*s*. (Dar es Salaam: Government Printer).

Scottish Marine Biological Association. Annual Report 1928-29. Pp. 24. (Millport).

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 34: Responses of Plant-Tissues to Electric Currents. By Prof. H. H. Dixon and T. A. Bennet-Clark. Pp. 415-420. 6*d*. Vol. 19 (N.S.), No. 35: Electrical Properties of Oil-Water Emulsions with Special Reference to the Structure of the Plasmatic Membrane. By Prof. H. H. Dixon and T. A. Bennet-Clark. Pp. 421-440. 1*s*. 6*d*. Vol. 19 (N.S.), No. 36: Studies in Peat. Part 4: Low Temperature Carbonisation under various Conditions. By Colm O'Sullivan and Joseph Reilly. Pp. 441-446. 6*d*. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

FOREIGN.

Memoirs of the College of Science, Kyoto Imperial University. Series A, Vol. 13, No. 1, January. Pp. 100. (Tokyo and Kyoto: Maruzen Co., Ltd.)

Proceedings of the United States National Museum. Vol. 77, Art. 3: A Revision of the North American Species of Ichneumon-Flies of the Genus Odontomerus. By R. A. Cushman. (No. 2826.) Pp. 15. (Washington, D.C.: Government Printing Office.)

Annalen van de Sterrewacht te Leiden. Deel 16, Stuk 4: Discussion of Old Eclipses of Jupiter's Satellites. By W. de Sitter. Pp. 80. (Leiden.)

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 67: Fortgesetzte Untersuchungen über asymptotische Bahnen im Problème Restreint; Über das System periodischer, in Bezug auf die ζ-Achse unsymmetrischer, asymptotischer Bahnen. Von Elis Strömgren. Pp. 61+2 Tafeln. (København: Bianco Lunos Bogtrykkeri A.-S.)

Occasional Papers of the Bingham Oceanographical Collection, Peabody Museum of Natural History, Yale University. No. 3: On the Osteology and Classification of the Pediculate Fishes of the Genera Aceratias, Rhynchoceratias, Haplophryne, Laevoceratias, Allector and Lipactis; with Taxonomic and Osteological Description of *Rhynchoceras longipinnis*, new species, and a special Discussion of the Rostral Structures of the Aceratiidae. By Albert Eide Parr. Pp. 23. (New Haven.)

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 54: Application of the Inverse Wiedemann Effect to Torque Variation Recordings, Part 2. By Tatuo Kobayasi, assisted by Hiroto Okumura, Kinmatu Simamura and Tatuo Koyama. Pp. 4+3 plates. 0.22 yen. No. 55: On the Stability of Kármán Vortex Street in a Channel of Finite Breadth, II. By Susumu Tomotika. Pp. 5-48. 0.47 yen. No. 56: Kuda no Tomonari ni ¡tuite (On the Resonance of Pipes with a Movable End). By Kôzi Satô. Pp. 49-92. 0.50 yen. No. 57: On the Possibility of Applying the Cathode-Ray Oscillograph to the Indicator for High-Speed Engines. By Jûichi Obata and Yukio Munetomo. Pp. 93-100+2 plates. 0.19 yen. (Tôkyô: Koseikai Publishing House.)

Columbia University. Bulletin of Information, Thirtieth Series, No. 23: Professional Courses in Optometry, 1930-1931. Pp. 30+3 plates. (New York City.)

United States Department of Agriculture. Circular No. 106: Tree Hoppers and their Control in the Orchards of the Pacific North-West. By M. A. Yothers. Pp. 15. 5 cents. Circular No. 109: Parasitism of the Mediterranean Fruit Fly in Hawaii, 1922-1924. By H. F. Willard and T. L. Bissell. Pp. 12. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 76, Art. 8: A new Variety of the Hexactinelid Sponge *Rhabdocalyptus dawsoni* (Lambe) and the Species of Rhabdocalyptus. By H. V. Wilson and J. T. Penney. (No. 2805.) Pp. 9+2 plates. Vol. 76, Art. 21: Ordovician Trilobites of the Family Telephidae and concerned Stratigraphic Correlations. By E. O. Ulrich. (No. 2818.) Pp. 101+8 plates. (Washington, D.C.: Government Printing Office.)

Collection des travaux chimiques de Tchécoslovaquie. Redigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 3, Mars. Pp. 113-160. (Prague: Regia Societas Scientiarum Bohemica.)

Rendiconti del Seminario Matematico e Fisico di Milano. Vol. 3 (1929-VII). Pp. xv+267. (Milano.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 23, Part 5. Pp. 151-187. (Tokyo: Maruzen Co., Ltd.)

Scientific Papers of the Institute of Physical and Chemical Research. Nos. 221-227: 221. Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck. 1: Versuche über die Katalysatoren mittels Erhitzungskurve, 1, von Shinjiro Kodama; 222. Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck. 2: Versuche über die Einflüsse einiger Stoffe auf die katalytische Wirkung des Kobalts mittels Erhitzungskurve, 2, von Shinjiro Kodama; 223. Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck. 3: Herstellung der flüssigen Kohlenwasserstoffe mit dem Kobalt-Kupfer-Thoriumoxydkatalysator, von Shinjiro Kodama; 224. The Separation and Determination of Gallium. 1: A new Method for the Determination of Gallium, by Sunao Ato; 225. On the Absorption Spectra of Salt Solutions. 1: The Absorption Spectra due to the Halogens and some Metallic Ions, by Sechi Kato; 226. Resistance of Impact on Water Surface. Part 1: Cone, by Shumpei Watanabe; 227. Effect of Superposing Alternating Currents on the Electrolytic Oxidation of Aluminium (abridgement), by Shoji Setoh and Akira Miyata. Pp. 193-274+plates 15-19. (Tokyo: Iwanami Shoten.) 1.25 yen.

Contents and Index of Scientific Papers of the Institute of Physical and Chemical Research. Vols. 1-11 (1922-1929). Pp. 40. (Tokyo: Iwanami Shoten.) 65 sen.

Ministerio da Agricultura, Industria e Commercio: Directoria de Meteorologia. A Previsão das Sêccas do Nordeste: Ensaios pelo methodo de correlações. Por J. de Sampaio Ferraz. Pp. 12. Memoria sobre o clima do Rio Grand do Sul. Por Ladislau Coussirat de Araujo. Pp. iv+101. (Rio de Janeiro.)

Abstract-Bulletin of Lamp Development Laboratory, Incandescent Lamp Department of General Electric Company, Nela Park, Cleveland, Ohio. Vol. 2, No. 1, January. Pp. ix+163+6 plates. (Cleveland.)

University of California Publications in American Archaeology and Ethnology. Vol. 28, No. 2: Textile Periods in Ancient Peru. By Lila M. O'Neale and A. L. Kroeber. Pp. 23-56+48 plates. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 60 cents.

Sudan Notes and Records. Vol. 12, 1929, Part 2. Pp. 119-272. (Khartoum.) 30 P.T.; 6s.

Publications of the Earthquake Investigation Committee in Foreign Languages. No. 25: Topographical Changes accompanying Earthquakes or Volcanic Eruptions. Pp. ii+143+39 plates. (Tokyo.)

Bulletins of the Pacific Scientific Fishery Research Station. Vol. 3, Part 6: Паразитические черви рыб залива петра великого (Parasitic Worms from the Fishes of Peter the Great Bay). By E. M. Layman. (With Summary in German.) Pp. 120. 1r. 60k. Vol. 4, Part 1: Морфометрическая характеристика западнокамчатской горбуши *Oncorhynchus gorbuscha* Walbaum (Morphometrical Characteristics of the West Kamchatka Humpback Salmon). By I. F. Pravdin. (With Summary in English.) Pp. 152. 3r. (Vladivostock.)

U.S. Department of Commerce: Bureau of Standards. Circular of the Bureau of Standards, No. 380: Architectural Acoustics. Pp. 8. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Department of Agriculture. Circular No. 107: The Normal Breeding Season and Gestation Period of Martens. By Frank G. Ashbrook and Karl B. Hanson. Pp. 7. 5 cents. Technical Bulletin No. 173: The Bluegrass Webworm. By George G. Ainslie. Pp. 26. 10 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the American Academy of Arts and Sciences. Vol. 64, No. 5: The Minimum of Resistance at High Pressure. By P. W. Bridgman. Pp. 75-90. 45 cents. Vol. 64, No. 6: The Reflecting Power of some Substances in the Extreme Ultra-violet. By Paul R. Gleason. Pp. 91-125. 75 cents. (Boston, Mass.)

Publikationer fra det Danske Meteorologiske Institut. Communications magnétiques, etc. No. 8: La balance de Godhavn, par D. la Cour; No. 9: Contribution à la théorie de l'intensionmètre magnétique à l'induction mutuelle de D. la Cour, par Helge-Petersen et D. la Cour. Pp. 28+4. (København: G. E. C. Gad.)

Proceedings of the United States National Museum. Vol. 76, Art. 17: Contribution to the Taxonomy of Asiatic Wasps of the Genus Tiphia (Scoliidae). By H. W. Allen and H. A. Jaynes. (No. 2814.) Pp. 105+4 plates. (Washington, D.C.: Government Printing Office.)

The Kyoto Imperial University. Publications of the Kwasan Observatory. Vol. 1, No. 1: General Descriptions of the Kwasan Observatory of the Kyoto Imperial University. By Prof. Issei Yamamoto. Pp. 16+4 plates. Vol. 1, No. 2: Shih Shen's Catalogue of Stars, the Oldest Star Catalogue in the Orient. By Joe Ueta. Pp. 17-48. (Kyoto.)

Smithsonian Institution: United States National Museum. Bulletin 104: The Foraminifera of the Atlantic Ocean. Part 7: Nonionidae, Camerinidae, Peneroplidae and Alveolinellidae. By Joseph Augustine Cushman. Pp. vi+79+18 plates. 35 cents. Bulletin 149: Composition and Structure of Meteorites. By George P. Merrill. Pp. vi+62+32 plates. 40 cents. (Washington, D.C.: Government Printing Office.)

Scientific Survey of Porto Rico and the Virgin Islands. Vol. 10, Part 2: The Fishes of Porto Rico and the Virgin Islands—Branchiostomidae to Sciaenidae. By J. T. Nichols. Pp. 159-295. 2 dollars. Vol. 10, Part 3: The Fishes of Porto Rico and the Virgin Islands—Pomacentridae to Ogcocephalidae. By J. T. Nichols. Pp. 297-399. 2 dollars. (New York: New York Academy of Sciences.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. A new Nightjar from Angola: Second Preliminary Paper on the Birds collected during the Gray African Expedition, 1929. By W. Wedgwood Bowen. Pp. 2. Two new East African Birds: Third Preliminary Paper on the Birds collected during the Gray African Expedition, 1929. By W. Wedgwood Bowen. Pp. 3-7. (Philadelphia.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 137: Effect of Small Changes in Temperature on the Properties of Bodies. By Mayo D. Hersey. Pp. 137-156. (Washington, D.C.: Government Printing Office.) 5 cents.

Annales de l'Observatoire de Paris, Section de Meudon. Publiées par H. Deslandres. Tome 7, Fascicule 1: Recherches sur la polarisation de la lumière des planètes et de quelques substances terrestres. Par B. Lyot. Pp. ix+161. (Orléans; Impr. Henri Tessier.)

Travaux et mémoires du Bureau International des Poids et Mesures. Tome 18. Pp. vi+41+12+85+82+44+126+19+6. (Paris: Gauthier-Villars et Cie.)

Proceedings of the United States National Museum. Vol. 77, Art. 4: The Lysianassid Amphipod Crustaceans of Newfoundland, Nova Scotia and New Brunswick in the United States National Museum. By Clarence R. Shoemaker. (No. 2827.) Pp. 19. (Washington, D.C.: Government Printing Office.)

CATALOGUES.

The Nickel Bulletin. Vol. 3, No. 3, March. Pp. 73-104. Publication R2: The Nickel-Copper Alloys containing more than 50% Nickel. Revised edition. Pp. 24. Series B, No. 6: The Practical Application of Nickel in Cast Iron. Pp. 12. Publication R1: The Nickel-Copper Alloys containing less than 50% Nickel. Pp. 28. Publication S1: Case-Hardening and the use of Nickel Steels. Pp. 16. (London: The Mond Nickel Co., Ltd.)

Medicinal Glucose (Pure Dextrose) B.D.H. Pp. 13. (London: The British Drug Houses, Ltd.)

Caprokol (Hexyl Resorcinol B.D.H.), the Urinary Antiseptic for Oral Administration. Pp. 15.

Diary of Societies.

THURSDAY, APRIL 24.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—H. A. Hayden: Asymptotic Lines in a V_m in a V_n.—V. Naylor: The Methods of Summation.—G. N. Watson: Theorems stated by Ramanujan (XII.).

FRIDAY, APRIL 25.

FARADAY SOCIETY (at Chemical Society), at 2.15.—Annual General Meeting.

ROYAL SOCIETY OF MEDICINE (Medicine Section), at 5.—Cinematographic Demonstration by Dr. L. G. Rowntree: Ganglionectomy in Chronic Arthritis.—Prof. Dixon and Dr. G. N. Myers: The Curative Action of Digitalis in Toxæmia.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—F. Carnegie: The Economical Production and Distribution of Steam in Large Factories.

ROYAL SOCIETY OF MEDICINE (Epidemiology Section), at 8.—Prof. S. L. Cummins: Some of the Clinical and Pathological Factors underlying Mortality Rates in Tuberculosis.

INSTITUTION OF ELECTRICAL ENGINEERS (West Wales (Swansea) Sub-Centre).—S. W. Melsom, A. N. Arman, and W. Bibby: Surge Investigations on Overhead Line and Cable Systems.

SATURDAY, APRIL 26.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.

PUBLIC LECTURES.

THURSDAY, APRIL 24.

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, PADDINGTON, at 5.—Sir Almroth E. Wright: Twelve Years' Work on Immunisation of the Blood *in vitro*.

THURSDAY, MAY 1.

INSTITUTE OF PATHOLOGY AND RESEARCH, ST. MARY'S HOSPITAL, PADDINGTON, at 5.—Prof. J. Mellanby: Absorption from the Alimentary Canal.

CONGRESS.

APRIL 25 TO 28.

FLEMISH CONGRESS OF NATURAL SCIENCES AND MEDICINE (at Antwerp).