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## Science and Agriculture in New Zealand.

SINCE Lord Bledisloe's appointment as Governor-General of New Zealand, he has taken every opportunity of emphasising the need for scientific work as the basis of development of the country's resources. He has the unusual advantage of combining administrative ability with agricultural knowledge and a high appreciation of the possibilities presented by scientific research, and he has the courage to express his convictions clearly and without ambiguity. Before leaving Great Britain, he had, as chairman of the Lawes Agricultural Trust, the committee which manages the Rothamsted Experimental Station, the opportunity of familiarising himself with the detailed working of a great agricultural experiment station, and as chairman of the Long Ashton Research Station Committee he had had similar experience of a fruit research station. He was therefore well equipped for his work. He has, of course, been fortunate in his field of action. In no part of the Empire is there a higher standard of intelligence and ability among agriculturists, pastoralists, and fruit growers than in New Zealand. Right from the outset, universities were founded and agricultural education fostered. Nowhere is a worker in agricultural science better received than in New Zealand.

It is no accident that, in a world of agricultural depression, New Zealand, although largely dependent on agriculture, is probably suffering less than any other country at the present time. The agricultural development of New Zealand reads almost like a romance: it has all occurred so rapidly, yet with such certainty. From 1840, when organised settlement began, until 1880, sheep ranching was the main occupation and wool the chief export. There had been an export of wheat after 1870, the result of Vogel's development policy, until the invention of refrigeration paved the way for the great dairy and lamb industries, which are now among the most remarkable and efficient agricultural industries in the world. The invention came from Australia; in 1873, James Harrison had been awarded a gold medal at the Melbourne Exhibition for his method of freezing meat. But the method was not developed until 1879, and then it was not successful. The first satisfactory cargo of frozen mutton and lamb arrived at London from New Zealand in 1882 in a sailing ship fitted with refrigeration appliances; ten years later steamers were introduced, and continuous improvements have since been made.

On the agricultural side also the industry has

developed remarkably, and from 1921 onwards it has been the subject of a good deal of legislative control, for the New Zealand farmer has learned to combine freedom of action in producing with united action in grading and marketing, and in consequence he has been able to send to Great Britain large and regular supplies of uniform high quality, and so to secure an enviable position in our markets. He does this at a profit, in spite of his great distance from our markets and of having to pay wages much higher per man (though not per job) than are paid here. The exports are rapidly rising. In 1929 that of butter was valued at £13·2 millions, of cheese £7 millions, frozen meat (mutton and lamb) £9·9 millions; in all, more than £30 millions by refrigeration transport, as against £15 millions of wool—a truly remarkable progress.

The development of the dairy industry, however, was not simply a matter of transport: it is a triumph for the bacteriologist, who has reduced to an exact science the art of producing clean milk, good butter, and cheese true to type.

No better illustration of the advantage of science to a community could be desired. But New Zealand does not rest satisfied with past achievements; it is perpetually improving its scientific equipment. The Cawthron Research Institute at Nelson in South Island, founded by Thomas Cawthron, a Camberwell man; the Canterbury Agricultural College, also in South Island; and the Massey Agricultural College in North Island, are all vigorous institutions, the first two well established and already held in high esteem among the agricultural institutes of the world, the last named new, well equipped, and with possibilities of a great career of usefulness. On the opening of this institution, Lord Bledisloe gave an address in which he summarised in a masterly way the economic and technical problems facing the New Zealand farmer, indicating also the lines on which they could be solved. "Even the most impoverished countries of the world", he said, "have found public expenditure upon scientific research and the scientific guidance of their farming population to be a sound and remunerative investment."

This is an undeniable truth, and it holds generally; it is not confined to the agricultural population. Of all departments of public life, those concerned with the fostering of scientific work can least be spared. In the present national emergency, agricultural scientific workers, like their colleagues in other branches, are prepared to help shoulder the burden, but they ask that the work shall not be allowed to suffer, for it is even more needed in days of trouble than in days of prosperity. Great Britain has a good organisation for agricultural research and education, and an enthusiastic body of workers who have gained the confidence of farmers by the proved value of the help they have been able to render to the industry. It has taken years of patient work to build up the organisation and to train the workers: once destroyed, it would take even longer years to rebuild, because of the lack of confidence. Happily, the indications are that those charged with the invidious and thankless task of making national expenditure fit national means are fully alive to the imperative need of keeping intact the scientific organisation of Great Britain.

## Sidelights on the British Association.

*Advancing Science: being Personal Reminiscences of the British Association in the Nineteenth Century.* By Sir Oliver Lodge. Pp. 191. (London: Ernest Benn, Ltd., 1931.) 6*s*. net.

MAXWELL'S "Treatise on Electricity and Magnetism" was published in 1873. H. J. S. Smith was president of Section A of the British Association which met at Bradford that year, and in his presidential address referred thus to the work: "For electricity now, like astronomy of old, has placed before the mathematician an entirely new set of questions, requiring the creation of entirely new methods for their solution". Among his hearers was Oliver Lodge, then an enthusiast, twenty-two years of age, attending his first British Association meeting, greatly impressed by the distinguished men present, who were taking an active part in the proceedings. Soon afterwards he conceived the idea, as he tells us in the interesting note contributed to the Maxwell commemoration volume,* of making the production and demonstration of the electromagnetic waves predicted by Maxwell the work of his life.

For the next twenty-five years or more Lodge was a regular and welcome attendant at British Association meetings, and we have now his personal reminiscences up to the end of the century. And most interesting they are to all who care to learn something of the development of science during that period, specially perhaps to one who, like the reviewer, attended many of the meetings and is reminded by this record of the sayings and doings of friends now passed away.

The book had its origin in a suggestion by Dr. Ferguson, secretary of the Physical Society, that Sir Oliver should record his notion of what the

* James Clerk Maxwell: a Commemoration Volume, 1831–1931. (Cambridge: At the University Press, 1931.) See NATURE, Oct. 10, p. 607.

British Association and the big men associated with it accomplished during the latter third of the nineteenth century; the headings of some of the sections are sufficient to illustrate its scope.

Commencing with a brief notice of Huxley, Tyndall, and Clerk Maxwell in the first chapter, we pass on to Crookes and radiant matter, and Fitzgerald on ether waves in the years 1879–83. Then comes an interesting account of the first Dominion meeting, at Montreal, under Lord Rayleigh's presidency, followed by Kelvin's vortex theory of the ether and the long discussions on the seat of the e.m.f. in a voltaic cell, 1885–87; the discovery of electric waves, Bath, 1888; the National Physical Laboratory with a section about the Red Lion Club; argon and the beginnings of wireless, 1892–1894, and finally the discovery of the electron, 1895–1900.

In his survey the author covers the whole range of subjects dealt with in Section A during thirty years, bringing back to the memory of many of his readers the salient points of discussions to which they listened and illustrating them by his own vivid recollections. Perhaps the most interesting pages are those in which he gives the history of electric waves and tells the story how he carried out the resolve made at Bradford in 1873.

Sir Oliver met Fitzgerald at Dublin in 1878 and was captivated at once by that most charming of men, a skilful physicist, a brilliant mathematician, and a daring thinker—witness his prediction in 1894 or '95 that the length of a yard stick might depend on its orientation; he had absorbed all that was involved in Maxwell's theory, and in 1880 laid before the British Association a paper on the possibility of originating wave disturbances in the ether by electromagnetic forces. At Southport in 1883 he calculated the energy lost per second by a circular ring carrying an alternating current and described a method of producing electromagnetic disturbances of comparatively short period; it was the method now used in wireless. But at the time the friends went no further. Four years later (1887) Lodge gave the Mann Lectures of the Society of Arts on protection from lightning, in which he directed attention to the importance of the self-induction of a lightning conductor leading to an alternating discharge. That same year, Hertz, at Carlsruhe, was investigating the "Outspreading of Electric Force", as he called the waves coming from a circuit carrying a rapidly alternating current.

We heard of this in Cambridge early in 1888 and welcomed with enthusiasm this verification of the theory of our master. It is all in Maxwell, we said; no one had realised that by tuning the receiving circuit the tiny effects which we knew were there could be made visible. Fitzgerald was president of Section A that year (1888) at Bath and made a description of Hertz's work a main portion of his address. A paper by Lodge dealing with the propagation of waves along wires appeared in the *Phil. Mag.* for August 1888. In the years following, lectures were given and experiments shown to illustrate the Hertzian waves; reference may be made to one by Lodge at Oxford in 1894, in which he outlined the possibility of their extension to wireless telegraphy; in this work he was helped by Alexander Muirhead.

Two years later, at Liverpool, Sir William Preece, Chief Engineer to the Post Office, told Section A of Marconi's work, and wireless as we now know it, aided by Lodge's work on tuning, came into being. The discovery of the electron, announced at Dover by J. J. Thomson, in 1899, completes the story. Wireless had been held back by the need for a sufficiently sensitive receiver, and somewhat later (1904) Fleming showed that the stream of electrons from a hot cathode in an exhausted bulb constituted a much better detector than any coherer or crystal device.

Sir Oliver treats in a similar way, though not so fully, many of the other discussions and discoveries of those pregnant five-and-twenty years; for the story we must refer the reader to his reminiscences; and these are not all dry science. He tells of the spade work of a delegate who persuaded the Association to visit Southport—he does not mention his speech to the General Committee met to determine the next place of meeting. The Committee was getting a little bored by a delegate from Leicester, who spoke of the antiquity and history of his city, of its interests from the time of Simon de Montfort to the present day, ending with a lecture on the geology of the neighbourhood. The Southport delegate followed with the statement: Southport has no history; Southport has no antiquities; Southport has no geological formation, but it will give the Association a hearty North Country welcome; and he sat down. The Committee voted for Southport.

Again, at Dublin, our author found there the senior fellows spent much time telling comic tales. I once heard an elderly lady—this is not in Sir Oliver's book—ask one of the brilliant group mentioned: "Is that really true?" to receive the reply, "Have you not yet learned, Mrs. M., that truth spoils stories?"

The secretaries often had amusing experiences;

no doubt they still have; let me conclude with one of my own. It was in a cathedral city, and in discharge of my duty I had declined as politely as possible a paper on the ether scarcely suited for Section A. It was too theological. I went to the cathedral service on the Sunday of the meeting, when a venerable gentleman ascended the pulpit and from that secure position read to the assembled congregation the paper I had returned to him some few days earlier.

But it is not stories of this kind which give value to Sir Oliver's book. In a life of eighty years, he has made many of us his debtors; he has added to our debt by telling of advancing science during the last quarter of the nineteenth century in a manner which only he could achieve.

R. T. G.

## Physics of the Earth.

*Bulletin of the National Research Council.* No. 77: *Physics of the Earth.* 1: *Volcanology.* By the Subsidiary Committee on Volcanology. Pp. viii+77. 75 cents. No. 78: *Physics of the Earth.* 2: *The Figure of the Earth.* A Collection of Short Papers, written by Leading Scientific Men in several branches of Geophysics, and treating of the Size and Shape of the Earth. Pp. v+286. 3.50 dollars. No. 79: *Physics of the Earth.* 3: *Meteorology.* Prepared under the auspices of the Subsidiary Committee on Meteorology. Pp. xi+289. 3.50 dollars. No. 80: *Physics of the Earth.* 4: *The Age of the Earth.* Pp. v+487. 4.50 dollars. (Washington, D.C.: National Academy of Sciences, 1931.)

THE books under review are the first four of a series of nine bulletins of the United States National Research Council, on various branches of geophysics, begun in 1926 under the stimulus of Prof. J. S. Ames. The preparation of each is in the hands of a very representative subcommittee.

The first, on volcanology, is in three sections, by Drs. K. Sapper, I. Friedlander, and T. A. Jaggar. It must be recognised, and the authors do recognise throughout, that physical volcanology has a considerable future, but no past and not much present. The first two chapters are mainly descriptive of the various forms of volcanic activity, with brief accounts of former attempts at explanation. The latter give the impression that most of them would have been better left buried. Jaggar's essay is what the subject needs; it is stimulating and full of ideas for future work. One may pick out for special mention his suggestion of the use of spectroscopic methods to determine the composition of the gases emitted, his explanation of the difference in level between the craters of Kilauea and Mauna Loa, and the following remark, in relation to volcanic rocks: "The real geological interest is quantity of commonest types. The laboratory interest is quality of uncommon types." Much use is made of the work of Day and Shepherd on the temperatures of lavas; but one wishes that Day himself had contributed more than a preface.

The second volume, nominally on "The Figure of the Earth", covers the figure of the earth, isostasy, tides, and the variation of latitude. There are sixteen chapters, by various authors; some deal with observational technique, some with methods of computation, while others are purely theoretical. Dr. A. T. Doodson contributes a comprehensive semi-popular account of tidal theory, explaining in general terms the amphidromic points—those places in open seas and oceans around which the tidal wave appears to circulate—and brings out the interesting point that the tide in the Atlantic as a whole is largely a matter of resonance. Dr. H. A. Marmer's account of mean sea-level makes the theorist marvel at the observational skill of the survey that has shown that the mean level of the sea is not perfectly flat, but shows variations of a few inches as between places hundreds of miles apart. Dr. W. D. Lambert's chapters on the bodily tides and on tidal friction constitute an excellent historical and critical summary of the present state of these subjects.

Dr. W. Bowie gives a historical account of the theory of isostasy, and gives proper credit to Airy as the real originator of the idea. But Prof. H. Fielding Reed, in the next chapter, seems to go completely astray in deciding for Pratt's theory against Airy's on geological evidence. He admits folding as the cause of mountain structure, while Pratt made no allowance whatever for folding. Granted the existence of several distinct layers in the crust, each lighter than the one below it, which is demanded both by geological evidence and by the modern study of near earthquakes, any crustal shortening such as gives rise to folding means an extra thickness of light matter on top. If then there is no corresponding excess of gravity, this can be due only to a deficiency of the heavier matter below; that is, to a depression of the base of the lighter layers. This is precisely Airy's theory. Prof. Reed gives evidence that in some cases the folding took place before the uplift, and argues that this fact is in favour of Pratt's theory and destructive of Airy's. This is not the case. Granted

compression without uplift, the result would be a replacement of heavy matter by an equal *volume* of light matter, and therefore a deficiency of gravity. If then subsequent uplift took place by Pratt's mechanism—vertical expansion—the mass per unit area would remain as it was, and the deficiency of gravity would persist. This is in contradiction to the observed fact that gravity in mountainous regions is sensibly normal. Prof. Reed's theory errs in the opposite direction from the old idea of the mountains as excess loads.

Dr. Lambert contributes a further article, largely historical, on the theory and measurement of the figure of the earth. It is pleasant to see an account of Stokes's formula for the determination of the deviation of the geoid from the spheroid, given the variation of gravity over the surface; as Lambert says, eighty years after Stokes enunciated his theorem, observations of gravity are becoming sufficiently numerous to make its application possible.

Dr. Swick gives an account of methods of measuring gravity (including that of Meinesz). Other geodetic articles are contributed by D. C. Barton, D. L. Parkhurst, H. G. Avers, and C. V. Hodgson, and Dutton's classical paper is reprinted.

The final section deals with the variation of latitude, Lambert again being the principal author. He discusses incidentally Darwin's paper on the secular shifting of the pole, and shows that by a mathematical oversight Darwin was more favourable to this hypothesis than the circumstances warranted.

The third volume deals with meteorology, both from the observational and theoretical points of view. It is very full, both in description and in the accounts of the thermodynamics and dynamics of the atmosphere. But we notice with wonder that what we are used to call the eddy viscosity is called the Austausch coefficient, that this is said to be the usual English practice, and that Prof. G. I. Taylor is not mentioned in relation to it. Nevertheless, the amount of material is remarkable, considering the size of the volume.

The appearance and arrangement of the books are attractive, though there are rather too many misprints.

The first three volumes are in the nature of critical summaries of existing knowledge. The fourth, however, is a full and detailed account. The greatest part of it, nearly three-quarters, is by Prof. Arthur Holmes, and deals with the measures of geological time based on radioactive disintegration. A serious attempt has been made to discuss all the relevant analyses, a formidable mass of material. Holmes begins at the beginning with a general account of radioactivity; he adopts the view that the lead isotope of atomic weight 207 is the final product of the actinium series, derived ultimately from an isotope of uranium, probably of atomic weight 235. Rutherford's interesting estimate of a maximum age of the earth from the amounts of the elements in the actinium series is given fully. Pleochroic halos occupy a chapter. In the discussion of lead/uranium ratios the constants adopted are altered slightly from those previously recommended by Holmes and Lawson, and the whole of the data have been recomputed. It is to be hoped that there will be no further change in the practice in this matter; it can be assumed that the present values are accurate enough for any geophysical application, and we do not want further confusion owing to different workers using different values.

Full particulars of the known radioactive minerals are given, with an enormous number of analyses and age determinations from all parts of the world. The helium problems are also discussed. The helium/uranium ratio, though not very useful for finding the ages of minerals, seems to be coming into its own in application to complete rocks, from which the loss of helium by leakage is much less, and in the hands of Dubey and Günther this method is giving valuable results. A careful discussion of the needful precautions in interpreting lead and helium ratios is given. Future workers on geological time will certainly find Holmes's work indispensable.

The book begins with a short introduction by Prof. Adolph Knopf. Prof. Schuchert treats the older denudational and biological methods of estimating geological time, but also contributes one based on the maximum (instead of the mean) thickness of each formation and the rate of accumulation. This principle has already been applied by Reade and Goodchild, and gives results in general agreement with those derived from radioactivity. Schuchert goes rather further and draws a somewhat startling conclusion: that deposition in the Tertiary and Mesozoic was three or four times as fast as in the Palæozoic. We are used to the idea that post-glacial deposition has been abnormally rapid, but Schuchert thinks that the rate has increased steadily.

Prof. Knopf, in discussing the age of the ocean, mentions the possibility that the excess of sodium is removed from it by adsorption at the bottom. This would explain one great difficulty: how it is

that the ocean, drawing its sodium and chlorine from independent sources, has managed to remain neutral throughout geological time. Prof. A. F. Kovarik gives a very elaborate account of the radioactivity data from the point of view of the experimental physicist; the values for the various constants that he finally decides upon as the best have been adopted in Holmes's section.

Most of the book deals really with the estimation of geological time rather than with the age of the earth. We are now in a position to compare directly the ages of formations in different parts of the earth by radioactivity, without reference to fossils, and therefore the new methods are available to make fundamental contributions to ordinary geology. If an igneous rock is found to have an age of 200 million years, we can say that its age is Permian even if there is no sedimentary rock near by between the Pre-Cambrian and the Tertiary.

Prof. E. W. Brown gives a brief account of astronomical clues to the age of the earth. Two of these, referring to the times needed for resonance phenomena to produce certain orbital features, are new. He suggests that my own estimate, based on the theory of the resisting medium, needs reinterpretation to allow for accretion on the planets; but as I suppose the medium to be hydrogen, the question of accretion does not arise. His general conclusion is that astronomical evidence is consistent with geophysics but less definite; and with this we may readily agree. HAROLD JEFFREYS.

## A New History of Astronomy.

*Die Geschichte der Sternkunde: von den ersten Anfängen bis zur Gegenwart.* Von Prof. Dr. Ernst Zinner. Pp. xi + 673 + 13 Tafeln. (Berlin: Julius Springer, 1931.) 21·80 gold marks.

PROF. ERNST ZINNER is to be congratulated on having produced a captivating volume. What is most astonishing is the easy mastery with which he reviews the very different subjects that are contained in his work. There is here no heavy muster of facts, but enough to enable us to understand the lines of discovery and the development of ideas, the causes that contributed to progress, stagnation and decay, and the difficulties that had to be encountered. Astronomy is throughout brought into relation to the civilisation, the religion, the educational organisation, and the material environment of each age, and yet every important advance in observation, in theory, in apparatus is duly recorded. It seems strange to find combined in one book the beliefs of primitive peoples, the results of archæological research in Egypt and the Euphrates valley, the work of the Greek mathematicians, and of medieval schoolmen; the steady march of modern dynamical and observational astronomy, with a remarkable appreciation of the present position of research and of the conditions that govern research in all the numerous departments of present-day astronomy; and in each case the treatment is illuminating. It would be an achievement to have acquired such familiarity in a lifetime, but it may be noted that our author was only forty-four years of age when this volume appeared.

Not only the great astronomers of the past, but also most of the distinguished, and many of the less well-known, living astronomers are mentioned somewhere in this book. As the treatment is by subjects, not by persons, it is in some measure chance that determines whether a particular astronomer shall be mentioned by name or not. Unlike too many of his compatriots, the author shows no tendency to name the work of his fellow-countrymen in preference to foreigners. The catholicity of his interests may be illustrated by the fact that no fewer than four living alumni of the University of Oxford are mentioned. I have not attempted the task of enumerating the living alumni of Cambridge. The only trace of German national pride seems to lie in the use made of the word *Germanen*. The first fifteen parts of the book, comprising nearly the whole, profess to give the astronomy of different nations or races. The thirteenth of these, the astronomy of the *Germanen*, runs to 295 pages and includes the whole of modern astronomy, for, to our author, all nations that have received the German *Kultur* are entitled to be included under the generously comprehensive designation of *Germanen*.

What readers will miss most in this book is references. The author was probably right in omitting them. They would have added greatly to its bulk, and might easily have added many years to the labour of preparation. There is a general bibliography, six pages long, but, alas! it is arranged in alphabetical order by the authors' names and not by their subjects, and, what could probably not be helped, it includes only books, not papers. There is also a four-page bibliography of astronomical biographies, which ought to be valuable. Here and there bibliographical information is given in the text. But one would like to be able to trace the authority for some of the more speculative reconstructions of ancient science and ancient calendars, and to know, when results obtained by

others are not accepted, whether the rejection is due to ignorance or considered judgment. For example, when Prof. Zinner devotes nearly a page to the comets alleged to have accompanied the conception and accession of Mithridates, his rejection of my conclusions on that subject might be deliberate, but his failure to notice the passages cited by me from Sï-ma Tsiän suggests that my discussion had escaped his notice. On the whole, it is probably more a merit than a defect that our author not only teaches his readers much, but also sets them hunting for his sources and for further information.

J. K. FOTHERINGHAM.

## Qualitative Analysis by 'Spot' Tests.

*Qualitative Analyse mit Hilfe von Tüpfelreaktionen: theoretische Grundlagen und praktische Ausführung.* Von Dr. Fritz Feigl. Pp. xii + 387 + 2 Tafeln. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.) 28 gold marks.

PROF. EMICH, the famous microchemist, has called "Tüpfelanalyse" "the qualitative analysis of the future", and looks forward to the time when there will be a specific test for every inorganic ion, with enormous saving of time and material in analysis. Dr. Feigl has written the first textbook on Tüpfelanalyse, or 'spot' tests, after ten years' research in the subject, and shows that the methods are not of the future alone, since already for almost every ion there are two or more 'spot' tests worked out in detail. There are several methods of complete qualitative analysis using 'spot' tests only, and one method, combining the tests with some of the older group separations, is already in use in the chemistry course of the University of Delft.

'Spot' tests all involve a colour change, and the apparatus is very simple, since the tests are all carried out either in test tubes, on a porcelain tile, or on filter paper previously impregnated with the reagent and dried. The reagents are mainly organic compounds. The author points out that one advantage of organic reagents is the higher molecular weight of the reaction products, which tend to be more visible than those formed with inorganic reagents.

The first part of the book is theoretical. Complex salt formation, which is involved in most of the tests, is discussed in detail. In an account of masked reactions, Dr. Feigl shows how an unspecific reagent may be made specific by the use of different solvents and by the addition of a reagent before the test which gives a complex salt with the interfering ions. An example of this is the thiocyanate test for cobalt in the presence of iron. The test is carried out in acetone solution and an alkali fluoride or syrupy phosphoric acid is added before the test to reduce the ionic iron concentration. In this way 1 $\gamma$ of cobalt may be detected in a dilution of 1 : 50,000 in the presence of a thousand times the amount of iron. The possibilities of increasing the sensitiveness of a test by varying the conditions and by catalytic reactions are also dealt with.

There is an important chapter on induced reactions as they may be used to improve a test in qualitative analysis. The author gives a large number of examples, one of which is the barium test by sulphate precipitation. When the clear solution of lead sulphate in an acetic acid solution of an alkaline acetate is used as the precipitant for barium salts, not only is barium sulphate precipitated but also a considerable amount of lead sulphate, rendering the test eight times more sensitive, so that as little as 0·4 $\gamma$ of barium in 1 : 125,000 dilution can be detected.

The chapter which has entailed the most detailed research is written on the organic groupings which react specifically with certain inorganic ions, the nickel specific $\begin{matrix} & & \\ & \| & \| \\ -C & - & C- \\ & NOH & NOH \end{matrix}$ group, the ferrous iron specific $\begin{matrix} & & \\ & \| & \| \\ =C & - & C- \\ OH & & NOH \end{matrix}$ group, the $-CO-CH_2-CO-$ group which is specific for thallium in the presence of carbon disulphide, the copper specific $\begin{matrix} & & \\ & \| & \| \\ >C & - & C- \\ OH & & NOH \end{matrix}$ group, and the silver specific $NH-$ group. A large number of compounds containing the different groups have been prepared, in order to discover the compounds most suitable to use for the tests.

There is a chapter on the effect of various organic groups on the solubility of the reaction product, and another on capillarity as it applies to spot tests, for the capillary properties of the filter papers are often of importance when two or three elements are to be detected simultaneously.

The practical section consists of a detailed description of the tests for all the inorganic ions. The tests are admirably described, being both complete and clear. The smallest amount of the element recognisable and the limit of dilution are given for each test; where other ions interfere, alternative procedure is given, and the largest amount of the interfering substance that may be present without disturbing the test. Where the

reagents are rare, their preparation is described. There is a useful reference table at the end of the book summarising the tests and the reagents used. There are a few coloured illustrations, but as these are not clearly referred to the page and test illustrated, they are not very useful.

The book admirably achieves its object in combining both a book of reference and a practical handbook, and will therefore be valuable to all pure and applied chemists and everyone interested in the development of new methods of analysis.

## Short Reviews.

*La Grotte d'Isturitz.* 1 : *Le Magdalénien de la Salle de Saint-Martin.* Par Dr. René de Saint-Périer. (*Archives de l'Institut de Paléontologie humaine*, Mémoire 7.) Pp. 124 + 13 planches. (Paris : Masson et Cie, 1930.) 120 francs.

As an archæological site the cave of Isturitz (Bayonne) was brought to the notice of Piette in 1895. Proposals for its exploration came to nothing. It was then being worked by a commercial company for its phosphates ; and a series of objects of palæolithic age, which had been found in the course of the work, was given to the Société de Borda of Dax. Attempts were made to put a stop to the exploitation of the cave, but without success. A suit at law was instituted and the case dragged on until 1898, when a verdict was given against the company. Unfortunately, no injunction against further work had been granted while the matter was *sub judice*, and when operations ceased in 1898 the two galleries over which suit had been brought had been completely worked out. Valuable objects known to have been found, including examples of palæolithic carving and sculpture, have disappeared.

The opening of a second entrance to the cave on the death of the second owner, Dr. Langin, enabled systematic excavation to be begun in 1913. This was continued intermittently until 1921 ; but after that nothing further was undertaken until Dr. de Saint-Périer began operations in 1928. A second large series of related galleries was discovered in 1929. It is estimated that the complete exploration of the cave will take some years. In his desire to submit the evidence to his colleagues and to place the results on record at the earliest possible moment, Dr. de Saint-Périer has published this preliminary account of his excavation to date of the Magdalenian deposits of what he calls the " Salle de Saint Martin ".

The conclusion to which the evidence points is that the inhabitants lived on the horse, of which they brought the joints and not the carcases to the cave. The horse is also the subject most frequently represented in their art. The cave was thickly populated, the climate dry and cold. The fauna and the culture alike point to early Magdalenian, the latter showing affinities with Tuc d'Audoubert, Les Trois Frères and Gantier, and corresponding with Lespugues *B*, the Magdalenian IV of the Abbé Breuil.

Archæologists will be grateful to the author for publishing his results with such commendable promptitude, even though his conclusions must be regarded as to a certain extent provisional, pending further excavation. Still more are they indebted to the Institut de Paléontologie humaine for the profusion of illustrations of high quality.

*Elektrophorese, Elektroosmose, Elektrodialyse in Flüssigkeiten.* Von Dr. P. H. Prausnitz und Dr. J. Reitstötter. (*Wissenschaftliche Forschungsberichte, Naturwissenschaftliche Reihe*, herausgegeben von Dr. Raphael Ed. Liesegang, Band 24.) Pp. xii + 307. (Dresden und Leipzig : Theodor Steinkopff, 1931.) 18·50 gold marks.

THIS is a very valuable book which will be of the greatest service to a wide variety of students and investigators, since it deals in a most comprehensive manner with a range of phenomena of equal interest to the physicist, chemist, and physiologist. To all those who are more particularly interested in colloid chemistry and physics the book will be indispensable.

The book is divided into five chapters : (1) General, (2) electrophoresis, (3) electro-osmosis, (4) electro-analysis, (5) technical applications. Throughout the book, and especially in the last chapter, special attention is paid to the extensive patent literature. This is a feature which will greatly enhance its value for the very large class of readers who are concerned with industrial processes and phenomena.

Although the authors refer the reader to the monograph on " Elektrochemie der Kolloide " (Pauli and Valko, 1929) for a fuller account of the theory of the subject, they give enough in the introduction and general part to enable the reader to understand the basic principles underlying the processes described. This portion of the book contains a description (with diagrams) of the various forms of apparatus employed in laboratory investigations —another very useful feature.

The documentation is extremely thorough and valuable. Thus the book concludes with 47 closely printed pages, embracing bibliography, patent register, author index, and subject index.

The work of Drs. Prausnitz and Reitstötter may be warmly recommended to all serious students of physical and colloid chemistry.

F. G. DONNAN.

*The Paradox of the Ludicrous.* By Prof. Samuel S. Seward. Pp. vii + 145. (Stanford University, Calif. : Stanford University Press ; London : Oxford University Press, 1930.) 12*s.* 6*d.* net.

THE real nature of laughter may be described as a standing scientific puzzle. Some of the greatest names in the history of philosophic thought, say from Hobbes to Bergson, are associated with attempts to solve the puzzle. Why do we laugh at the sight of a bishop running after his hat ? Is it because we are at heart crowing over another's mishap ? Or is it because a dignified person is being taken down several pegs ? Or is it merely our reaction to an incongruous situation ? Or did

Nature 'invent laughter' at minor misfortunes in order that man's vitality might not be sapped by an excess of sympathy? All these hypotheses, and others, have been tried, but none of them fits all the facts. For the facts are as disparate as laughing because one is metaphorically tickled by a joke, and laughing because one is literally tickled in the ribs.

Now comes Prof. Seward of Stanford University with his extremely interesting and well-written book, in which he says in effect that previous investigators have all been on the wrong tack, that they have all addressed themselves to the wrong question. Instead of seeking, as they have vainly sought, for a common quality in all causes of laughter, they ought to have been marking how the boisterous laughter of childhood leads on gradually to the quiet, mature chuckles at a joke in *Punch*. In other words, if we understand Prof. Seward aright, the evolution of laughter is an 'emergent' evolution. There we must leave the subject, but not without our reiterated appreciation of this excellent monograph. T. R.

*Let's Help! a Collection of Good Causes.* By Sir Charles Bright. Pp. xv + 198. (London: George Routledge and Sons, Ltd., 1931.) 4*s.* 6*d.* net.

IN this volume Sir Charles Bright has brought together interesting information regarding numerous organisations which exist to further various kinds of good work. Among those described are a number of bodies engaged in extending the services of science in various directions, such as the British Science Guild and the National Institute of Industrial Psychology. The former was founded in 1905 by the late Sir Norman Lockyer to bring together all persons throughout the Empire interested in promoting the development and applications of science. The Guild has established numerous committees, such as those on the design and manufacture of microscopes, provision of glass and other laboratory ware, and the synchronisation of clocks. In 1921 it published a "Catalogue of British Scientific and Technical Books", containing 6627 titles, but in the 1930 edition the number of titles has grown to 13,915. Sir Samuel Hoare is president of the Guild and Sir Richard Gregory is chairman of the council of management.

The National Institute of Industrial Psychology, founded in 1921, has undertaken investigations under the direction of Dr. C. S. Myers for more than 180 firms representing nearly sixty different industries. Vocational tests have been devised and successfully applied to the selection of engineers, weavers, packers, chocolate makers, solderers, clerical workers, and many others. Research has also been carried out into problems of daily variations in efficiency, the nature of mechanical ability, and vocational problems of the blind. Numerous investigations have been made into the best methods of work in various occupations, but the error made by the pioneers of 'scientific management' in rigidly standardising movements has been avoided, since it is recognised that each worker, within limits, must develop his own style.

*The Japanese Earthquake of 1923.* By Dr. Charles Davison. Pp. xii + 127 + 6 plates. (London: Thomas Murby and Co., 1931.) 7*s.* 6*d.* net.

IN this small volume Dr. C. Davison gives an intensely interesting account of the great Japanese earthquake of 1923 from two points of view: first, as it affected man and his works, and secondly, from the point of view of geophysics. The Japanese Home Office in 1926 issued a large report on the former aspect, and much of the first part of the book, including some interesting illustrations, is based upon that. The geophysical discussion summarises forty-one scientific memoirs, almost entirely by Japanese writers. Dr. Davison considers that though other earthquakes have been more violent, and some have taken a greater toll of human life, there has probably never been one that was so appalling in the total havoc wrought, largely because of the terrible fires that followed it. "In all probability there will never be another like it, for no city now exists with so many wooden houses as Tokyo contained in the days before the earthquake."

The story of the admirable behaviour of the populace in the midst of the disaster, and of the extraordinarily able and successful efforts of the Government in re-establishing the social organisation, is one of surpassing interest—perhaps the more so in view of the possible parallel man-wrought disasters of fire and explosion, if not of earthquake and tidal waves, that the future may have in store for other great capitals, if the nightmare threat of aerial warfare is not removed by international agreement.

*Nuer Customs and Folk-Lore.* By Ray Huffman. Published for the International Institute of African Languages and Cultures. Pp. xv + 108 + 8 plates. (London: Oxford University Press, 1931.) 8*s.* 6*d.* net.

MISS HUFFMAN has lived for some years among the Nuer, members of the Nilotic group of tribes who are among the less accessible of the Sudanese peoples. Comparatively little is known about them, as they have a preference for their own ways, and, being slow to appreciate the advantages of European civilisation, have been able to preserve their state of reserve and seclusion. The author's thorough acquaintance with their language has enabled her to get closely into touch with them, and in this brief study she has set down much information which, if it does not give a complete account of their culture, is at any rate for the most part new. It is supplemented by an introduction by Dr. Westermann, giving a brief summary of the main features of their culture, which is dominated by their cattle tending and the periodic flooding of their country. The cult of what is apparently a rain deity holds a position of special significance in their beliefs. A number of folk-tales, in which the Nuer language is rich, is included.

## The Evidence of Palæontology with Regard to Evolution.

A DISCUSSION on the extent and value of the contribution which the study of fossils can make to the study of organic evolution took place on Sept. 25 at a meeting of Section C (Geology) of the British Association. Even if it is agreed that palæontology is as incapable of providing a direct proof of evolution as is neontology, it must be admitted that palæontology reveals a whole series of facts which are correlated by that principle but are at present otherwise unexplained. It is generally agreed that the evidence of palæontology supplements that of neontology. Many palæontologists, however, would claim more than this for their subject; Prof. H. L. Hawkins emphasised that palæontologists see the problems of evolution in three dimensions, perhaps rather dimly, but claimed that a more satisfactory impression can be obtained in that way than from a sharper picture in one plane only, such as is ordinarily available for the student of living forms.

It is unfortunately true that in some respects the evidence which palæontology is able to contribute is scanty. Especially is this true in regard to the evolution of man, where fossil evidence does little more than supplement the evidence derived from the study of living Primates. Thus Sir Arthur Keith believes that from the fossil evidence alone we cannot construct man's genealogical history. The geological information is nevertheless important; "it permits us to verify and amplify the theory of man's evolution, which has been constructed from the evidence of anatomy, physiology, and embryology", but it is manifest that much more information is needed before our knowledge of man's origin rests upon a sound basis of ascertained facts. This incompleteness of the known fossil record of human evolution is emphasised by the different interpretations of the details of man's genealogy put forward by such authorities as Sir Arthur Keith and Prof. H. Fairfield Osborn.

In other groups of animals, however, and especially in those groups of mammals which have been investigated in such magnificent detail by Prof. Osborn, more complete series of fossils have been available, and the phylogenies of many families are reasonably clear. In such groups as the horses and the Titanotheres, the fossil record is at any rate sufficiently complete to warrant the assertion that the general lines of their evolution are moderately well known and can be demonstrated from fossil evidence.

In the case of the invertebrates also, the evidence of palæontology is of considerable weight, although the material available for study has certain obvious limitations, since the skeletons of the invertebrates are usually less closely related to the vital parts of the organism than is the skeleton of a vertebrate. Several of the speakers in this discussion claimed that, in spite of these disadvantages, invertebrate remains do afford valuable material for the study of evolutionary problems. The great numbers of specimens which are available for investigation make it possible to find series of specimens showing progressive changes in definite directions. The more abundant the specimens, the more completely may the seriation be demonstrated. In this way the palæontologist has been able to indicate certain series of invertebrate fossils which, in some cases, may accord closely to lineages or lines of evolution. The number of well-established lines among invertebrates (such as those of *Zaphrentis delanouei* and of the Chalk *Micrasters*) is admittedly small, for it is becoming increasingly clear that many so-called lineages are only approximations to lines of evolution, but there is abundant evidence of progressive changes by almost imperceptible gradations.

Many students of invertebrate fossils have paid great attention to the development of the skeleton during the life history of the individual. Certain invertebrates preserve in their skeletons a record of the changes in the skeleton during growth, for whereas the skeleton of a vertebrate is progressively modified during growth, the shells of many adult molluscs and the hard parts of many corals preserve unchanged the skeletons of the young individuals.

In the course of this discussion, several palæontologists (including Dr. F. A. Bather, Dr. W. D. Lang, Prof. H. H. Swinnerton, and the writer) emphasised the value of these ontogenetic characters in determining relationships—a value which has been recognised by palæontologists for many years. It was admitted that a more important criterion in establishing phylogenies is the recognition of transitional forms in a correct geological order, and that few palæontologists would propose to use ontogenetic evidence alone for constructing lineages. It was suggested, however, that, used with caution, ontogenetic evidence is of great value as a criterion of relationship. Dr. Lang maintained that some of the objections which have recently been urged against the recapitulation hypothesis are due to a failure to understand the views of palæontologists. He pointed out that not all the features seen in a developing organism (or preserved in the early part of its skeleton) are regarded by palæontologists as recapitulating adult characters; further, it is not an earlier adult *stage* which is normally represented in ontogeny, but rather certain individual *characters* possessed by an earlier adult.

Prof. Swinnerton emphasised the further importance of ontogenetic studies in relation to the behaviour of unit characters in development. He claimed that palæontology has important contributions to make to many of the problems which have been the concern of the geneticists. He pointed out that while palæontologists have studied more particularly those complex groups of characters which are represented in fossils by single structures (while the geneticist is concerned chiefly with unit characters), they have meanwhile accumulated much illuminating information relating to problems of inheritance. He suggested, moreover, that geneticists may too often have neglected the behaviour of those characters during development.

It may be remarked that Prof. D. M. S. Watson expressed grave doubts concerning the validity of the arguments used by some of the palæontologists who took part in the discussion. He especially deplored the use of ontogenetic evidence alone in the establishment of supposed phylogenies. He also criticised severely some current interpretations of the analyses of statistics relating to variability among invertebrate fossils, to which reference had been made.

In short, palæontologists are agreed as to the general extent and importance of the contributions of their subject to the solution of evolutionary problems; it is as regards the interpretation of the details of the evidence that there is much difference of opinion. A. E. TRUEMAN.

## The Gene and the Theory of Living Structures.

DR. C. B. BRIDGES, whose name is associated with those of Morgan and Sturtevant in the now classical studies on the cytogenetics of *Drosophila*, and who recently went to Russia for a stay of some months, gave an address before the Genetical Society on Oct. 19, on the subject of "The Gene and the Theory of Living Structures".

Dr. Bridges led up to the question of the gene by a general discussion of scientific method. His general method of approach is an analysis from two aspects, that of structure and that of behaviour. This analysis is made at successively deeper levels, each simplification of the unit reducing complexity of structure; or, looking at it the other way, each change from a lower to a higher unit offering new possibilities of complexity not necessarily predictable at the lower level. Thus a crystal of sugar is successively analysable into sugar molecules, atoms arranged in a definite space-lattice, electrons, etc., composing the respective atoms. Reversing the process, the electrons must have preceded the atoms, the atoms the molecules, thus giving rise to evolution by progressive stages of aggregation, each stage presenting a fresh type of complexity. This might be called a form of the doctrine of emergent evolution, only the emergence is as true in the case of non-living as of living things. Of course, there is some disintegration as well as integration, but there is no reason to suppose that the process of integration is at an end, that the clock is running down; indeed, one might suppose that the time clock will only stop when it is wound up as tight as it will go.

At each stage of emergence, then, new characters arise which are not simply related to the properties of the components. Further, all these existences are affected by external conditions. The sciences describing matter and its properties may approach from the point of view of structure, like chemistry; or of behaviour, like physics: thus forming, as it were, a warp and weft of knowledge. Any simplification in the expression of structure calls for a corresponding complication in the expression of behaviour, and conversely.

The particular aspect of this evolutionary process which is presented to us depends on our local time and space. We have traditionally our three 'kingdoms'—animal, vegetable, and mineral; they might easily be two only, biontic and abiontic; and at some stage there must have been one only, the abiontic. Life exists only at certain levels of evolution and has no meaning outside these, just as temperature has no meaning below the molecular horizon, as it is a symbol of molecular activity.

What, then, is the essential property of living organisms? It lies in the manner of their reproduction, which is always continuous in time and space with an existing organism, and always autocatalytic in form. The process characteristic of living organisms is increase in spatial boundaries followed by splitting, either of the whole unicellular organism or, in higher plants and animals, of 'delegated' cells. It is clear that the machinery which brings about this type of multiplication must be as simple as a single cell. The significance of the nucleus in heredity is shown by the fact that the paternal influence equals the maternal in animals, where the sperm consists almost entirely of nuclear material, scarcely any cytoplasm being carried over into the new zygote. Taking the analysis a stage further, we find the nucleus formed from smaller bodies, the chromosomes, and the chromosomes in turn composed of still smaller particles, the genes. The genes correspond to the hypothetical units used by Mendel in his classical researches.

Now, when in the genetic investigation of *Drosophila* about twenty pairs of characters had been found, the fly having four pairs of chromosomes, it became clear that some of the chromosomes must carry more than one pair of factors. From this was developed the theory of the linear order of the factors and the conception of the gene as a particle having a definite place on the chromosome thread. The theory was confirmed by the discovery of non-disjunctions and of translocation: the genes in the translocated portion, said Dr. Bridges, have moved into a new street and have a new street number.

The actual size of a gene is probably of the order of $2\text{-}7 \times 10^{-6}$ cm., smaller than any observed chromosomal structure. Probably each gene forms the central core to a body consisting of a skin and a core with chromonemal sap between. When the chromonema, which lies coiled in the chromosome like a spring in a tube, is uncoiled from its spiral it may be seen as a tangled skein bearing little knots; so if we cannot see the genes, we can see, as Dr. Bridges said, the tiny houses they live in. From Muller's X-ray work, which shows that a gene affected by irradiation is turned over at one stroke, the structure of the gene would seem to be simple and not compound.

What is the physical rank of the gene? It cannot be below a molecule, and must be built up from the molecules available in the nutrient sap surrounding it. It may possibly be a molecule of a new and unexpected type.

As regards the process which gives rise to two genes in place of one, two theories are mechanically possible. Either the daughter gene may be built up by the side of the old one, at a catalytic surface, with a point by point correspondence, or the original gene may become doubled and then split. The first would lend itself to a sort of 'zip-fastener' pattern with linear sub-units, as postulated by Serebrovsky. In Dr. Bridges' view, however, the phenomena described by Serebrovsky can be satisfactorily explained on lines of developmental mechanics without the postulate of linear sub-units of the gene. The gene might be a structure shaped like a pancake, having a single layer of molecules built into a definite pattern. A difficulty in the way of assuming that the daughter gene is formed at the surface of a vesicle as repetitions of unitary patches is the fact that genes mutate suddenly as if acting as simple units.

It is probable that the structure of all genes will be found to be of one type. This follows from increasing simplicity with descent in the scale of units. There is far less difference between chromosomes than between organisms, and hence probably far less difference between genes than between chromosomes. H. S.

## New Game Reserves in South Africa.

By Prof. H. B. FANTHAM.

THE conservation of the natural fauna of a country is a matter of considerable importance. With the advance of agriculture and industrial development, the animals of South Africa, as in other parts of the world, have been in danger of extinction. In fact, within the last hundred years, six of its unique species, the bloubok, quagga, Namaqualand giraffe, Orange River buffalo, black-maned Cape lion, and the red hartebeest, have become extinct in the Cape Province, and many other species are in danger of extinction. The blesbok, bontebok, and white-tailed gnu only occur on private lands and have been preserved through the efforts of a few individuals.

The South African Government has not been unmindful of the interest and value of its fauna, and a number of large and important game reserves have been established, of which the Kruger National Park in the Transvaal of 5,000,000 acres (more than 7000 square miles) in extent, and the Umfolosi Reserve in Zululand—the home of the fast disappearing white rhinoceros—are perhaps the best known. Recently, on July 3, the Government of the Union of South Africa proclaimed three new game reserves, the constitution of which had been approved by Parliament on May 8.

The largest of these new reserves is termed the Kalahari Gemsbok National Park, in the Division of Gordonia, some distance north of Upington. This Kalahari reserve is about 1,800,000 acres (some 3000 square miles) in extent. It is an arid area, situated in the Kalahari thorn country between the Oup (Aub) and Nosop (Nossob) Rivers. The elevation is 2000-4000 ft. The vegetation consists mainly of thorn bush (species of *Acacia*), thorn-trees such as the cameeldoorn (*Acacia giraffæ*), which is the most characteristic tree of the region, and sparsely spaced tufts of desert grasses. The rivers are frequently dry sandy beds, which flow after rain, but water can always be obtained by sinking shallow wells. This reserve shelters a number of vertebrates, which feed on succulents and xerophytic vegetation, on which they thrive. These include the graceful and handsome gemsbok (*Oryx gazella gazella*), the red hartebeest, the blue wildebeest, and the springbok. The gemsbok was formerly widely distributed in southern Africa, but now has become relatively rare and even extinct in many parts of the country. They flourish in the Kalahari wastes, where they roam in herds and feed on succulent roots and underground stems dug out by their hoofs. Under protection in the new reserve they should increase in numbers. In addition to the antelopes mentioned, the kudu occurs in the reserve, klipspringer are said to be present, and wild ostrich are known.

The second reserve is the Addo Elephants National Park in the Divisions of Alexandria and Uitenhage, Eastern Cape Province. It comprises an area of more than 11,000 acres, well covered with dense scrub and bush. Portions of the Union Forest Reserve and of a number of farms have been combined to form this game reserve, where the now small herd of the southern geographical race or subspecies of the African elephant can live and propagate. Abundance of *Acacia*, succulent *Portulacaria*, aloes, and other succulents provide ample food. A few years ago the Government was obliged to reduce the herd greatly, as they invaded neighbouring farms and did considerable damage. The presence of good watering places in the new reserve, it is hoped, will prevent further damage to cultivated lands by these interesting small elephants. Cape buffalo, which were almost exterminated by rinderpest, still survive in the Addo reserve, and kudu and bushbuck occur in herds. A similar race of elephants occurs in the Knysna reserve, comprising the finest indigenous forests in the Union, and in both the Knysna and the Addo wild pig are abundant, accompanying the elephants and feeding on their droppings, thus aiding in the dispersal of the seeds of trees.

The third reserve is styled the Bontebok National Park. It is situated in the Division of Bredasdorp in the south-western Cape Province. It is a small reserve, some 1700 acres in extent, and will be a sanctuary for the rarest of the South African antelopes, the bontebok (*Damaliscus pygargus*). For many years this small but most beautiful and richly coloured antelope has been confined to a few farms in this area and has been preserved through the efforts of a few individuals. Formerly it was widely distributed along the coastal strip, and without the active interests of the animal lovers

already mentioned it would, without doubt, have become extinct. It is highly important that the bontebok, the only indigenous large mammal of the south-west Cape, should be given a permanent refuge.

From my friend, Dr. E. Warren, Director of the Natal Museum, I learn that the mountain zebra at Cradock are still not adequately protected. These animals are more beautiful than Burchell's zebra, and have adapted themselves to mountain life and bleak stony wastes. It has been suggested by Sir Lionel Phillips that they should be established in a reserve at Bain's Kloof, and, for the sake of posterity, it is to be hoped that a mountain zebra reserve will be proclaimed in the near future.

## News and Views.

AMONG the many members of the Society of Jesus who have added to scientific knowledge, few were better known than the seventeenth century natural philosopher Franceso Terzi de Lana, the tercentenary of whose birth falls on Dec. 13. Like his friend and contemporary, Father Kircher, Lana published various works among which was his now very rare book, "Prodromo, overo Saggio di alcune Inventioni . . ." of 1670. In this, he described a series of useful discoveries and it has been called the first book of the science of aeronautics. To raise oneself in the air he suggested the use of four thin metal spheres exhausted of air and attached to a car. The experiment was never made, but Lana's ideas foreshadowed the balloon and airship. His other work of note was his "Magisterium Naturæ et Artis . . .", in which he intended to cover the entire field of the natural sciences; only three of the intended nine volumes were issued, but these have been referred to as "a veritable cyclopædia of all sciences connected with natural philosophy". Born at Brescia, Lana entered the Society of Jesus in 1647, studied at the Roman College and afterwards taught at Terni, Ferrara, and elsewhere. When his health began to decline, he returned to his native city and died there on Feb. 22, 1687.

ON Wednesday, Dec. 2, in the University Museum, Oxford, Prof. E. Freundlich, director of the Astrophysical Observatory at Potsdam, delivered a lecture on the results of the Potsdam Solar Eclipse Expedition to Sumatra in May 1929, to determine the deflexion of light in the sun's gravitational field and to examine its variation with distance from the sun. Dr. Freundlich dealt solely with the results obtained from the series of plates exposed in one of the two telescopes which were employed at Sumatra. Four of these plates were exposed on the star field immediately surrounding the sun and the remaining three on a star field at a distance of 25° from the sun. Exposures on the same star fields were also made at the same place some months later and at night. In order to obtain the highest possible accuracy it was not advisable to measure the distance apart of two star images on the eclipse plate and compare it directly with the corresponding distance on the night plate. Plates exposed so as to obtain laterally inverted images of the star fields were adopted as intermediate standards of comparison.

PROF. FREUNDLICH showed that after corrections for aberration and refraction had been made, the star image displacements could be expressed as the sum of two terms, one, the scale effect term due to small variations in focal length of the observing telescope, and the other due to the actual light deflexion. The change in focal length is primarily a temperature effect. It manifests itself in the same way as the light deflexion, that is, it gives rise to a dilatation, which, however, increases with increasing distance from the sun, whereas the light deflexion effect decreases. Unfortunately, the weight of the coefficient of the scale effect term is approximately two hundred times greater than that of the light deflexion term, but by superimposing on each plate the image of a specially prepared 'reseau' placed at the focus of a collimating lens, Prof. Freundlich and his collaborators were able to differentiate between the two terms and obtained the value $2{\cdot}24'' \pm 0{\cdot}20''$, instead of the value $1{\cdot}75''$ as predicted by theory for the deflexion of a beam of light in the sun's gravitational field. A recalculation of the results of the Lick expedition paying particular attention to the influence of the scale effect term yielded a value of $2{\cdot}2''$. A revision of the field equations of the theory of relativity would appear to be of the highest importance.

DURING the last few weeks, much interest has been aroused by the discovery of fossilised remains of the mammoth (*Elephas primigenius*) near Nottingham. Similar remains have been found, from time to time since the middle of last century, at other places in the vicinity of the city. Unfortunately, nearly all of these have been lost or destroyed. Even so recently as three years ago, a complete skull was found and promptly destroyed by the workmen, and only a small fragment of one of the tusks was rescued. It is hoped that the publicity given by the newspapers to the present find will result in a more enlightened treatment of such remains in future. The Trent Gravel Company's workings are in a patch of the older river gravels, situated half a mile away from the river Trent at Attenborough. These gravels were deposited after the last erosional phase of the river and now underlie its present flood plain. The remains which were recently found consist of one tusk five feet long, a third upper and a corresponding lower molar. They were found twenty feet below the surface, in the bottom layers of gravel. One molar was much worn by rolling, and must therefore have been derived from older deposits. The condition of preservation of the other, and the fact that it had not been rolled, show that it was contemporary with the gravel in which it was embedded. It thus furnishes additional testimony in favour of the view that the mammoth survived into post-glacial times in Great Britain.

A REMARKABLE group of meteorite craters near Henbury in Central Australia was explored in May 1931 by Mr. A. R. Alderman, of the University of Adelaide, and his account of them was given before the Mineralogical Society on Nov. 3 (see NATURE of Dec. 5, p. 977). Later, in June of this year, a second expedition to the locality was undertaken by Mr. R. Bedford, of the Kyancutta Museum at Kyancutta, South Australia, who travelled about 3000 miles by motor truck. Numerous masses of meteoric iron, weighing from a fraction of an ounce up to 170½ lb., have been found scattered around the thirteen craters, and 1350 pieces were collected by the two parties. A selection of the 542 complete masses of the iron, together with his sketches and photographs of the craters, recently sent by Mr. Bedford to the British Museum, are now on view in the meteorite pavilion of the Natural History Museum at South Kensington, as a temporary loan exhibit from the Kyancutta Museum. In the report in NATURE of Mr. Alderman's paper, the last sentence should read: These craters, which are very similar to the famous Meteor Crater in Arizona, though much smaller, were evidently formed by the impact of a shower of meteorites at some remote period.

AT the meeting of the International Seismological Association in Stockholm in 1930 a committee under the chairmanship of Commander Heck of the United States Coast and Geodetic Survey was appointed to consider what modifications are desirable in the code used for seismological telegrams or broadcast messages. It is now announced that a provisional code has been adopted and will be brought into use as from Jan. 1, 1932. The code will be submitted to the Association for approval or modification at the meeting which is to be held at Lisbon in 1933. The principal departure from the code in use hitherto is that provision is made for reporting phases other than $P$ and $S$. Originally the letters $P$ and $S$ signified merely the first and second conspicuous disturbance in an earthquake record, but more precise meanings are given nowadays. For example, if a station is about 110° from the epicentre, the first phase on the record may be $PR_1$, a longitudinal wave reflected at the surface, whilst the next clearly defined phase may be $S_cP_cS$, a wave which is initially and finally transversal, but longitudinal in the central liquid core of the earth. With the new code the times of these or other pairs of phases can be reported. The other new feature of the code is the inclusion of check groups. The check figures are obtained by adding figures of the significant groups according to specified rules. When the figures tally, the recipient may be certain that he has a correct message, and experience with similar check groups in meteorological broadcasts shows that when figures do not tally the recipient has a reasonable chance of discovering what error has been made. Copies of the code may be obtained by application to M. E. Rothé, director of the International Seismological Bureau, 38 Boulevard d'Anvers, Strasbourg.

ON Nov. 30 an interesting experiment in electric traction was carried out on the Great Southern Railways Company's line from Dublin to Bray, when a special train driven by current supplied from Drumm storage batteries was successfully tried. The train was 135 ft. long and weighed 75 tons, and an average speed of thirty miles an hour was maintained. The battery, which is the invention of Dr. J. J. Drumm, of Dublin, is of a new design, its special feature being that it is capable of supplying a heavy discharge during periods of acceleration, and of being rapidly charged to its full capacity. Though full particulars of the battery have not yet been published, information regarding it was issued by a department of the Irish Free State Government during preliminary tests made about a year ago. The positive plates of the cells are of nickel and graphite, but the negative plates appear to be of nickel gauze. The containers are of monel metal and the electrolyte is stated to be mainly a solution of caustic potash in distilled water. A party of experts, with Mr. P. J. McGilligan, Irish Free State Minister for Industry and Commerce, travelled in the train on Nov. 30, and all expressed their satisfaction with the results of the trial. It is hoped that by the use of the Drumm battery it will be possible to electrify the Irish Free State railways at a comparatively small cost. An account of the preliminary tests was published in *Engineering* for Sept. 5, 1930.

A NEW departure has been made at the Science Museum, which is visited by many thousands of children annually, by providing a gallery specially planned to be attractive and interesting to them. The descriptive labels of objects in the main galleries are for the most part scarcely within their grasp, and consequently their interest in the objects is not aroused. In the new Children's Gallery, which will be opened to the public on Dec. 12, illuminated perspective scenes are freely used, and these are supplemented by working models. One series of exhibits illustrates the development from man-transport through various types to the mechanical transport of to-day; another shows how primitive forms of lighting have been successively replaced by more efficient methods. Three of the earliest of human crafts, the flint tool-maker, the potter, and the smith, are represented, and films of each at his work will be shown. With each exhibit is a reference to the Museum Gallery in which similar objects are to be seen. Time measurement, the making of a pot, and a model aeroplane in a wind channel are also included in the exhibits; illuminated transparencies show astronomers at work; alchemists and modern chemists' shops are compared; and the development of the aeroplane is sketched.

THE United States Patent Office has issued the specification of the first plant patent to be granted under the new provisions which were added to the patent law last year. The revised statute states that a patent may be granted to "any person who has invented or discovered and asexually reproduced any distinct and new variety of plant other than a tuber-propagated plant", and that the patent shall grant to the inventor "the exclusive right to asexually re-

produce the plant ". The law applies, therefore, only to the production of new varieties by grafting, budding, etc., and not by seeds. The patentability in any particular case will be determined according to the ordinary principles of patent law, but it is clear that a new plant must have characteristics which clearly distinguish it from known varieties, whether those characteristics relate to colour, immunity from disease, flavour, perfume, resistance to cold or heat, storage qualities, and so on. The specification of Plant Patent No. 1 granted on Aug. 18, 1931, is for the climbing rose 'New Dawn', which is stated to be distinguished from the 'Dr. Van Fleet' by its everblooming habit, and when grown in the latitude of New Brunswick, N.J., to provide "a succession of blossoms on a single plant from about the end of May to the middle of November or until stopped by frost".

IN connexion with the project, fostered by the Canadian Government, for establishing a regular steamship service during the summer navigation season between Churchill, the new port on the western coast of Hudson Bay, and Europe, which was described in an article in NATURE for July 11, p. 53, it is of interest to record that test shipments of grain, amounting to 545,000 bushels, were loaded and cleared from the port on Sept. 18 and 22. No further transport movement has been attempted this year, but it is hoped to bring the port into regular operation in 1932. The point of crucial importance is the duration of the navigable season in the Strait and Bay. In the report of Capt. N. B. McLean, quoted in the article above referred to, the period of free navigational movement was given as about four months, between the dates of July 19 and Nov. 16. This tentative conclusion was based on observations made on the formation and prevalence of ice during the seasons of 1927 and 1928. A report is now to hand on the "Navigable Conditions in Hudson Bay and Strait during the 1930 Navigation Season", from which it appears that the Strait had become fairly clear of ice by the last week in July, though there was "heavy, close-packed ice" at Burwell on July 25-26. At Nottingham Island Direction Finding Station, no ice of consequence was observed after July 24. Churchill harbour was free from ice so early as June 11, and ice was apparently not again formed until Oct. 19. The first ice which might affect navigation on the Hudson Bay route was reported on Oct. 16 by the Nottingham Island Station, and on Nov. 4 at the same station there was "heavy, close-packed ice as far as could be seen". As regards fog, between Aug. 2 and Oct. 31 there were about seventy hours' dense fog and from 20 to 50 hours' light fog, according to locality.

FURTHER news is to hand of the investigation of the Oldoway bone beds by the East African Archæological Expedition which, under the leadership of Dr. L. S. B. Leakey, has accompanied Dr. Hans Reck to the site on which the latter discovered the Oldoway skeleton in 1913. According to a dispatch from Nairobi in the *Times* of Dec. 3, stone tools have now been discovered in all five of the bone beds. It will be remembered that when Dr. Leakey and Dr. Reck addressed to NATURE the joint letter which appeared in the issue of Oct. 24, p. 724, Bed No. 2, to which it had been determined that the skeleton belonged, had yielded only two flakes showing bulbs of percussion, while the overlying beds 3 and 4 had yielded unrolled coups-de-poing typical of late Kenya Chellean and Acheulean. It would now appear that in Bed No. 2 early Chellean implements have been found in the lower layers and advanced Chellean at the top, while Beds 1 to 4 provide a complete sequence from pre-Chellean to advanced Acheulean. It is also stated that part of an articulated skeleton of a deinotherium, usually regarded as of miocene age, was discovered in a bed associated with pre-Chellean implements in conditions which preclude the possibility that it is derivative. Confirmation and fuller details must be awaited; but it does not necessarily follow that an extremely high antiquity must be attributed to the artefacts. Although Prof. J. W. Gregory has assigned certain beds which he correlated with Kumasian deposits to the Miocene, this classification is not accepted in Dr. Leakey's recent book. The members of the Expedition are inclined to regard the Oldoway beds as of lower and middle pleistocene age. In any event, a much higher antiquity is attributed to *Homo sapiens* than has previously been accepted. Dr. E. J. Wayland's letter on p. 1003 of this issue should also be read in this connexion.

IN the American journal *Engineering and Contracting* for September 1931 is a reprint of an interesting article by Col. T. T. P. Luguer, of the Corps of Engineers Reserve, on Mason and Dixon's Line, which was first published in the *Military Engineer*. Charles Mason, who was born in 1730 and died in 1787 and was assistant to Bradley and to Maskelyne, was engaged with Jeremiah Dixon in 1763 to settle the boundary controversy between Pennsylvania and Maryland, which had raged with exceeding bitterness for a century. Col. Luguer gives a sketch of the history of the boundary dispute, which involved among other things a lawsuit in the Court of Chancery lasting fifteen years, and describes the methods used by Mason and Dixon, and the fixing of the boundary marks. There were many difficulties and dangers to be overcome, and on Oct. 9, 1767, having proceeded a little more than 230 miles from the north-east corner of Maryland, the Indians refused to permit the line to be run farther. The accuracy of the work was good, considering the apparatus used, and at the last survey, about twenty-five years ago, the maximum deviation from the true parallel was found to be about 1000 ft., and that for the greater part of the distance the errors were very small. A special report on the resurvey of the Maryland-Pennsylvania Boundary was published by the State of Pennsylvania in 1909.

AT the Crystal Palace Show in the third week of November the most interesting section was that of the fur-bearing mammals, of which were exhibited not only the usual variety of rabbits, but also choice colour varieties (silver and 'cross') of the common fox, the form of the Arctic fox which remains coloured in winter, musk-rats, coypus, polecat-coloured

ferrets—dignified by the title of 'fitch'—and in particular, specimens of the mink, an animal not at all common in zoological collections, and of particular interest as being intermediate in form and habits between the otters and the terrestrial weasels. The show of poultry was not so interesting as that of the Poultry Congress at the Crystal Palace last summer, because there was the usual limitation of species—no guinea-fowls, whereof the Congress exhibited several species and hybrids, and only one specimen of the swan-goose (*Cygnopsis cygnoides*), commonly known in England as the Chinese goose. It is, however, the domestic goose of eastern Asia generally, being found in its least specialised form in India, and in China showing several breeds as distinct as those of the western greylag; at the Congress most of these could be compared. The wild race of the swan-goose appears never to have been imported, and is little known.

IN the North Mammal House at the London Zoological Gardens can now be seen no less than three species of tree-kangaroos (*Dendrolagus*) from New Guinea, specimens of *D. matschiei*, which was only described for the first time in 1907, having recently been received. This is the brightest coloured of all kangaroos, having a body of rich bay, while the extremities are buff. A young one, about six months old and mostly independent of the pouch, is as bright as its mother. This species is rather small as kangaroos go, and so is the black tree-kangaroo, *D. ursinus*, which is strikingly quadrupedal in its movements and looks rather like a huge clumsy marten. The third species, the grizzled grey tree-kangaroo (*D. inustus*), is, however, a hopping biped like the ground-kangaroos and looks far more like them, though with small ears and a decidedly sheepish-looking head; this is small in proportion to the body, which is of good ordinary kangaroo size. This species shows very plainly that the tree-kangaroos really display no approach to the phalangers, that approach being made by the little rat-like musk-kangaroo (*Hypsiprymnodon*) which has not yet been exhibited in England.

AT a meeting of the Section of the History of Medicine of the Royal Society of Medicine on Dec. 2, Dr. J. D. Rolleston disposed of a legend current in the medical profession and elsewhere concerning Sir Benjamin Ward Richardson, F.R.S., who died in 1896, when a sympathetic obituary notice appeared in NATURE for Nov. 26, 1896, p. 80. Although Richardson's work and even name are unknown to a large proportion of the present generation, his memory, according to Dr. Rolleston, is still kept alive by those interested in the alcohol problem, in the scientific investigation of which he was a pioneer, as shown by his paper read before the British Association in 1866; the establishment of model abattoirs, for the provision of which he founded a society; and the biographies of medical men and natural philosophers which he published in the *Asclepiad*. The legend in question was that Richardson, with the fanatical zeal of a teetotaller, poured down the sink the contents of a priceless wine cellar, which had been left him by Sir Walter Trevelyan in 1879 "to be applied for scientific purposes". Richardson was much embarrassed by the gift, although he had numerous suggestions as to its disposal. Finally nothing was done, and the bottles and their contents, one of which was exhibited by Dr. Rolleston, remained in possession of Richardson's family. Last July, a large consignment was sent to the late Prof. W. E. Dixon at the Pharmacological Laboratory at Cambridge, where it still remains, Dixon's death having taken place before he was able to examine it.

THREE years ago a series of tests on street lighting was organised at Sheffield by the Department of Scientific and Industrial Research. The tests were carried out by a group of independent observers, and ten different street-lighting installations were examined. The analysis of the results indicates that there was a tendency to assess the degree of 'glare' by the amount of discomfort experienced rather than by the reduction of visual sensitivity. A further series of tests was carried out a year ago at Leicester. The results have just been published by the Department in Illumination Research, Paper No. 13 (London: H.M. Stationery Office). In this test a series of eight street-lighting installations was arranged in Leicester, and the observers had to assess, without using any apparatus, the relative advantages and disadvantages of the various systems of lighting. Particular attention was paid to general visibility, attractiveness, and glare. The results show that the order in which the eight installations were placed by various observers was identical so far as regards estimates of the visibility of objects on the roadway, the reduction of ocular sensitivity, and discomfort from glare are concerned. The agreement arrived at, however, was not in accordance with the results obtained by computing the ocular sensitivity by laboratory experiments. Apparently, in estimating glare in street lighting, observers are influenced mainly by the sensation of discomfort experienced. Most of the observers thought that the most attractive installation consisted simply of large diffusing bowls. It has to be kept in mind that the observations were made by pedestrians. It is possible that the driver of a fast-moving motor-car might come to other conclusions, as he is liable to be affected by considerations which do not apply to pedestrians.

THE annual general meeting of the Association for the Promotion of Co-operation between Scientific and Technical Societies and Institutions within the British Empire was held at Burlington House, London, on Dec. 1. The report, which was adopted, referred to the appeal for a central building in London issued in February of this year to the members of the constituent societies and institutions, in which it was stated that options had been secured for a limited period on a site near Westminster Abbey, and that an estimated sum of £350,000 would be required to defray the cost of the complete building, including the purchase of leases, etc. It was further mentioned that to complete the purchase of the leases it would be necessary to secure £100,000 in cash by June 24, 1931, when the options on the site would expire. A considerable

response to the appeal was received, but the sum available by June 24, however, fell considerably short of the amount required in cash, and the Council of Management decided to allow the options on the leases to lapse. The acute financial and industrial conditions prevailing during this year, culminating in the recent crisis, have rendered it necessary for the Council to postpone a public appeal until national conditions have improved. Though regretting the consequent delay in proceeding with the central building scheme, the Council will not relax its efforts to bring the scheme to fruition at the earliest possible moment.

THE British Engineering Standards Association has now been reorganised to permit of it dealing with standardisation questions in the chemical, engineering, building, and textile industries, these groups or divisions of industry being controlled by representative divisional councils of equal standing. A supplemental Royal Charter has been granted to the Association authorising this reorganisation and changing the title to the "British Standards Institution". The Institution is governed by a Grand Council on which the above divisions of industry have equal representation. This latest development in the standardising movement, which has grown enormously since the first committee was set up by the Institution of Civil Engineers in 1901 as the "Engineering Standards Committee", is a clear indication that industry as a whole has increasingly recognised the economic value of the work, and for the first time the chemical and allied industries are now possessors of the proper machinery for setting up national standards for chemical materials, plant, and apparatus, and for methods of analysis and testing. The British Standards Institution is an entirely independent body, in the closest touch with industrial requirements and modern technical knowledge, and with full government support but free from government control. It exists to assist industry by preparing British standard specifications based on what is best in present practice, and do not attempt to attain an ideal which might be too costly to adopt.

WE have received a short communication from Mr. Alfred Rosewood, of San Francisco, on "Disasters at the Moon's Third Quarter". He refers, among recent earthquakes, to those of Tuscany on Sept. 4, Solomon Island on Oct. 4, and Japan on Nov. 2, all occurring within about a day of the moon's third quarter; and, among other disasters, to the fall of the Quebec Bridge on Aug. 29, 1907, and the failure of the St. Francis dam during the night of March 12-13, 1928, both within the same interval of third quarter. The coincidences, at first sight, are striking, but if we extend the survey over a longer period the relation vanishes. For example, of fifty-eight of the most destructive earthquakes of the present century, three (April 14, 1906, on Formosa, Nov. 10, 1922, at Copiapo, and Sept. 2, 1923, in Japan) occurred on the day before the third quarter, and two (March 17, 1906, in Formosa, and April 14, 1928, in Bulgaria) the day after. If we take two days before and after, the number is increased by three. Thus, destructive earthquakes are not more frequent about the time of the moon's third quarter than at other parts of its period.

THE Registrar-General's Statistical Review, 1930; Tables, Part ii, Civil, has been issued (H.M. Stationery Office. Price 2*s*.). The chief subjects of its statistics are population, births, marriages and divorces, registers of electors, and populations of British Dominions. The marriages in England and Wales during 1930 numbered 315,109, a few less than the previous year, equal to a rate of 15·8 persons married per 1000 population. This rate is the highest recorded since 1921, notwithstanding the present economic depression, and it is of interest that 22 males and 699 females married at the age of sixteen years, the lowest legal age at which marriages may be solemnised. The births registered numbered 648,811, an increase over the previous year of 5138, though the rate remained the same (16·3 per 1000 population). This increase is probably accounted for by the high marriage rates of the last two years. The proportion of the sexes in the births registered was 1044 males to 1000 females.

THE small-scale maps of the Ordnance Survey was the subject of a paper to the Royal Geographical Society by Brigadier H. S. L. Winterbotham on Nov. 9, in which he referred to various innovations and improvements in recent editions. The new relief edition of the 'one-inch' is well under way, and the Plymouth sheet has already been published. A new 'half-inch' map is also in progress which will have hill shading and contours. The 'ten-inch' map, which, among other claims to value, is an excellent map for the main roads, is shortly to be put on sale in one sheet, mounted on both sides so as to facilitate easy reference by the motorist. Other innovations which the Ordnance Survey is introducing include diagrams of large towns bound up with the relevant quarter-inch sheets, and attempts to label the main roads so that the passage from one sheet to another shall be simplified and entail no searching.

A SCHEME whereby the activities of immigrant insects may be more closely recorded has recently been formulated by the Hastings and St. Leonards Natural History Society. It is hoped to obtain detailed information concerning the influence of weather conditions on the route of flight, periodicity of migrations, the sex condition of the migrants, etc. A standard card for recording information has been prepared, and, at the beginning, only the commoner and more conspicuous migrants will be recorded. A number of the printed cards will be sent to anyone who wishes to co-operate in the work on application being made to Dr. Norman Ticehurst, 24 Pevensey Road, St. Leonards, Sussex. Specimens for dissection should be sent to Dr. C. B. Williams, The University, 10 George Square, Edinburgh.

THE Christmas Lectures at the Royal Institution will be delivered by Sir William Bragg on "The Universe of Light", beginning on Dec. 29.

AT the conclusion of his leave of absence from England, Dr. B. A. Keen has resumed his duties as assistant director of the Rothamsted Experimental Station. For the past twelve months he has been director of the Imperial Institute of Agricultural Research, Pusa, India. His scheme of reorganisation of agricultural research has been accepted, and certain portions of it are being put into effect at once. As we have already directed attention to the drastic curtailing of research grants in India, it is satisfactory to record that agricultural research has not only escaped, but has even secured funds for an appreciable expansion of its activities.

THE following appointments in the Colonial agricultural service have recently been made by the Secretary of State for the Colonies: Mr. W. N. C. Belgrave, plant physiologist, Federated Malay States, to be chief research officer, Federated Malay States; Mr. N. Greenwood, agricultural chemist, Nigeria, to be chemist, Agricultural Department, Gold Coast; Mr. E. S. Garner, to be agricultural officer, Sierra Leone; and Mr. J. G. M. King, to be agricultural officer, Tanganyika Territory.

THE annual meeting of the American Ornithologists' Union was held in Detroit, Mich., on Oct. 19–23. The officers were re-elected for 1932 as follows: *President*, Joseph Grinnell, Berkeley, Calif.; *Vice-Presidents*, A. C. Bent, Taunton, Mass., J. H. Fleming, Toronto, Ontario; *Secretary*, T. S. Palmer, Washington, D.C.; *Treasurer*, W. L. McAtee, Washington, D.C.; *Additional Members of the Council*, James P. Chapin, Ruthven Deane, H. C. Oberholser, J. L. Peters, C. W. Richmond, T. S. Roberts, P. A. Taverner. The election of new members included three corresponding fellows: Albert Collin, of Helsinki, Finland; M. B. Kinnear, of London; and Ernst Mayr, of Berlin. The Brewster Medal, given biennially for the most meritorious work on American birds, was awarded this year to Mrs. Florence Merriam Bailey for her "Birds of New Mexico".

ACCORDING to a report issued by Science Service, of Washington, D.C., two workers at the State University of Iowa, H. S. Olcott and D. C. McCann, have found that carotene, the yellow colouring matter of the carrot, is transformed into vitamin A by the action of an enzyme contained in the liver. Experiments showed that carotene is destroyed and vitamin A appears when carotene is incubated with fresh liver tissue derived from rats lacking vitamin A. Further research showed that the change is due to an enzyme for which the name of 'carotenase' is proposed.

A GENERAL discussion on the "Adsorption of Gases" has been arranged by the Faraday Society, to be held at Oxford on Jan. 12–13. The general introduction to the discussion will be given by Prof. Hugh S. Taylor (Princeton). The discussion will be divided into three sections. Section I., on experimental methods, will be opened by Prof. E. K. Rideal; Section II., on kinetics and energetics, by Prof. H. Freundlich (Berlin); and Section III., on theories of adsorption, by Prof. M. Polanyi (Berlin). Among the foreign visitors are Dr. Chariton (Leningrad), Dr. H. Dohse (Ludwigshafen), Prof. H. Mark (Ludwigshafen), Prof. O. Volmer (Berlin), Prof. B. K. Bonhoeffer (Frankfurt), Dr. W. Frankenburger (Ludwigshafen), Prof. E. Hückel (Stuttgart), and Prof. A. Magnus (Frankfurt).

WE have received the August–October issue (vol. 17, Nos. 4 and 5) of the *National Medical Journal of China*. It is a parasitological number and contains a collection of twenty-two papers dealing with various aspects of the subject, clinical and scientific. Some of them are of considerable interest and importance, for China still offers a wealth of material for investigations on parasitic diseases. There is, however, no contribution on the subject of malaria, which still remains a formidable menace to public health in South China.

A WORK on the "Medicinal and Poisonous Plants of Southern Africa", by Prof. J. M. Watt, professor of pharmacology in the University of the Witwatersrand, and Dr. Maria G. Breyer-Brandwijk, is announced by the publishers, Messrs. E. and S. Livingstone, 16 and 17 Teviot Place, Edinburgh. The plants are being grouped under their natural orders, and their poisonous or medicinal effects are fully discussed. The book will be well illustrated and should be very useful to the medical man and pharmacist. Publication is promised in 1932 provided that a certain proportion of the production costs are guaranteed before going to press. The book is therefore offered at a special pre-publication price of twenty shillings post free. Subscriptions should be sent to the publishers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An administrative assistant in the University College of Hull—The Registrar, University College, Hull (Dec. 16). A fellow in the Department of Coal Gas and Fuel Industries of Leeds University, for the prosecution of post-graduate research in gas chemistry—The Clerk to the Senate, University, Leeds (Dec. 17). A junior lecturer in chemistry at University College, Southampton—The Registrar, University College, Southampton (Dec. 17). A George Henry Lewes student in physiology in Cambridge University—Prof. Barcroft, Physiology School, Cambridge (Dec. 31). A professor of pathology in the Medical College, Calcutta, and bacteriologist to the Government of Bengal—The High Commissioner for India, General Department, India House, Aldwych, W.C.2 (Dec. 31). A senior lecturer in anatomy in the University of the Witwatersrand, Johannesburg—The Secretary, Office of the High Commissioner for the Union of South Africa, 73 Strand, W.C.2 (Jan. 15). A scientific research fellow at Girton College, Cambridge, for research in mathematical, physical, and natural sciences, including engineering, medicine, and agriculture—The Secretary, Girton College, Cambridge (Feb. 1). A graduate assistant for physics and mathematics at Darlington Technical College—The Chief Education Officer, Education Offices, Darlington.

## 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 Internal Temperature of White Dwarf Stars.

IT has recently been discovered by S. Chandrasekhar,[1] B. Swirles,[2] and R. C. Majumdar,[3] independently, that the opacity of a degenerate gas is very small compared with what would be computed for a classical gas at the same density and temperature, the ratio being an inverse power of Sommerfeld's degeneracy-criterion parameter. This discovery seriously affects estimates of the internal temperatures in white dwarf stars. It has previously been held that interiors of the white dwarf stars are amongst the hottest of stellar interiors; for example, Russell and Atkinson [4] remark that their internal temperatures must be of the order of 50 times those of a main sequence star built on the 'diffuse' model. Again, Jeans [5] says "it appears that the central temperatures of the white dwarfs must be enormously high, while those of giant stars of large radius must be comparatively low". This has given rise to the paradox that the coolest stellar interiors appeared to be the best generators of stellar energy, the hottest the worst. To quote Jeans [6] again, "... many of the hottest and densest stars are entirely put to shame in the matter of radiation by very cool stars of low density, such as Antares and Betelgeuse".

If, however, the opacity in the interior of a white dwarf is very low, the temperature gradient in the interior must be very small. In the limit of zero opacity (assuming also small conductivity) the temperature-distribution is isothermal. The degenerate core is therefore a mass at an approximately uniform temperature, and the value of this temperature is determined purely by the observed mass $M$ and luminosity $L$ and the intrinsic opacity $\kappa_1$ of the gaseous envelope which surrounds the core. On the 'generalised standard model', in which the energy-sources are uniformly distributed and the opacity takes a constant value $\kappa_1$ in the gaseous envelope, the temperature $T'$ of the approximately isothermal degenerate core is, in the standard notation:

$$T' = \frac{(R/\mu)^{\frac{1}{3}}}{(\frac{1}{3}a)^{\frac{1}{3}}K}\left(\frac{\kappa_1 L}{4\pi cGM - \kappa_1 L}\right)^{\frac{2}{3}}. \quad . \quad . \quad (1)$$

For the observed mass and luminosity of the Companion of Sirius, $T'$ is $0{\cdot}34 \times 10^6 \kappa_1^{\frac{2}{3}}$ degrees, or, even if we adopt the high value $\kappa_1 = 300$ for the gaseous envelope, the value of $T'$ is only 15 million degrees. For smaller values of the envelope-opacity it will be still smaller. For an almost completely degenerate star the internal temperature is determined by the *photospheric* opacity in the thin gaseous envelope.

According to my conclusion that all stars contain a degenerate zone surrounded by a gaseous envelope, formula (1) applies to all stars. Stars with a high value of $L/M$ have small, incompletely degenerate cores, in which the temperature gradients though small are larger than in completely degenerate cores. Formula (1) still gives the interfacial temperature between core and envelope, and is thus a lower limit to the central temperature. It follows that stars with large internal generation of energy, that is, large values of $L/M$, have very hot central cores. Such stars will not be built on the standard model, but the effect of concentrating the energy sources to the centre, keeping other parameters constant, is only to increase the central temperature. Jeans's paradox, therefore, completely disappears; the best generators of energy have the hottest cores, and this applies to stars of all types, from white dwarfs to giants.

This result is quite obvious physically. The gaseous envelope acts simply as a blanket the rôle of which is to keep the core warm. A high energy-generator surrounds itself with a thick blanket, which keeps it very warm; a low energy-generator with a thin blanket. The actual value of the temperature attained in the core depends naturally on the intrinsic opacity of the blanketing envelope.

The above considerations illustrate, by a particular example, my contention that we cannot discuss the internal state of a star without discussing the opacity of its outer layers. In the case of a completely degenerate white dwarf, to ignore the effect of the photospheric opacity would be to obtain an utterly false estimate of the internal temperature.

The above results were communicated to Section A of the British Association on Sept. 29, 1931, at the discussion on the evolution of the universe, but did not appear in the printed accounts. I may add that the full theory of the 'generalised standard model', now fairly completely worked out, affords possible explanations of many of the observed characteristics of the stars in general, including some of those summed up in the 'Russell diagram', the approximate 'mass-luminosity' law for non-dense stars, the occurrence of pulsating stars and Novæ, and the possible existence of several types of configurations for large $M$ and $L$ ($O$-type, giant $M$-type, $N$-type, etc.) stars.

E. A. MILNE.

Wadham College, Oxford,
Nov. 17.

[1] S. Chandrasekhar, *Proc. Roy. Soc.*, **133**, A, p. 241, Sept. 1931.
[2] B. Swirles, *Monthly Notices, R.A.S.*, June 1931, p. 861.
[3] R. C. Majumdar, *Astr. Nach.*, Nr. 5809, Aug. 1931.
[4] H. N. Russell and R. d'E. Atkinson, NATURE, May 2, 1931, p. 661.
[5] J. H. Jeans, "Astronomy and Cosmogony", p. 139.
[6] J. H. Jeans, "Astronomy and Cosmogony", p. 125.

### Molecular Weights of the Proteins in their Native State.

MOST of the determinations of molecular weights of the proteins carried out in this laboratory by means of the ultracentrifugal method were made on material which had been subject to purification using ammonium sulphate as a precipitating or crystallising agent.[1] When trying to isolate the lactalbumin from cows' milk, we observed that no product homogeneous with regard to molecular weight could be prepared —the figures ranging from 12,000 to 25,000—and that the molecular weight increased during the process of purification.[2] A closer study of this phenomenon showed that the condensation is due especially to the action of the ammonium sulphate used for the 'purification'. The bulk of the native material in cows' milk from which the lactalbumin is formed has a low molecular weight, probably not exceeding 1000. This startling discovery made it an urgent task to re-examine as many of the proteins previously studied as possible without any chemical treatment at all or at least under conditions closely resembling those of their native occurrence. A short summary of the results so far obtained is given below.

*Ovalbumin.*—An extensive ultracentrifugal investigation of the white of hen's egg was undertaken by Mr. B. Sjögren. He found that the sedimentation constant of the egg-white diluted with 1 per cent sodium chloride is always lower than the sedimentation constant of the purified ovalbumin,[3] which is $3{\cdot}5 \times 10^{-13}$. Sometimes a sedimentation constant so low as $1{\cdot}5 \times 10^{-13}$ was observed, and sometimes values

approaching that of purified ovalbumin was found. The cause of these irregularities has not yet been traced. The sedimentation constant for the egg-white from eggs which had been preserved in water-glass solution for one and a half years was the same as for purified ovalbumin. A solution of egg-white of low sedimentation constant gave the normal ovalbumin value after treating it with ammonium sulphate.

The study of egg-white will be taken up again, but it is already clear that the ovalbumin does not always exist in the egg in the same form as that of the 'purified' ovalbumin. On the other hand, it seems that ovalbumin of the normal sedimentation constant is sometimes present in the egg and is very easily formed from egg-white under the influence of such salts as ammonium sulphate. The molecular weight 34,500 is the upper limit of the condensation process,[4] which corresponds to a sedimentation constant of $3{\cdot}5 \times 10^{-13}$.

*Hæmoglobin.*—For the determination of the molecular weight of hæmoglobin, Fåhræus and I[5] prepared solutions by simple water hæmolysis of the blood corpuscles. Measurements were made both on electrolyte-free (dialysed or electrodialysed) solutions and on solutions to which had been added sodium or potassium chloride in concentrations of 0·1 to 1 per cent. In all cases the same molecular weight, namely, about 68,000, was found. Nichols and I[6] later determined the molecular weight of hæmoglobin which had been crystallised by means of ammonium sulphate and found the same value. It therefore seems that hæmoglobin is not affected by the ammonium sulphate treatment and really does exist in the blood corpuscles.

*Serum Albumin and Serum Globulin.*—The question of the real state of the serum proteins in the blood has been the subject of much discussion. At the present time the ultracentrifugal technique offers the best means of attacking this problem. Preliminary determinations by Mr. K. O. Pedersen, Mr. P. v. Mutzenbecher, and Miss Inga-Britta Eriksson have shown that serum diluted with 1 per cent sodium chloride solution gives a sedimentation constant which is of the same order of magnitude as that of purified serum albumin and purified serum globulin. When using the refractive index method for recording the sedimentation, indications of a double maximum corresponding to the sedimentation constants of the two serum proteins were found. The question of the individual existence of serum albumin and serum globulin in the native serum can probably be settled by means of the new high-speed ultracentrifuge which has recently been installed in this laboratory.

*Amandin* (determinations by Miss Inga-Britta Eriksson).—This substance was chosen as a representative of the oil-seed proteins. A 10 per cent sodium chloride solution extract of almonds showed a high molecular protein with a sedimentation constant of the same order of magnitude as that of purified amandin. The extract also contained a substance of much lower molecular weight, the presence of which prevented an accurate determination of the sedimentation constant of the former substance.

*Phycocyan* (determinations by Miss Inga-Britta Eriksson).—An aqueous extract of the alga *Aphanizomenon* diluted with 1 per cent sodium chloride solution showed a sedimentation constant of $11{\cdot}5 \times 10^{-13}$, identical within the limits of error with the value $11{\cdot}2 \times 10^{-13}$ previously obtained for purified *c*-phycocyan.[7]

*Phycoerythrin* (determinations by Miss Inga-Britta Eriksson).—An aqueous extract of the alga *Ceramium* diluted with 1 per cent sodium chloride solution gave within the limits of error the same sedimentation constant, namely, $11{\cdot}4 \times 10^{-13}$, as that of the purified *r*-phycoerythrin, namely, $11{\cdot}5 \times 10^{-13}$.

The proteins phycocyan and phycoerythrin therefore exist in the aqueous extracts of the algæ and probably also in the living cells with the same molecular weight, namely, 208,000, as in the purified laboratory products.

*Hæmocyanin* (determinations by Mr. B. Sjögren and Miss Inga-Britta Eriksson).—Blood from the vineyard snail, *Helix pomatia*, was studied both undiluted (protein concentration 3 per cent) and diluted with 1 per cent sodium chloride (protein concentration 0·1 per cent). The values for the sedimentation constant were in perfect agreement with those obtained previously for the purified hæmocyanin.[8] In dilute solution the value $98 \times 10^{-13}$ was found for the blood as well as for the purified protein. It is obvious, therefore, that the hæmocyanin is present in the blood of *Helix* with the same enormous molecular weight, namely, 5,000,000, as in the purified hæmocyanin.

From the above determinations it seems justifiable to draw the conclusion that most of the proteins do possess the same molecular weight in their native state as in the purified laboratory products. On the other hand, there are cases where the protein exists in the form of a low-molecular pro-protein in the living organism and is brought into the shape of a real protein by the 'purification' process, especially by the action of such salts as ammonium sulphate.

THE SVEDBERG.

Laboratory of Physical Chemistry,
University of Uppsala,
Uppsala, Sweden, Nov. 6.

[1] NATURE, **123**, 871; June 8, 1929.
[2] Svedberg and Sjögren, *Jour. Amer. Chem. Soc.*, **52**, 3650; 1930.
[3] Svedberg and Sjögren, *Jour. Amer. Chem. Soc.*, **52**, 5187; 1930.
[4] Svedberg and Nichols, *Jour. Amer. Chem. Soc.*, **48**, 3081; 1926.
[5] *Jour. Amer. Chem. Soc.*, **48**, 430; 1926.
[6] *Jour. Amer. Chem. Soc.*, **49**, 2920; 1927.
[7] Svedberg and Katsurai, *Jour. Amer. Chem. Soc.*, **51**, 3573; 1929.
[8] Svedberg and Chirnoaga, *Jour. Amer. Chem. Soc.*, **50**, 1399; 1928; Svedberg and Heyroth, *ibid.*, **51**, 550; 1929.

## An Aspect of Co-ordination.

A CO-ORDINATE union between a bivalent atom, for example, of oxygen, and an atom or group $X$ may be regarded as having resulted from the attachment of a neutral atom of the bivalent element to $X$, and its mode of formation frequently corresponds to this, although the transference of an already co-ordinated bivalent atom from another atom to $X$ is a frequent variant of it. In any compound, therefore, the combination may be expected to behave as a composite atom or group, so that electronic effects, which in the original group would assert themselves at $X$, will assert themselves similarly in a qualitative, though possibly not quantitative, manner at the bivalent atom in the combination. For example, the composite thiosulphate ion, which is formed from the sulphite ion and sulphur, is stable only so long as it preserves its double negative charge, and breaks down into its components on partial or complete neutralisation. This, however, can occur in two ways, because there are two alternatively possible effective seats of the negative charge to which a cation may attach itself—the original ionic group or the attached sulphur atom:

$$(H\bar{S}O_3)\,.\,S \leftarrow (\bar{S}\bar{O}_3)S \rightleftarrows (SO_3)\bar{S} \rightarrow SO_3\,.\,SPb \rightarrow SO_3 + PbS.$$

$$\downarrow$$

$$S + \bar{S}O_3H$$

It might be expected that a cation of suitable intermediate character could be found which can attach itself in either manner, and this possibility appears recently to have been realised.[1]

The salt formation of tertiary amines involves the

lone pair of electrons on the nitrogen atom, and even when these are used in co-ordinating an oxygen atom, the capacity for salt formation is nevertheless retained in the resulting amine oxide. The oxides are recoverable from their salts, as are the amines :

$$R_3N + H\bar{A} \rightleftarrows [R_3NH]\bar{A}$$

$$R_3NO + H\bar{A} \rightleftarrows [R_3NOH]\bar{A}.$$

Although this is a particular case of the application of the principle of transmission of electronic effects by electrostatic induction, the implications attached to the relationships thus exemplified seem not to have been fully appreciated hitherto.

Thus, it will doubtless be agreed that the interaction of nitrosobenzene with β-phenylhydroxylamine will yield (I.) in the first place :

$$\mathrm{Ph \cdot \overset{OH}{\overset{|}{N}} \cdot \overset{OH}{\overset{|}{N}} \cdot Ph \longrightarrow Ph \cdot \overset{\bar{O}}{\overset{|}{N}} \cdot \overset{+}{N}Ph \longrightarrow Ph\overset{O}{\overset{|}{N}} = NPh.}$$

I.

$$\mathrm{Ph \cdot \overset{H}{\overset{|}{N}} \cdot \overset{OH}{\overset{|}{N}} \cdot Ph \longrightarrow Ph \cdot \bar{N} \cdot \overset{+}{N}Ph \longrightarrow PhN = NPh.}$$

II.

Since, however, the lack of basic properties in azobenzene indicates that (II.) would at once break down into azobenzene and water, so (I.) at once furnishes azoxybenzene, and it will be noted that the modern, rather than the obsolete cyclic formula is thus deduced for the product.

The pinacone-pinacoline change has been the subject of extended discussion during recent years,[2] but does not seem to have been connected with the formation of azoxybenzene. Yet the grouping $\diagdown\!\!\diagup C \cdot O$ may be regarded in the manner just discussed, and in fact the formation of *o*-nitrosobenzyl alcohol from *o*-nitrotoluene in presence of alkali must be regarded as proceeding by transference of a co-ordinated oxygen atom to a negatively charged carbon atom. The mode of formation of tertiary alcohols from their hydrocarbons also is probably of this kind.[3] The behaviour of pinacone towards acid therefore corresponds to that of methyl *iso*propyl carbinol, as indeed was suggested by Tiffeneau :

$$\mathrm{\overset{OH}{\overset{|}{Me_2C}} \cdot \overset{OH}{\overset{|}{C}} \cdot Me_2 \longrightarrow Me_2\overset{\bar{O}}{\overset{|}{C}} \cdot \overset{+}{C}Me_2 \longrightarrow Me\overset{O}{\overset{||}{C}} \cdot \overset{Me}{\overset{|}{C}} \cdot Me_2}$$

$$\mathrm{\overset{H}{\overset{|}{Me_2C}} \cdot \overset{OH}{\overset{|}{C}}Me_2 \longrightarrow Me_2\bar{C} \cdot \overset{+}{C}Me_2 \longrightarrow Me_2C = CMe_2.}$$

This view is also the basis of the electronic mechanism adopted by Robinson in regard to the reaction, but the present angle of approach seems worthy of record, since it may help to correct a not uncommon tendency to regard the pinacone change as something apart, rather than as essentially a particular case of the Hofmann decomposition of amines (as the dehydration of alcohols also may be considered to be).

Whereas, in the cases of the nitrogen compounds and of methyl *iso*propyl carbinol, neutrality of the product can be achieved by the sharing of a lone pair of electrons, originally present or resulting from the reaction, no such pair is available in the case of pinacone, and the necessary electrons can only be provided by transference at the same time of the group attached to them. This, it is suggested, is the real significance of Meerwein's demonstration that the Wagner and similar rearrangements are dependent on a cationic condition of the complex involved.

The above comparison between nitrogen and carbon compounds also lends point to the view that, in an entirely different field, the ortho-para directive properties of alkyl groups do not differ fundamentally in their origin from those of the amino-group, but correspond with the relative positions of carbon and nitrogen in the periodic system.

J. KENNER.

College of Technology,
Manchester,
Oct. 23.

[1] Compare Priyadaranjan Rây, NATURE, vol. 127, p. 856, June 6, 1931.
[2] A review is provided in the Annual Reports of the Chemical Society, 1930, p. 114.
[3] Compare Jones and Kenner, *Jour. Chem. Soc.*, p. 1846, 1931.

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## Cotton Growing in Egypt.

IN his review (NATURE, Oct. 31, p. 766) of recent publications on the working of the Seed Control Law in Egypt, Mr. Slater directs attention to the complementary nature of this law to the work of pure seed propagation carried out by the scientific staff.

As an agricultural research worker I very much doubt if it is correct to say that the cotton plant is the best studied agricultural crop. But with regard to legislation, it is probably true to say that no crop is subject to such an amount of careful legislative control as is the cotton crop in Egypt. Apparently the cultivator does not always know what is good for him, since attempts to evade the law appear to have been numerous. Perhaps it is unfortunate that the operation of the law has synchronised with a period of progressive market depression, so that it is not possible to make any estimate of the effect of the law from the economic point of view. Mr. Slater, who is in a position to know, does not comment on the effect of the law from the consumer's point of view.

These publications, unfortunately, do not give any information of a scientific nature on the principles underlying the working of the law, but it is said that the administration is indebted to the prevalence of a certain type of cotton plant known as Hindi which serves as an index of impurity. This Hindi cotton is recognised in the field by its white flower and general resemblance to American cotton. Its seed is quite naked, and except for its sharp point at the micropylar end is almost identical with the seed of Sea Island cotton. It thus possesses the characters of both its parents, Sea Island and American. The Seed Control Law operates only by excluding seeds of this naked Sea Island type. No account is taken of the lint characters, nor has anyone proved that the lint of naked seeded cottons is inferior to the lint of fuzzy seed cottons. I have seen evidence to the contrary, and also that cotton from fully fuzz seed is frequently inferior in spinning properties. From the genetic point of view, the Seed Control Law operates to exclude types resembling that of the best long staple parent, and propagates seed of full fuzz regardless of its lint quality.

Egypt certainly presents us with an interesting experiment in legislative control of an important crop. If the result is ultimately beneficial to the cultivator he will doubtless support it, but should it turn out to be nothing more than pseudo-scientific interference it will require more than scientific ingenuity to circumvent the evaders.

N. W. BARRITT.

Rothamsted Experimental Station,
Harpenden, Nov. 8.

In replying to Mr. Barritt, I am conscious of a feeling of uncertainty of what he wishes me to say to some of his veiled criticisms, largely levelled at the administrative policy of the Egyptian Ministry of Agriculture.

I may be wrong, but I fear Mr. Barritt has not quite grasped the meaning of the words 'quality' and 'uniformity' and their relative significance in a commercial commodity such as raw cotton. It appears to me that he is taking a very limited view of quality by ignoring uniformity, owing to his acceptance of spinning properties as the ultimate criterion of textile quality. I may point out that cotton is not only grown to be spun, but also to provide clothes which are acceptable to the wearer, who is becoming more critical year by year. Cotton which spun into the strongest yarn ever yet made would not find a market in one-hundredth part of the trade if it were so uneven that it would not dye to a level colour, or provide the many other desirable properties of a finished fabric.

The Egyptian Seed Control Law seeks to maintain uniformity in raw cotton by penalising those who attempt to mix seed-types. The consumer in Great Britain would not cavil at raw cotton which contains a low but constant proportion of Hindi cotton, but if there is no law to control that proportion, and the farmer is allowed to mix his seed according to his taste or fancy, it is difficult to see how the consumer is to benefit. If Mr. Barritt means that propagation of Hindi cotton or similar types would provide the consumer with better and more uniform fabrics at the same price, not stronger yarn, I am in agreement with him. At the same time, I must point out that Mr. Barritt puts forward no evidence other than a reference to spinning, which is only the beginning of the textile industry in Great Britain, to justify a complete reversal of the botanical policy of the Egyptian Ministry of Agriculture.

If I have answered Mr. Barritt's criticisms only from the consumer's point of view, it is because I believe the grower's and consumer's interests have much in common. I leave it to the Egyptian botanical experts to reply to his suggestions from the botanical side, but from my own experience I can say that mere mention of the Sea Island parentage of Hindi cotton is valueless as an indication of quality. Cotton grown from pure Sea Island seed in localities other than its native habitat is often inferior to cottons of lower pedigree. Moreover, the amount of genuine Sea Island (West Indian) cotton grown is ridiculously small, and yet there is more available than the textile industry is able to consume.

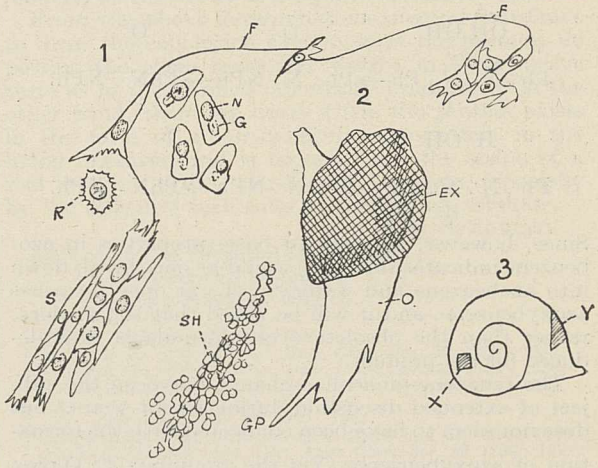
F. P. Slater.

Rock Bank,
Bollington, near Macclesfield,
Nov. 13.

### Outgrowths from Pieces of *Helix aspersa*, the Common Snail.

In connexion with a cytological problem now being investigated, an attempt has been made to culture snail tissue. It is well known that snails are able to repair extensive injuries under what must be extremely septic conditions. The epithelium beneath the shell and elsewhere is not keratinised or otherwise protected, except perhaps for its faculty to produce mucus. It follows that such material might provide easy material for tissue culture, very careful aseptic precautions not being necessary.

Blood is procured from a snail by carefully cracking a hole in the shell, as shown in Fig. 3, *X*. A glass needle is stuck into the tissue and the blood wells up into the space between the shell and the snail, from which it is removed with a pipette. The front of the shell is peeled, *Y*, and pieces of mantle cavity epithelium with underlying tissue removed. These are cut up with a very sharp knife into ½ mm. pieces, in blood or Ringer solution, which need not be sterile. Indeed, except for flaming the coverslips and pipette, no aseptic precautions have been taken. A small drop of blood is put on the middle of a square coverslip and a piece of tissue (with as little Ringer solution in it as possible) added. The whole is sealed over a hollow slide, vaseline being used. Such preparations will grow out at room temperature (15° C. in my laboratory), but the best results are obtained at 25° C. in an incubator. I have also tried 30° C. Various forms of growth can be noted. Amœbocytes first come out (*F* in Fig. 1) and form a network of cells around the piece. After a day they form groups (*S*)




apparently dividing and growing at the ends. Small round cells (*R*) also occur. By twenty-four hours the epithelial cells (*NG*) tend to come away from their layer, and flatten on the slide. Crystals (*SH*) now appear singly, and eventually join up to form long lines just beside the explant. These are at present regarded as shell material secreted by the epithelial cells. Now, besides this outward migration, in many cultures complete sheets of sub-epithelial connective tissue grow out, as in Fig. 2, *EX* being the explant, *O* the outgrowth, and *GP* one of the growing points, and also remarkable bulbous growths appear.

It seems important to wash the explant pieces in blood or Ringer solution before placing them in the blood on the coverslip. Apparently those bacteria, normally troublesome in vertebrate tissue cultures, do not interfere with growth in snail cultures, so that a person unused to the niceties of strict aseptic conditions should have no trouble in observing forms of growth in such snail cultures. Pieces of muscle keep alive and move spasmodically for as long as a week in such cultures. What seem to be very active outgrowth and division of both shell epithelial and vascular epithelial cells, has more recently been got as follows. The ordinary hanging drop preparation of mantle wall is made, and a piece of narrow coverslip added underneath, so that the explant lies between. All mantle cavity wall explants seem initially infected, but the bacteria keep in bounds for about three days, after which, unless the explant is well washed in blood, they multiply exceedingly. This account of some of the experiments can only be regarded as preliminary, as very little is known yet about the best conditions for this type of work on the snail.

In the epithelial cells *NG*, the Golgi apparatus (*G*) is very clearly to be seen *intravitam*, thus supporting

the previous findings of R. Ludford [1] on the presence of this cell element in tissue cultured cells.

I am grateful to Miss Honor B. Fell for her courteous answers to inquiries about literature.

J. BRONTË GATENBY.

Zoology Dept., Trinity College,
Dublin, Oct. 19.

[1] *Proc. Roy. Soc.*, B, vol. 101, 1927.

### The Specific Heat of Ferromagnetics and Ewing's Model of the Magnetic Atom.

PROF. W. GERLACH has recently investigated the connexion between the spontaneous magnetism and the specific heat of a ferromagnetic, and he confirms the close relationship between them, pointed out by Prof. P. Weiss, which seems to imply the existence of an immense intrinsic magnetic field within a magnet. The magnitude of this field, however, is so large that there is a difficulty in accounting for its origin from observed magnetic values.

In a paper I submitted to the *Philosophical Magazine* of March 1922, an experiment was described which showed that an applied alternating magnetic field brings about a loss of ferromagnetism at a lower temperature than the normal critical temperature, leaving unaltered the temperature at which the specific heat suffers a sudden diminution, a temperature which is the same as the normal critical temperature for magnetism.

This almost certainly rules out the hypothesis that the large intrinsic field required to account for the specific heat changes emanates from the rotating magnetic element in a ferromagnetic substance. Hence the suggestion was made in the paper referred to that there must be two fields in a magnet interacting in some way on each other, one concerned with magnetic quantities as commonly observed and the other with specific heat changes.

Now Ewing's new model of the atom offers a possible solution of some of the difficulties mentioned above and supplies the double field required. In Ewing's words, "Each atom forms a magnetic system comprising a Weber element capable of turning, but controlled by magnetic forces exerted on it by other parts of the atom which are taken as fixed". Mechanically, the model consists of a central pivoted magnetic needle controlled by bar magnets of equal strength, arranged radially in pairs at equal distances around the central needle with poles of one name all facing outwards. The poles pointing inwards produce an almost neutral control on the moving needle as required by the facts of magnetic induction, although the control magnets themselves may be very strong. To make this model fit the facts of ferromagnetism and abnormal specific heat we have only to suppose that it is as likely that the outwardly pointing poles of any atom will be north as south, and so one half the atoms may be supposed to have one polarity externally and the other half the opposite polarity. Between two atoms of opposite polarity there will be a strong attraction and a strong field, and they will tend to join together, forming molecules and groups of molecules. Such molecules or their component atoms, when subjected to thermal agitation, will acquire translatory movements, and these will inevitably set up atomic or molecular oscillations in virtue of the strong magnetic ties between one and another. The Weber element will be constrained to partake of these vibratory movements, and the substance as a whole will appear to lose magnetism and to gain in specific heat as the atoms or molecules successively take up vibrations with rise of temperature.

The model affords an explanation of the experiment mentioned above in which an alternating field applied to a ferromagnetic lowers its critical temperature, but leaves the temperature of the discontinuity of the specific heat unchanged. Such an alternating field would facilitate the vibrations of the Weber element, but would have no influence on the system of 'fixed' atomic magnets. Rupturing of atomic ties with accompanying loss of potential energy due to violent thermal agitation would account for the discontinuity of the specific heat.

That this model of the ferromagnetic atom should offer a plausible view of how an immense intrinsic magnetic field may exist in a magnet and yet not be influenced by external magnetic forces, and how the magnetism and specific heat of a ferromagnetic may be linked together, is the more noteworthy when it is remembered that the model was devised for an entirely different purpose, namely, the removal of a difficulty occurring in the early stages of magnetic induction with which the older and simpler model was confronted and was incompetent to meet.

J. R. ASHWORTH.

Rochdale, Nov. 3.

### *Homo sapiens* and African Prehistory.

THE confirmation by Dr. Leakey and Mr. Hopwood of the antiquity of Hans Reck's Oldaway man, and Mr. Reid Moir's letter in NATURE of Nov. 7, encourage me to publish, for the first time, a disconcerting discovery made in Uganda about a year ago.

At Nsongegi, in Ankole, the Kagera river is flanked by some remarkably fine terraces of which there are three. The upper and oldest is represented by mere remnants and carries in its upper parts an industry which, though not yet fully studied, is clearly seen to display marked Clactonian affinities, and is dated as Pluvial I. (Leakey's Kamasian). The second, or the hundred foot terrace, like the first, marks a time when in consequence of high precipitation the lakes rose and flooded back into their feeder valleys, and is dated as Pluvial II. (Leakey's Gamblian). Pluvial II. had, it would appear, two rainfall peaks, and during the relatively short period between them lake levels subsided to some extent, and thereby alluvial deposits in the valleys were exposed and became fertile plains, the hunting ground of prehistoric man. This interregnum was sufficiently long to permit of a moderate amount of denudation, and for the freshly exposed land surface to become more or less lateritised before it was again covered by gravels and silts. The temporary land surface yields stone tools, cores, and flakes in amazing abundance, representative of what in Europe would be regarded as two cultures: one of very late Acheulean and the other of early Mousterian facies, and it may be noted in passing that cleavers and some peculiar cores are of common occurrence. It would seem that a somewhat similar culture (the Nanyukian) of unproved but supposedly Interpluvial I. date (that is, between the Kamasian and the Gamblian) has been discovered in Kenya.

A number of pits were put down under my direction through the second terrace just referred to, and in one of them there was discovered *in situ*, 16 feet below the old occupation site that yields so many artefacts, a 'digging-stone', the usual large, round, flattish stone with a hole pierced through the middle. It was made from a comparatively soft rock (phyllite). Others have, I understand, been found resting on bed rock some 6 feet from the surface on the neighbouring hillsides. The specimen in question was found in well-bedded and quite undisturbed deposits belonging (unless our interpretation is radically wrong) to the

earlier part of Pluvial II. times which, according to the Glacio-pluvial correlation, would belong to Riss days. The discovery was so disturbing that, beyond recording the facts in private letters, I forbore to give it wider publication pending further research. This will be carried out next year.

The discovery is not quite unique, however, for in 1926, Mr. T. Hirst, of the Geological Survey of Uganda, discovered a broken digging-stone stone at a depth of 3 feet from the surface in undisturbed deposits of a gravel apron connecting the 50-foot terrace of the Kafu river in Bunyoro with the river-flat deposits, both of which are interpreted as of Pluvial II. date, the latter being brought in by secular disturbances in Pluvial II. times. This inconvenient discovery appears to have been set aside and overlooked, and was only brought to light again when the corroborative evidence of the digging-stone of Nsongegi was produced.

Digging-stones have been regarded as of late appearance, but I have some which almost certainly date back to the dry period following Pluvial II. and preceding the Makalian Pluvial (presumably of Bühl date) of Kenya. They have not hitherto been found apart from the work of neanthropic man, and the two discoveries cited above strongly suggest that neanthropic man was in existence in the early part of Pluvial II. days, a possibility which, as I have said, I have hesitated to indicate. There is, however, less objection to it now that Reck's claim has been re-examined and upheld. E. J. WAYLAND.

15 Westcliff Terrace Mansions,
Ramsgate, Nov. 13.

### Organisation of Scientific Abstracting Services.

As chairman of a small committee entrusted with the task of surveying the methods employed in scientific and technical abstract services, I invite the co-operation of editors and intelligence officers in collecting a body of information from which suggestions leading to increased efficiency may be derived. A conference recently held at the invitation of Mr. H. T. Tizard, president of the Association of Special Libraries and Information Bureaux, was attended by representatives of a large number of such services. Consideration was given, *inter alia*, to methods of dealing with foreign publications; this is one of the subjects in which information is sought, but the opportunity is being taken to gather confidential statements of fact and opinion which will form the basis of a comprehensive report on this most essential contribution to scientific progress. Responsible officers of organisations of the character indicated are invited to complete a questionnaire which has already been dispatched, or will be forwarded on receipt of a post-card, by Mr. S. S. Bullock, general secretary of the Association of Special Libraries and Information Bureaux, 16 Russell Square, London, W.C.1.

A. A. ELDRIDGE.

Imperial College of Science and Technology,
London, S.W.7,
Dec. 4.

### Gravity Anomalies.

IN India, Hayford gravity anomalies are unsatisfactory. The large negative and positive anomalies that are found cannot be ascribed to purely local density anomalies in the superficial crustal layer.

As a result of a somewhat lengthy investigation of these gravity anomalies, I have come to the conclusion that the Hayford hypothesis of isostatic compensation is incorrect, and that gravity anomalies can be adequately explained by a warping up and down of the crustal layers. According to this hypothesis, the main gravity anomalies, after removing topographical effects without compensation, are due to departures of the granite-tachylyte and tachylyte-dunite interfaces from their normal levels. The Airy system of compensation applies to folded sedimentary ranges under which there has been a deep down warp of the crustal layers, but horst ranges and other positive elements of the crust are entirely uncompensated.

Although these conclusions have been mainly derived from observations made in India, there appears to be good evidence that gravity anomalies, outside India in both continental and oceanic areas, can be successfully explained by crustal warpings without compensation. In particular, this hypothesis appears necessary to account for the remarkable anomalies found by Dr. Vening Meinesz in the East Indian Archipelago.

A paper describing these investigations will be published shortly as one of the Professional Papers of the Survey of India. E. A. GLENNIE.

Geodetic Branch, Survey of India,
Dehra Dun.

### Rotatory Magnetic Polarisation.

H. BECQUEREL [1] a énoncé le résultat suivant :

Pour les corps d'une même famille chimique le quotient de la rotation magnétique du plan de polarisation de la lumière $\Lambda$ par le produit $n^2(n^2-1)$, $n$ désignant l'indice de réfraction, est un nombre qui varie peu.

J'ai montré [2] que ce quotient $\frac{\Lambda}{n^2(n^2-1)}$ variait avec la température pour l'eau de 0° à 100° et pour le sulfure de carbone de 0° à 40°.

Il m'a semblé intéressant de faire la même étude pour le $\beta$ méthylnaphtalène, dont Constantin Salceanu [3] a mesuré récemment la constante de Verdet et l'indice de réfraction à l'état fondu à six températures comprises entre 34° et 174°. Le tableau suivant montre que l'expression calculée augmente considérablement avec la température.

| Températures. | $n$. | $\Lambda \times 10^5$. | $\frac{\Lambda}{n^2(n^2-1)} \times 10^5$. |
|---|---|---|---|
| 34° | 1·6056 | 4512 | 1109 |
| 78·5° | 1·5864 | 4359 | 1142 |
| 111·7° | 1·5695 | 4187 | 1162 |
| 142·5° | 1·551 | 4039 | 1194 |
| 174° | 1·5286 | 3879 | 1242 |

EDM. VAN AUBEL.

Gand, le 10 octobre, 1931.

[1] *Annales de chimie et de physique*, 5e série, tome 12, p. 5; 1877.
[2] *Journal de physique*, Paris, novembre, 1896.
[3] *Comptes rendus de l'Académie des Sciences*, Paris, 20 juillet 1931, p. 161.

### Superconductivity at High Frequencies.

WE have recently repeated with unsilvered vacuum flasks our experiments reported in NATURE of Aug. 29, p. 373, and in the *Phil. Mag.* of September last, and find lead and tin become superconducting with currents having frequencies of the order of $10^7$ per second. We also find that the transition temperatures are progressively lowered as the frequency is increased.

J. C. MCLENNAN.
A. C. BURTON.
A. PITT.
J. O. WILHELM.

Toronto.

## Research Items.

**Indian Archæology in Eastern Canada.**—At the time of settlement of Eastern Canada by the French in the sixteenth and seventeenth centuries, the country was inhabited by tribes who spoke entirely different languages—Algonkian and Iroquoian. Algonkian sites are located on the banks of streams and lakes, usually on the north and west, and avoid clay. The Iroquoian sites of the semi-permanent villages in many cases are on the tops of flat-topped peninsula-like sand hills, the surrounding land being suitable for corn and other vegetable foods. The characteristics of the Algonkian and Iroquoian cultures are differentiated by Mr. W. J. Wintemberg in *Bulletin* 67 of the National Museum of Canada. The stone artefacts from both Algonkian and Iroquoian sites consist of chipped, ground, and polished implements, but the Algonkians were pre-eminent as stone-workers, and their artefacts of this material excel those of the Iroquois in number, variety, and uses. Stone pipes, indisputably of Algonkian origin, are not known on their sites, with the exception of the so-called 'Micmac' pipes, which are late. Iroquoian stone pipes are of many different types. Objects of native copper are found in many different localities, but in most cases not on sites yielding Algonkian pottery, those found here probably belonging to the mound-builders. Very few are found on Iroquoian sites, and then as a rule from those of the earlier periods. Earthenware from both classes of sites consists of fragments, a few whole pots and a few pipes. The bone work of pre-European Algonkians is poor; but the Iroquois were highly skilled bone-workers, and no artefacts are more abundant on their sites than those made of bone.

**The Impaling Instinct of Shrikes.**—In his systematic revision of the American shrikes (*Lanius*) Alden H. Miller includes many notes upon habits and behaviour, but we refer particularly to his observations upon the characteristic habit of impaling food (*Univ. California Pub. Zool.*, vol. 38, No. 2, p. 11, 1931). Young shrikes reared in cages, without the opportunity of learning methods of impaling, showed an initial inherited reaction fairly complete on its first appearance. It consisted, at its simplest, of the dragging of food along a perch until it met some resisting object (in this case nails inserted in the perch), when a series of tugs often lodged the food firmly on the projection. The object is to afford suitable fixation for rather large food objects so that they may be more readily torn to pieces. Small objects were eaten without any attempt at impaling. There was no indication that objects were impaled with the object of forming a store of food for future use, although there was evidence that even caged birds killed more than they could eat and kept on impaling surplus animals which they never touched again. Such actions are interpreted as automatic reactions to moving prey, an incomplete series of the ordinary feeding reactions; but it would be wrong to attribute them to a 'lust for slaughter' or to deliberate cruelty, since they appear to be purely instinctive. Indeed, contrary to popular opinion, shrikes usually kill their food thoroughly before impaling it.

**Development of the Egg.**—The attention of teachers and students of zoology is directed to a symposium on the development of the egg given at the Carnegie Institution, Washington, in November 1930 and published in three parts in the *Scientific Monthly* for June, July, and August 1931. In the first part, Dr. G. L. Streeter gives an account of the development of the egg as seen by the embryologist, based chiefly on the study of mammalian eggs. He traces briefly the development of the egg, for example, of the rabbit, gives a rapid summary of human development from the blastocyst stage, and adds some remarks on the importance of the quality of the egg: "Good eggs produce hardy, long-lived individuals and poor eggs succumb during intra-uterine life, infancy, or early years of maturity". Dr. Carl G. Hartman discusses the development of the egg as seen by the physiologist, follows the fortunes of the egg as it reacts with the ovaries and the anterior lobe of the pituitary, and considers the conditions produced by it during its sojourn in the mother's body, including the interplay of some of the endocrines. In the third article, Dr. C. W. Metz takes the geneticist's view of the developing egg and refers principally to the chromosomes and their influence in heredity and development. All three articles are well illustrated, and the first is particularly noteworthy for the photomicrographs of living mammalian eggs which form two of the full-page illustrations. One of these full pages contains eleven photomicrographs reproduced from Dr. P. W. Gregory's memoir on the early stages of the rabbit's egg; the other shows photographs, by Prof. Warren H. Lewis and others, of the eggs of the mouse, guinea-pig, monkey, etc. Three eggs of the mouse are shown in the two-cell stage (with polar body), and in the next figure ten eggs of the mouse are seen in the later cleavage, about the eight-cell stage.

**Size-inheritance in Poultry.**—An extensive study of the weight of fowls in crosses between Leghorns and Brahmas has been made by Mr. Wilson T. Waters (*Rhode Island Agr. Expt. Station Bull.* 228). Nearly 3000 birds were studied in experiments extending over ten years. Records of growth in weight were made, including the $F_1 - F_4$ generations, as well as back crosses and controls. Both breeds reach their full size in ten months. The reciprocal $F_1$ hybrids were intermediate in weight at the end of ten months. After the third week, Brahma chicks grow more rapidly than Leghorns, and thus attain a larger size. The $F_1$ and $F_2$ hybrids follow the growth curve of the Brahmas up to the seventh month, and the growth rate then becomes intermediate. Hybrid vigour is thus shown only in the earlier months of development of the hybrids. Segregation for size was shown in the $F_2$ and later generations. It is concluded that the difference in weight between the two breeds depends chiefly on two independent genes, each of which affects the weight equally, and they are cumulative in their effects.

**Cellular Permeability.**—Marcel V. L. Homes (*Bull. de l'Acad. Roy. de Belgique, Classe des Sciences*, **17**, 3, 409–419; 1931) states that the absorption of solutes by living cells may be represented by an equation of the form $Q_t^e = Ae^{-at} + B$, where $Q_t^e$ is the total quantity of the dissolved solute outside the cells at time $t$, and $A$, $B$, and $a$ are constants. $A$ and $B$ may be evaluated in terms of the initial and equilibrium values of $Q$. It is shown that the constant $a$ has dimensions $\frac{1}{[T]}$ and it is called by the author, who regards it as an important index of cellular permeability, the 'rate factor'. The rate factor may be experimentally determined in terms of the concentration of the external solution at equilibrium, at any time $t$, and at zero time, and in one case quoted is shown to be approximately constant. The actual rate of absorption at any time $t$, namely, $dQ/dt$, is simply derived from the value of the constant $a$ and the initial and equilibrium values of $Q$. The permeability of a cell

for a given solute is regarded as defined by two quantities: (1) the accumulation factor at equilibrium (as used by Hoagland and Davis), (2) the rate factor ($a$), which is expressed in the units reciprocal hours.

**Adobe Brick Analysis for Plant Contents.**—Exact knowledge regarding the early introduction of crop and weed plants into America is somewhat meagre, and the method of adobe brick analysis adopted by G. W. Hendry is yielding much valuable information, some account of which is given in *Agricultural History*, vol. 5, 1931. Adobe or sun-dried bricks readily disintegrate in water and yield their plant contents in a good state of preservation. The material so far collected has been small, but examination of the walls of various historic buildings has already thrown much light on the question of plant introduction. As regards crop plants, the wheats afford a good example of the importance of the discoveries made by this method. Propo wheat has been found in twelve out of fourteen buildings examined, the date of foundation of the earliest of which is given as 1701, and appears to have been the most extensively grown variety during the Spanish and Mexican periods. The introduction of this variety into California had, however, previously been thought to have been so late as 1870. Similarly, Little Club Wheat, usually considered as introduced from Chile about 1860, is shown to have been abundant in California, Arizona, and Sonora about a century earlier, thus assigning its introduction to the agency of Spanish missionaries from Mexico. New evidence is also provided regarding the introduction into California of alien weeds. Three species only, *Rumex crispus*, *Erodium circutarium*, *Sonchus asper*, all of which have a wide distribution, appear to belong to the pre-missionary period, namely, before 1769, and the writer regards them as probably present at the time of occupancy by Europeans. Other species are found particularly associated with the missionary period (1769–1824), while a further group would seem to be of definitely later introduction. Further studies of material collected from areas extending southward into Mexico would greatly extend the discoveries already obtained.

**The Macdonnell Ranges.**—The Macdonnell Ranges in Central Australia are relatively little known and are poorly mapped. Mr. C. T. Madigan describes the results of three expeditions to these ranges in the *Geographical Journal* for November. The whole area appears to be a series of eroded folds with east and west axes. The ranges are limbs of folds near anticlinal axes and the plains are filled synclinal troughs. The main range is described as an ancient geosyncline which has been above the sea since early Palæozoic times. The country to the south was invaded by Permo-Carboniferous and Cretaceous seas carrying icebergs, but the old ranges remained dry land. In later Palæozoic times isostatic adjustments to the results of erosion took place and the formations to the south were buckled. This buckling possibly continued into Tertiary times. To the north of the range the strata appear to have been practically undisturbed since Cambrian times. Mr. Madigan notes that the rivers with their southernly flow cut at right angles across the ridges and are excellent examples of antecedent rivers. The paper is illustrated by some striking photographs.

**Pre-Cambrian Rocks of Quebec.**—*Memoir* 166 of the Geological Survey of Canada (pp. 314 and geological map, 1931), by H. C. Cooke, W. F. James, and J. B. Mawdsley is devoted to a district in Quebec lying just east of the Ontario boundary. The main topics discussed are the Keewatin and Timiskaming series; pre-Huronian technics and intrusives; the Cobalt series; and the economic geology (sulphide deposits and gold and molybdenum deposits). The Keewatin series was here formerly called the Abitibi volcanics, but doubt as to the proper correlation has now been removed by continuous mapping from Ontario into Quebec. The internal structures of the Keewatin are described in precise and significant detail, and the observations are applied in interpreting the folding structures. Convincing evidence is given that the Timiskaming series of sediments is later than the Keewatin. Generally the discordance is slight, but in places the contacts suggest that highly-folded Keewatin lavas have been overthrust by sheets of Timiskaming formations. The intrusives include diorite-porphyry and amphibolite (earlier than the post-Timiskaming folding) and a gabbro-diorite-granodiorite-granite series (later than the folding). There are also many altered peridotites of which the age relationships are imperfectly known.

**The Radioactive Constants.**—The September number of the *Journal de Physique* contains the report, which also appears in the *Philosophical Magazine* and elsewhere, of an international committee which was appointed to decide upon the best values of the radioactive constants. Whilst largely devoted to tables of numerical data, it also contains some interesting comments on these. The value chosen for the number of $\alpha$-particles emitted per second by a gram of radium is $3{\cdot}7 \times 10^{10}$. This is rather higher than the mean of older values, but is departed from to only a small extent by several apparently reliable recent determinations. For the uranium-radium ratio in old minerals the value $2{\cdot}94 \times 10^{6}$ has been adopted. In the matter of standard ranges of particles, certain discrepancies are noted, which perhaps throw doubt upon the accuracy of the useful relation which states that the range of an $\alpha$-particle is proportional to the cube of its speed, and the report again emphasises that the use of a coefficient of absorption for $\beta$-particles, in the sense of the modulus of an exponential expression, is, although convenient, somewhat indefinite.

**The Diffraction of Proton Waves.**—An electrical investigation establishing the wave nature of protons of medium speed is described by Y. Sugiura in a *Scientific Paper* (No. 310) from the Tokyo Institute of Physical and Chemical Research. The method used was closely similar to one which has been used for electrons. A beam of protons was rendered homogeneous by sorting in a magnetic field, and was made to impinge upon a film of metal deposited on glass; diffraction took place at the metal crystals, and the pencils passing off were detected by an electrometer device. An electrically heated palladium tube, exposed externally to hydrogen gas, was used both as the source of hydrogen for the inside of the apparatus, and as the anode for the discharge system for accelerating the protons to the desired speeds. This proved very satisfactory, giving many more charged atoms of hydrogen than charged molecules. The wave-lengths concerned were of the order of a few hundredths of an angstrom unit, and the diffraction patterns obtained, although not very well resolved, were those which would be expected from the crystal structure as found by X-rays for the metals used.

**Gallnuts as a Chemical Reagent.**—In a paper in *Isis* for November, Dr. M. Nierenstein discusses the history of the use of gallnuts as a reagent. Pliny states that the black colour produced on paper soaked in extract of galls will serve to detect iron in verdigris. Although many ancient authors wrote on 'atramentum', no attention seems to have been paid to the phenomenon until Albertus Magnus referred to it in his botanical writings. Paracelsus describes the use of

galls in detecting iron in water. Tachenius was mainly interested in the astringent principle present in the gall, and may be regarded as the founder of the chemistry of the tannins. Since alkalis react with vitriol, Tachenius regarded tannin as an alkali. A lengthy extract from this author is given, and also one from Boyle, on the use of galls in water analysis. The further references to the use of the reagent in testing for iron are more briefly discussed.

**Isolation of the Radical Ethyl.**—Two years ago Prof. Paneth and Herr Hofeditz of Königsberg succeeded in demonstrating the somewhat transitory existence of the radical methyl in the free state (NATURE, **124**, 161, July 27, 1929). In the November issue of the *Berichte der deutschen chemischen Gesellschaft*, Prof. Paneth and Herr Lautsch describe further experiments which have resulted in the isolation of the radical ethyl by a method which differs only slightly in detail from that used in preparing methyl. Thus the lead tetra-ethyl was vaporised at − 25° C. instead of at − 70° C., and since it dissociates at a lower temperature than lead tetramethyl it was possible to substitute hard glass for quartz. The gaseous product obtained in these experiments resembled methyl somewhat closely, so that its identity had to be established. This was done by bringing it into contact with zinc, with which it reacted to form a compound which had the same melting and boiling points as zinc ethyl. Further proof was obtained when the zinc ethyl was oxidised to zinc oxide and ethyl alcohol, the existence of the latter being established by means of the iodoform reaction. The ethyl also combined with antimony to give antimony triethyl. Attempts to isolate the *n*-propyl and isobutyl radicals have not yet been successful, since these more complex products show a tendency to break down. In discussing the mechanism of the reaction involved in the disappearance of the free radicals, the authors come to the conclusion that the latter process takes place on the walls of the containing vessel and is unimolecular. They have also shown that the main product in this case is *n*-butane, which was also identified, but they did not succeed in obtaining ethane from methyl.

**Portable X-Ray Medical Unit.**—We have received *Bulletin* A2 from Messrs. Watson and Sons (Electro-Medical), Ltd., describing the Watson-Sankey Portable X-ray Unit, which has been designed in collaboration with Dr. R. H. Sankey. The component parts consist of a trolley base on which the apparatus is mounted, a switch board, a high-tension transformer, and a tube stand. These components are small and light, making for easy transport, and fit comfortably into dust-proof canvas cases. They can be assembled within a few minutes. It would appear to be an advantage that the apparatus can be operated on the ordinary power supply or, if necessary, on the lighting circuit. The price of the outfit is about £160, including one Metalix Radiator X-ray tube.

## Astronomical Topics.

**The Leonid Meteors.**—The observations made in Iowa in the early hours of Nov. 16 have already been noticed (NATURE, Dec. 5, p. 972). A Science Service Bulletin of Nov. 19 reports that a richer shower was seen on the morning of Nov. 17. Dr. Olivier observed from the Catskill Mountains, where the weather was perfect. Fully 900 meteors were seen here, including some fine fireballs; two of these left trains that lasted for 12 minutes each. He states that he saw more meteors this year than in 1901, which was the best display at the last visit of the rich part of the swarm. The richest half-hour was from 3.30 to 4 A.M. (add 5 hours to reduce to U.T.). Mr. A. M. Skellett observed the effect of the meteors on the transmission of wireless waves: he says, "A cloud of electrified particles accompanies every meteor in its descent. When the meteor enters the Kennelly-Heaviside conducting layer this disturbs the condition of balance, so that the effective height of the layer is temporarily lowered. A fogging of radio-signals results." This is a point that should be examined if the expected rich shower occurs next November.

Mohd. A. R. Khan, principal of the Osmania University College, Hyderabad, Deccan, writes that he observed twelve Leonids on Nov. 15, between $22^h\ 10^m$ and $23^h$ (Greenwich Time). Of these, the eighth was conspicuously bright. The sky was cloudy during the nights of Nov. 13 and 14, while Leo was above the horizon.

**Sir William Herschel's Mirrors.**—Capt. M. A. Ainslie has recently acquired two mirrors made by Sir W. Herschel; it is highly probable that one of them is the actual mirror that was in use when the planet Uranus was discovered. They are of seven-inch aperture and seven-foot focus. The two mirrors are exactly alike in these respects, and Capt. Ainslie notes that they were probably used in an attempt that was made to use them together in a binocular telescope; by placing the flats at different distances from the mirrors, it is possible to form the images at a distance apart equal to the distance between the eyes. Capt. Ainslie has had the mirrors mounted, and tested them carefully on double stars and other test objects. He gave an account of his observations at the meeting of the British Astronomical Association on Nov. 25. The reflecting power of the mirrors is not very good; it has doubtless deteriorated; but the quality of the images is astonishingly good, and some very close double stars could be separated. He observed the planet Uranus, and noted that a power of 200 showed clearly that it had a disc.

**The Velocities of Distant Nebulæ.**—A re-examination of the increase of radial velocity with distance for the extra-galactic nebulæ has been made by Hubble and Humason in the *Astrophysical Journal*, vol. 74, p. 43. The main difficulty lies in determining the distances of these nebulæ, for which purpose various indirect methods have to be applied. For those nebulæ in which individual stars can be recognised, the presence of cepheids, novæ, and other suitable objects forms a valuable and fairly accurate guide; the cepheids being the most trustworthy data of all. Such nebulæ then form a sample collection from which the average total luminosity of a nebula may be determined. Individual luminosities are found to be closely grouped round this mean value, which may thus be used for estimating the distances of the more remote nebulæ. This is, in fact, the only method available for such bodies, some of which are estimated to be 32,000,000 parsecs distant. The velocity-distance relation has been re-determined with the aid of new material (including Shapley's revision of the luminosity-period relation for cepheids), and the authors express it in the form: velocity = distance/1790, with an uncertainty of about ten per cent.

A paper by Humason in the same journal, p. 35, gives the results of radial velocity measurements for forty-six extra-galactic nebulæ as observed at the Mount Wilson Observatory. The largest observed velocity was 19,700 km./sec., and the observations (with one exception) confirm the velocity-distance correlation.

## Scientific Management Problems.

A SIGNIFICANT feature of the centenary meeting of the British Association was the inclusion for the first time of a department devoted to industrial co-operation in Section E (Economics). Whether or not, as Major L. Urwick suggested in opening a discussion on the aims, methods, and progress of research into management problems, the contrast between the control over natural resources with which science has endowed us and our lack of control over economic and social forces exemplified in the grave economic crisis has provided the stimulus, the application of scientific methods in this field is pregnant with possibilities. While the assertion that business is science or even a profession might be challenged by many who are well aware of the debt that industry owes to science, and who might even admit that the only hope of the survival of business is in its submission to the logic of scientific method, comparatively few would dispute the statement that the only hope of any control of economic forces lies in the application at every point in the business structure of the world as the final criteria governing its actions, of the logic and methods of inductive science by which those forces have been created.

The discussion opened by Major Urwick indicates that, by inviting industrial representatives to discuss industry from the scientific point of view, the British Association has recognised the integration of industry and science. Management research aims at bringing the whole volume of existing scientific knowledge and technique to assist in the solution of problems of planning, supervision, control, and legislation involved in economic operations. As pursued by the International Management Institute, such research is free from the grotesque and unintelligent forms which so-called research of this type can assume in the service department of American universities, a tendency from which, as Flexner has shown, even the Harvard School of Business Administration is not exempt. Major Urwick rightly pointed out that the research worker in management has little concern with popular differentiations between organisations on the ground either of objective or of ownership. The service to be rendered by science in this field must be disinterested and represent in the main attempts to enlarge the boundaries of an existing department of science or to apply scientific methods to discover general principles of management.

The rapid extension of this field of inquiry, especially in America, has led to two main difficulties which retard development. The first difficulty lies in the mass of published work, much of which has unfortunately been uncritical and even unscientific. This difficulty becomes less serious with the increasing number of managers who have received formal training and with the emergence of authoritative textbooks, but the serious difficulty presented by the absence of industrial co-operation is only slowly giving way before the formation of management research groups or the use of management ratios. Even yet we know practically nothing of the principles which should govern the large-scale combinations characteristic of modern business, and beyond this, traditional thinking and vested interests of all kinds oppose scientific reorganisation of the world economy. The increased power production conferred by science has been used by all kinds of groups—social, professional, national, or venal—to secure differential advantages; and revolutionary change or social chaos can only be avoided if we can achieve methods of organisation which will give us control of the forces released by a rapidly mechanised economy. The integration of science and business on lines initiated by the British Association may secure a new approach to the whole situation.

In describing the American position, Dr. H. S. Person, managing director of the Taylor Society, New York, remarked that very little management research was comparable with the scientific research carried out in laboratories, although in its best manifestations management research sought to substitute the control of knowledge for whim and casualism, and the possibility of developing the principles and technique for the control of our economic destiny had already been demonstrated. The present industrial difficulties in the United States may be connected with individualistic and imperfectly applied industrial research which creates problems of management. Discussing the research into methods of management which in the aggregate has transformed American management, Dr. Person emphasised its practical and pragmatic basis, the methods adopted and the extent of the inquiry being determined by the specific problem under investigation. Management research was also characterised by specific findings which made it vital and constructive, and despite its rapid expansion was still incomplete and was now tackling problems of collective government. The readiness of American industry to exchange information is due to the conviction that general improvement in management and general prosperity create an environment favourable to greater individual prosperity.

Sir Horace Wilson, discussing the British position, pointed out that management research differed from technical research in that progress was almost impossible in its main subjects except by co-operative methods. Training for industry was one aspect of management research which had attracted much attention in Great Britain, and the limitation of the training given in the Department of Business Administration at the London School of Economics to students of good general education who had had two years' practical experience in business indicated a method of avoiding some of the pitfalls of such training in America. Other problems with which management research was concerned were the recruitment of personnel both for administration and for shop management, and in addition there was little experience yet available to guide us in the management of large industrial units or to indicate the limits of effective control of such units. Management research should materially assist in discovering the principles to be observed in organising such units and in providing the men capable of managing them. Many institutions, such as the British Engineering Standards Association (now the British Standards Institution), the Industrial Welfare Society, and the National Institute of Industrial Psychology, had made important contributions to special management problems. The mutual exchange of experience in the solution of particular problems could never take the place of the proper selection of personnel for key positions, but over a wide field could improve and assist the practice of management.

Dr. Hellmuth Boller, describing the Austrian position, referred to the effect of foreign competition and the foreign market required for nearly sixty per cent of Austria's industrial output as well as the persistence of a steady fifteen to twenty per cent of unemployment in the working population in forcing on management research and efficiency. Under a

National Board, groups had been organised for the exchange of experience, covering the metal, textile, and foodstuffs industries. The importance of securing the full co-operation of employees had clearly been demonstrated, and the close and intensive co-operation secured between the groups of chiefs and of subordinates was an essential method of organising exchange of experience. Confidence and mutual interest were the only sound basis for management research, and particularly in the Austrian method of critical visits to selected departments combined with advance or preliminary reports which were afterwards elaborated. No objections had been raised to the publication of the findings of sub-groups of experts based on these reports, and particular attention had been paid to budgetary control.

## The Lister Institute.

THE Report of the governing body of the Lister Institute for 1931 refers to the various changes which have occurred in the membership of the governing body, council, and members and staff of the Institute during the past year, and describes in brief the numerous researches in which the staff and their co-workers have been engaged. A bibliography is appended to the Report, to which those interested in particular subjects may be referred for the fuller information to be obtained from original papers. Among the changes in staff may be mentioned the retirement of Sir Charles Martin and Prof. A. Harden. Prof. J. C. G. Ledingham took up the directorship of the Institute and Dr. R. Robison succeeded Prof. Harden as head of the Biochemical Department on Jan. 1.

The researches described may be roughly classified into investigations in experimental pathology and bacteriology and studies on nutritional subjects. The National Collection of Type Cultures is housed at the Institute, although the salaries of the necessary staff are furnished by the Medical Research Council: during the year, more than 5000 strains of bacteria and fungi have been distributed to workers in various parts of the world, and 200 types, including many new species, have been added to the collection. A third and enlarged edition of the catalogue of the collection is in course of preparation.

Prof. Ledingham has found in his studies on fowlpox that the Bollinger bodies seen in the epithelial cells of the lesion consist of agglomerations of Borrel bodies (0·25$\mu$ diameter) in a lipoprotein matrix. The Borrel bodies pass through Berkefeld V filters and a single one can infect, so that it is possible that these minute bodies are the actual etiological agents. Dr. G. H. Eagles and Dr. D. McClean have been able to cultivate vaccinia virus in a cell-free kidney extract and carry through a series of subcultures. The virus survives for considerable periods under anaerobic conditions in the cold, but filtration of the centrifuged kidney extract removes some property essential to prolonged survival. The virus can be filtered through the Berkefeld V: as with fowlpox virus, it is probable that the elementary bodies found in the lesions are the actual infecting agents.

Dr. E. W. Hurst has confirmed the observation that the virus of poliomyelitis (infantile paralysis) is transmitted along the axis-cylinders of the nerves. Monkeys can be infected with regularity by combining intrasciatic inoculation of the virus with mild trauma to the nerve. Virus and lesions first appeared in the lumbar cord, the latter first on the side of the inoculated nerve: the leg area of the opposite motor cortex was the next site to harbour virus, other areas only being involved much later. The lumbar cord is connected chiefly with the opposite motor cortex: there are only few connexions with other parts of the central nervous system. With Dr. R. W. Fairbrother, Dr. Hurst has also shown that infection with vaccinia virus does not modify a simultaneous infection with poliomyelitis. Dr. Morgan has been able to immunise two out of four horses to poliomyelitis and obtain a potent anti-serum. The potency is precipitated with the euglobulin fraction of the serum protein by adding up to 34 per cent by volume of saturated ammonium sulphate solution: the precipitate can be dialysed and redissolved in normal saline, giving a concentrated preparation which should be of great advantage in the treatment of the disease by the intraspinal route. Contacts with cases of infantile paralysis have been found to possess antibodies in their serum, although they have not developed the disease.

Work has also been carried out on the preparation of gas gangrene antitoxin, on the preparation of a dysentery toxin (Shiga) for use as a test toxin, and on the preparation of toxic extracts of the meningococcus for the purpose of titrating anti-meningococcal sera. A concentrated anti-staphylococcus serum has also been produced by the immunisation of a horse with staphylococcal filtrates.

Some preliminary work has been carried out under the auspices of the Accessory Food Factors Committee on vitamin standards. Miss Hume and Miss H. Smith have been investigating the suitability of pure recrystallised carotene as a standard for vitamin A; Dr. H. Chick and Miss H. M. Jackson, a concentrate adsorbed on kaolin from an extract of rice polishings, provided by Dr. Jansen, as a standard for vitamin B; and Dr. Zilva, decitrated lemon juice as a standard for vitamin C. Miss Hume, Miss Pickersgill, and Miss M. Gaffikin have been examining the standard solution of irradiated ergosterol issued by the Medical Research Council for use in the estimation of vitamin D. They find that it is stable when kept at 0° C. Data have also been collected on the accuracy of the biological test for vitamin D. Consistent results were obtained with ten animals on each dose, good results with six, but inconsistent results with only three or four on each dose. An attempt is being made to construct a curve relating dosage and degree of calcification.

Dr. H. Schütze and Dr. S. S. Zilva have established the existence of a very definitely lowered resistance to infection with *S. Suipestifer* among rats deprived of vitamin A, as compared with animals on a complete diet.

Dr. H. Chick and Miss Copping have found that vitamin $B_2$ is destroyed by strengths of alcohol above 50 per cent: its solubility and precipitation limits are uncertain and appear to depend on the compounds with which it may be associated in solution. Egg white is a convenient source of this vitamin since it contains no vitamin $B_1$. Active concentrates have been prepared by aqueous acid extraction, which cure the dermatitis developing in rats on a vitamin $B_2$-free diet, but do not stimulate growth for more than a few weeks. Autoclaved yeast extracts are, however, satisfactory. It thus appears that a third factor is required by the rat for growth in addition to vitamins $B_1$ and $B_2$. This factor is also present in green-leaf vegetables, egg-yolk, and ox-liver, but absent from wheat embryo, meat, and white vegetables. Its thermostability

distinguishes it from the other B vitamins hitherto described. Miss Roscoe has found no relationship between fat in the diet and the need for vitamin $B_2$: fat lessens the need for vitamin $B_1$.

Dr. W. R. Aykroyd has found that the endosperms of wheat, rice, and maize contain little vitamin $B_1$ as compared with the embyro or whole grain. Parboiled rice, however, even after milling, contains definite amounts, due apparently to diffusion inwards from the germ and pericarp during the boiling. Maize has been found a good source of vitamin $B_2$, as good as wheat, and better than rice. Pellagra, however, occurs among maize-eating peoples and is rarely observed where rice is the staple food. This result is against the theory that pellagra is due to a simple deficiency of vitamin $B_2$.

Miss E. M. Hume and Miss H. H. Smith have compared the effect on bone calcification in rats of diets low and rich in ergosterol, the animals being given a complete synthetic diet without vitamin D but irradiated daily. The bone ash was slightly lower in the animals on the low ergosterol diet which were not irradiated than in any of the other groups. The diet used contained no fat: many of the rats developed scaliness of the tails, which has been attributed to absence of fat from the diet. Hume and Smith observed the condition, however, in other rats on a diet containing fat, so that it must be due to some other defect in the diet.

Dr. N. S. Lucas has reinvestigated the permeability of human epidermis to radiations between 4370 A. and 2400 A. The transparency has been much underestimated, since considerable scattering of the incident light occurs, so that it fails to reach the slit of the spectrograph, although it may ultimately be transmitted by the skin at a distance from its point of entry. When allowance is made for this, by producing scattering of the light before it reaches the skin, it is found that 55 per cent is transmitted at 3130 A. and 26 per cent at 2940 A. The absorption curve agrees closely with those of casein, serum albumin, tryptophane, and tyrosine.

Dr. Smedley-MacLean and Miss Pearce have shown that when a large excess of peroxide acts on oleic acid at 95° C., less than 20 per cent of the carbon appears as formic, carbonic, and acetic acids, acids with 15 and 12 carbon atoms being obtained, that is, oxidation occurs first at the double bond followed by oxidation of the 18 carbon chain in the $\gamma$ position. In the presence of a cupric salt, the oxidation proceeds much further, 70 per cent appearing as the lower acids. At 60° C. the chief products are 4-keto 7-hydroxy caprylic and succinic acids with 20 per cent of the lower acids. The evidence lends no support to the view that fatty acids are broken down by $\beta$-oxidation in the body. The presence of succinic acid is of interest since an oxidising enzyme for this acid is widely distributed throughout the tissues.

Among other researches with which the Report deals may be mentioned those of Dr. Robison on calcification *in vitro* and on the chemistry of the hexosephosphates and the work of Dr. V. Korenchevsky on the amount of fat in castrated and cryptorchid animals: degeneration or removal of the seminiferous tissue leads to an increase in fat deposition.

## A New Illumination Device for Microscopy.

THE microscopic examination of opaque materials and the surface structure of natural objects have recently attracted much attention. The root idea of the Lieberkühn has been embodied in various types of ring illuminator in which the light may reach an annular reflector from below, or may be dealt with in a manner more analogous to the vertical illuminator.

Messrs. Ernst Leitz have recently brought out improved apparatus of the latter kind in which the light reaches the object from an annular illuminator around the objective, but avoiding the restriction in the size of the object which has been necessary in some arrangements. A small 8-volt lamp and condenser project a roughly parallel beam which is reflected downwards by an annular mirror held at 45° to the beam and to the axis of the microscope tube. The reflector is pierced with a central aperture which transmits the upward image-forming rays from the objective. The annular beam thus produced from the reflector enters an annular lens (or reflector system for the higher powers) and is focused on the object without traversing the objective itself. Thus the disadvantages of back reflections and stray light are avoided. The general arrangement of the parts is shown in the accompanying illustration (Fig. 1).

A special series of fifteen new objectives, comprising 'dry', 'water immersion', and 'oil immersion' lenses has been produced, in which the low-power lenses are designed to work without a cover glass over the object. Each of the low-power lenses has its own ring condenser, and rapid transition from one object to another is facilitated by the use of a convenient objective changer which clamps firmly and definitely into position. The lamp and condenser system need not be changed.

One advantage of apparatus of this kind is that the illumination can be controlled with much greater precision than with any more or less haphazard reflector arrangement, and that a systematic study of objects can therefore be commenced with less uncertainty. The interpretation of the images in some cases, especially with the higher powers, is not an easy matter,

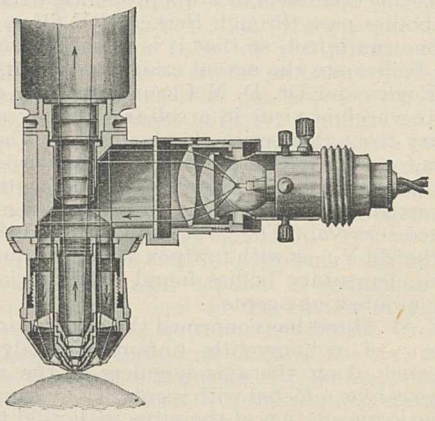


FIG. 1.

and will require careful study; diffraction effects can easily be mistaken for surface colour; nevertheless, it is clear that new investigations are possible. The well-illustrated catalogue of this 'Ultropaque Illuminator' gives photographs of various objects, amongst which are vegetable tissues, skin, chromatophores, leather, wood-sections, fabrics, and so on. This method may also have important possibilities in metallography. L. C. M.

## Mycorrhiza in Relation to Forestry.

IN Section K (Botany) at the recent meeting of the British Association, a report was read by Dr. M. C. Rayner on "Mycorrhiza in Relation to Forestry". The paper was drawn up by Dr. Rayner, and comprised the Report of the Committee (Mr. F. T. Brooks, Dr. Rayner, and Mr. W. H. Guillebaud), to which a grant of £40 had been made by the British Association to be spent in investigation work in this branch of research.

The purpose and scope of the investigations are explained in a preliminary statement printed in last year's British Association Report. In this statement the main objects of research are summarised as follows: (1) To ascertain whether the formation of normal mycorrhiza may fairly be regarded as a causative factor in the healthy growth of young trees, it being already assumed that it is an invariable concomitant of such growth. (2) To determine whether the absence of mycorrhiza associated with unsatisfactory growth is related to:

(*a*) Absence of the mycorrhiza-forming fungi appropriate to the trees; or

(*b*) the existence of soil conditions inimical to the formation of functional mycorrhiza of a beneficial type. (3) To ascertain whether it is practicable to supply deficiencies or ameliorate existing soil conditions by experimental treatment of nursery stock or in other ways.

The experiments carried out under (1) were made with Scots, maritime, and Corsican pines. Evidence for the first only is as yet available, but it appears to support the view that the formation of normal mycorrhiza is a causative factor of great importance to the growth of young trees. Under the second head, the presence or absence of the appropriate fungi, some interesting investigations have been carried out which in many cases require further work for substantiation upon a practical basis. The Wareham and Ringwood plantations formed the site of this research work, and under (3) it is stated that certain definite conclusions have been reached respecting the inimical causes operating in the Wareham plantations, and that experiments on the lines inaugurated will show that practical field methods at a reasonable cost can be undertaken to ameliorate the existing poor conditions.

The Report should be consulted for the details of this valuable piece of research, and it is to be hoped that funds will be available to continue it to a practical conclusion.

## University and Educational Intelligence.

BIRMINGHAM.—The new ore-dressing laboratory of the Mining Department is to be opened on Dec. 16 by the Right Hon. Sir Robert Horne. At the degree congregation to be held on the same day, honorary degrees will be conferred on Sir Robert Horne and on Mr. Evan Williams, president of the Mining Association of Great Britain.

The Council is recommending to the Court of Governors that the title of emeritus professor be conferred on the former vice-president and professor of mechanical engineering, Prof. F. W. Burstall, and on the former professor of brewing and biochemistry, Prof. A. R. Ling.

The number of registered students for the current session shows a considerable increase, new entries being nearly nine per cent above those for 1930.

CAMBRIDGE.—Dr. H. C. Darby has been appointed University lecturer in geography.

The John Humphrey Plummer professorship of mathematical physics has been established. The stipend of the professor is £1200 a year or, if he holds a fellowship with dividend, £1000 a year. Candidates are requested to communicate with the vice-chancellor on or before Jan. 6. No testimonials or references need be sent. If a candidate desires to submit any, they should not exceed four in all, and in the case of testimonials, ten copies of each should be sent to the vice-chancellor not later than Jan. 6.

It has been recommended that the following sub-departments in the University shall be recognised: In the Department of Botany, the sub-departments of (1) Plant Physiology, (2) Mycology; in the Department of Zoology, the sub-departments of (1) Experimental Zoology, (2) Entomology. The directors of these sub-departments shall be the University readers in the subjects.

LONDON.—The following degrees have recently been conferred:—D.Sc. degree in chemistry on Thomas J. Drakeley (University College) for a thesis entitled "The Reactivity of Coke" (*Jour. Soc. Chem. Ind.*, Aug. 1931). D.Sc. degree in geology on Leo Picard (Imperial College—Royal College of Science) for a thesis entitled "Geological Researches in the Judean Desert" (obtainable from Max Weg, Leipzig). D.Sc. degree in physical chemistry on Frederick K. V. Koch (Imperial College—Royal College of Science) for a thesis entitled "On Ionic-Molecular Interaction" (*Jour. Chem. Soc.*, 1927–28, 1930–31; *Phil. Mag.* 1930–31). D.Sc. degree in zoology on Marjorie J. Triffitt (Bedford College) for a thesis entitled "Studies on *Heterodera Schachtii*" (*Jour. of Helminthology*, 1928–31; Imp. Bureau of Agric. Parasitology Bulletin). D.Sc. degree in chemistry on Terence T. H. Verschoyle (Imperial College—Royal College of Science) for a thesis entitled "The Ternary System Carbon Monoxide-Nitrogen-Hydrogen and the Component Binary Systems between Temperatures of −185° and −215° C., and between Pressures of 0 and 225 Atmospheres"; with two subsidiary contributions.

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AN election to Beit fellowships for scientific research, founded and endowed by the late Sir Otto Beit, and tenable at the Imperial College of Science and Technology, South Kensington, will take place on or about July 12, 1932. The annual value of a fellowship is £250, and it is tenable for two years. Candidates must not hold any other scholarship or fellowship. Not more than three fellowships will be awarded in 1932. Applications must reach the Rector, Imperial College, South Kensington, London, S.W.7, from whom further information and forms of application may be obtained, not later than April 12, 1932.

THE thirty-second annual meeting of the Science Masters' Association will be held on Dec. 29–Jan. 1, at the Chemistry Department, Imperial College of Science, South Kensington, S.W.7. The president, Dr. Cyril Norwood, will deliver his presidential address on Dec. 29. Lectures will be given by Prof. Jocelyn Thorpe, on schools and research, Dr. G. C. Simpson, on modern weather forecasting, and Prof. E. W. MacBride, on the inheritance of acquired characteristics. Several discussions have been arranged, amongst which is a consideration of the size of classes for practical work in science. Amongst the lecture-demonstrations which will be given are those on experiments in colour, by Mr. E. G. Savage, and on television suitable for school laboratory work, by the Television Society. In connexion with the meeting, several visits of interest, and members', trade, and publishers' exhibitions have been arranged.

## Birthdays and Research Centres.

Dec. 13, 1874.—Prof. R. S. TROUP, C.I.E., F.R.S., professor of forestry in the University of Oxford and Director of the Imperial Forestry Institute, Oxford.

Among the many important problems affecting the British Empire at the present time there are few which afford more scope for useful investigation than the question of co-ordinated surveys dealing with vegetation and soil in relation to climate on one hand and biotic factors on the other, with a view to the recognition of the climax types which may occur and a survey of their distribution. Such surveys would place the economic use of the land on a more scientific basis than is the case at present, since they would indicate the trend of natural processes on distinct soils and sites, and would tend to prevent the policy and practice of agriculture and forestry from running counter to natural laws. The effect of clearing forest in causing the rapid deterioration of the soil opens up a large subject of investigation in different parts of the Empire.

Dec. 16, 1859.—Prof. D. H. CAMPBELL, professor of botany in Stanford University, California.

There is great need for a classification of the archegoniates and spermatophytes more in accord with our present knowledge than is the very antiquated system employed by many taxonomists both in Great Britain and the United States. Too often taxonomists are more interested in the discovery of new species and in questions of nomenclature than in a comprehensive study of the relationships of the major plant groups.

The importance of the genetic problems, which have attracted so large a number of botanists at the present time, is unquestionable, and our knowledge of the mechanics of heredity has been greatly advanced. However, this absorption in the *methods* of evolution has directed attention from important problems dealing with the history of the plant kingdom, and we must still depend mainly upon comparative morphology, ontogeny, and the fossil record for an understanding of the course of evolution in the higher plants.

Dec. 16, 1884.—Prof. J. W. BEWS, professor of botany in the Natal University College, Pietermaritzburg.

The study of South African plant ecology and plant geography continues to yield interesting results, which have an important bearing on the larger question of the evolutionary history and differentiation of the flowering plants as a whole. I am still directing my attention to these problems, from both the morphological and physiological sides. Detailed studies of other families (besides the grasses already dealt with) are being undertaken, while comparative physiological work on the water-relationships and carbohydrate metabolism of more and of less highly evolved types of plant is also being carried out with the help of students. As a further development, I am becoming interested in the study of 'human ecology'.

Dec. 17, 1861.—Mr. EDWARD HERON-ALLEN, F.R.S., hon. mem. R. Accad. S. Caecilia, Rome, past president of the Royal Microscopical Society.

My seventieth birthday finds me with my collaborator, Mr. Arthur Earland, in the middle of Part 2 of our monograph of the "Foraminifera of the *Discovery* Expedition". When the whole of this work is finished we hope to deal with those of the Great Barrier Reef Expedition. My monograph of the "Recent Foraminifera of Great Britain", which is kept up to date, must wait for publication (which is provided for) until after my death. Our collections and library will shortly be concentrated in a room placed at our disposal at the Natural History Museum, and their rearrangement and the keeping of them up to date, catalogued and indexed, will occupy all my 'idle' hours for the rest of my life.

Dec. 17, 1882.—Mr. F. T. BROOKS, F.R.S., reader in mycology in the University of Cambridge.

I am especially concerned at present with the problems of disease resistance in plants, particularly with those relating to parasitic invasion. These problems are of great botanical interest, and they are also of considerable economic importance. The interplay of host, parasite, and environment is an intriguing study.

Dec. 18, 1856.—Sir J. J. THOMSON, O.M., F.R.S., Master of Trinity College, Cambridge, and formerly Cavendish professor of experimental physics in the University of Cambridge.

Experimental researches on problems relating to the discharge of electricity through gases, and the preparation, in collaboration with my son, Prof. G. P. Thomson, of the second volume of "Conduction of Electricity through Gases". Theoretical investigations on the use of lines of electric force to give a physical representation of the processes going on in the electromagnetic field, including the phenomena associated with electronic waves.

## Societies and Academies.

LONDON.

Geological Society, Nov. 27.—A. C. Seward: (1) Fossil plants from the Bokkeveld and Witteberg beds of South Africa. With a few exceptions the specimens are referred to a single genus, for which a new generic name is proposed. The fossils are portions of stems of a plant allied to some of the psilophytalean genera characteristic of Middle Devonian rocks in Europe. They bear a close resemblance to stems of *Cyclostigma*, but there are grounds for regarding the South African plant as rather more primitive than any of the arborescent Lycopodiales, and probably more closely related to the Psilophytales.—(2) Carboniferous plants from Sinai. In 1868 Salter briefly described a specimen from the Sinai Peninsula as *Lepidodendron mosaicum*: this name is adopted for the best specimens in this collection, and others are named *Lepidodendron sp.* and *Halonia tortuosa*. *Lepidodendron mosaicum* Salter is compared with *L. obovatum* Sternberg and with other species. The age of the Sinai beds as indicated by the plants would seem to be either near the upper limit of the Lower Carboniferous, or possibly early Westphalian. A brief reference is made to phytogeographical problems raised by the occurrence of Carboniferous plants to the south of the Tethys Sea.—T. N. George: The British Carboniferous reticulate Spiriferidæ. The short-hinged spirifers which are customarily referred to the genus *Reticularia* fall into two main groups. One group, constituting *Reticularia* proper (genotype *Terebratula imbricata* Sowerby), is characterised by relatively large forms which possess a coarse shell-structure and an apparent absence of biramous spines. The second group, referred to a new genus, contains relatively small forms with a fine shell-structure which do not advance beyond an incipiently uniplicate stage in the development of shell-sculpture.

### DUBLIN.

Royal Irish Academy, Nov. 9.—R. K. Boylan: The mobilities of atmospheric large ions. Observations made by the McClelland method and also by the Zeleny divided-electrode method disclose the existence in atmospheric air not only of the Langevin ions of mobility 0·0003 cm./sec./volt./cm., but also of groups of large ions of higher and lower mobilities.—R. Southern and A. C. Gardiner: Reports from the Limnological Laboratory (2). The diurnal migrations of the Crustacea of the plankton in Lough Derg. Continuous observations on the vertical distribution of seven species of Crustacea of the plankton were made during the day and night for a period of six days from a boat anchored in the middle of Lough Derg. The daily migrations of the plankton are shown in a series of twenty histograms. Considerable variation in distribution was shown from day to day, and the causes of this variation are investigated. Certain species are composed of classes differing in their behaviour. The migrations of adult *Daphnia longispina* are precisely reversed in the case of immature forms of the same species. The males of *Cyclops strenuus* remain in deep water throughout the day and night, whilst the females and immature individuals migrate to the surface at night.

### PARIS.

Academy of Sciences, Nov. 3.—The president announced the death of Gabriel Kœnigs, member of the section of mechanics.—C. Gutton and G. Beauvais: Oscillators with very short waves. An experimental study of the effects of gas pressure in a valve producing short waves. For very low pressures, some hundred thousandths of a millimetre, the oscillation frequencies depend on the real frequency of the oscillating circuit. With higher pressures in the valve (0·008 mm.) a higher frequency is obtained, which is determined by the dimensions and potentials of the valve electrodes.—Alessandro Terracini: The reducibility of certain algebraical correspondences.—F. Leja: The convergence factor of series of polynomials.—D. Belorizky: The solution of the problem of three bodies given by Sundmann.—Mlle. Suzanne Veil: The diffusion and cataphoresis of methylene blue in gelatin. An application of the microphotometer to the problem. The curve of diffusion is regular and gives no evidence of the discontinuity noted by Mokruschin. The phenomenon of cataphoresis of methylene blue in gelatin is much more complex than that of diffusion.—J. Hérenguel and G. Chaudron: The preparation of pure magnesium by sublimation. The apparatus used is described and figured. After two sublimations in a high vacuum (mercury vapour pump) the magnesium contained less than 0·001 per cent of chlorine and was free from silicon and iron. The metal was fused to an ingot in the same apparatus in argon under a pressure of some centimetres.—D. Ivanoff: The mechanism of the reaction between ethyl carbonate and the Grignard reagent.—L. Hackspill, A. Stieber, and R. Hocart: Crystallised boron. It is shown that the substance sold as crystallised boron consists mainly of compounds of this element. The authors have prepared a boron of 99 per cent purity by the action of a high frequency discharge in a mixture of hydrogen and boron trichloride. Pure boron can also be obtained by the action of an incandescent tungsten filament on the vapour of boron tribromide. Both these give the same X-ray spectrum.—Bogdan Varitchak: The movements of the protoplasm in an Ascomycete, *Sordaria fimicola*.—Raymond Hovasse: Silicoflagellate or Radiolaria? A new protist, *Bosporella trianoides*.—Jean Saidman: The comparative biological properties of high frequency and very high frequency currents. Four out of the five properties discovered by d'Arsonval for high frequency currents are shown to persist with very high frequency currents. Details of four cases treated are given.—Mme. Z. Gruzewska and G. Roussel: The α-lipase of horse serum. Its activity in multiple bleedings.—Cl. Fromageot and A. Porcherel: The action of pancreatin upon different types of wool. Different kinds of wool show differences in the reaction with pancreatin, the coarser wools proving the more resistant. The loss of weight of the wool may reach 82 per cent.—A. Ch. Hollande and Mme. G. Hollande: The cytological structure of the human type of tubercle bacillus. The evolutive cycle of *Mycobacterium tuberculosis*.

### PRAGUE.

Czech (Bohemian) Academy of Arts and Sciences (Second class, Natural Sciences and Medicine), April 17.—K. Domin: Races and forms of *Carex semper-virens*.—F. Němejc: A study of the systematic position of cones of the type *Sporangiostrobus* Bode.—F. Novotny and F. Toul: An experimental study on the estimation of traces of elementary oxygen. The Binder-Weinland method is unsuitable for detecting traces of oxygen, as the red coloration, which should indicate oxygen, is very sensitive to impurities.—F. Bílek: Nomographic anamorphosis in a hyperbola.

June 5.—V. Hlavaty: An introduction to the theory of Lie groups.—F. Herles: The influence of digitalis drugs as shown on electrocardiograms.—J. Vítek: The relation of the alkaline reserve of the cerebro-spinal liquid to the alkaline blood reserve and its bearing on the diseases of the nervous system.—J. Babička: Polarographic analysis with the dropping mercury cathode of extracts from plant tissues. The discovery of Prof. B. Němec that the nuclei of meristematic plant cells dissolve in hot water, whereas the nuclei of non-meristematic cells are coagulated, has been confirmed by polarographic micro-analysis. The proteins which by the action of hot water split off from chromosomes were found most abundantly in the root tips of *Vicia faba* and *Alium cepa*, whilst the other parts of the root showed a gradual diminution.—P. Sillinger: The species *Festucetum carpaticæ* in the Low Tatra mountains compared with an analogous association in other parts of the western Carpathians.—B. Brauner and E. Švagr: A physico-chemical study of the sulphates of the rare earths. The degree of hydrolysis has been determined in sulphates of Sc, Y, La, Ce, Pr, Nd, Sm, Gd, Tb, Er, Yb, Th by conductivity measurements of the normal and acid sulphates, by the inversion of saccharose and catalysis of methyl acetate.—V. Hovorka: A study of the oxidation of hydrazine and semicarbazide by potassium iodate. Free iodine, liberated in this oxidation, is bound by the addition of mercuric chlorate. The reaction is promoted by acidifying with hydrochloric acid, which dissolves precipitates formed in the reaction mixture. Excess of acid is, however, undesirable. At the end of the oxidation, potassium iodide is added and the excess of iodate determined by the iodine thus liberated.—K. Michal: (1) The relation between the population density and the optimum for life, and of this to the sex ratio, in some invertebrates. The animals congregate to maintain a higher temperature and humidity. The optimal conditions yield more females, whilst unfavourable conditions lead to excess of males. The deciding factor is nourishment.—(2) Oscillation in oxygen consumption during the day and during the whole life of invertebrates (meal-worm, house-fly). Maximum of oxygen consumption is reached in early

morning hours, when feeding is most intense; minimum at noon. Greatest consumption of oxygen occurs when the organism is half grown, and does not correspond to the rate of growth of the body.

ROME.

Royal National Academy of the Lincei, May 3.—**G. Armellini**: The horizontal diameter of the sun in 1929 and 1930. At the Campidoglio Observatory measurements are made at noon on every clear day of the sun's horizontal diameter by four independent observers. In order that the results obtained over a series of years may be strictly comparable, the method of measurement has been kept unchanged since it was introduced by Respighi in 1876. The mean values (in seconds) thus obtained for the sun's radius during the past seven years are: 1924, 961·03; 1925, 960·63; 1926, 961·02; 1927, 961·54; 1928, 961·58; 1929, 961·63; 1930, 961·68. The causes of these more or less periodic fluctuations in the solar radius are being sought in the fact that the energy produced by the sun is not always exactly equal to the energy irradiated. —**G. Abetti**: Height of the chromosphere in 1930. Observations at Arcetri show a diminution in the mean height of the solar chromosphere from 10·38″ in 1929 to 10·28″ in 1930. The observations made at Madrid and Catania indicate decreases of 0·32″ and 0·3″ respectively. The total area of the prominences, which fell by 156 units in 1928–29, has again fallen by 291 units for 1929–30. According to the international observations collected and reduced at Zurich, the relative numbers of spots underwent reduction from 65·0 in 1929 to 35·7 in 1930, and it appears that the minimum solar activity of the present cycle starting in 1923 is not far distant.—**Q. Majorana**: New photoelectric effect in alkali metal cells.—**P. Vinassa**: Valency and symmetry. The forces acting in chemical reactions modify substances, often considerably, but either do not alter the symmetry of the components or change it into other symmetrical groupings. In the depths of the earth, rocks are fused to a magma which is greatly dissociated and ionised, but the symmetry remains unaltered.—**M. Betti and P. Pratesi**: Optical resolution of racemic aldehydes (2). By means of its reaction with β-naphthylphenylaminomethane, racemic *p*-methylhydratropic aldehyde may be resolved into its optically active components.—**F. Zambonini and S. Restaino**: Praseodymium and thallous sulphates. These sulphates form the following crystalline double sulphates: $Pr_2(SO_4)_3$, $5Tl_2SO_4$; $Pr_2(SO_4)_3$, $4{\cdot}5\ Tl_2SO_4$; $Pr_2(SO_4)_3$, $3Tl_2SO_4$, $H_2O$, and $Pr_2(SO_4)_3$, $Tl_2SO_4$, $4H_2O$.—**Giuseppe Corbellini**: The associability of *m* congruences of curves in space of *n* dimensions.—**G. Mammana**: The product of series capable of summation by Cesaro's method.—**A. de Mira Fernandes**: Centres of gravity of plane sections of a homogeneous body.—**Pia Nalli**: Rigid transports of vectors in Riemannian spaces.—**B. Segre**: Poincaré's problem of pseudo-conformal representation.—**G. Colonnetti**: Theory of arches with one or two hinges. —**G. Lampariello**: The impossibility of wave propagation in viscous fluids.—**R. Zoja**: The distribution of the tensions in a solid with rectilinear axis and with rectangular section of varying height (2).—**Paolo Straneo**: The unitary theory of gravitation and electricity (2). Presentation and preliminary discussion of the equations of the field. By development of the unitary theory previously considered, equations of the field are now deduced which are the simplest to express, at the limit, the gravitational equations of Einstein on one hand and Maxwell's electromagnetic equations on the other. —**A. Corbellini**: Stereoisomerism of derivatives of 1:1′-dinaphthyl. 1:1′-Dinaphthyl-8:8′-dicarboxylic acid, obtainable in good yield by reducing the diazo-compound of 8-amino-1-naphthoic acid, may be separated into its two optical antipodes by fractional crystallisation or precipitation of its brucine, cinchonine or strychnine salts. Unlike those of other analogous acids, the optical isomerides here described readily undergo racemisation in alkaline solution, even at the ordinary temperature.—**F. Rodolico**: Diopside and tremolite from Monte Spinosa in the Campigliese. The composition of the sample of tremolite analysed is in agreement in some respects with the older formula, $CaMg_3(SiO_3)_4$; if, however, the substitutions assumed by Warren (1929) are accepted, the analytical results exhibit moderately good agreement with the formula $H_2Ca_2Mg_5(SiO_3)_8$. When allowance is made for the traces of limonite present and for a certain amount of alteration which the mineral has evidently undergone, the composition of the diopside examined is in accord with the accepted formula.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 17, No. 8, Aug. 15).—**A. L. Shalowitz**: The physical basis of modern hydrographic surveying. Acoustic depth sounding, in addition to increasing enormously the rate at which surveys can be carried out, has led to the development of a rapid method of position-finding at sea. A small charge of T.N.T. is exploded near the ship, the sound waves are picked up by hydrophones near the shore, and automatically radio signals are sent out from a shore station. The time interval between the explosion and receipt of the radio signal gives the distance from ship to hydrophone, provided the horizontal velocity of sound in water is known. Extensive data on the latter show close agreement between measured and theoretical velocity based on bottom temperature of the sea, suggesting that the sound wave travels mainly along the bottom layers of water.—**Andrew C. Berry**: A metric for the space of measurable functions.—**Lincoln La Paz**: The Euler equations of problems of the calculus of variations with prescribed transversality conditions.—**G. A. Miller**: Theorems relating to the history of mathematics.—**Y. H. Woo**: On the intensity of total scattering of X-rays by gases (1 and 2). A general theory for a polyatomic gas is developed, assuming that only the coherent scattered radiation from the different atoms will interfere while the incoherent radiation will be simply added up. The theory gives results in fair accord with Barrett's work on hydrogen, oxygen, and nitrogen.—**E. O. Wollan**: Note on scattering by diatomic gases. Woo's results (above) accord with the author's recent experimental work, suggesting that Woo's equation is valid wherever one can assume spherical symmetry for the atoms of the gas molecule.—**Wilder D. Bancroft and John W. Ackerman**: The solid solution theory of dyeing.—**Wilder D. Bancroft and John E. Rutzler, Jr.**: Reversible coagulation in living tissue. The sensitivity of *Mimosa pudica* can be decreased by sodium thiocyanate and salicylate (peptising agents) and also by sodium citrate and amytal (coagulating agents). Experimental results suggest that anæsthetisation of plants as of animals is due to reversible coagulation of proteins which, being partly coagulated in the normal plant of *M. pudica*, account for its sensitivity.—**Barbara McClintock**: The order of the genes *C*, *Sh*, and *Wx* in *Zea mays* with reference to a cytological known point in the chromosome.—**Harriet B. Creighton and Barbara McClintock**: A correlation of cytological and genetical crossing-over in *Zea mays*. Evidence has been obtained that pairing chromosomes, heteromorphic in two regions,

exchange parts when they exchange genes assigned to these regions.—**Clyde E. Keeler**: A reverse mutation from 'dilute' to 'intense' pigmentation in the house mouse.—**Howard B. Frost**: Trisomic inheritance of doubleness, complicated by lethals, in *Matthiola incana*.

## Diary of Societies.

*FRIDAY*, DECEMBER 11.

ANDERSONIAN CHEMICAL SOCIETY (at Royal Technical College, Glasgow), at 3.15.
BIOCHEMICAL SOCIETY (at London School of Hygiene and Tropical Medicine), at 3.30.
ROYAL ASTRONOMICAL SOCIETY, at 5.—Prof. Freundlich: On the Gravitational Deflection of Light (Total Solar Eclipse, 1929, May 9).
ROYAL GEOGRAPHICAL SOCIETY, at 5.—The British Expedition to Greenland (Films).
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (at Royal Eye Hospital, St. George's Circus), at 5.
ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.
MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.
INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society), at 6.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.
INSTITUTION OF STRUCTURAL ENGINEERS (Informal Meeting) (at Chamber of Commerce, Birmingham), at 6.30.
SOCIETY OF DYERS AND COLOURISTS (jointly with Manchester Literary and Philosophical Society—Chemistry Section) (at 36 George Street, Manchester), at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 7.
GEOLOGISTS' ASSOCIATION (North-East Lancashire Group) (at Blackburn Technical College), at 7.
OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at College of Technology, Manchester), at 7.
WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.15.
SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (jointly with Institute of Chemistry) (at Thomas' Café, Swansea), at 7.30.
JUNIOR INSTITUTION OF ENGINEERS, at 7.30.
TEXTILE INSTITUTE (Lancashire Section) (at Manchester), at 7.30.
KEIGHLEY ASSOCIATION OF ENGINEERS (at Queen's Hotel, Keighley), at 7.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. H. J. Fleure: City Morphology in Europe.

*SATURDAY*, DECEMBER 12.

GEOLOGISTS' ASSOCIATION (Demonstration at Natural History Museum), at 2.30.
NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.
ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Roger Fry: Great French Painters (2).
HULL ASSOCIATION OF ENGINEERS (at Municipal Technical College, Hull), at 7.15.

*MONDAY*, DECEMBER 14.

ROYAL SOCIETY OF MEDICINE (United Services Section), at 5.
INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 6.15.
INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Yorkshire Section) (jointly with Refractories Association of Great Britain) (at Royal Victoria Hotel, Sheffield), at 7.
INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.
INSTITUTION OF ELECTRICAL ENGINEERS (Western Centre) (at Bristol).

*TUESDAY*, DECEMBER 15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. F. J. W. Whipple: Air Waves and how they are used to explore the Upper Atmosphere (2).
ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.
INSTITUTION OF CIVIL ENGINEERS, at 6.
INSTITUTE OF INDUSTRIAL ADMINISTRATION (Annual General Meeting) (at Institute of Hygiene), at 6.30.
LONDON NATURAL HISTORY SOCIETY (Entomology Section) (at London School of Hygiene and Tropical Medicine), at 6.30.
SOCIETY OF CHEMICAL INDUSTRY (Birmingham and Midland Section) (at Chamber of Commerce, Birmingham), at 6.45.
INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at North British Station Hotel, Edinburgh), at 7.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.
QUEKETT MICROSCOPICAL CLUB (at 11 Chandos Street, W.1), at 7.
SOCIETY OF CHEMICAL INDUSTRY (Edinburgh and East of Scotland Section) (jointly with Institute of Chemistry—Edinburgh and East of Scotland Section) (at 36 York Place, Edinburgh), at 7.30.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.

*WEDNESDAY*, DECEMBER 16.

SOCIETY OF GLASS TECHNOLOGY (at Leeds), at 2.
GLASGOW UNIVERSITY ALCHEMISTS' CLUB (at Glasgow University), at 3.30.
ROYAL SOCIETY OF MEDICINE (Comparative Medicine), at 5.
ROYAL METEOROLOGICAL SOCIETY, at 5.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.
NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at 17 Fleet Street), at 5.30.
ROYAL MICROSCOPICAL SOCIETY (at B.M.A. House, Tavistock Square), at 5.30.
INSTITUTION OF AUTOMOBILE ENGINEERS (Leeds Centre) (at Metropole Hotel, Leeds), at 7.15.
FOLK-LORE SOCIETY (at University College), at 8.
ROYAL PHILOSOPHICAL SOCIETY OF GLASGOW (at 207 Bath Street, Glasgow), at 8.
ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The British Expedition to Greenland (Films).
INSTITUTE OF BREWING (North of England Section) (at Midland Hotel, Manchester).

*THURSDAY*, DECEMBER 17.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.
NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Mining Institute, Newcastle-upon-Tyne), at 6.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.
INSTITUTION OF ELECTRICAL ENGINEERS (Irish Centre—Dublin) (at Trinity College, Dublin), at 7.45.
CHEMICAL SOCIETY, at 8.—Discussion on The Critical Increment of Homogeneous Reactions.
INSTITUTE OF BREWING (Scottish Section) (at Caledonian Hotel, Edinburgh).

*FRIDAY*, DECEMBER 18.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Zoology, University College), at 10.30 A.M., at 2.15, at 4, and at 5.30.
INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 6.15.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.
SOCIETY OF DYERS AND COLOURISTS (Glasgow Section) (at George Hotel, Glasgow), at 7.15.

SOCIETY OF CHEMICAL INDUSTRY (Glasgow Section) (at Royal Technical College, Glasgow), at 7.30.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at Technical College, Cardiff), at 7.30.—Christmas Lecture.

LEICESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemistry Section) (jointly with Leicester Association of Engineers) (at College of Technology, Leicester), at 7.30.

SOUTH LONDON BOTANICAL INSTITUTE (at 323 Norwood Road, S.E.24), at 8.

INSTITUTE OF CHEMISTRY, at 8.—Sir Frank E. Smith: The Chemist and the Community (S. M. Gluckstein Memorial Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Rev. Dr. C. Alington: The Education of the Average Man.

*SATURDAY*, DECEMBER 19.

SOCIETY FOR EXPERIMENTAL BIOLOGY (in Department of Physiology, University College), at 10.30 A.M., and at 2.15.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Roger Fry: Great French Painters (3).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Tees-Side Branch—Graduate Section) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.

### Public Lectures.

*SATURDAY*, DECEMBER 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. G. Ivens: Negroid Peoples of the Pacific Islands.

*TUESDAY*, DECEMBER 15.

IMPERIAL INSTITUTE, at 2.15.—Capt. A. E. Watts: Hong Kong.

*WEDNESDAY*, DECEMBER 16.

IMPERIAL INSTITUTE, at 2.15.—Capt. H. Luxmoore: New Zealand.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Sir Pendrill Varrier-Jones: The Welfare of the Tuberculous Citizen.

*THURSDAY*, DECEMBER 17.

IMPERIAL INSTITUTE, at 2.15.—Major G. D. Heslop: Tanganyika.

SCIENCE MUSEUM (South Kensington) (in connexion with Exhibition of Modern Glasses), at 4.45.—J. Hogan: Stained and Painted Glass.

## Official Publications Received.

BRITISH.

Southern Rhodesia Geological Survey. Bulletin No. 18: The Geology of the Country around Shamva, Mazoe District. By R. Tyndale-Biscoe. Pp. 87+11 plates. 3*s*. 9*d*. Short Report No. 27: Notes on Mixing in the Felixburg Goldfield. By J. C. Ferguson. Pp. 16. (Salisbury.)

Annual Report for the Year ended March 31st, 1931, of the Executive Council of the National Institute for the Blind. Pp. 84. (London.)

Union of South Africa: Department of Mines and Industries: Geological Survey. The Geology of the North-Eastern Pretoria District and adjoining Country. An Explanation of Sheet No. 18 (Moos River). By B. V. Lombaard. Pp. 48. (Pretoria: Government Printing Office.) 5*s*. (including Map).

Society of Chemical Industry: Chemical Engineering Group. Proceedings, Vols. 11 and 12, 1929 and 1930. Pp. 153. (London.) 10*s*. 6*d*.

Journal of the Royal Microscopical Society. Series 3, Vol. 51, Part 3, September. Pp. xvi+221-346. (London.) 10*s*. net.

Battersea Polytechnic, London, S.W.11. Report of the Principal for the Session 1930-31. Pp. 43. (London.)

Colony of the Gambia. The Annual Report of the Department of Agriculture for the Year ended March 31st, 1931. Pp. 51. (London: The Crown Agents for the Colonies.) 5*s*.

Heriot-Watt College, Edinburgh. Calendar, Session 1931-1932. Pp. 314. (Edinburgh.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1388 (Ae. 510—T. 2956): Velocity in a Wind Channel Throat. By T. E. Stanton. Pp. 3+2 plates. 4*d*. net. No. 1396 (Ae. 517—T. 2934a): Breakaway of Boundary Layer on a Cylinder and an Aerofoil. By J. J. Green. Pp. 3+2 plates. 6*d*. net. No. 1406 (Ae. 527—T. 2980, "a" and "b"): Take-Off and Landing of Aircraft. By D. Rolinson. Pp. 25+26 plates. 1*s*. 9*d*. net. (London: H.M. Stationery Office.)

Proceedings of the Royal Irish Academy. Vol. 40, Section B, No. 10: The Loo Valley, Co. Kerry. By A. Farrington. Pp. 109-120. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

Department of Scientific and Industrial Research. Report of the Radio Research Board for the Period ended 31st December 1930. Pp. iii+90+4 plates. (London: H.M. Stationery Office.) 2*s*. net.

Western Australia. Annual Progress Report of the Geological Survey for the Year 1930. Pp. 16+10 plates. (Perth: Fred. Wm. Simpson.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 4 (New Series), No. 9, September. Abstracts Nos. 1547-1782. Pp. 295-330. (London: H.M. Stationery Office.) 9*d*. net.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1931. Vol. 43, No. 9, October. Pp. 393-448+xxxviii. (London.)

Proceedings of the Cambridge Philosophical Society. Vol. 27, Part 4, 31 October. Pp. 491-604. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Proceedings of the Geologists' Association. Edited by A. K. Wells. Vol. 42, Part 3, October 28th. Pp. 217-303. (London: Edward Stanford, Ltd.) 5*s*.

FOREIGN.

U.S. Department of the Interior: Geological Survey. Water-Supply Paper 737-D: Geology and Water Resources of the Middle Deschutes River Basin, Oregon. By Harold T. Stearns. (Contributions to the Hydrology of the United States, 1930.) Pp. v+125-220+plates 10-18. 35 cents. Water-Supply Paper 638-A: A Preliminary Report on the Artesian Water Supply of Memphis, Tennessee. By F. G. Wells. (Contributions to the Hydrology of the United States, 1931.) Pp. ii+34+2 plates. Water-Supply Paper 642: Surface Water Supply of the United States, 1927. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. v+103. 20 cents. Water-Supply Paper 651: Surface Water Supply of the United States, 1927. Part 11: Pacific Slope Basins of California. Pp. ix+299. 45 cents. Water-Supply Paper 652: Surface Water Supply of the United States, 1927. Part 12: North Pacific Slope Drainage Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. v+111. 20 cents. Water-Supply Paper 653: Surface Water Supply of the United States, 1927. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+230. 35 cents. Water-Supply Paper 654: Surface Water Supply of the United States, 1927. Part 12: North Pacific Slope Drainage Basins. C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vi+142. 20 cents. Water-Supply Paper 661: Surface Water Supply of the United States, 1928. Part 1: North Atlantic Slope Drainage Basins. Pp. vii+235. 35 cents. Water-Supply Paper 664: Surface Water Supply of the United States, 1928. Part 4: St. Lawrence River Basin. Pp. v+119. 20 cents. Water-Supply Paper 666: Surface Water Supply of the United States, 1928. Part 6: Missouri River Basin. Pp. vii+207. 35 cents. Water-Supply Paper 667: Surface Water Supply of the United States, 1928. Part 7: Lower Mississippi River Basin. Pp. iv+80. 15 cents. Water-Supply Paper 669: Surface Water Supply of the United States, 1928. Part 9: Colorado River Basin. Pp. iv+96. 20 cents. Water-Supply Paper 670: Surface Water Supply of the United States, 1928. Part 10: The Great Basin. Pp. v+95. 20 cents. Water-Supply Paper 671: Surface Water Supply of the United States, 1928. Part 11: Pacific Slope Basins in California. Pp. ix+304. 45 cents. Water-Supply Paper 672: Surface Water Supply of the United States, 1928. Part 12: North Pacific Slope Drainage Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. vi+138. 25 cents. Water-Supply Paper 665: Surface Water Supply of the United States, 1928. Part 5: Hudson Bay and Upper Mississipi River Basins. Pp. v+109. 20 cents. Water-Supply Paper 668: Surface Water Supply of the United States, 1928. Part 8: Western Gulf of Mexico Basins. Pp. v+123. 20 cents. Water-Supply Paper 673: Surface Water Supply of the United States, 1928. Part 12: North Pacific Slope Drainage Basins. B: Snake River Basin. Pp. vi+172. 25 cents. Water-Supply Paper 674: Surface Water Supply of the United States, 1928. Part 12: North Pacific Slope Drainage Basins. C: Pacific Slope Basins in Oregon and Lower Columbia River Basin. Pp. vi+155. 25 cents. Water-Supply Paper 691: Surface Water Supply of the United States, 1929. Part 11: Pacific Slope Basins in California. Pp. ix+294. 45 cents. (Washington, D.C.: Government Printing Office.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 325: The Isothermal and Adiabatic Compressibilities, the Specific Heat and the Heat Conductivity of Liquids. By Hikoichi Shiba. Pp. 205-241. 40 sen. Nos. 326-327: Hyperfine Structure of Mercury, by Kiyoshi Murakawa; Note on the Zeeman Effect of Neon, by Kiyoshi Murakawa and Tatsuro Iwama. Pp. 243-259. 25 sen. Nos. 328-329: La malmoligo de *Moti*, Japana Rizmangajo, de Tutomu Maeda kaj Ryûzô Syôzi; Kial Alkoholoj Malakcelas la Malmoligon de Gipscemento? de Sigeru Yamana. Pp. 261-283. 35 sen. Supplement No. 14: The Effects of Iron on the Electrical Conductivity and Tensile Strength of Aluminium. By Masawo Kuroda. Pp. 2. 10 sen. (Tokyo: Iwanami Shoten.)

CATALOGUES.

A Collection of Modern Books in all Classes of Literature offered at Greatly Reduced Prices. (No. 451.) Pp. 32. (London: Bernard Quaritch, Ltd.)

A Classified List of Scientific Periodicals and Publications of the Learned Societies. (New Series, No. 26.) Pp. 56. (London: Wheldon and Wesley, Ltd.)

The B.D.H. Book of P.P.P. Standards. Pp. 35. (London: The British Drug Houses, Ltd.)

Nickel, B.8: Nickel Cast Iron in the Automobile Industry. Pp. 20. (London: The Mond Nickel Co., Ltd.)

Recent Purchases from the Libraries of the late Very Rev. H. Montagu Butler, Dr. Joseph R. Tanner, Mrs. H. M. Butler, and other sources. (No. 460.) Pp. 44. (Cambridge: Bowes and Bowes.)

After-Treatment in Photography. Pp. 12. (London: Burroughs Wellcome and Co.)

A Catalogue of Important and Rare Books on Botany, Agriculture, Forestry, Fruit-Culture, Gardens and Gardening, Herbals, Early Medicine and Surgery, Tobacco. (No. 450.) Pp. 124. (London: Bernard Quaritch, Ltd.)