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"To the solid ground
Of nature trusts the Mind that builds for aye."—WORDSWORTH.

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"To the solid ground
Of Nature trusts the mind that builds for aye."—WORDSWORTH.

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A Hundred Years Ago

ON another page in this issue will be found the names of some of the most notable men of science, engineers and inventors who died in 1834. The list, although it is not an exhaustive one, is representative, and recalls the activities of some of those who lived in the first third of the nineteenth century, a period which was marked by a great increase in scientific studies, in the number of scientific and technical journals and in the list of scientific societies. It was, moreover, a period which ushered in those revolutions in transport and communication which will always render the nineteenth century memorable.

The year 1834 was perhaps not marked by any such epoch-making event as the inauguration of regular steam navigation by Fulton in 1807, the discovery of electro-magnetism by Oersted in 1819, or the opening of the Liverpool and Manchester Railway in 1830, but the immense activities of the time are reflected in the pages of many publications, in the records of Patent Offices, and in the proceedings of Parliament. The world was just beginning to reap the harvest sown in the eighteenth century by such men as Franklin, Cavendish, Black, Lavoisier, Arkwright and Watt, and men's minds were filled with the possibilities of still richer rewards to be gained. The achievements of our own days, it must be said, far surpass the visions of 1834, but there are many incidents of that time worth recalling, and during the present year we propose to record some of the

happenings—scientific, industrial and social—of 1834 such as would have been noticed in the columns of NATURE had it been founded in that year instead of 1869.

A picture of the world of science in 1834 presents many interesting details and includes many notable men. In Great Britain, among the outstanding men of science were Brewster, Lyell, Herschel, Dalton, Whewell, Babbage, Faraday, Wheatstone, Forbes, Murchison and Graham; abroad, among the most distinguished were Ampère, Arago, Liebig, Oersted, Hansen, Gauss and Humboldt. In 1834, Sir John Herschel, at the Cape, was engaged on his survey of the southern heavens; Faraday at the Royal Institution was investigating the action of the voltaic cell; Wheatstone at King's College was determining the velocity of electricity; Liebig at Giessen was making his laboratory the Mecca for young chemists, while Darwin in the *Beagle* was exploring the coasts of South America.

A century ago scientific societies were multiplying apace and the British Association, then three years old, largely through the efforts of J. D. Forbes, in 1834 held its meeting at Edinburgh. Sir Thomas Brisbane was the president a hundred years ago and among the distinguished visitors from abroad was Arago. The notable scientific books of the year included Baden Powell's "History of Natural Philosophy", Prout's "Bridgewater Treatise" on chemistry, Arago's "Astronomie Populaire" and the first part of Becquerel's "Traité de l'Electricité et du Magnetism". It was also in 1834 that the French railway engineer Clapeyron published in the journal of the École Polytechnique his memoir "Theorie mécanique de la chaleur", which was destined to lead Kelvin to search for a copy of Sadi Carnot's essay of ten years earlier.

At the same time, in the world of practical engineering great advances were being made in many directions. Improvements were being introduced in the manufacture and working of iron and steel, in the construction of machine tools and in the building of iron structures. The Stephensons, Locke, Brunel, Rastrick and others were engaged on the plans for the London and Birmingham Railway and other lines; Hancock, Maceroni, Church and Scott Russell were attacking the problem of applying steam to road vehicles, a promising line of invention the success of which was prevented partly by the railways and partly by legislation, and shipbuilders and marine engineers were planning to build steam vessels capable of crossing the Atlantic under all conditions of weather. Mails and passengers were even then carried to Alexandria by steam, and steam vessels were found in all waters, but a voyage across the Atlantic was still done under sail, occupying sometimes six or eight weeks.

The growing interest in all these matters is shown by the records of patents and by the establishment of journals appealing mainly to the engineer and mechanic. One of the journals of a century ago which combined in its pages accounts of the work of men of science with descriptions of machines and engineering practice was the *Mechanics' Magazine, Museum Register, Journal and Gazette*, briefly known as the *Mechanics' Magazine*, published first in 1823. In the preface to the first volume its editors said that:

"the object proposed by this publication at its outset was one of entire novelty and no inconsiderable importance. A numerous and valuable portion of the community, including all who are manually employed in our different trades and manufactures had begun for the first time, to feel the want of a periodical work, which at a price suited to their humble means, would diffuse among them a better acquaintance with the history and principles of the arts they practise, convey to them earlier information than they had hitherto been able to procure of new discoveries, inventions and improvements and attend generally to their peculiar interests as effected by passing events."

The successful way in which the journal fulfilled these objects led Dr. Birkbeck, at the opening of the London Mechanics Institution—now the Birkbeck College—to declare that the *Mechanics' Magazine* was "the most valuable gift which the hand of science had yet offered to the artizan".

The recognition by the editors of the *Mechanics' Magazine* of the interdependence of abstract science and mechanical progress was but a sign of the times. Scientific thought was invading many departments of human endeavour, and the advancement of science was seen to be a matter of national importance. It was this that had led to the founding of the British Association. The gibes and sallies with which the birth of the "Parliament of Science" was greeted have long been forgotten, but in recalling the events of that time we shall be reminded of the benefits which have come from the labours of some of its founders and stimulated in our attempts to further the welfare of mankind.

Organising British Farming

The Foundations of Agricultural Economics together with An Economic History of British Agriculture during and after the Great War. By Dr. J. A. Venn. Second edition. Pp. xx+600+20 plates. (Cambridge: At the University Press, 1933.) 25*s*. net.

AN old French proverb asserts that there are three ways in which a gentleman may lose his money without dishonour: on wine, on horses and on agriculture. The British farmer, whether gently born or not, has had much experience of the last of these methods, but he is perhaps inadequately consoled by the reflection that he has not lost honour. For some five or six years now, large classes of farmers have either failed to make a profit or else have actually lost money, and there are great sections of the country where farmers are heavily in debt to the banks or the merchants, and will have some difficulty in getting out. Happily the Government is fully alive to the situation, and the strenuous advocacy of the Minister of Agriculture has enabled schemes for the improvement of agriculture to be developed and pressed forward which ten years ago would have seemed quite impossible.

The fundamental trouble is the marketing and distribution of the produce. The scientific worker can hold himself blameless so far as the immediate difficulties are concerned, though of course he has actually caused trouble by opening up for cultivation regions which fifty years ago were waste and produced nothing. However, it is widely recognised that this question of production would right itself if only the marketing and distribution were more effective.

The Government schemes now being put into operation involve much organisation of the industry, both for production and marketing. The essential feature is that the organisation is to be done by the industry itself, and not by the State. The advantages claimed are that the consumer is assured a supply of fresh food of good quality at reasonable price, and has, moreover, the knowledge that more labour is being used on the land, and therefore more people remain self-supporting and are kept from the various public assistance funds, than on the old methods. The farmer, on the other hand, is assured of a market at a price which has some relation to the minimum wage forced on him by law. It is too early to see how the schemes will work out, but among countrymen there is a general tendency to give them a fair trial.

A new factor in the situation is that townspeople are to-day much more interested in British agriculture than ever before in our time, and they are prepared to give up cherished ideas in order that agriculture may have a chance of success. This has put a new responsibility on the shoulders of the farmer and the agricultural expert: a high standard of efficiency in agricultural production and distribution must be maintained, and the worker must be given a fair share of whatever prosperity comes to the countryside.

Fortunately, at this critical stage in the history of British agriculture, Dr. Venn has brought out a second edition of his well-known "Foundations of Agricultural Economics". The first edition appeared ten years ago; but this has been so completely revised and so greatly extended that it has become a new book. In the meantime, a considerable amount of new material has become available in the form of various Government and other reports, and moreover Dr. Venn has travelled widely and greatly enriched his agricultural experience. The result is a book which we can unreservedly recommend as a great success.

After a description of the various methods of land tenure, past and present, and of certain of the more serious proposals for expropriation, the author passes to a consideration of the relation between size of holding and farming efficiency. Good summary tables are inserted showing the main facts very clearly. Cereal production and sheep farming emerge as the special prerogative of the large farmer and pig keeping as that of the small-holder, but the main facts are shown in the following figures:—

Size group (acres)	Farm capital per acre (£)	Manual workers per acre (number)	Gross output per acre (£)	Gross output per £100 manual labour (£)
20–50	13·4	5·6	10·1	187
50–100	10·8	4·2	7·4	183
150–300	9·3	2·8	5·9	212
Over 500	8·1	2·4	4·8	215

In this table lies the crux of the whole discussion about small-holdings. Are we to aim at higher output per man with low capital charges, small number of workers and low output per acre; or shall we prefer higher output per acre with its accompanying higher capital charges, greater density of settlement but lower output per man? If we decide on fostering the system of lower output for the sake of the greater numbers of people settled on the land, who is to bear the burden of the difference between the £187 as the

manual output from the small farm, and the £215 as manual output from the large farm? At present the capital charges of the small farms are largely borne by the State: the cost of this Dr. Venn estimates at nearly one million pounds per annum. The difference in return as compared with the large farm is borne by the small-holder and his family, and a hard life they often have in comparison with the worker employed on the large farm.

So long as these arrangements can be maintained, of course the small-holder is likely to survive, for there are always men who prefer independence to paid employment. Dr. Venn shows, however, that the attractiveness of the agricultural wage earner's position is steadily increasing, and never in his long history has he been so well off as to-day: labour costs, which fifty years ago amounted to 20 per cent of the farm outgoings, amount to-day to 38 per cent; while expenditure on materials, livestock and implements, formerly more than 50 per cent, now is 36 per cent of the total. Rent has fallen from 17 per cent to 13 per cent and rates on farmed land from 1·8 per cent of outgoings to nothing. It is shown, too, that farm workers frequently become tenant farmers or occupying owners.

Some interesting relationships are brought out between the yields of crops and the conditions of cultivation. The yield of cereals in different countries varies inversely with the area grown. The yield of potatoes, on the other hand, varies directly with the density of population. This generalisation will be new to many agriculturists, but the diagram on p. 124 is very convincing. Dr. Venn can find no evidence that this is a question of size of holdings: he attributes it to the greater use of spade husbandry and the better supplies of fertilisers and manures in densely populated countries; but one may ask whether the climatic and other physical conditions that make for dense human populations are not also those that best suit the potato crop?

Throughout the book there are many stimulating suggestions for the investigator in agricultural economics. Why, for example, should there be a marked fall in wheat acreages every ninth year from 1877 onwards—masked only in 1922 but brought out again in 1931?

Some interesting chapters follow on the recording of the amount of agricultural production, one of the most difficult problems confronting the agricultural expert. It is relatively easy in Great Britain to estimate the quantities of food imported, but exceedingly difficult to know how much is produced here. Farmers rarely weigh their produce: estimates are by eye. Dr. Venn gives reasons for thinking the official estimates are too low, and the disparity between the recent estimates of pigs available for bacon production in the near future, and the number actually offered by farmers, is still fresh in the public mind by reason of the revision it entailed in the quota permitted to Denmark. He prefers the estimates of the *Times*, but agrees that the method proposed (and in point of fact now being investigated) of weighing the produce of certain selected areas is the soundest and will give the best results if it can be put into operation.

The book concludes with an interesting account of the changes in British agriculture during the War and afterwards, and it gives a good summary of the measures now proposed for its improvement.

E. J. RUSSELL.

Social Life in Old Israel

Ancient Hebrew Social Life and Custom as indicated in Law, Narrative and Metaphor. (The Schweich Lectures of the British Academy, 1931.) By R. H. Kennett. (Published for the British Academy.) Pp. vi+114. (London: Oxford University Press, 1933.) 6*s*. net.

EVERY period has its special interests and similarly the sciences their special fashions. During the last century, interest in the Old Testament was predominantly theological and historical, from the point of view of Christian theology and the history of the Christian religion; we, however, in our times have learnt to look at parts of the Old Testament from a social aspect. For us, life has changed and its centre has been transferred to the economic and social sphere. Prof. Kennett's book is pointing to this direction, and we have good reason to tender our grateful admiration to this eminent scholar and our thanks to Prof. Burkitt for having published the manuscript after Prof. Kennett's death. The author has limited his skilful investigation to the Scriptures, and it is amazing what a brilliant picture he has given us from the somewhat scanty indications scattered over the whole Old Testament. In this small study he again shows his supreme intimate knowledge of the Scriptures and his great gift of vivid description.

The Hebrew people were a nation of peasants; agriculture was the basis of the social life. The

customs and habits were first and foremost rural; therefore most of the book deals with the life of the countryside. We can almost see the Hebrews in their houses, at their meals and at work. We follow them from birth to death; watch them in their rejoicing and mourning. It is obvious that the social classification should find its expression in the way of housing, clothing and food. The poorer class houses, for example, were built of unbaked bricks, or unhewn stones cemented with clay, whereas the houses of the rich and wealthy were of hewn stone and not seldom had painted or inlaid walls. Parables and metaphors teach us that the poor shared their one-roomed house with the cattle. As throughout the Orient, the flat roof played an important rôle and also served sometimes as a foundation for summerhouses for the wealthy people. Houses with upper floors contained separate bedrooms and often accommodation for guests. Royal palaces, of course, were distinguished by a richer architecture and ornaments and had store-rooms, even wine-cellars.

Wine leads us on to the water supply, perhaps more precious, and certainly most important, for the Orient. What we read here of the Hebrews of old will be confirmed by every traveller in the Near East. Wells are rare and a privilege of the rich. Usually, we find a cistern hewn in the rock. We know that Jerusalem was supplied with water from outside by a subterranean conduit (Siloah Tunnel) which was very important in times of war and siege.

We read of beds, tables, pottery, lamps and other household utensils, of how the people cleaned and ground the corn. The nomads lived mostly on milk; the non-nomadic majority on bread baked into loaves both leavened and unleavened. Were the corn short the poor man ate "a portion of green herbs"—even roots and wild vegetables served as food. Strongly flavoured vegetables were the rule, whereas cucumbers, for example, were considered a luxury. There was also animal food, mainly mutton and goat. Locusts, a frequent plague in Palestine, were a common food. Grapes took the first place amongst various kinds of fruit; figs and pomegranates were frequent. Banquets were held on special occasions, such as the circumcision of newly-born sons, a wedding, etc., accompanied in early times by sacrifices. It is amusing to hear that the portion served to each guest corresponded to the esteem in which he was held and to the honour the host wished to pay him.

With regard to clothing, there was a great variety amongst the rich. Girdles were the most common 'garments'; they were of various shapes, from the belt to the apron, and of course were used to gather in the coat. A tunic was generally worn next to the skin; the upper classes wore a long robe as an outer garment. The material consisted of wool, flax and linen; spinning and weaving were practised at home. The various colours mentioned indicate that dyeing was known. Sandals were worn covering the front part of the foot only. A covered head was a privilege of the nobles and the dignitaries. Women used various sorts of cosmetics. Prof. Kennett states that the status of women was not equal to that of men, but we may say that Jewish women were much more highly respected than any other Asiatic women; eminent women are known and the female characters of the Old Testament show that the Hebrews knew and appreciated the virtues of a good woman. Usually the Queen Mother had a considerable influence.

Music and dancing were a part of religious ceremonies as well as a natural expression of human joy, and there is no indication of their origin in "nature-worship superstition", as Prof. Kennett is inclined to think.

As to the occupations of men, first of all was the warrior; next came the owner of flocks and herds. The majority, however, earned a livelihood by agriculture, but their social position was considered as somehow inferior. The plough and yoke were the chief implements. The land was divided into portions, and accumulation in one hand to the disadvantage of others was forbidden by law. The social justice of old Israel, never surpassed, is to be seen in the laws concerning the land and its distribution; for example, the command to leave the corner of the field to the poor in harvest time as well as to divide the land anew in every seventh year, the year of fallow coinciding with the release of the slaves. Land, vineyards and gardens, cultivated by the peasantry, supplied the necessary food for the population, and workers in wood and metal, mechanics, etc., provided the other necessities of life. Luxury trades (goldsmiths, jewellers, perfumers) were also represented in the towns. A chapter on the administration of justice and law and the verification of a 'trial by ordeal' amongst an Arab tribe of the present day conclude this interesting book.

This is not the place to discuss and appreciate the scholarly value of this work for biblical research, but it may be recommended to those interested in the life described in the Old Testament.

The Problem of Population

Roman Catholic Methods of Birth Control. By Dr. Marie Carmichael Stopes. Pp. xv+235. (London: Peter Davies, Ltd., 1933.) 6*s*. net.

IN this book Dr. Marie Stopes is mainly occupied with her quarrel with the Roman Catholic Church, the authorities of which have actively opposed her campaign on behalf of birth-control. But Dr. Stopes succeeds in showing that that Church is not so obscurantist as some of the religious bodies more nearly allied to it. For, as she points out, the Church does sanction certain methods of contraception, and her complaint is that these methods are obsolete, since they are ineffective and physiologically undesirable.

It is not our purpose to discuss the relative merits of more modern methods, and in particular of the method which Dr. Stopes advocates, though in passing we may remark that a great stride forward was made when it was discovered that one of the most effective contraceptives was ordinary soap and water. Rather we would wish to point out that whatever method may ultimately be adopted, some form of control is absolutely necessary unless the three great calamities, war, pestilence and famine, described by Tertullian as the divinely appointed agents in regulating population, are again to recur.

The biologist feels doomed to play the rôle of Cassandra: he sees catastrophes approaching but is fated for the most part to prophesy to deaf ears. It is gradually becoming clear that populations of mammals, birds, and fish at least, and probably of all other animals as well, undergo periodic enormous increases, followed by devastation by multiplying enemies and disease until they are again reduced to their natural dimensions. One of the best-known instances of this is the recurring plagues of lemmings, which, urged on by a wild impulse of migration which always supervenes on overcrowding, emerge from the forests which are their natural home, and devastate the cultivated lands. These hordes of rats are harassed on their course by crowds of their natural enemies such as hawks and weasels, and they are decimated by disease. The last survivors plunge into the Atlantic and swim towards the west vainly seeking for the lost Atlantis that has drifted away from them. More familiar phenomena are, however, due to the same cause. A succession of good 'fishing years' is followed by others when the yield is poor. It has been shown that 'poor years' do not result from a lesser production of spawn. What determines a good or a poor year is the number of eggs which survive. In a word, it is not the birth-rate but the survival rate which determines the size of the adult population. The survival rate in turn is due to the food in the form of diatoms, etc., available for the young when the yolk-sac is exhausted. A lucky year in which plenty of diatoms were available has produced a population of herrings which have supplied the fishermen with abundance for sixteen years! When we recollect that all the efforts of modern philanthropy are directed to increasing the human survival rate, the effect of increasing the herring survival rate gives us serious matter for thought.

In the Middle Ages, and until as lately as two hundred years ago, the growth of population in England was kept in check by very similar agencies as those which now control the populations of herrings. Then, out of every five children born in London, three died before they were five years old. Indeed, the sudden increase in population which began in the latter part of the eighteenth century, and which has usually been attributed to the so-called 'Industrial Revolution', has been shown by Miss Buer to have been largely due to vaccination and better drainage.

England is now the most thickly populated country in the world with 486 people to the square mile; our better classes are restricting their families, but the least skilled go on recklessly breeding, and we frequently read of railway workers with eleven children indignantly demanding houses to contain them, of men on the dole with thirty shillings a week producing nine children. Foolish and sentimental optimists point to our Dominions, large red patches on the maps, as homes for this increasing population. They forget that more than a half of Canada is an icy tundra, and three-quarters of Australia a burning desert. It is true that the backbone of the population of both these countries is made up of the descendants of hardy British emigrants; but these emigrants settled long before the days of doles and social services.

In the last resort it would appear that wars are always due to racial pressure. Politicians may be foolish and arrogant, but they dare not risk wars unless supported by the people behind them. A feeling of over-population and being 'hemmed in' has obsessed Germany for a long time: the reviewer heard it forcibly expressed by a German friend in 1892. Since the War the over-population

of Germany has been proclaimed by Herr Hitler. Japan is about the size of the British islands, but only about one tenth of its area is arable. The population is 61,000,000, and is increasing by one million a year. It is scarcely necessary to look further for causes of the recent Chino-Japanese war. Because catastrophes such as those which occur in the animal kingdom do not take place every twenty or thirty years amongst human populations, the short-sighted ridicule the idea that they ever will occur, but the most superficial study of history proves that the optimists are wrong. It seems to us that the most stupendous task that lies before our rulers in England is the regulation of population; to see that no one is permitted to bring into the world children whom he cannot support, and that we should breed from the thrifty and competent and not from the idle and shriftless. E. W. M.

Insects and Man

(1) *Medical Entomology*. By Prof. Robert Matheson. Pp. xiii+489. (London: Baillière, Tindall and Cox, 1932.) 29*s*.

(2) *Medical Entomology: a Survey of Insects and Allied Forms which affect the Health of Man and Animals*. By Dr. William A. Riley and Dr. Oskar A. Johannsen. (McGraw-Hill Publications in the Zoölogical Sciences.) Pp. xi+476. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1932.) 27*s*. net.

WHILE medical entomology is mainly concerned with the parts played by insects and ticks in the transmission, causation and spread of disease, its limits have to go farther afield. It needs to embrace all kinds of stinging creatures, species with vesicating and urticating properties, and other forms which function solely as intermediary hosts of human parasites. The growing subject of myiasis requires full exposition and, to-day, the utilisation of dipterous larvæ as healing agents in cases of chronic osteomyelitis can scarcely be passed over. A modern textbook will also need to discuss the rôle of Oscinid flies in connexion with conjunctivitis: the little-known diseases of turalæmia and onchocerciasis, together with the growing importance of mites (*Trombicula*, etc.), and of sand-flies in relation to obscure tropical and subtropical diseases. The literature in these diverse fields grows with such rapidity that few, excepting professed medical entomologists, can keep properly abreast of current developments. This task is rendered the more difficult owing to the range of periodicals, monographs and government publications that have to be consulted.

(1) Dr. Matheson's book is to be commended as a handy and up-to-date manual. He has explored his subject with thoroughness and provided a clear and orderly presentation of facts and theories. He has, in fact, written a thoroughly sound and comprehensive introductory text which should appeal to the entomologist, medical man and student alike. The bibliographies at the ends of the chapters greatly enhance its value, and its two hundred or so illustrations are clear and well chosen; none of these latter is a familiar 'old stager'. The book is singularly free from omissions and misprints, but we think that its utility may be restricted owing to its somewhat high price.

(2) Messrs. Riley and Johannsen explain in the preface of their book that it is a revision of their earlier manual entitled a "Handbook of Medical Entomology", published in 1915. It differs from its predecessor in that the subject matter has been rearranged while the text has been extended and much new knowledge incorporated. In a compass of little more than 450 pages, practically every known disease or affection connected directly or indirectly with insects or other arthropods is taken into account. The essential facts respecting the etiology of such diseases are clearly presented while preventive and remedial measures are adequately discussed.

On the entomological side, very full taxonomic keys serve to identify the different species of insects, etc., that are involved, while their habits and measures of control are also dealt with. On the other hand, the book is much less informative as regards the structure and physiology of the essential parts and organs directly concerned with disease transmission by insects. The reader, for example, will have to go elsewhere for information on the mouth-parts of a mosquito, *Stomoxys* and *Glossina*. Little is said about the complex feeding apparatus of the house-fly and its allies, and a proper understanding of this subject is necessary in order to appreciate the rôle such insects play in relation to disease organisms. Apart from omissions of this kind, the book can be recommended as a sound and up-to-date exposition of its subject.

The works of a large number of authorities have been drawn upon in its preparation. It is, however, disappointing to find many names quoted are omitted from the list of references and that their spelling is not always correct. A. D. I.

Short Reviews

Die Tierwelt der Nord- und Ostsee. Begründet von G. Grimpe und E. Wagler. Herausgegeben von G. Grimpe. Lief. 23. Teil 1.b: *Biologische Geschichte der Nord- und Ostsee*, von Sven Ekman; Teil 2.c_2: *Tintinnidæ* (*Nachträge*), von E. Jörgensen und A. Kahl; Teil 2.c_3: *Ciliata libera et ectocommensalia*, von A. Kahl; Teil 10.g_3: *Mysidacea*, von C. Zimmer; Teil 10.g_4: *Cumacea*, von C. Zimmer. Pp. 40+27–146+29–120. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1933.) 24 gold marks.

THE twenty-third issue of "Die Tierwelt der Nord- und Ostsee" is full of interesting matter. Dr. Ekman's survey of the biological history is excellent, dealing chiefly with the late and post-Glacial history of the North Sea fauna and of the Baltic fauna and of present-day relicts. Dr. Zimmer's accounts of the *Mysidacea* and *Cumacea* cover a large number of species with details of their biology, anatomy and systematics, much of the special biology being based on his own investigations.

The largest part is occupied by Dr. Kahl's monograph on the *Ciliata* (free and ectocommensal). This includes not only those forms which are known from the area, but, because of the probable cosmopolitan distribution of many species, it also embraces those from the seas and brackish waters of the world. 700 species are here described with notes on the general characters, biology and habitat. Original instructions for collecting and a short paragraph on the culture of these interesting Infusoria are added. Out of 117 pages, 100 are taken up with the systematic account, which consists of keys to the orders, sub-orders, families and genera and, under each genus, a list of species with short diagnoses. Full-page figures containing many drawings, as well as text figures, illustrate these. To describe so many forms in so small a space is an achievement which must have involved an enormous amount of work, only possible from one who knows his subject very thoroughly. In Dr. Kahl we have such a specialist and he is to be congratulated on the result, which will be helpful to all workers.

Colon Classification. By S. R. Ranganathan. Part 1: *Rules of Classification;* Part 2: *Schedules of Classification;* Part 3: *Index to the Schedules.* (Madras Library Association: Publication Series, 3.) Pp. xiv+128+136+106. (Madras: Madras Library Association; London: Edward Goldston, Ltd., 1933.) 15*s.* net.

THE interesting library classification code set forth in this book by the Librarian of the University of Madras differs from others in that instead of showing a class subdivision for every topic, the schedules contain standard divisions arranged into groups according to function or characteristic, and the class-mark of any topic is obtained from a combination of the appropriate divisions of the various groups arranged in a specified order, the connecting links between the different groups being a set of special devices of which the most important is the colon from which the system derives its name. It is rightly claimed that the schedule thus produced, while securing as great a degree of minuteness for the classification, occupies a great deal less space in print, but it has the disadvantage that the class allotment of every book necessitates reference to several sections before its correct place is found.

The classification, though dictated to a certain extent by the needs of the system, has been well done, and the scheme is both elastic and comprehensive, while at the same time providing for sensible variations to meet local circumstances. The schedule for Indian literature has been very fully worked out. The class-mark for NATURE under the scheme would be Am 561 : M 68, and that for the book itself regarded as the classification code of the University of Madras Library, 251 : 33 : 44111q N33. A. G.

A Textbook of Biochemistry: for Students of Medicine and Science. By Prof. A. T. Cameron. (Churchill's Empire Series.) Fourth edition. Pp. xi+556+2 plates. (London: J. and A. Churchill, 1933.) 15*s.*

THIS is the fourth edition of a work which is based on lectures given to students of medicine. It is divided into six sections of which the first is introductory and physical, dealing with the conceptions of catalysis and hydrogen ion concentration. Section 2 describes the constituents of the food-stuffs, sugars, fats, proteins, etc. Section 3 treats with the chemistry of digestion, the circulation and the excreta, Section 4 with all that is comprised under the heading "Intermediate Metabolism". Section 5 handles quantitative metabolism, and the final section introduces the student to immunology and pharmacology. To do all this within the compass of 500 pages is a feat; at the same time one cannot help reflecting how much the medical student is expected to master, especially when some of the complex formulæ are examined. In this edition such subjects as the endocrine principles, the vitamins and the sterols have received increased attention as the knowledge of them has progressed. The author has wisely incorporated recent work even at the risk of seeing some of it retracted; in this connexion he might well have made reference to that of Hilditch on the constitution of the fats.

As a minor correction we might note that strophanthin is no longer regarded as containing rhamnose and mannose, but consists of glucose and a unique sugar, cymarose. The book merits continued success.

Plant Distribution in the Aberystwyth District: including Plynlimon and Cader Idris. By Prof. Lily Newton. Pp. 50+8 plates. (Aberystwyth: The *Cambrian News*, n.d.) n.p.

THE scope of this book is to give a readable ecological account of a district which, as Prof. Salter rightly remarks in his preface, has been much neglected by botanists. Accounts of the physical features and geology of the district, and a brief section devoted to the ecological study of plant distribution, precede descriptions of the various types of maritime, lowland and upland vegetation of the area bounded by Aberayron and Tregaron on the south and Plynlimon and the Barmouth estuary and Cader Idris on the east and north. Descriptions of the submerged forests of Cardigan Bay and of the old lead-mining areas and their ecological significance are included and a comparison given of the two mountains, of which Cader Idris is the more varied and floristically richer.

Quantitative data as to plant frequencies and soil and light conditions are excluded from the treatment of the plant associations, and both English and Latin names are given for the species cited. Too brief a section dealing with factors influencing distribution emphasises the relation between altitude and plant distribution, but scarcely does justice to the rôle of soil factors. The book should be useful as a general ecological survey of the district and as a basis for more detailed investigation of its constituent plant associations.

The Cultivated Conifers in North America: comprising the Pine Family and the Taxads. Successor to The Cultivated Evergreens. By L. H. Bailey. Pp. ix+404+48 plates. (New York: The Macmillan Co., 1933.) 37*s.* 6*d.* net.

ALTHOUGH this book deals very largely with the conifers that can be grown out of doors in North America, the information it contains will be found to be useful to people in other countries also. Moreover, the range of conditions existing in North America is such that the majority of conifers from other regions thrive in one or another part of the continent; therefore comparatively few kinds are omitted.

The work is divided into two parts; the first is devoted to systematic descriptions of the genera and species hardy in North America, and the second to the cultivation of conifers for decorative purposes. A very useful feature of the first part will be found in the very good keys to species that accompany the descriptions of the larger genera. The second part of the book deals with cultivation, propagation, the selection of kinds for different positions, pests and diseases. Amongst name alterations, the name of the Douglas fir has been changed back to *Pseudotsuga Douglasii* from *P. taxifolia* without explanation. If such a change were necessary, a reason should have been given. Presumably *P. taxifolia* is regarded as a homonym.

Elementary Statistical Methods. By Dr. E. C. Rhodes. (London School of Economics and Political Science: Studies in Statistics and Scientific Method, No. 1.) Pp. v+243. (London: George Routledge and Sons, Ltd., 1933.) 7*s.* 6*d.* net.

IF this first volume of a new series of studies gives a true indication, the series is designed to introduce statistics to a public for which no language can be too elementary, no remark too obvious, no emphasis too crude. The attempt is significant, for stability of democratic government may well depend on the possibility of such an introduction, and when the experiment is made in the popular press, the journalist will be fortunate in having an authoritative model. Dr. Rhodes describes excellently the precautions with which the raw material of a statistical inquiry should be compiled, the nature of simple and weighted averages, the meanings of median and quartile and of deviation and dispersion, the use of graphs, and the analysis of time series by means of a moving average. There is a wealth of numerical and graphical illustration, but the index does not conform to any reasonable standard. E. H. N.

Broadcasting. By Hilda Matheson. (The Home University Library of Modern Knowledge, No. 168.) Pp. 256. (London: Thornton Butterworth, Ltd., 1933.) 2*s.* 6*d.* net.

THIS book is written by an author fully conversant with the subject. That radio communication is not unmixed good is generally admitted, and that its possibilities have as yet only partially materialised is patent to all who have watched its development. Anything that tends to bring about *rapprochement* between the nations is welcome. The suggestion offered, that radio in the home may increase the sum of laziness, must be noted, but this may be more than balanced by the broadening outlook of rural communities. Finally, it may be quoted, that "Broadcasting will only mechanise men, if it becomes the tool of a mechanistic State". P. L. M.

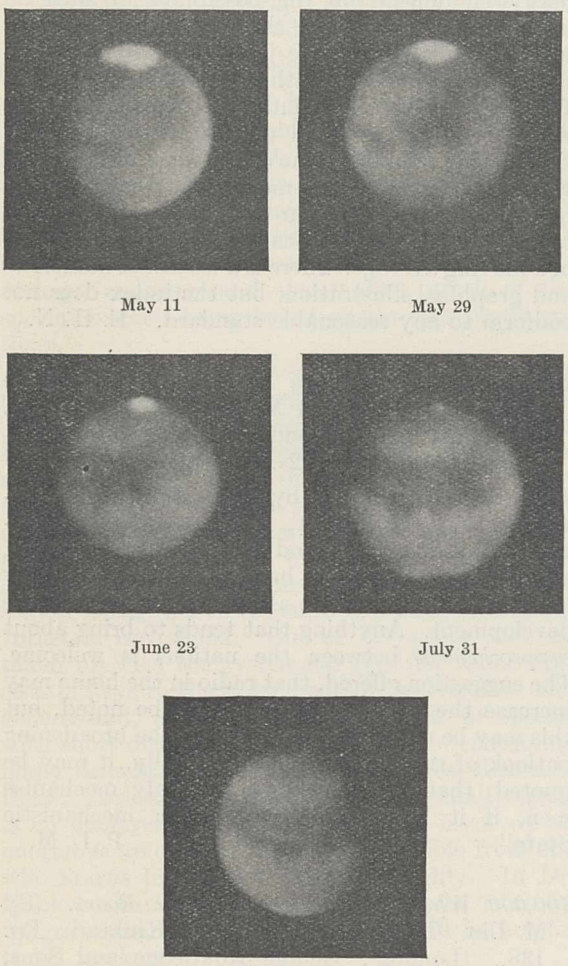
100,000 Whys: a Trip around the Room. By M. Ilin. Translated by Beatrice Kinkead. Pp. 138. (London: George Routledge and Sons, Ltd., 1933.) 3*s.* 6*d.* net.

THOSE best know how little they know, who are credited with knowing everything; and it may be that M. Ilin's small guide to general knowledge will serve in lessening to a slight degree the load of ignorance which so many carry. "Knowledge comes, but Wisdom lingers", so that even when our learning is the greater, by reason of the assimilated contents of this book, our wisdom may be not one whit increased. Both text and illustrations are likely to appeal most to the immature section of the general public to whom M. Ilin offers his book. The translation merits full praise.

Planetary Photography*

By DR. V. M. SLIPHER

THE Lowell Observatory was founded in 1894, by the late Percival Lowell, who maintained and directed it during his lifetime and endowed it by his will, that it might permanently continue astronomical research and in particular that of the planets. For nearly four decades now, it has been occupied with planetary investigations. It is situated at Flagstaff, Arizona, because, of the numerous places he had tested, it was here that Lowell found the conditions best for planetary studies. The major instruments of the Observatory are: (1) 24-inch aperture Clark refractor of 32 feet focus, (2) 42-inch Clark reflecting telescope, (3) a new 13-inch photographic telescope, (4) 15-inch Petit-didier reflector, and in addition several smaller instruments, together with a number of spectrographs, special cameras for photographing the planets, radiometric apparatus for use with the 42-inch reflector, for measuring the heat of the planets, and such laboratory equipment as is needed in the work carried on.



May 11 May 29

June 23 July 31

August 20

FIG. 1.—Photographs of Mars showing the shrinking of the polar cap and the growth of dark areas.

During the first decade, the work at the Observatory was mainly visual observations of the planets, then it was extended to include their spectrographic study, and during the second decade direct photography of the planets was added and has been continued since, giving a permanent record of them to the present time. During the past decade, their heat measurement has also been made a regular part of the observational programme. In short, whenever it has been possible to apply new means, they have been made use of in order that the planets be studied from every possible point of view.

During the early years of the Observatory, Lowell was able to observe Mercury and to confirm Schiaparelli's conclusion that the planet constantly keeps its same face to the sun, as our moon does to the earth. Thus its small mass and the intense heating by the sun long since dissipated its atmosphere. Venus proved more difficult, and with very faint surface markings, its length of day was left somewhat uncertain, while from all considerations it appeared that this planet also keeps the same face constantly toward the sun, for even the spectrograph showed no evidence of a day shorter than a few weeks. Spectral studies of Venus have failed to give any evidence of an earth-like atmosphere, no bands of oxygen or water being found, although it might have been expected that Venus would be the planet most like the earth.

From this non-committal and veiled planet we pass to the best observed of all, Mars, which has long attracted wide interest. Martian seasonal change shows itself clearly in the polar caps, which alternately increase and decrease, and in the blue-green markings which darken in the growing season and pale again as winter approaches, the great ochreish expanses, changing little from winter to summer, except as influenced by light spots and clouds. The shrinking of the polar cap with summer's coming is to be seen in Fig. 1, where are shown five photographs of the same face of the planet showing particularly the upper hemisphere, but made at Martian seasonal dates. With the contraction of the cap the shaded areas darken and enlarge, as may readily be seen in the photographs.

Dark rifts appear in the melting caps, always at precisely the same time and the same places each Martian year, which clearly prove the caps to be deposits on the planet's surface. Irregularities of the surface must cause this patchy melting of the caps to be repeated always with most punctual harmony to the Martian calendar. Such features of the melting caps are to be seen in Fig. 1. The

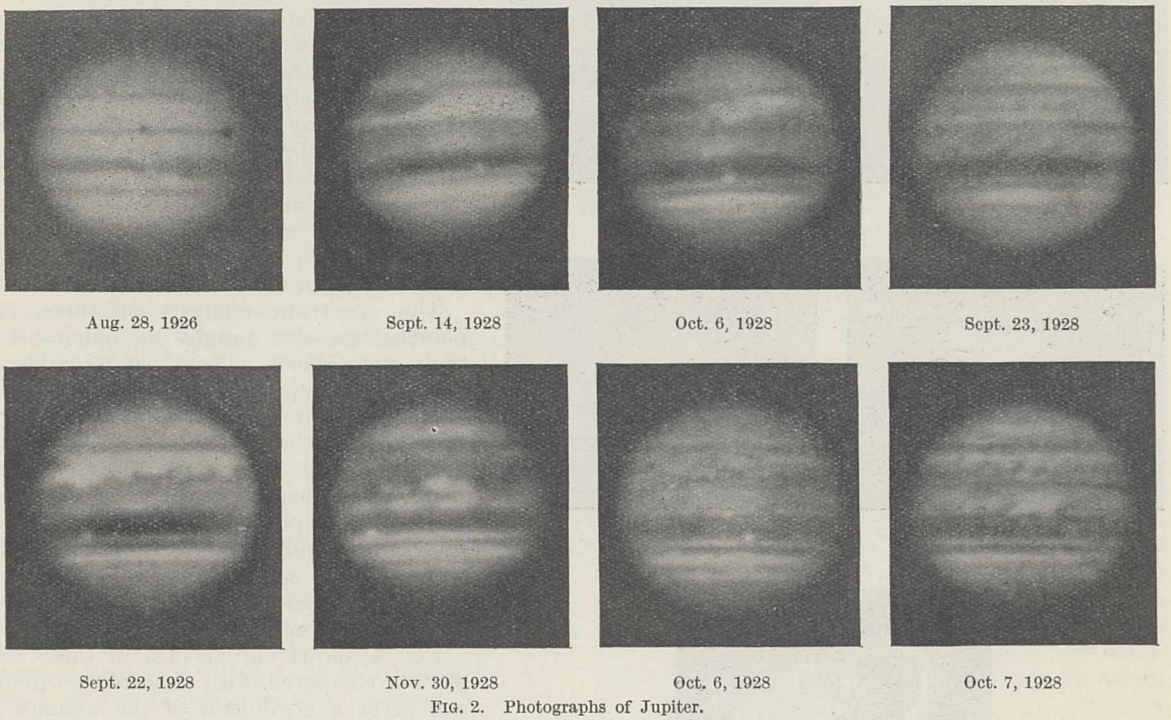
* From a discourse entitled "Planet Studies at the Lowell Observatory", delivered at the Royal Institution on Friday, May 19.

melting cap is bordered by a dark collar, and is more disposed to be regular in outline than the forming cap, which is irregular in outline and indefinite, and to begin with is erratic storm clouds only. An autumn cap appears at the opposite side of the planet to the polar cap.

The behaviour of the caps means that Mars has an atmosphere, for that is the only vehicle which does such transportation of substance. Occasionally, when Mars is so placed that we look a little into its night sky, we see on it a bright streak of light due to a cloud high in its atmosphere, catching the sunlight, while the surface is dark beneath it. Such allow us to measure their height above the Martian surface, and a fine one in 1903 was fully 15 miles high, whereas clouds are rarely more than 5 miles above the earth. Hence Mars must have quite a considerable atmosphere, and the spectrograph at Flagstaff showed it to contain water and oxygen, but no strange substances. Thus it closely resembles that of the earth, but is less dense, because the Martian surface gravity is only three-eighths of ours. There is, therefore, good proof that the polar caps of Mars are snow. Long ago someone suggested they might be frozen carbonic acid gas, but Faraday himself showed experimentally the conditions of pressure and temperature required to solidify this gas; conditions which we are sure cannot prevail on Mars.

Lowell, some years ago, deduced the temperature of Mars from a full evaluation of the factors involved, such as albedo, the behaviour of the caps, etc., and arrived at a value of 48° F. This has recently been confirmed by the radiometric measurements made at Lowell Observatory by Coblentz and Lampland.

While there is room for difference of opinion as to the interpretation of the canals of Mars, their existence as true markings on the planet has been clearly established, for they have been photographed and have been seen by nearly all skilled observers who have observed the planet carefully with powerful instruments. The Lick astronomers Schaeberle, Campbell and Hussey of the early observers, and Trumpler more recently, all drew the canals. Because changes take place in the planet's features in quite short time intervals sometimes, observers may seem to disagree and yet both be right.



Aug. 28, 1926 Sept. 14, 1928 Oct. 6, 1928 Sept. 23, 1928

Sept. 22, 1928 Nov. 30, 1928 Oct. 6, 1928 Oct. 7, 1928

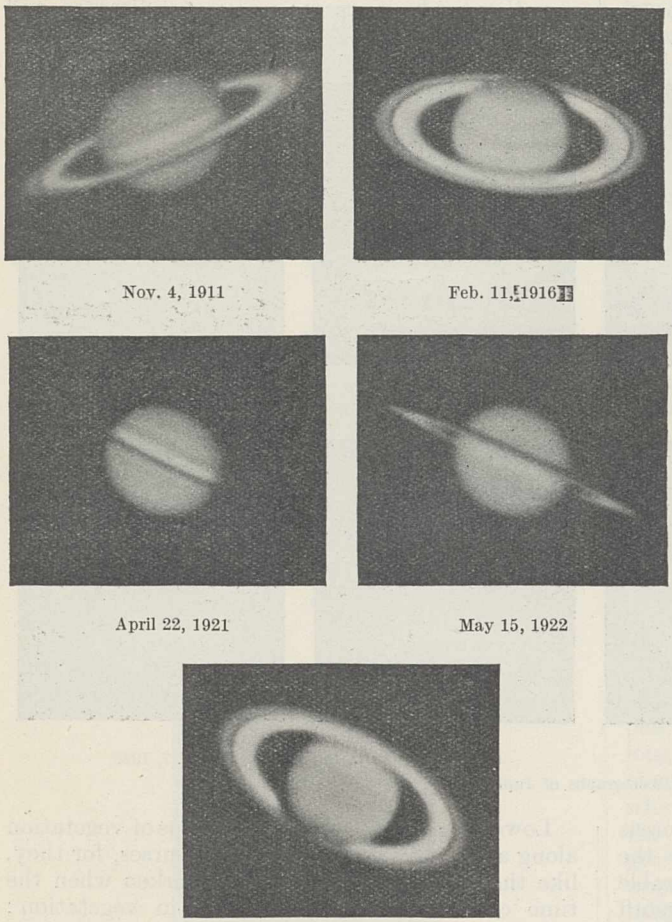
FIG. 2. Photographs of Jupiter.

Lowell regarded the canals as strips of vegetation along artificially produced water courses, for they, like the larger blue-green areas, darken when the time comes for seasonal growth in vegetation; and this led to the belief that vegetable life, and hence also probably animal life of some degree of intelligence, exist on Mars.

Jupiter has received much study at the Lowell Observatory. What we see on Jupiter are mostly atmospheric features, apparently nothing of a solid surface appearing. Usually so much detail is present that the visual observer, owing to the planet's rapid rotation, has difficulty in recording properly in drawings and notes all he is able to see under good observing conditions. In these circumstances the aid of photography has been very important, and a photographic record of the planet, as complete as possible, has been kept at Flagstaff since 1905. Fig. 2 indicates the nature of the Jupiter markings and gives some idea of

their rapid and sometimes extensive changes, which give some hint of the very great activity present on the planet.

Spectrum analysis of the light of Jupiter has revealed a great number of dark bands in the red and infra-red, due to the selective absorption of its atmosphere. Most of these are yet unidentified, but ammonia is present, and possibly also methane gas. The most remarkable quality of the planet's atmosphere is its rapidly increasing absorption into the longest wave-lengths, which must affect the radiation in a decided manner.



Nov. 4, 1911 Feb. 11, 1916

April 22, 1921 May 15, 1922

Sept. 2, 1929

FIG. 3. Photographs of Saturn.

Saturn has been regularly observed at Flagstaff, visually, photographically, and spectrographically. Lowell studied theoretically the planet's law of mass distribution, the polar flattening and relation of satellites to divisions in the ring system, leading to new results. Photographs of the planet and rings in light of different colours show some surprising changes, sometimes from year to year. It was found in 1921, when the earth and sun were very near the plane of Saturn's rings, that, contrary to previous belief, the rings could always be seen, and that the rings caused two dark lines across Saturn's ball, one the shadow of the rings and the other the rings themselves as seen dark against Saturn (Fig. 3).

Spectrum analysis of Saturn's light shows much the same absorption bands as were found for Jupiter (except that those of ammonia are weaker in Saturn), so their atmospheres are much alike. The rings show no atmosphere, but are meteoric. The fact that the cloud belts of Saturn are so much weaker than those of Jupiter is doubtless due to the former having a very great seasonal disturbance owing to its highly tipped axis. This factor is practically absent from Jupiter, and so allows its clouds to form and continue strongly belted parallel to the equator, whereas for Saturn the seasonal disturbance tends to destroy such belts.

While Uranus and Neptune are each more than sixty times the volume of the earth, their great distances, nineteen and thirty times our distance from the sun, give them only tiny discs even in the largest telescopes, and markings on them are very difficult of observation. Hence to get the rotation of Uranus the spectrograph was employed; it showed the planet's day to be 10·7 hours, and the rotation to be in the direction in which the satellites revolve.

The spectrum analysis of these two planets has also taught us much as to their atmospheres. They bear resemblance to those of Jupiter and Saturn, but show much more intense and numerous absorption bands, the strongest of which are present in the two latter planets. This atmospheric band system is much more intense in Neptune than in Uranus; in short, the bands increase from Jupiter to Uranus and again from the latter to Neptune, somewhat with the distance of the planet from the sun.

Fig. 4 shows the spectra of these four planets compared with that of the moon, and gives a good idea of the manner in which the absorption bands increase from Jupiter to Neptune. It is of interest to note that the ammonia band clearly evident in Jupiter, a little way to the left of C, is weak in Saturn, Uranus and also in Neptune.

This study of the planets at the Lowell Observatory, in addition to many results not given here relative to the several planets, has much emphasised the differences of the two main groups of planets: Earth, Venus, Mercury and Mars, and the giant group—Jupiter, Saturn, Uranus and Neptune. The first group are comparable with the earth in size, in density, in energy they receive from the sun and in atmospheres, so far as they show any at all. The other group are much larger bodies, but of much lower densities, and have a very different type of atmosphere, while the solar energy they receive is much less than the earth's share—ranging from 1/26 for Jupiter to 1/900 for Neptune. But these studies indicate that these

planets may be much more effectively utilising this small energy gift from the sun than does the nearer group of planets, for their atmospheres, as their spectra show, are as blankets retaining

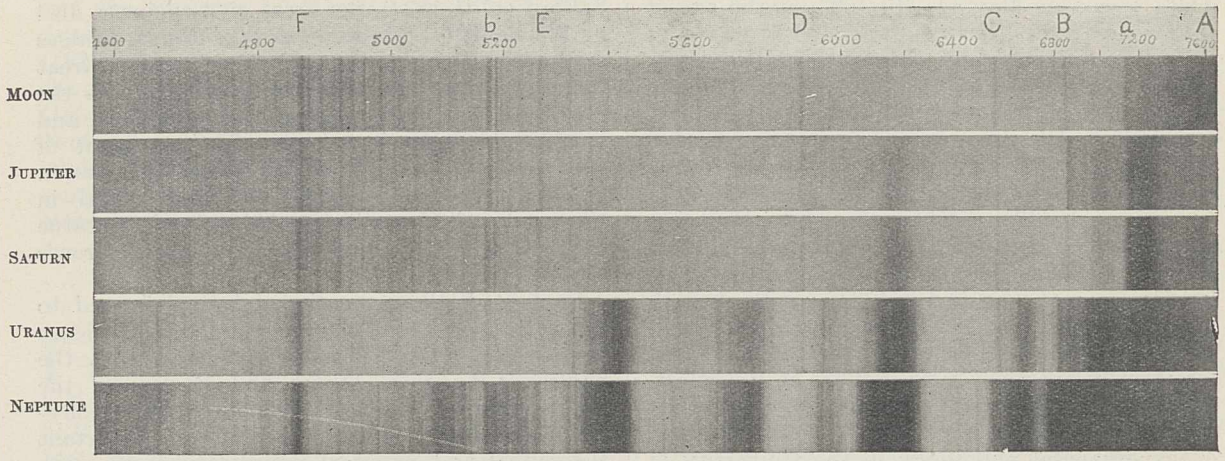


FIG. 4. Spectra of planets and the moon.

energy of the longer heat-waves, and may let little or none pass out in the heat spectrum available to observers on the earth.

These studies further direct attention to that important break between the two groups of planets between Mars and Jupiter, and emphasise the need of its further study, and perhaps from theoretical grounds as well, for when we know what has happened to produce the asteroids and cause this vast change in the planetary bodies, we shall better understand the past of the solar system.

Scientific Centenaries in 1934

By ENG.-CAPT. EDGAR C. SMITH, O.B.E., R.N.

THE records of the past year contain accounts of many commemorations of the centenaries of notable men such as Wren, Pepys, Priestley and Trevithick. In some instances the celebrations included the arrangement of interesting exhibitions, the delivery of lectures and the erection of memorials, but in every case they reminded the world of its benefactors and brought to light new information regarding the lives and work of those commemorated. If the sole value of the practice of commemorating centenaries were that it reminded us of great achievements it would be justified, for most men are like Emerson who said: "I cannot even hear of personal vigour of any kind, great power of performance, without fresh resolution." Then, too, we are all debtors of the dead, appropriating from their labours what is pure grain, rejecting what has proved to be chaff and utilising their discoveries and inventions for furthering our immediate ends.

In looking forward once again, it will be found that the centenaries falling within 1934 recall names worthy in every way to be placed beside those brought to mind during the past year. In their own time, and in their particular spheres of activity, few men held higher positions among their fellows than Mendeléeff, Langley, Weismann, and Haeckel, who were all born a century ago, or Jacquard and Telford, who died in 1834. But they only built on the work of their predecessors, and in commencing a short review of the scientific centenaries of 1934, it is of interest to go back to the revival of learning and the days of the Reformation. The outstanding figure in the science of those days was Copernicus (1473–1543), one of whose contemporaries was Otto Brunfels, who died on November 23, 1534, four centuries ago. The son of a German cooper, Brunfels was in turn a Carthusian monk, a Lutheran preacher, a schoolmaster at Strasbourg and a doctor in Berne. His study of herbs caused him to be called a reviver of botany and his name was afterwards given to a genus of plants by Plumier. The year of Brunfels's death saw the birth of another German botanist, Joachim Camerarius (1534–98), son of the learned scholar who reformed the University of Leipzig. The pupil of Melancthon, Camerarius received the degree of M.D. at Bologna in 1562, then settled in Nuremberg and there formed one of the earliest botanical gardens. A French botanist of a hundred years later was Denis Dodart (1634–1707), physician to Louis XIV, a member of the Paris Academy of Sciences and one of the compilers of the "Mémoires pour servir à l'histoire des plantes" published in 1676.

It was but natural that the early botanists should be recruited from the ranks of the

physicians, from which came also some of the early chemists. Among the medical men of the seventeenth and eighteenth century whose names are indelibly inscribed on the roll of scientific worthies is Georg Ernst Stahl, the bicentenary of whose death occurs on May 14. In 1693, at the age of thirty-three years, he was appointed professor of medicine, anatomy and chemistry in the newly established University of Halle and in 1698 he enunciated the famous phlogiston theory which, embraced in Germany, spread to Sweden, France and England and continued an orthodox article of faith until overthrown by the experiments of Lavoisier. In 1716 Stahl removed to Berlin as physician to the King of Prussia, Frederick William I (1688–1740), and there he died. Two less famous men who died in 1734 were the French mathematicians Thomas Fantet de Lagny (1660–1734), a foreign member of the Royal Society and for many years royal hydrographer at Rochefort, and Peter Polinière (1671–1734), who it is stated was the first person appointed to deliver lectures on experimental philosophy in the University of Paris.

The year 1734 also saw the birth of many individuals who achieved distinction in science and engineering. These included Edward Waring (1734–98), F.R.S., for thirty-eight years Lucasian professor of mathematics at Cambridge, whose "profound researches were not," it was said, "adapted to any form of communication by lectures"; Wolfgang, Baron de Kempelen (1734–1804), the Hungarian statesman and mechanician, who devised an automatic chess player, which was exhibited in London, and a process of printing books for the blind in embossed type; the French agriculturist Francis Rozier (1734–1793), who in 1771 founded the *Journal de Physique et d'Histoire Naturelle*; Thomas Henry (1734–1816), F.R.S., the chemist, who was first secretary, and later on president of the Manchester Literary and Philosophical Society, and Robert Mylne (1734–1811) the engineer and architect who is buried in St. Paul's Cathedral close to Wren. Mylne designed the Gloucester and Berkeley Canal, the Eau Brink Cut at Lynn and the first Blackfriars Bridge, the third bridge to span the Thames at London. For a very long period Mylne was the surveyor of St. Paul's.

Turning to the deaths and births of just a hundred years ago, the list, without being exhaustive, contains many familiar names. In 1834 died Jean Nicholas Peter Hachette (1769–1834), a professor at the École Polytechnique, whose development of the descriptive geometry of his colleague, Monge, proved of great value to the constructors of machinery in France; the German astronomer Karl Ludwig Harding (1775–1834), who in 1804 discovered Juno, the third asteroid, and the Swiss physicist Charles Gaspard de la Rive (1770–1834), who like his son Auguste de la Rive was a friend of Faraday. On February 26, 1834, Alois Senefelder (1771–1834), the inventor of lithography, died in Munich; on August 7 Joseph Marie Jacquard (1752–1834), the inventor of the loom for figure weaving, died near Lyons; on August 19 General Henri Joseph Paixhans (1783–1834), a pioneer in the improvement of artillery, passed away at Metz, and on September 2, Thomas Telford (1757–1834), the great civil engineer, died in Westminster. Telford's roads, canals, bridges and docks are to be found in many parts of Great Britain. After the death of Rennie he was the recognised head of the engineering profession, and in 1820 he was elected the first president of the Institution of Civil Engineers, a position he held until his death. He was buried in the nave of Westminster Abbey and a statue of him is to be seen there in St. Andrew's Chapel.

So far, all those mentioned have belonged to the western nations of Europe, but of men of science born in 1834 the list may well begin with the names of Langley, Young and Powell, of the United States. Samuel Pierpont Langley (1834–1906) will always be remembered for his important theoretical and practical investigations on aeronautics, but he was also distinguished as a physicist and astronomer, and for many years was secretary of the Smithsonian Institution. His contemporary, Charles Augustus Young (1834–1908), of Princeton University, was also an eminent astronomer, while Major John Wesley Powell (1834–1902) was, from 1879 until 1902, Director of the United States Bureau of Ethnology and from 1881 until 1894 Director of the United States Geological Survey.

These three eminent men were born in the eastern States of America; the birth of the great Russian chemist, Dmitri Ivanowitsch Mendeléeff (1834–1907), carries us to the plains of Siberia, to Tobolsk, where his father was a schoolmaster. Mendeléeff was born on January 27 (O.S.) or February 8 (N.S.) and died in 1907 on January 20 (O.S.) or February 2 (N.S.). His life and work were the subject of a memorial lecture delivered to the Chemical Society in 1909 by Sir William Tilden. Two of Mendeléeff's contemporaries, born in Germany and famous as chemists, were Carl Schorlemmer (1834–92) and Hermann Johann Philipp Sprengel (1834–1906) both of whom, however, spent the greater part of their lives in England, Schorlemmer being the colleague of Roscoe at Owens College, Manchester. Sprengel was famous for his invention of the improved mercury air pump and for his work on explosives. Another German man of science born in 1834 was Philipp Reis (1834–74) a pioneer of the telephone whose apparatus was used so early as 1865 by D. E. Hughes when lecturing before the Emperor of Russia, Alexander II.

Leaving the ranks of the workers in physical science for those of the inventors and engineers, mention may be made of Daimler, Wedding, Preece, Woodbury, Vavasseur and Perkins, who were all born in 1834. Loftus Perkins (1834–91), the grandson of Jacob Perkins, was a pioneer in the use of high-pressure steam at sea, and in 1880

built the yacht *Anthracite*, which crossed the Atlantic using steam at 350 lb. per sq. in.; Joseph Vavasseur (1834–1908) is remembered for his improved method of controlling the recoil of large guns, while Walter Bentley Woodbury (1834–85) was the inventor of Woodburytype and other developments in photography. Sir William Preece (1834–1913) was widely known as a distinguished electrical engineer; Gustav Hermann Wedding (1834–1908) was both an honorary member and Bessemer medallist of the Iron and Steel Institute; while Gottlieb Daimler (1834–1900) will always be remembered as the colleague of Langen, Otto and Maybach, and as the first to construct a high-speed internal combustion engine suitable for road vehicles.

In conclusion, passing reference may be made to the approaching centenaries of the birth of Sir John Lubbock, first Lord Avebury (1834–1913) which falls on April 30, 1834, whose writings on primitive man and on bees and ants delighted a large circle of readers; of August Weismann (1834–1914) the German biologist, born on January 17, 1834, who was the first to think out a coherent theory of heredity, and of Ernst Heinrich Haeckel (1834–1919), born on February 16, 1834, who has been spoken of as "probably the most influential advocate of Darwinism".

Experiments in the Stratosphere

IT has recently been reported in the daily Press that an attempt is shortly to be made by balloon ascent to reach higher altitudes than 61,000 ft. (pressure 50 mm.) claimed to have been reached by Prokofiev and his companions in the U.S.S.R. balloon. It is to be recalled that observations were made by Regener in 1932 using self-registering apparatus attached to rubber balloons up to a pressure of 22 mm. It was reported that the American balloonists Settle and Fordney reached a pressure last autumn of about 64 mm., whilst the minimum pressure from the records of the Belgian flights of Cosyns, Kipfer and Piccard was 73 mm.

The new attempt represents a departure from the previous methods in that the observers are to travel in an open basket but will themselves be completely sealed in flexible rubber suits. To prevent these from ballooning at low external pressure the suits, adequately supported, will be exhausted down to the minimum that a man can withstand with comfort if he be supplied with sufficient oxygen. The advantages claimed are that the great saving in weight by the absence of the heavy gondola of the previous flights will enable the observers to reach greater heights. The apparatus has already been tested with safety up to an external pressure supposed to correspond to a height of 90,000 ft.—roughly that attained by Regener's balloons. These preparatory ground experiments are being conducted by an American, Mr. M. E. Ridge, with the advice of Dr. J. S. Haldane, at the works of Messrs. Siebe, Gorman and Co. Ltd. at Lambeth, London. It is assumed that the ballooning of the suit at the greatest height attainable will not incommode the occupant even though he himself is under a very much reduced pressure. The observer will be enabled to move about freely and make meteorological and other observations with instruments in contact with the atmosphere.

It is true that from the point of view of record breaking, this saving in weight is an important feature, for it was made clear by Dr. M. Cosyns, when lecturing in England a short time ago, that the only practical limits imposed turned on the very awkward elongated cigar shape of an extremely large envelope when filled with hydrogen only to a small fraction—one fifth or one tenth—of its capacity on the ground. The whole risk lies with the possible entangling of the practically parallel ropes supporting the gondola. When once off the ground the mishap cannot be rectified. So great was the risk that, in the last Belgian ascent, the balloon was purposely filled with twice as much hydrogen as was required in order to keep the ropes apart, the surplus being discharged en route.

Turning now to the instrumental observations, it must be remarked at the outset that the values of J, the rate of production of ions per cubic centimetre by the cosmic rays, obtained by the Belgian observers, lie within the limits of those of Regener and agree well with them. Those of the stratostat *USSR* are said to agree slightly better with the Belgian than with Regener's results. Other interesting experimental results from the Russian source are that the composition of the air is the same at the lowest pressure reached as on the ground, the relative humidity fell from 92 per cent on the ground to 42 per cent on the borders of the stratosphere and that, contrary to expectations, gradients of temperature over a few degrees were experienced within the stratosphere. It is noticeable, however, that previous observers have attempted rather too much on each flight, but commenting on the new departure and its relation to previous methods, the barothermograph looks after itself, as does the recording electrometer for obtaining the potential gradient. Perhaps a small advantage would be obtained here in manipulating the leads strung out from the car. The Kolhörster ionisation chamber failed to work on the Belgian flight due to the deposition of body moisture on the insulations, but the advantages of exposing the battery, insulators, electrometers, etc., to the rigorous conditions of the stratosphere are doubtful. Spectrometers for recording the sun and sky light, pyrheliometer for determining the solar constant, air samplers and camera can all be worked in the open. Eyes and ears must unfortunately always

be enclosed. The deep purple of the sky noticed by both the Belgian and the Russian observers must always be seen through glass.

Of all the observations likely to be made, the greatest promise comes from the projected Wilson chamber experiments by Dr. Cosyns that were mentioned in NATURE of November 25, p. 812. The need for a further examination of cosmic rays is urgent, for their origin remains unknown. The interesting effect accentuated in the Belgian flights was the difference in the behaviour of the ionisation chamber and the Geiger counter as standardised on the ground with γ-rays from radium and used in the upper atmosphere. The relative indications of the counter increase at a greater rate than those of the ionisation chamber, and in the highest altitudes reached, the activity of one has become thrice that of the other. The greater attenuation of the ions along the track of the cosmic ray than along that of the standardising β-ray accounts for the comparative falling off of the indications of the ionisation chamber, whilst the counter goes on no matter how small the disturbance. This result, however, is deceptive, for as the ground experiments of Blackett and Occhialini have abundantly shown, only a very inadequate part of the life-history of a cosmic ray may be obtained from the study of a localised portion of the track of one of the secondary particles. The intrinsic ionisation per centimetre along the track with its secondaries and tertiaries may be just as high as along that of a β-ray. It is well known that, of all the instruments, the Wilson chamber set for photographing β-rays and cosmic rays is most delicately poised. Small variations in temperature conditions and expansion ratio with water or alcohol vapour as indicator upset the observations. Such an instrument, if it is ever constructed for the purpose, must be used in a closed gondola, on account of its heavy coils for obtaining the requisite magnetic field and extra large chamber for taking in as much as possible of these simultaneous happenings, the non-ionising links, the tracks radiating forwards from diffuse centres consisting of neutral particles and positive and negative electrons and the localised heavy bursts of ionisation supposed to be associated with the complete destruction of a chance heavy molecule.

Apart from the investigations in pure science for which such heroic efforts have recently been made and are likely to be made in the future, the reported change in tactics has reopened the question of the feasibility of employing such a flying suit in an open aeroplane flying the stratosphere. It is claimed that the control will be easier than from a completely sealed cockpit.

Obituary

MR. H. R. A. MALLOCK, F.R.S.

WHEN Mr. Henry Reginald Arnulph Mallock died on June 26, 1933, we endeavoured to find particulars of his career upon which a suitable obituary notice could be based, but were unsuccessful. He was an esteemed contributor to our correspondence columns, yet, on account of his dislike for publicity, few personal details were known concerning him, and no one felt able, therefore, to deal adequately with his life and work. Dr. C. V. Boys has, however, since contributed to the *Proceedings of the Royal Society* an appreciative account of Mallock's upbringing and some of the products of his fertile brain and mechanical ingenuity. We give below an abridgement of this obituary notice and are glad thus to be able to place on record a tribute to a great physicist and engineer.

Arnulph Mallock, the youngest son of the Rev. William Mallock, was born at Cheriton Bishop, on March 12, 1851. After leaving school he entered St. Edmund's Hall, Oxford, and when he left Oxford he assisted his uncle, Mr. W. Froude, of Chelston Cross, Torquay, in working out the very beautiful gear of the original ship model tank. In 1876 Mallock went as assistant to the late Lord Rayleigh. He had some doubt whether his mechanical skill would be sufficient to enable him to meet Lord Rayleigh's requirements. It would seem that his misgivings were unnecessary for two reasons. He was in fact an accomplished mechanic, capable of the finest instrument construction if he had suitable tools, and Lord Rayleigh was such a genius in devising means almost absurdly simple for conducting experiments of the most crucial character. The time spent under that benign influence must perhaps have been the most precious of all in encouraging Mallock, if indeed he needed encouragement, in confidence in first principles where difficult problems were to be met.

Mallock was fortunate in having lived among a group of brilliant men in the engineering world —Brunel, Froude, Tower, of spherical engine fame, Baker, Metford and others—and with his very great mechanical skill and considerable mathematical ability and ingenuity, was ready to attack and solve problems as they arose.

Perhaps the class of experiment for which Mallock showed especial genius was any in which the smallest movements, tremors, bendings or stretchings had to be determined. He designed and either made himself or designed and superintended the construction, by the firms of Troughton and Sims or Adie in particular, of the beautiful instruments with which he examined tremors due to the underground railway, disturbances of St. Paul's Cathedral, problems connected with the Forth and Tower Bridges and many more. As a civilian member of the Ordnance Committee he wrestled with many of the problems of ballistics.

Mallock was also interested in many problems in optics, and in particular he was skilled in dissection under the microscope and wrote many

papers on the eyes of insects and the eyes of spiders. For his microscopical mountings Mallock made use of Styrax, on which he contributed two letters to NATURE in 1924. His optical interests naturally drew him to experiment, as so many have done, with the brilliant colours of butterflies' wings and the metallic hues of beetles.

So long ago as 1874 Mallock noticed a colour phenomenon not very conspicuous, but ready to hand for almost everyone. As is well known, two sheets of wire gauze or perforated zinc laid one over the other give rise to patterns of the watered silk type but without colour. If, however, only one piece of fairly fine gauze be used and the other is the reflection in an ordinary looking-glass on which it is laid, the patterns are seen as before, but now they are coloured mainly with tempered steel colours. The simple explanation is given in the *Proceedings of the Royal Society* in 1918, and it is followed by a note on the colours of tempered steel.

Mallock was associated with Mr. Metford in the design of rifle bullets and in ascertaining their trajectories. He also carried out experiments on the extreme range of rifle bullets with Lord Cottesloe. An interesting example of his ingenuity and painstaking research is to be found in his apparatus for measuring the growth of trees. For this purpose he adopted an instrument which he had formerly used for observing changes in the dimensions of cracks on St. Paul's and other buildings. Another of his enterprises was the design and construction with his own hands of a machine for ruling diffraction gratings. This machine is now at the National Physical Laboratory.

These notes refer to a few only of Mallock's contributions to physical science out of a great number. Fifty-six of his papers appeared in the *Proceedings of the Royal Society* and eighty-nine contributions from him were published in NATURE.

In 1904 Arnulph Mallock married Helena Maria Caroline Finlay, of Castle Toward, Argyllshire. In his last years with rapidly increasing blindness her devotion did much to alleviate his distress, for his mind and interests remained acute but first his beloved microscope and gradually all print ceased to be available to him.

WE regret to announce the following deaths :

Dr. Howard Ayers, president of the University of Cincinnati from 1899 until 1904, formerly professor of biology in the University of Missouri, on October 17, aged seventy-two years.

Prof. Erwin Baur, director of the Kaiser Wilhelm Institut für Züchtungsforchung, Berlin, on December 2, aged fifty-eight years.

Prof. Edwin S. Crawley, emeritus professor of mathematics in the University of Pennsylvania, known for his work on the geometry of curves, on October 18, aged seventy-one years.

Mr. Edward Evans, formerly in charge of the science classes at Burnley Municipal College, author of "Botany for Beginners", on December 23, aged seventy-eight years.

Prof. J. Cossar Ewart, F.R.S., formerly regius professor of natural history in the University of Edinburgh, a pioneer in animal breeding research, on December 31, aged eighty-two years.

Prof. T. Swale Vincent, formerly professor of physiology, University of London, an authority on the ductless glands, on December 31, aged sixty-five years.

News and Views

New Year Honours

THE New Year Honours List includes the following names of scientific workers and others associated with scientific work: *K.C.V.O.:* Sir Richard Glazebrook, chairman of the Aeronautical Research Committee, 1908–33. *Knights:* Dr. S. C. Cockerell, director of the Fitzwilliam Museum, Cambridge; Mr. G. Evans, principal of the Imperial College of Tropical Agriculture, Trinidad; Dr. Kenneth Lee, chairman of the Industrial Grants Committee, Department of Scientific and Industrial Research; Col. C. E. Merrett, president and trustee of the Royal Agricultural Society, State of Victoria; Prof. Robert Muir, professor of pathology, University of Glasgow; Dr. C. T. Hagberg Wright, secretary and librarian of the London Library. *C.S.I.:* Brigadier R. H. Thomas, lately Surveyor-General of India. *C.M.G.:* Prof. R. E. Alexander, director of Canterbury Agricultural College, Lincoln, near Christchurch, New Zealand; Mr. A. Holm, lately director of agriculture, Kenya. *C.I.E.:* Lieut.-Col. A. D. Stewart, director of the All-India Institute of Hygiene and Public Health, Calcutta; Lieut.-Col. Ram Nath Chopra, professor of pharmacology, School of Tropical Medicine and Hygiene, Calcutta. *C.B.E.:* Mr. J. S. Buchanan, deputy director of technical development, Air Ministry; Mr. R. G. Hatton, director of the Horticultural Research Station, East Malling, Kent. *O.B.E.:* Mr. G. H. J. Adlam, senior science master, City of London School; Mr. M. C. C. Bonington, lately divisional forest officer and forest development officer, Andamans; Mr. C. Coles, principal of Cardiff Technical College; Mr. D. Mackay, for service in connexion with scientific exploration and survey in the interior of Australia; Prof. W. Makower, professor of science, Royal Military Academy; Dr. P. D. Strachan, superintendent, Leper Settlement, Botsabelo, Basutoland; Mr. H. B. Thomas, deputy director of surveys, Uganda Protectorate; Mr. A. H. Unwin, conservator of forests, Cyprus. *M.B.E.:* Mr. A. S. Buckhurst, assistant in the Plant Pathological Laboratory, Harpenden; Mr. B. J. Hartley, district agricultural officer, Tanganyika Territory; Mr. C. A. Pinto, curator in the Zoological Gardens, Lahore, Punjab; Mr. M. J. S. Rosair, extra assistant conservator of forests, Burma.

Science News a Century Ago

WHEN we were arranging for the publication during 1934 of notes on topics and events of scientific interest week by week a century ago, and of industrial changes or incidents in public affairs having contacts with science, we invited several contributors familiar with particular fields to send us occasional notes for this new "Calendar" of past occurrences. One of these contributors, who has special knowledge of social and political subjects, has carried his mind back to the beginning of the year 1834, and has sent us what might have been editorial comments upon some matters then under discussion. The columns of "Science News a Century Ago", which we propose to publish throughout the year, will not usually be of the nature of comments but rather selected notes from papers or other publications during 1834. There is, however, so much of interest in our correspondent's retrospective remarks on the first day of that year that we have no hesitation in reproducing them below. The notes accurately represent the atmosphere at the time, and they remind us, among other things, that the United States had its gold problem then as now, and also that Empire communication as we know it to-day had no existence then.

January 1, 1834

"IT is natural on New Year's day to look both backward and forward—to take stock, and even to speculate as to the future. This coming year will bring the commencement of the fifth year of the reign of His Gracious Majesty King William IV; and it finds that eminent Whig, Earl Grey, who some two years ago piloted the Reform Bill to the Statute Book, still in the saddle as Prime Minister. Perhaps the most notable piece of legislation during the year which has just closed was the enactment of the abolition of slavery in Great Britain and its Colonies, despite the opposition of that rising hope of the younger Tories, Mr. William Ewart Gladstone, M.P. for Newark. Probably a century hence this measure will be regarded as one of the boldest and most enlightened efforts of the Reformed Parliament, as well as one of its earliest. Who can tell ?"

"LOOKING abroad, we cannot fail to be interested in what goes on in the United States of America. Their recent severance from the British sovereignty, and their close ties of consanguinity, militate against indifference to their welfare in this country. Like most young communities, they have their own troubles to face; and, economically, the welfare of the whole world has been adversely affected by the prolonged Napoleonic wars. We feel the pinch here, even yet, most acutely, but our economic fabric is more firmly established than theirs. It is an object-lesson in the far-reaching effects of these factors that this overseas community, situated so far from the seat of the Napoleonic conflagration, is nevertheless so seriously affected. American citizens continue to be agitated by the contest which began last year as to the legality of the conduct of their President in withdrawing the public deposits from the National Bank. Meanwhile, the importation of gold into the States has assumed unprecedented proportions since January, 1833. Some there are who attribute all these happenings to a republican form of government; but that is probably too sweeping a generalisation. The States are young, vigorous, and are as yet developed to nothing like their full extent. On the other hand, many believe that they have before them a future the brilliance of which has never been matched in the Old World. Time alone can show. Anyway, these happenings are of absorbing interest, and make us increasingly impatient for the arrival of each sailing packet with mails. In some quarters this impatience takes the form of suggesting that matters would be improved if the new motive agent —the steam engine—could be brought to such a state of perfection as to replace sailing ships by steam ships: but that day is not yet, and the Atlantic is a turbulent piece of water to be conquered by so new an invention."

Centenary of Philipp Reis, 1834–1874

On January 7 occurs the centenary of the birth of the German physicist, Johann Philipp Reis, one of the earliest pioneers of the telephone. Reis was born in Gelnhausen, and died at Friedrichsdorf near Homburg on January 14, 1874 at the early age of forty years. Left an orphan, he had to struggle against many difficulties and it was while an apprentice to a painter that he laid the foundation of his knowledge of chemistry and physics. Eventually he was offered a post as a teacher at the Institut Garnier in Friedrichsdorf, which he had attended as a boy. It was in his own private workroom that he made the apparatus which he called the "Telephon". His work was based on the true theory of telephony, and he probably designed ten distinct forms of transmitter and four forms of receiver. On October 26, 1861, he exhibited his apparatus before the Physical Society of Frankfort-on-Main and a year or two later lectured on it at Giessen. His apparatus was also placed on the market, and when D. E. Hughes went to Russia in 1865 in connexion with his printing telegraph, he took one of Reis's telephones with him and exhibited it to the Emperor Alexander II at Czarsko-Zelo. But in spite of the correctness of his views and his ingenuity, Reis failed to impress others of the value of his invention. Towards the end of the 'sixties he was attacked by consumption and this led to his early death. He passed away entirely unnoticed, but after the telephone came into common use his country attempted to make some amends for the neglect he had suffered, and the Government erected a monument over his grave in the cemetery at Friedrichsdorf. His biography was written in 1883 by Silvanus Thompson, and on January 7, 1884 the Electrotechnische Gesellschaft of Frankfort held a special meeting followed by a banquet to commemorate the fiftieth anniversary of his birth.

Science and Psychical Research

IT was suggested in a leading article in NATURE of December 23, that investigations in the field of abnormal psychology, and the alleged physical

phenomena said to accompany particular states of mental dissociation, might appropriately be taken up by a department of a university or other responsible scientific institution as subjects of post-graduate research. Since then we have received a circular relating to the formation of-a body with the title of the International Institute for Psychical Research, "for the furtherance of knowledge in regard to psychic phenomena". The president is Prof. Elliot Smith, and two of the vice-presidents are Prof. Julian Huxley and Prof. E. W. MacBride. The chairman of the executive committee is Mr. J. Arthur Findlay, a well-known business man in Glasgow, whose book "On the Edge of the Etheric", published last year, described a series of sittings with a Scottish "direct voice" medium. Judging from this book, Mr. Findlay has little conception of the critical attitude of science towards the evidence which he presents and the explanations he gives of the phenomena he describes. In the words of our reviewer of his book: "But from reading Mr. Findlay's records the scientific method might be thought not to exist. He seems to have no appreciation of the implications underlying many of his remarks; no desire to see the phenomena described in accurate and scientific terminology."

PERHAPS the men of science who have become office bearers in the new organisation will be able to see that whatever investigations are undertaken are more in accord with what science demands than are those the explanations of which are accepted by Mr. Findlay. In any event, we need scarcely say that we do not regard the new body as satisfying the conditions of psychical research in a university or similar institution referred to in the leading article in our issue of December 23. Its aims and intentions do not seem to us to differ essentially from those of the Society for Psychical Research or from Mr. Harry Price's National Laboratory for Psychical Research.

The Sea-Fish Commission

IN accordance with the provisions of Section 5 of the Sea-Fishing Industry Act, 1933, the Secretary of State for Home Affairs, the Secretary of State for Scotland, and the Minister of Agriculture and Fisheries, have appointed a Sea-Fish Commission consisting of the following: Sir Andrew R. Duncan (chairman), Viscount Wolmer, M.P., Mr. Francis Beattie, Mr. Edwin Fisher, and Mr. Lawrence Neal. We note with regret that no man of science has found a place on this Commission, notwithstanding that some of its functions make scientific knowledge desirable—particularly piscicultural knowledge. To emphasise this desirability, it may be mentioned that the functions of the Committee will include the investigation of matters relating to the storage and treatment of fish after landing; and it is also inevitable that pre-landing problems will call for investigation. It is most disappointing that the tendency to ignore scientific workers in the personnel of various kinds of commissions and committees should still persist; it is the more difficult to understand when we remember that some members of the Cabinet have hitherto shown themselves to be scientifically minded.

"Codex Sinaiticus"

AN appeal to the public for the amount necessary to acquire the "Codex Sinaiticus" for the British Museum could not fail to meet with a generous response, especially when backed by the offer of the Government to provide an amount equal to that raised by public subscription up to a limit of £50,000. The unique place of the Bible in English life and literature renders it peculiarly appropriate that of the two oldest and most valuable sources of the Greek text, the "Sinaiticus" and the "Vaticanus", one should find an abiding resting place beside the later "Alexandrinus" in the British Museum, while the other lies in Rome. The price to be paid to Russia is undoubtedly large, even though the method of payment will lighten the burden; but it cannot be held too high for the enhanced prestige which it will confer on Britain's greatest national museum and the increased opportunities it will afford British scholarship in biblical studies, which already stands high. The crowds which thronged the British Museum in the days following the Christmas holidays, for a brief glimpse of the manuscript—by the end of the week there had been 20,000 visitors—and the readiness with which small subscriptions poured in, were an eloquent testimony of the extent to which the imagination of the public outside scholastic and learned circles had been touched by the interest of this document of almost unique importance in the history of civilisation.

Archæological Exhibitions at the British Museum

Two loan exhibitions were opened on January 4 in the Department of British and Medieval Antiquities, British Museum, at the head of the main staircase, containing respectively pre-Crag flints from Suffolk and palæoliths from the Raised Beach and Coombe Rock of Sussex. Mr. Reid Moir's exhibit is intended to show at least four periods, indicated by different patinations, for the rostro-carinates and other types from the Bone-bed at the base of the Crag; and one example in particular, which has a sandy deposit adhering, is held to prove its flaking prior to the Diestian deposits of the Lower Pliocene. Excavations by Mr. J. B. Calkin at Slindon Park, between Chichester and Arundel, have produced a series of worked flints which can be dated geologically, as some (mostly rolled) were found in the upper level of the Raised Beach there (surface-level 135 ft. O.D.), others on the top of the Beach and in the lower part of the Coombe Rock above it. Sufficient specimens have been found to prove that the Raised Beach dates from late St. Acheul times, and the Coombe Rock covered a Levallois working-floor as at Northfleet. The Raised Beach a little south, at a height of 80–90 ft. O.D., has not produced enough to establish its identity.

Archæological Exploration in Persia

MUCH as it may be regretted that the British School of Archæology in Iraq (Gertrude Bell Memorial), in accordance with the decision announced at the end of last season, will not itself be responsible for expeditions of archæological exploration in its special province, pending more satisfactory arrangements under the antiquities laws of the country, the announcement of the grant of £500 from the funds of the School to Sir Aurel Stein towards the cost of excavating mounds in south-western Persia will afford archæologists some measure of consolation for the suspension of activities in northern Iraq. The archæological work which Sir Aurel proposes to carry out with the assistance of this grant is in continuation of certain investigations which he has made during the past two seasons in south-eastern Persia, where a number of early sites were examined. He will cover a field in which it is anticipated that much needed evidence will be obtained bearing on the relations of the early culture of Elam and possibly, it is hoped, the relationship of the Indus valley civilisation to that of western Asia—at the moment the most intriguing of the problems of Middle Eastern prehistory. It is also announced that the British School has made a grant of £100 towards the expenses of the short season of excavation at Ur which is now opening.

Prehistoric Art in the Libyan Desert

SHOULD preliminary announcements be confirmed by subsequent examination of the evidence, a further link in the relations between the prehistoric art of northern Africa and the Bushman art of South Africa is afforded by discoveries made by Dr. Leo Frobenius in the Libyan Desert. Dr. Frobenius, who has just returned from his eleventh expedition to Africa, reports, according to a Frankfort dispatch in the *Times* of December 28, that he has discovered in the Auwenat massif a centre of supplies for the stone implement factories of various parts of North Africa, with evidence in the form of rock-drawings, stone tools and traces of pottery of two distinct cultural periods, the older coming from Lower Egypt in the north, the later, of a character hitherto unknown, coming from the south. Moving south to the oasis of Selimah in northern Kordofan, Dr. Frobenius discovered a new southern culture with a ceramic industry dating from between 6000 and 4000 B.C. in an area which he regards as having been the valley of a third or 'Yellow' Nile. On the route to this centre, 44 stone implement factories were discovered as well as several hundred rock-drawings, representing men and animals engaged in various activities. It is maintained that these discoveries throw a new light on the relations of the art of North Africa, East Spain and South Africa, while the dating of the 'factories' makes it possible to determine the direction of culture drift.

Presentation to Sir Herbert Jackson, K.B.E., F.R.S.

THE Council of the British Scientific Instrument Research Association held an informal luncheon at the Connaught Rooms on December 21 in honour of Sir Herbert Jackson, who occupied the position of Director of Research of the Association from its beginning in 1918 until July 31, 1933. Some thirty members of council and friends, representing all sides of the scientific instrument industry, attended. After the luncheon, Sir Herbert Jackson was presented with a gold minute-repeater watch and a vase of carved white jade, and Lady Jackson received a pair of ivory-backed brushes and a mirror. Mr. Conrad Beck, in proposing the toast of Sir Herbert and Lady Jackson, spoke of the valuable work which Sir Herbert Jackson had done and of the friendly relations which had existed between Sir Herbert and all the members of the Association. Sir Frank Smith and Mr. H. T. Tizard both referred to the wide range of Sir Herbert's activities and to the wealth of helpful suggestion which he could invariably bring forward in discussions on non-technical as well as on technical matters. In the remarks made by Mr. R. S. Whipple, Mr. F. Twyman and Mr. J. Hasselkus, special tribute was paid to Sir Herbert's power of inspiring self-confidence in those with whom he came into contact, and to the encouragement he had always given to instrument makers not to be satisfied with an instrument that was good enough, but to produce an instrument which was really outstanding. High tribute was paid also by all the speakers, to Lady Jackson, who shares the affection in which Sir Herbert himself is held. Sir Herbert Jackson, after thanking the council and members of the Association for their expressions of appreciation and for their gifts, referred to the assistance and co-operation which he had received from the industry itself, and to the spirit of enterprise which animated the industry: without these it would have been possible to do but little.

The Physical Society's Exhibition

THE catalogue of the Annual Exhibition of Scientific Instruments and Apparatus to be held at the Imperial College by the Physical Society on January 9–11 is an octavo volume of 184 pages, the trade section occupying 148, the research and experimental section 26, and the index to the trade section 5 pages. Reference to the exhibits, the stands and the firms exhibiting has been greatly facilitated by the number of the stand and the name of the firm being printed at the head of each page. A considerable number of illustrations are provided, but there is still a number of firms satisfied with showing little more than the outside appearance of a piece of apparatus, for example, a box on the top of which are a handle for carrying, a small window and a few terminals, instead of a diagram of its mechanism or a view of its interior. As a contrast, the descriptions in the research and experimental section are full of the information which a potential user of an instrument or a method requires in order to determine whether it will suit his purpose. In the trade section, instruments which have not been exhibited previously are marked with an asterisk and on the stalls with a red star. Many of them are connected with branches of physics which have in recent years become important in industry, for

example, detectors of dangerous gases in air, X-ray equipment, colorimeters, valves and photoelectric cells. Others introduce new methods into old fields, for example, an engraving machine which seems likely to displace etching, a gas tube which leaks an electrostatic charge away if the potential exceeds a fixed value, a polish measurer working photoelectrically, and an optical tube of small diameter for examining the inside surfaces of long tubes. For this device the name "introscope" has been invented. Other new names are "grapher" for recorder, "hygrograph", "opacimeter", "stormograph" and "stormoguide" for forms of barograph, any of which may at some future date find places in a new Oxford dictionary.

The late Mr. W. W. Ouless, R.A.

THE death of the distinguished portrait painter, Mr. W. W. Ouless, on December 25, at the age of eighty-five years, recalls his skill in the portrayal, in much faithfulness, of many well-known men of science. An oil painting of Charles Darwin, a treasured possession of the family, was executed in 1875, and a replica by the artist himself hangs in Christ's College, Cambridge Considered by Darwin's children to be an outstanding presentment, it was etched very successfully by M. Rajon. It is recorded in the "Life and Letters" that the portrait was finished at the end of March 1875 ; that Darwin felt the sittings a great fatigue in spite of Mr. Ouless's considerate desire to spare him so far as was possible. In a letter to Sir Joseph Hooker, Darwin remarks, "I look a very venerable, acute, melancholy old boy ; whether I really look so I do not know." Another portrait by Ouless was of Sir William Bowman, F.R.S. (1816–1892), eminent in ophthalmic surgery. Bowman's admirers at home and abroad specially engaged the services of Ouless for this work, whilst at the same time they arranged for a reprint of all his scientific treatises, with Prof. Burdon Sanderson and Mr. Hulke as supervisors of the issue. In 1928 Ouless painted a portrait of Sir Arthur Keith.

Asiatic Society of Bengal

ON January 15, 1934, the Asiatic Society of Bengal, which was founded under the name of the "Asiatick Society", on January 15, 1784, by Sir William Jones, will reach the age of a hundred and fifty years. The Society was founded to inquire into the history, civil and natural, the antiquities, laws, arts, sciences and literature of Asia, and during its long existence its usefulness has spread far and wide, and it has to its credit a wonderful record of achievements. The president and council of the Society have decided to celebrate, on January 15, the 150th anniversary of this foundation. The anniversary programme will consist of a conversazione in the Indian Museum, and a banquet in the hall of the Society, followed by a special anniversary meeting to receive addresses from learned societies and to elect a number of honorary anniversary members of the Society. In connexion with the centenary celebration in 1884, a volume depicting the progress of letters and science during the preceding hundred years was published ; and it has been decided to undertake the preparation of a special volume on similar lines covering the period of the last fifty years.

The Electronic Organ at Poste Parisien

AMONG the many applications of the thermionic valve is the invention of a new type of organ, which makes use of valve-produced electrical oscillations converted into sound through the agency of a loud-speaker. Many types of such 'electronic' organs are being developed in different parts of the world and some of these are already being used for broadcasting purposes. An illustrated description of this type of organ installed at the Poste Parisien broadcasting station is given in the *Wireless World* of December 22. This organ has three manuals, each of four and a half octaves, together with two and a half octaves of pedals, making a total of about two hundred notes. For each of these notes a three-electrode valve is provided with its oscillatory circuit, comprising a fixed condenser and an iron-cored inductance, tuning being effected by a screw-adjustment of the iron core. Another two hundred valves are fitted in the amplifiers which feed thirteen loud-speakers. A number of auxiliary instruments, mostly pneumatically operated, are fitted to produce the various noises and 'effects' required in connexion with broadcasting programmes. A notable feature of the new instrument is the 'swell' action, which is controlled by a pedal-operated rheostat applied to the whole of the organ, and not only to one or two manuals as in the case of the normal organ. The oscillations produced by the first valves are very rich in harmonics and by switching in various filter circuits the quality of the tones emitted can be varied to a considerable extent. The whole instrument is very compact and, for broadcasting purposes, the loud-speakers are not required in circuit since it is obviously unnecessary to convert the electrical into acoustical energy in order to control a wireless transmitting station.

Stream-line Form in Motor-Cars

EXPERIMENTS carried out on models in a wind tunnel by R. H. Heald, of the U.S. Bureau of Standards, shows that the trend towards stream-line form in the construction of modern cars leads at high speeds to a substantial saving of power and therefore of petrol. The tests show the air resistance of the 1933 car is more than twice that of a completely stream-lined car of the same frontal area. According to a mail report from Science Service, the tests were made on models ranging from one quarter to one fifteenth natural size with wind velocities varying from thirteen to seventy miles per hour. Some of the models were of cars of the past, but two represented cars which may be used in the future. The 1933 model had disk wheels, exposed bumpers, fenders, head-lights and a spare tyre. One of the models of the motor-car of the future had a wind-shield which made an angle of 45° with the horizontal, the chassis was rounded at the top and back and the lines were

smoothly moulded. The other model had the whole upper part rounded, was blunt at the front and tapered at the back. Mr. Heald computes from his results that, at 60 miles per hour, the 1922 Sedan requires 27 h.p. to overcome air resistance ; 26 h.p. is taken by the 1928 Sedan and 18 h.p. for the 1933 model. The two stream-lined models took 8 and 6 h.p. respectively. At 48 miles per hour it was found that the horse-power expended on air resistance was halved and at 76 m.p.h. it was doubled. Mr. Heald concludes that the 1933 motor, shorn of its projecting bumpers, head-lights and spare tyre, and fitted with a rounded top and sloping wind-shield, would consume 10 h.p. less at 60 m.p.h. and 20 h.p. less at 70 m.p.h.

Earthquake Insurance in New Zealand

ACCORDING to a message published in the *Times* of December 21, the Judicial Committee of the Privy Council in New Zealand has decided that, under the Workers' Compensation for Accidents Act, compensation could be claimed for the death or injury of labourers engaged in their occupations during the recent Hawke's Bay earthquake. The insurance companies stated that their liability in the event of a great disaster would be so serious that they could not undertake the risk. The Government accordingly introduced a measure to remove employers' liability in such cases in future. This proposal being opposed, a compromise was reached limiting the total liability of the companies to £50,000 in a single earthquake or in a series of earthquakes lasting for seven days.

Teaching of Biology in South Africa

AN address by Dr. E. P. Phillips on "The Teaching of Biology", read to the South African Biological Society, appears in the Society's Pamphlet No. 6, 1933. Dr. Phillips advocated an introduction to biology in the schools by easy stages, which would give pupils an insight into biology as a concrete whole and not as isolated facts. His scheme, beginning like many others, with the differences between living and non-living, leads gradually and finally to knowledge of elementary human physiology, and includes information on the great generalisations of biology. The discussion which followed showed a widespread feeling that biology is not satisfactorily taught in schools, and Dr. Janse placed his finger upon the weak spot in the present system when he made a plea for better trained teachers in biology.

Lovibond Comparator with B.D.H. Indicators

INCLUDED in the "Catalogue of B.D.H. Fine Chemical Products", recently received from the British Drug Houses, Ltd., London, N.1, is a leaflet describing the Lovibond comparator for use with B.D.H. indicators. The apparatus consists of a metal case, opening like a book, and furnished at the back with an opal glass screen and two partitions to take the test-tubes containing the liquid under examination. The standard colour glasses, nine in number, are fitted into a flat disc which may be rotated in the front half of the case, which contains two holes, in front of the test-tubes. By rotating the disc, a colour glass is brought into view in front of one test-tube, containing the liquid only ; through the other hole the test-tube containing liquid with the correct amount of appropriate indicator added is visible simultaneously. The colour comparison can thus be quickly made. The *p*H value of the colour appears at a third hole in the front of the case. Discs are available for different indicators of *p*H 2·8–9·6 and also for B.D.H. Universal indicator, *p*H 4–11.

Eclipses of the Sun in 1934

THERE will be a total eclipse of the sun on February 13–14, which is invisible at Greenwich. The sun will rise eclipsed over Borneo, and the path of totality runs across the Pacific Ocean without crossing any land except a few very small islands. Oroluk Island, Losap Island and Wake Island lie on the path of totality. No British expedition has been organised to observe the eclipse from any of these small islands. In Borneo the eclipsed sun will, of course, be so low down that no useful spectroscopic observations can be made. The second solar eclipse which will take place in 1934 will be an annular eclipse on August 10, also invisible at Greenwich. The track crosses South Africa from Mossamedes to Inhambane.

Announcements

A CONFERENCE on atomic physics will be held in 1934, under the auspices of the Physical Society. It will be opened by Lord Rutherford, and will probably extend over two days at least, some of the meetings being held in London and some in Cambridge.

WE regret that in referring to "Street Traffic Flow" by Mr. Henry Watson in NATURE of December 30, p. 987, the price quoted was 31*s.* net. Messrs. Chapman and Hall, Ltd., inform us that the price of the book is 21*s.* net.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A junior technical assistant for the Directorate of Ordnance Factories, War Office—The Permanent Under-Secretary of State (C.4), The War Office, London, S.W.1 (Jan. 15). A chief technical assistant to the electricity undertaking of the Metropolitan Borough of Poplar—The Town Clerk, Council Offices, High Street, Poplar, E.14 (Jan. 19). A principal of the Croydon Polytechnic and Evening Institutes—The Education Officer, Education Office, Katharine Street, Croydon (Jan. 31). A specialist serologist in the Union of South Africa—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (Feb. 6). A principal of the Grimsby Technical Evening School—The Secretary, Education Offices, Grimsby. A chemist under the Sudan Government, at Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1.

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.*]

Positive Electron Tracks

I. CURIE-JOLIOT, Anderson and Neddermeyer, Meitner and Philipp have been able to observe positive electrons produced by the hard γ-rays of thorium C″ in lead and other elements. An attempt to explain the phenomenon has been made by Oppenheimer and Plesset, who consider it as a kind of photo-effect from the levels of negative energy, the absorption of a quantum of light energy resulting in the formation of two material particles, a negative and a positive electron. A pair of these electrons, formed in the gas of a Wilson chamber, is to be seen on one of the photographs published by Curie-Joliot[1].

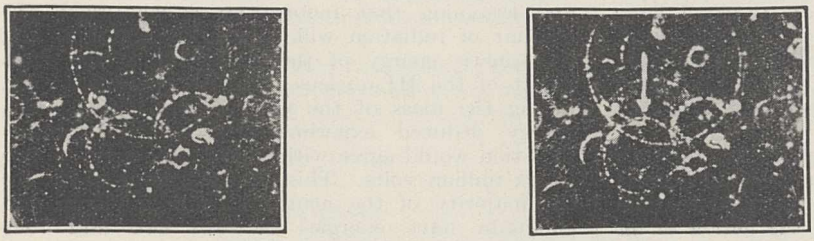


FIG. 1. Stereoscopic photographs of electronic tracks.

So early as 1931, I myself observed similar cases in the course of my researches on the Compton effect. In this, the hard γ-rays of thorium C″ were used and a Wilson chamber placed in a magnetic field. One of several pairs of stereoscopic photographs which show the phenomenon is reproduced as Fig. 1.

The origin of the track which is to be seen in the middle of Fig. 1 can be interpreted in two different ways :

1. The track may be due to a single negative electron which first moved along the arc of the larger circle (counter clock-wise), lost most of its energy in a non-elastic collision (Krammer's jump), then suffered a deviation by about 180° and finally pursued its way along a curve of smaller radius, of which a whole turn is shown.

2. The two branches may belong to two electrons of different sign issuing from the same point (which is marked by an arrow) and deviated by the magnetic field in opposite directions.

In the case illustrated in Fig. 1, as well as in three other analogous cases, the radius of the electronic tracks can be determined with comparative accuracy ; therefore we are able to verify whether the energy is such as can be deduced from theoretical considerations on the assumption that the effect is due to photons of the line $h\nu = 2620$ ekilov[2].

As is well known, the sum of their kinetic energies is :

$$h\nu - 2mc^2 = 1600 \text{ ekv.}$$

The table below contains the values measured for four photographs :

No.	ε_+	ε_-	$(\varepsilon_+ + \varepsilon_-)$	Angle formed by the two electrons	Angle formed by the γ-rays and the vector representing the sum of the impulses of both electrons
1*	1150	450	1600	26°	11°
2	1000	575	1575	22°	2°
3	1350	325	1675	90°	12°
4	675	975	1650	76°	165°

*Reproduced in Fig. 1.

The good agreement of the calculated and the observed data is much in favour of the second assumption.

In the fourth case, the first assumption does not hold at all, since it requires the collision to be accompanied by an increase of energy.

It is interesting to note that, in three cases out of four, the ratio $\varepsilon_+/\varepsilon_-$ gives approximately the same value, something between 2 and 4, the same as in the case observed by Curie-Joliot. It appears as if, on the average, the positive electron were endowed with a considerably greater energy. For heavy elements, as in Curie-Joliot's experiments, the energy appears to be divided into nearly equal parts.

The study of the series of photographs, including the four cases of the above table, showed that the total number of Compton electrons corresponding to the line 2620 ekv. is about 700. It may be said that, in the case of light atoms (nitrogen, in particular) the number of electronic pairs is of the order of 1 per cent of the Compton electrons, in good accordance with the value computed by Oppenheimer and Plesset[3].

In general, the above-mentioned facts are in fairly good agreement with the computations of these authors as well as with Curie-Joliot's results concerning the variation of the effect with the atomic number of the element.

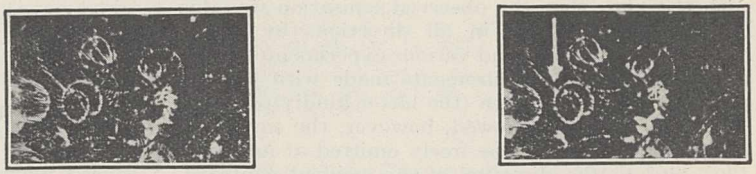


FIG. 2. Stereoscopic photographs of electronic tracks.

The data of Curie-Joliot seem to indicate that the ratio, number of pairs/number of Compton electrons, is proportional to the atomic number, as also follows from the Oppenheimer-Plesset theory.

II. The stereoscopic photograph reproduced as Fig. 2 represents apparently a case never observed before, namely, a pair $e_+ + e_-$, produced by a β-particle. On the left is seen the track of the primary particle (e_-) ; at the end of this track, marked by an arrow, two new tracks can be observed belonging to comparatively slow electrons emitted in opposite directions and deviated by the magnetic field in a different way. Each of the two electrons possesses

an energy of about 100 ekv. The energy of the primary electron does not allow of very accurate evaluation, but it is sure to approach some 1200 e.v. (E). The energy balance is thus seen to be correct:

$$E = 2mc^2 + \varepsilon_+ + \varepsilon_-$$

(After collision, the kinetic energy is carried only by one of the two negative electrons which take part in the process.)

During the impact, the impulse of the primary particle is wholly passed on to the nucleus and the latter acquires sufficient energy to produce several ionisations. At the intersection of the three tracks there is to be seen a distinct thickening due, perhaps, to the 'recoil' of the nucleus.

Among my remaining photographs, I have one very similar to that of Fig. 1, but it is less to be relied upon, since, on it, the electronic track lies on the boundary of the illuminated region.

The total length of the electronic tracks I have hitherto examined amounts to several hundreds of metres. The probability of the effect is thus seen to be rather high; in any event, it is much above the corresponding theoretical value found by Furry and Carlson[4].

Assuming the above interpretation and Dirac's conception of the positron to be correct, an intense 'annihilation radiation' should be expected to take place from the anticathode under the action of an electronic beam if the velocity of the electrons exceeds 1000 ekv.

D. SKOBELTZYN.

Physical Technical Institute,
Leningrad.
Nov. 6.

[1] I. Curie and F. Joliot, *J. Phys.*, **4**, 429; 1933.
[2] C. D. Ellis, *Proc. Roy. Soc.*, A, **138**, 318; 1932.
[3] J. R. Oppenheimer and M. S. Plesset, *Phys. Rev.*, **44**, 53; 1933.
[4] W. H. Furry and J. F. Carlson, *Phys. Rev.*, **44**, 237; 1933.

Combination of Proton and Neutron

SOME time ago, experiments were made, in collaboration with Dr. L. H. Gray, in which the scattering of neutrons by various materials was detected, with the aid of a high-pressure ionisation chamber containing nitrogen[1]. The results were on the whole compatible with the view that the observed ionisation was due to neutrons scattered in all directions by elastic collisions with nuclei, and various experimenters have confirmed this[2]. Measurements made with paraffin wax and liquid hydrogen (the latter kindly provided by Dr. P. Kapitza) showed, however, the surprising result that radiation was freely emitted at angles of 120°–180° to the direction of the incident neutrons. It is clearly impossible for neutrons to be scattered at angles greater than a right angle by single elastic collisions with protons, and calculation shows that multiple scattering cannot explain the observed effects.

Recently the experiments have been resumed, and the scattering in the backward direction from paraffin has been measured in terms of the ionisation produced in two high-pressure chambers filled with argon and hydrogen. A given intensity of gamma-radiation produces an ionisation current twelve times greater in argon than in hydrogen, while for neutrons the ratio is rather less than unity. Accordingly it was possible by comparing measurements in the two gases to distinguish between gamma-radiation and neutrons. When allowance was made for the carbon present in the paraffin (by observation of the scattering from graphite) the results showed that the radiation scattered from hydrogen was entirely gamma-radiation. Absorption measurements extended up to a thickness of 3·4 cm. of lead indicated that the scattered gamma-radiation was heterogeneous and of mean quantum energy of two to four million volts.

No mechanism is known to account for the backward scattering by hydrogen of the hard gamma-rays present in the radiation from the source of polonium plus beryllium, and experiments with thorium C″ gamma-rays failed to show any scattering under similar conditions. The most plausible way of explaining the results is to suppose that in some of the collisions between the neutron and proton the particles combine to form H^2, the heavy isotope of hydrogen. The combination will result in the emission of energy in the form of gamma-radiation, and assuming that momentum is conserved, the amount of radiation will be roughly equal to half the kinetic energy of the neutron plus the mass defect of the H^2 nucleus (about one million volts, taking the mass of the neutron as 1·0067). The energy deduced experimentally for the gamma-radiation would agree with a neutron energy of two to six million volts. This is of the right order, for the majority of the neutrons from beryllium and polonium have energies between two and four million volts, and some have more.

It is to be expected that H^2 nuclei produced in this way could be observed in the expansion chamber as short tracks confined to directions within a few degrees of the direction of the neutrons. It is possible from the present data to make only a very rough calculation of the number of such tracks compared with the number of recoil protons, but it is estimated that the proportion may be as high as one quarter.

These experiments have been made with the active support of Dr. J. Chadwick, to whom I am much indebted. I wish especially to thank him for preparing the polonium source, and for suggesting the interpretation of the experiments.

D. E. LEA.

Cavendish Laboratory,
Cambridge.
Dec. 22.

[1] Chadwick, *Proc. Roy. Soc.*, *A*, **136**, 704; 1932.
[2] de Broglie, *C.R.*, **194**, 1616; 1932. Dunning and Pegram, *Phys. Rev.*, **43**, 497; 1933.

Cosmic Ultra-radiation and Auroræ Boreales

RECORDS of the ionisation in a closed vessel, caused mainly by the cosmic ultra-radiation, have been obtained at Abisko in northern Sweden (lat. 68° 21′ N.) during two periods: October 1929–July 1930 and September 1932–July 1933[1]. During the first period, a Kolhörster apparatus, placed within an iron shield 6–11 cm. in thickness (free opening upwards), was used; during the second period, a Steinke apparatus, placed within a lead shield 10 cm. in thickness in all directions, was used. Every second fortnight the Steinke apparatus recorded, however, with the shield open upwards. The results of both periods have been compared with simultaneous observations of the auroræ boreales and also, for the first period, with the simultaneous magnetic records of the Geophysical Observatory of Abisko[2].

The ionisation found during auroræ of different types and of different extension over the sky of the

first period is shown in Table 1. It is seen that the ionisation *increases* during auroræ and also with their extension to the southern part of the sky. The material of the first period is unfortunately not great, but the indication in Table 1 of an increase of the ionisation during auroræ is strongly supported by the similar increase of the ionisation during magnetic disturbances in the same period, which was shown in an earlier paper[2].

Table 1.

Extension over the sky	Clear sky, no aurora	Homogeneous arcs	Arcs with rays	Diffuse surfaces	Pulsating aurora	All types
Northern sky	2·68(12)	2·74(11)	2·79(7)	2·95(1)	3·12(1)	2·79(20)
Southern sky		2·83(8)	2·83(19)	2·79(7)	2·88(7)	2·83(41)
	2·68(12)	2·78(19)	2·82(26)	2·81(8)	2·91(8)	(61)

The numbers are pairs of ions/c.c./sec. in air of 1 atm. pressure.
The numbers within parentheses are numbers of records.

A catalogue of 757 observations of auroræ boreales (1,134 noted auroral phenomena), carried out mainly at Abisko from the end of August 1932 to the end of March 1933, will be published elsewhere[3], and the catalogue contains also the simultaneously recorded values of the ionisation in the Steinke apparatus. Some results of the comparison between simultaneous auroral observations and records of ionisation are briefly collected in Table 2; further results are found in the above mentioned catalogue.

Table 2.

Height of auroræ in the sky	Shield open upwards		Closed shield	
	Intensity of auroræ ⩾ 0·5	⩾ 2	Intensity of auroræ ⩾ 0·5	⩾ 2
0° N–60° N	2·783(174)	2·783(127)	1·944(63)	1·945(48)
60° N–60° S	2·780(78)	2 770(53)	1·942(33)	1·937(20)
60° S– 0° S	2·774(59)	2·769(28)	1·933(16)	1·928(12)
During clear sky and no aurora	2·787(66)		1·956(56)	

The numbers are pairs of ions/c.c./sec. in air of 1 atm. pressure.
The numbers within parentheses are numbers of records. N = North, S = South.

As is seen in Table 2, the ionisation in 1932–33 *decreased* during auroræ and also with their extension to the southern horizon and with the intensity of the auroræ (scale: 0–4). It is curious that this decrease, expressed as a percentage of the ionisation with a clear sky and no aurora, is greatest when the vessel was shielded from above by a lead shield of 10 cm. thickness, that is, for the harder radiation.

V. F. Hess and R. Steinmaurer[4] have found mainly a decrease of the ionisation during magnetic storms in the period September 1931–March 1933 from their records at Hafelekar, near Innsbruck. Like the results from the second period at Abisko (great auroral displays being always accompanied by magnetic disturbances, which probably cause the change of the ionisation) this is in "apparent contradiction" to the results from the first period at Abisko. Studying Table 4 of the exhaustive paper by R. Steinmaurer and H. Graziadei[5], we find that in 1931 there were 4 increases and 1 decrease during 5 magnetic storms, but in 1932 there were 3 increases and 15 decreases during 18 magnetic storms. Thus the material from Hafelekar indicates a change from mainly increasing to mainly decreasing ionisation during magnetic storms in 1931–32.

At the present time, I cannot see any other explanation of the above mentioned "apparent contradiction" between 1929–30 and 1932–33 than that some connexion exists between the ionisation and the sunspot period. The last sunspot maximum occurred at 1928·4, and the relative numbers for 1929 and 1930 were 65·0 and 35·7 respectively. For 1932 the relative number was 11·1, and the sunspot minimum occurred in 1933.

The mechanism of the relation of terrestrial magnetism to cosmic ultra-radiation is still unknown, but as we now know no cause why the ultra-radiation should behave in opposite ways during magnetic storms at sunspot maxima and sunspot minima, it seems to me more probable that the cosmic ultra-radiation always decreases during magnetic storms, and that the observed increase of the ionisation in 1929–30 is caused by an increased influence from the sun at sunspot maxima. This influence may be either an increased penetrating radiation from the sun itself, capable of reaching sea-level, or, possibly, an increased secondary radiation of the cosmic ultra-radiation, caused directly or indirectly by the solar corpuscles, which to some extent produce the auroræ.

Certain phenomena observed by other investigators[6] seem to support this explanation. Also the minor decrease of the ionisation for the open shield during magnetic storms at Abisko in 1932–33, mentioned above, may be due to a remaining primary or secondary soft radiation from the sun, tending to increase the ionisation.

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Nov. 17.

[1] Cf. *Phys. Z.*, **31**, 1065; 1930; and *Lund Obs. Circ.*, 1 and 6, 1931–32.
[2] *Lund Obs. Circ.*, **1**, 1931.
[3] *Medd. Lund Obs.*, **2**, No. 67; 1934.
[4] NATURE, **132**, 601, Oct. 14, 1933.
[5] *Berlin Ber.*, **22**; 1933.
[6] V. F. Hess, NATURE, **127**, 10, Jan. 3, 1931; and *Z. Phys.*, **71**, 171; 1931. O. Freytag, *Gerl. Beitr.*, **39**, 1; 1933. E. Regener, NATURE, **132**, 696, Nov. 4, 1933.

Electrolytic Concentration of Diplogen

WE have recently made some preliminary investigations of the effect of various factors on the efficiency of the concentration of diplogen by electrolysis in alkaline solution. The diplogen-hydrogen ratio at various stages was determined by specific gravity measurements after repeated distillation. These measurements were carried out in pyknometers of 5 c.c. and 25 c.c. capacity with an estimated accuracy of one part in a hundred thousand. In calculating the diplogen concentrations, we have used Lewis's[1] value for the specific gravity of pure D_2O and Bleakney and Gould's[2] estimate of the D/H ratio in ordinary water.

We have investigated the influence of the following factors: (*a*) the nature of the cathode metal, (*b*) the concentration of the electrolyte, (*c*) the temperature

of the electrolyte, and (d) the current density at the cathode. We have expressed the efficiency of the separation by the factor α, defined by Lewis and Macdonald[3] by means of the equation

$$d \ln D = \alpha \, d \ln H \qquad (1)$$

A correction was made for evaporation and the maximum error in our values of α is estimated to be $\pm$ 0·05. The following results were obtained :

Effect of Cathode Metal

Stage of concentration : D/H = 0·1–0·3 per cent

Cathode	Electrolyte	α
Ni	1 per cent NaOH	0·22
Pt	,,	0·19
Cu	,,	0·19

Effect of Concentration of Electrolyte

Stage of concentration : D/H = 0·1–0·3 per cent

Cathode	Electrolyte	α
Ni	1 per cent NaOH	0·22
Ni	8 per cent NaOH	0·20

Effect of Temperature

Stage of concentration : D/H = 0·25–0·5 per cent

Cathode	Electrolyte	Temperature	α
Ni	2 per cent NaOH	10° C.	0·23
Ni	2 per cent NaOH	100° C.	0·26

Effect of Current Density

Stage of concentration : D/H = 0·05–0·15 per cent

Cathode	Electrolyte	Current Density	α
Ni	1 per cent NaOH	10 amp./cm.^{2}	0·18
Ni	1 per cent NaOH	0·07 ,,	0·27

The most striking feature of these results is that the factor α is unexpectedly insensitive to the conditions of electrolysis. Neither the temperature nor the nature of the cathode metal appears to have any effect on the efficiency of separation, and it is doubtful whether the small difference observed in the current density experiments is greater than the experimental error.

It may appear strange that the efficiency is not affected by the differences in hydrogen over-voltage of the metals employed. Such a state of affairs is, however, in accordance with the theory of over-voltage advanced by Gurney[4]. He derives the following expression for the rate of discharge of hydrogen ions at an inert electrode :

$$\ln i_H = \frac{E_0 - E_1 + \varepsilon V}{\gamma k T} + \log T + \text{constant} \qquad (2)$$

where i_H is the current density, E_0 is the neutralisation energy of an H_3O^+ ion in its lowest energy state by an electron, E_1 is the work function of the metal, ε is the electronic charge and V is the applied cathodic potential ; γ is a correction factor a little greater than unity. The discharge of diplogen from the ion DH_2O^+ at the same cathode is governed by an exactly similar expression except that the value of E_0 will be different in the two cases. The nature of the cathode should therefore have no effect on the ratio i_D/i_H, in agreement with our results.

The actual value of i_D/i_H ($= \alpha$) is given by the relation

$$\ln \alpha = \ln \frac{i_D}{i_H} = \frac{(E_0)_D - (E_0)_H}{\gamma k T} \qquad (3)$$

The difference in the E_0 values in the two cases depends on the difference in zero point energy of the two links O—H and O—D, which has been calculated by Sherman and Eyring[5] as 1,400 calories per mole. The insertion of this value in equation (3) leads to our observed separation coefficient (which agrees with that found by Lewis[3]), if γ is given the plausible value of 1·4. It may be noted that on the basis of equation (3) the influence of temperature on α over the temperature range studied is just within our present experimental error, but could be observed with a slight increase in accuracy.

The above results are provisional, and more accurate investigations are in progress.

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[1] G. N. Lewis and R. T. Macdonald, *J. Amer. Chem. Soc.*, **55**, 3057 ; 1933.
[2] W. Bleakney and A. J. Gould, *Phys. Rev.*, **44**, 265 ; 1933.
[3] G. N. Lewis and R. T. Macdonald, *J. Chem. Phys.*, **1**, 341 ; 1933.
[4] R. W. Gurney, *Proc. Roy. Soc.*, A, **134**, 137 ; 1931.
[5] A. Sherman and H. Eyring, *J. Chem. Phys.*, **1**, 345 ; 1933.

Catalytic Hydrogen Replacement and the Nature of Over-voltage

IN NATURE of December 16, 1933, J. Horiuti and M. Polanyi state that they have found that the replacement of heavy hydrogen in water under the catalytic influence of platinum black is faster in pure water than in either acid or alkaline solutions, and suggest that these observations "seem to settle the question" of the nature of the inertia which is responsible for the hydrogen over-voltage at platinum electrodes. There are, however, a number of other possibilities besides the two mentioned by Horiuti and Polanyi. I need only mention one, namely, that the effect of the acids and bases may be merely to cause a partial coagulation of the particles of the platinum, thus reducing the area available for the catalysis. Until such possibilities have been excluded, no definite conclusions as to the mechanism of the process can legitimately be drawn and it certainly appears to be extravagant to suggest that the experiments settle the question of the hydrogen over-voltage.

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Reaction Rates of the Hydrogen Isotopes

IT seems to be generally assumed that diplogen will always react more slowly than hydrogen. As I may partly be responsible for this view[1], I should like to point out that this is not always correct. Lower reactivity of diplogen compared with hydrogen results mainly from two causes : (1) the existence of zero point energy ; and (2) the quantum mechanical leakage of particles through energy barriers. Whilst the leakage through the barrier is always greater for the hydrogen than for the diplogen atoms, the effect of the zero point energy may occasionally favour the reverse ratio. I will confine myself to one special case, as the general treatment will be published shortly by C. E. H. Bawn and G. Ogden. Compare the reaction of a free hydrogen and a diplogen atom ; in the initial state the atoms possess no zero point energy and their energies will be equal. However, at the top of the barrier there will be a zero point energy present[2], and this will be greater for the complex reacting with the hydrogen

atom than for that reacting with the diplogen atom. The effect of the zero point energy at the top of the barrier is, therefore, to increase the activation energy of the hydrogen atoms to a greater extent than that of the diplogen atoms.

M. POLANYI.

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Dec. 18.

[1] Cremer and Polanyi, *Z. phys. Chem.*, **19** B, 443 ; 1932. See also Eyring, *Proc. Nat. Acad. Sci.*, **19**, 78 ; 1933.
[2] Eyring and Polanyi, *Z. phys. Chem.*, **12** B, 279 ; 1931.

New Developments in *Gammarus chevreuxi*, Sexton

IN the course of some experiments on eye-colour in the amphipod, *Gammarus chevreuxi*, a number of mated pairs were brought in to the Laboratory from the Chelson Meadow salt-marsh between February 20 and March 13, 1933. Half the specimens were placed in an incubator, kept at an approximately constant temperature of 21° C. and half were put in an unheated room.

The F_1 from these pairs numbered 12,164.

The normal eye in the wild *Gammarus* is a compound structure, composed of a number of ommatidia, each of which is provided with five retinular cells containing black pigment, the spaces between the ommatidia being filled with white 'accessory pigment' cells. It is this pigment which gives to the eye of the living animal the effect as of a superficial white network spread over a black ground. In the embryo eye, the retinular pigment commences as bright red, and darkens to black before extrusion.

During the twenty years of our work on this species we have never found any but black-eyed animals in the wild, nor have any changes in eye-structure or in colour appeared in the laboratory cultures before the F_2 generation. Lately, however, we have come to the conclusion that the character of the wild stock is changing. The conditions of its habitat have altered, owing probably to the installation of new sluice gates at the outlet from the salt-marsh. These being operated at infrequent intervals have caused considerable variation in the depth, temperature and salinity of the water in the draining ditches where the *Gammarus* live, and are responsible for what is probably the most influential factor in the change, namely, the great fluctuations in the numbers of the population within comparatively short periods. But whatever the causes may be, we have noticed in recent experiments that not only is there a much higher percentage of variation than formerly, but a much wider range as well.

For the first time, we have had colour changes in the F_1 from the wild, and, for the first time also, a remarkable example of different coloured eyes in the same animal, one eye black and the other bright red. Both instances came from a dredging taken on March 13.

The first, an ovigerous female, which hatched her eggs in the cold room a few days after being brought into the Laboratory, had evidently mated with a heterozygous male in the wild, for her brood when extruded contained 2 red-eyed young and 9 black-eyed. She was then mated with three different males from the same dredging, and gave an F_1 of 62 black with the first, 37 black with the second, and 34 black with the third, the red appearing in the F_2.

The second instance, the specimen with eyes of different colours, came from one of the pairs in the incubator. This pair produced three broods, the first numbering 13 black, and the third, 15 black, died without offspring. The second brood consisted of 14 black and the one-sided red specimen just referred to, which had the right eye red. Fourteen reached maturity, seven black males, six black females, and the one-sided red, a male. The blacks, mated together, gave in some pairs an F_2 of black and red in a 3 : 1 ratio, and in others, all black offspring.

The one-sided red male's matings show that it behaves genetically as a heterozygous black. It was mated with two of the heterozygous black females, giving 77 black and 22 red with one, and 25 black and 12 red with the other. It was then tried with three of the F_2 red females and gave with the first 11 black and 10 red, with the second 10 black and 11 red, but with the third (which was from its own mating with one of the black females) the proportions were unexpected, 2 black and 20 red.

Not one of the offspring of the one-sided red, nor of the thirteen blacks of its brood, has had eyes of different colours, either in the F_2 or the F_3, so far.

With heterozygosity definitely proved to exist now in the wild stock, it seems strange that no red-eyed specimens have yet been found in the ditches. Dredgings have been made throughout the year, and all the animals captured, 5015, examined for eye colour, but all without exception had the normal black eyes typical of the species.

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Nov. 28.

Endocrine Factors in the Causation of the Creatinuria of Pregnancy

THE following points emerge from the experiments of Schrire and Zwarenstein[1].

1. Castration of male and female rabbits produces an increased excretion of creatinine. In females the excretion of creatine is not affected.

2. Injection of gonadal extracts reduces the high creatinine of castration to the pre-castration level. Injection of anterior pituitary extracts into normal animals produces an increased elimination of creatinine.

3. The castration effect on creatinine is a secondary effect due to functional hypertrophy of the anterior lobe of the pituitary, which occurs as a result of gonadectomy.

The experimental data are explicable on the following assumptions. The pituitary stimulates the formation of creatine. The transformation of creatine to creatinine in the muscles is controlled by the gonads in that they inhibit the formation of creatinine. In the gonadectomised animal, as a result of anterior pituitary hypertrophy, more creatine becomes available, and owing to the absence of the inhibitory activity of the gonads it is completely eliminated as creatinine.

A typical case of acromegaly (male, aged forty-five years) investigated by Mirvish and Schrire[2] excreted 0·59 gm. creatine, 2·58 gm. creatinine in 24 hours (average figures). The presence of creatine in large amounts, and the increased excretion of creatinine, can

be explained as follows: Hypertrophy of the anterior pituitary leads (*a*) to increased formation of creatine and (*b*) to stimulation of the gonads. The latter factor increases the inhibitory action of the gonads on creatine–creatinine change with the result that some of the excess creatine appears in the urine as such, and some appears in the form of increased creatinine.

On the basis of the above considerations, the following hypothesis is advanced as an explanation of the creatinuria of pregnancy. Functional hypertrophy of the anterior lobe of the pituitary occurs in pregnancy, and this leads to essentially the same processes as in acromegaly except for the effect of a persistent corpus luteum. It is suggested that the corpus luteum reinforces the inhibitory action of the ovary on the transformation of creatine to creatinine so that all the excess creatine is excreted as such and the creatinine level remains unchanged.

Thus, in the castrated animal the inhibitory action of the gonads is nil, and all excess creatine is excreted as creatinine. In pregnancy the inhibitory action is a maximum, and all excess creatine is eliminated as such. Acromegaly presents an intermediate condition which leads to the appearance of creatine in the urine of males, and an increased excretion of creatinine. In all these conditions the hypertrophy of the anterior lobe of the pituitary, and the production of excess creatine, is a common factor, but the differences in urinary output are due to quantitative differences in the amount and extent of the inhibitory action of the gonads on the transformation of creatine to creatinine in the muscles.

It is possible that the endocrine factors outlined above, coupled with the probability that the immaturity of the young animal's muscles is associated with a defective capacity to utilise creatine (Powis and Raper[3]), may supply a basis for an explanation of the creatinuria during growth.

The hypothesis suggested rests only partly on experimental evidence but it indicates the lines on which future inquiry may profitably be based.

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[1] Schrire and Zwarenstein, *Biochem. J.*, **26**, 118; 1932: **26**, 1886; 1932: in press, 1932: in press, 1933.
[2] Mirvish and Schrire, Private communication, 1933.
[3] Powis and Raper, *Biochem. J.*, **10**, 363; 1916.

Experiments on Evaluation of Helium from Radioactive Minerals and Rocks

IT is very well known that the rate of loss of helium from different radioactive minerals and rocks depends on the dimensions of the surface and on the temperature. When minerals are finely ground, or heated to a high temperature, there is a considerable loss of helium, which can attain about 90 per cent when both of the above mentioned factors are concerned.

Theoretical considerations make it very probable that the amount of helium lost from minerals depends in some cases also on the composition of the gaseous phase which surrounds the mineral or the rock sample. We have proved this assumption experimentally and the results obtained seem of sufficient interest to be recorded.

The amount of helium evolved from different minerals at a given temperature, if this temperature is above a critical one, depends on the presence of hydrogen in the gaseous phase and is the greater the higher the partial pressure of hydrogen. The rate of loss of helium from uraninite (pitchblende) during two hours' heating at 500° is as follows:—*in vacuo*, 10 per cent; in atmosphere of hydrogen at 25 mm. pressure, 17 per cent; in atmosphere of hydrogen at 100 mm. pressure, 36·5 per cent; in atmosphere of hydrogen at 500 mm. pressure, 60 per cent. The rate of loss from a mineral of the family of euxenite (chlopinite) at 900° is:—*in vacuo*, 13·3 per cent; in atmosphere of hydrogen at 250 mm. pressure, 56·1 per cent.

The influence of hydrogen upon the rate of evolution of helium from minerals is so well marked that small amounts of hydrogen in a gas mixture can be detected by means of this process. A more detailed description of these experiments, and the discussion of the results obtained, will be given in another paper.

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Crystal Absorption by Substrates

IN the course of recent experiments it was found, in agreement with French[1], that suitable polishing destroys the crystalline structure of metallic surfaces. In addition, new and remarkable facts came to light. Thus, we have observed that when certain metal vapours are condensed on a substrate consisting of a polished metallic surface, crystals are formed which, however, rapidly disappear at room temperature. This is borne out by the fact that, whilst the freshly formed deposit gives rise to a characteristic electron-diffraction pattern, the rings more or less rapidly disappear, and that without any appreciable broadening effect. On the other hand, in the case of a crystalline but otherwise similar substrate, the diffraction pattern yielded by the deposit is permanent.

Thus, the stability or otherwise of the deposit crystals is determined by the condition of the substrate. For example, we have found that zinc vapour suitably condensed on a cool, polished copper surface gives rise to an initially brilliant and well-defined electron-diffraction pattern which rapidly fades away, to become extinct within a few seconds. In one such experiment, twelve successive zinc layers were deposited. With each layer except the last the initial crystalline structure vanished at a rate decreasing with each successive deposit. Zinc deposited under otherwise similar conditions, but on sputtered or etched copper, or on a previously oxidised and then reduced copper surface, formed a crystalline film the structure of which remained unchanged. It seems to us that these facts afford direct experimental proof of the existence of the Beilby layer.

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A. G. QUARRELL.
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[1] *Proc. Roy. Soc.*, A, **140**, 637; 1933.

Observations of Water Trajectories in the Open Sea

DIRECT observations of continuous movements of water masses in the open sea do not appear to have been carried out before. We have, for this purpose, for some years been using free drifting current-crosses, followed by our research steamer the *Skagerak*. The crosses are made from two sheets of corrugated iron, intersecting at right angles, with the line of intersection vertical, and presenting an area to the current of approximately one square metre. They are suspended from a cylindrical buoy of small dimensions drifting at the surface with its axis vertical. The buoy carries a very light rod projecting upwards with a small electric lamp at the top, of the type used by drifters for their nets. By varying the length of the thin wire rope by which the cross is suspended from the buoy, one may study the water movements in different depths, since the small resistance due to the surface buoy does not affect the movements of the cross to any large extent, so long as the current below is not too weak relatively to the surface current. The positions of the buoy are observed at intervals of an hour or less by bringing up the ship as close to the drifting system as possible, without interfering with its movements. In daytime, with moderately strong currents, the movements of the buoy are followed from the ship at anchor by means of a Zeiss tele-meter. Such drifting systems have occasionally been followed right across the Skagerak from Skagen to the lighthouse Måseskär on the Swedish coast.

Last summer this method was found particularly useful for studies of the rotating currents discovered from the *Skagerak* in the central Baltic[1]. In order to determine the shifting positions of the drifting system as accurately as possible far from the shores (lat. 58° 01′ N., long. 20° 30′ W.), three large surface buoys carrying electric torches were anchored a few kilometres apart, by means of which the bearings of the ship following the drifting cross could be accurately found. With the cross at 10 metres below the surface the trajectories from thirty hours' observations were found to form two beautifully smooth loops, showing, beside the rotatory current, a general displacement towards the S.S.W. The rotating vector turned by a little more than 720° in the same time. The period thus is about fourteen hours, in good agreement with previous observations on these 'inertia currents'. The details will be published in *Svenska Hydrografisk-Biologiska Kommissionens Skrifter*.

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[1] NATURE, **131**, 586, April 22, 1933.

Ionospheric Investigations in Low Latitudes

DURING the recent expedition of the "Consiglio Nazionale delle Ricerche" in Eritrea for studying cosmic rays, I made many observations by the echo method on the state of the ionosphere at Asmara (lat. 15° 20′ N.; long. 38° 55′ E.), from September to November 1933. The most important results are as follows.

The limiting wave-length for the vertical reflection in region *F* during the daylight hours reaches a minimum value between 26 and 28 metres towards six o'clock in the afternoon (local time) and not at noon as in the middle latitudes. In correspondence with this maximum of ionic density, waves between 140 m. and the limiting wave are reflected at heights which differ by less than 5 km.: this shows the formation of an extremely thin ionised layer.

The most interesting phenomenon that has been revealed from these observations is that, toward two o'clock in the morning, a very strong decrease of the limiting wave-length in region *F* is frequently noted: it may pass from 60 m. to 40 m. (for the extraordinary ray) in an hour or two. Simultaneously, the virtual height of reflection decreases for all wave-lengths. After having shown this secondary nightly maximum, the ionic density decreases until about half an hour before sunrise, and then increases again during daylight. Another striking feature of the ionospheric conditions is the violent fading and complexity of echoes which accompany these nightly increases of ionic density. On many occasions I have observed the simultaneous rising of a particular type of atmospherics with continuous rustling.

Region *E* presents a maximum of ionic density, which is always less than that of region *F*, and it is also sometimes subject to nightly increases of ionic density, chiefly in the early hours of night.

The observed phenomena, especially the nightly increases of ionic density in region *F* and the occurrence of the daily maximum about six hours after the sun's radiation reaches its maximum, having regard to the geomagnetic latitude of Asmara (11° 30′), cannot be explained as due to electrified corpuscles from the sun or other cosmic origin, which may be able to ionise the high atmosphere. At present, the only logical suggestion which can be formulated is C. T. R. Wilson's[1] that the effects are due to the ionisation produced by the electric fields of thunderstorms, which undoubtedly reach very high values in tropical regions.

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[1] *Proc. Phys. Soc.*, **37**, 320; 1925. *Proc. Roy. Soc.*, A, **141**, 706; 1933.

Vibrational Energy Levels of Hydrogen Cyanide

THE infra-red spectrum of HCN vapour has been examined with fairly high dispersion in the region near 2μ. The following bands were observed:

Band	Position	Character
$\nu_2 + \nu_3$	4005·6 cm.$^{-1}$	perpendicular
$\nu_2 + 2\nu_1$	4993·9	perpendicular
$\nu_1 + \nu_3$	5405·0	parallel
$2\nu_3$	6523·5	parallel

The band at 5405 is somewhat distorted, due to water vapour absorption in the same region, and its position is accurate only to within a few wave numbers. The discovery of the two perpendicular bands makes it possible to construct the complete vibrational energy level diagram of the normal molecule with a high degree of precision. In a report to appear in the near future the detailed analysis will be presented, and also the application of the results to the determination of the thermodynamic potentials of hydrogen cyanide.

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Research Items

Polychrome Jewellery in Kent. A new view of the origin and dating of the garnet-inlaid jewellery from Teutonic graves in Kent is put forward by Mr. T. D. Kendrick in *Antiquity* for December. According to the generally accepted view of the two groups into which this jewellery falls, one (Style *A*) characterised by closonné and filigree, in which there is no chip-carving and niello is rare, is regarded as later than the class (Style *B*) in which chip-carving and cast settings are the rule, niello is common, and there is no filigree and no closonné. The earlier, Style *B*, is dated as from the early sixth century, while Style *A* is assigned to late sixth or early seventh century, one view holding that the latter represents Jutish supremacy under Ethelbert. It is here suggested, however, that a substantial part of the polychrome jewellery belongs to an earlier Kentish population than the Jutes of Ethelbert, and that the two groups are contemporary and belong to the archæology of the Jutish invasion, with a central date at about A.D. 500. It is clear that Style *A* had a cultural background of its own, remarkable for its 'luxury' or foreign aspect, being associated with Coptic bronze bowls, amethyst beads and cowries. It is also associated with 'British' hanging bowls. Its distribution in the main is along Watling Street, while Style *B* is found chiefly in Thanet and the Sandwich country. While Style *B* may well be Jutish, it is suggested that Style *A*, which exhibits unrivalled workmanship and is clearly a distinct culture, was of British origin. The distribution of the two cultures is explicable on the supposition that for a time the Dover road continued to be held by British when all other lines of communication had been blocked by the Jutes and that the Teutonic settlements along the Watling Street are those not of Jutes but of miscellaneous Teutonic mercenaries called in to help keep open communications with the Continent.

Rain-making in Neolithic Times. Prof. L. Joleaud (*Revue Scientifique*, Nov. 25) constructs a pedigree for certain rites connected with rain and the supply of water in rivers, lakes and wells in north-west Africa, which extends back to neolithic times, through references in classical authors, analogies from Ancient Egypt and the rock drawings of North Africa, more particularly in Morocco and the Sahara. The essential feature in the modern rites is a procession of domestic animals, especially rams and oxen, accompanied by men bearing ladles and spades and sometimes playing ball with sticks, hand or foot. The beasts are decked with various ornaments and trappings, feathers, leaves, amulets, etc. Both animals and men participating should urinate in the course of the ceremony : and special honour is paid to the genital organs of both men and beasts. The rock-drawings of Oran, and to a less extent of the Sahara, bear witness to the neolithic origin of these rites. Rams and oxen, similarly caparisoned, are shown in the drawings taking a prominent part in invocation rites. In some instances, what would appear to be intended for rain is falling on the animals. Sometimes men or beasts are shown urinating or preparing to perform that act. In a cave at Cape Spartel in northern Morocco a large number of terra-cotta models of neolithic date of the genital organ of rams and bucks have been found, which, apparently, had served as idols or *ex-votos*. The place of the ram, which is the most prominent animal in the neolithic rites, is taken later, at about the period of the æneolithic age in Egypt, by the bull. Prof. Joleaud traces the connexion of these early animal figures with animal-headed gods such as Ammon and their development into anthropomorphs.

Mammals of California. Dr. Joseph Grinnell has compiled a catalogue of the recent mammal fauna of California in which he indicates the place of the original description, the type locality and the range of 460 species and sub-species, including four sub-species of man (Univ. California Pub. Zool., **40**, No. 2, 71–234 ; 1933). This number of distinct forms, which includes 220 full species, has greatly increased since the first Californian list, of 1868, with its 115 kinds, or even the 1906 list of Frank Stephens, with 276 kinds. The list includes several species of non-native mammals such as the black and Norway rats, the Alexandrine rat and the house-mouse, only the first of which is relatively scarce and is confined to coast-wise cities. Equally successful in its powers of colonisation has been the Virginian opossum, first introduced by man probably about the beginning of the present century and now present in nearly all the counties of San Francisco Bay region and of the Pacific slope of Southern California.

Territory in the Life of Birds. The theory of territory in bird life, enunciated by Eliot Howard some twenty-five years ago and supported by the field observations of himself and others, has never gained complete acceptance ; and now David and Dr. Lambert Lack have formulated a reasoned argument against the wholesale application of the theory (*British Birds*, 179 ; Dec. 1933). Were territory a primary requirement for success in reproduction, it might be expected to be universal amongst birds. It is not universal, and many of the most successful amongst birds are colonial breeders. Moreover, according to the authors, there is no good evidence that territory is important in conserving a food supply for the young. Many territorial birds, like colonial birds, obtain their food, not from their own 'territory', but from a common feeding ground ; they allow other members of the same species to feed in their territory ; and, on occasion, even their own selected females may ignore the territory of their mate and build in that of another male. Indeed 'territory' is really nothing more than a male bird's song centre, in which he can sing and display in prominence, and since these activities are at their highest at the beginning of the breeding season, it is only at that period that territory is strictly maintained.

Russian Spiders. A list of the spiders of the U.S.S.R., prepared by Prof. D. Charitonov, has just been published by the Leningrad Academy of Sciences (Katalog Russkich Paulov, *Ann. Mus. Zool.*, **32**, 1–206). The classification adopted is that of Petrunkevitch (1928) and the list includes the names of 1,068 spiders found in Russia, with the localities and captors of each species. The introduction and notes are printed in Russian and German. All records to

1930 are included, but many districts are still unsearched and a large increase may be expected. Of the 222 genera mentioned, 163 are also British, so that the work supplies a welcome addition to our knowledge of the range of many British species. It appears that more than half the Russian spider fauna belongs to four families—Linyphiidæ 261, Lycosidæ 145, Attidæ 127 and Thomisidæ 110 species, the corresponding British figures being approximately 240, 36, 33 and 34. Before long, Great Britain will be the only European country in which a recent list of the native Araneæ is not existent, a fact which should be remedied.

Biology of *Calanus*. In a contribution to the literature of *Calanus*, Dr. Sydney G. Gibbons gives an account of material collected in a restricted part of the North Sea ("A Study of the Biology of *Calanus finmarchicus* in the North-Western North Sea". Fishery Board for Scotland. Scientific Investigations. 1933. No. 1) Of all the copepods caught in the nets, *Calanus* predominates to a large extent in almost every haul ; at certain times (May–August) the mean percentage abundance reaching 70 or more. Special attention is given to the separate stages picked out from the plankton, from nauplius to adult—eleven stages in all. The author is able to show that from the last larval stage (fifth copepodid stage), which shows no trace of external sexual characters, the perfect male or female arises. Besides this he has found a sixth nauplius stage, not before noticed, coming between the fifth nauplius and the first copepodid stages. The area investigated is difficult to compare with other regions where *Calanus* has been specially worked out. There is a very small winter population which in November consists of slowly developing late copepodid stages. By February many have grown into adults which breed, and nauplii appear. A rapid rise in numbers in April is due in the north to additions from outside, in the south from breeding of adults already there. Soon the southern section is inundated with 3rd and 4th copepodid stages from outside. The influx first affects the north, then the south, and the *Calanus* population is due both to movement from north to south and to development within the area.

Polyhedral Cells. F. T. Lewis has recently discussed the shapes of cells (*Proc. Amer. Acad. Arts and Sci.*, 68, June 1933), in the investigation of which he has employed the wax-plate reconstruction method. He states that tissues are not composed of rhombic dodecahedral cells, truncated or otherwise, for these shapes have characteristic tetrahedral angles which cells avoid. In a mass of cells of approximately uniform size, the average cell has fourteen faces of contact with its neighbours ; it is a tetrakaidecahedron. Data in support of this are given for 100 cells in elder pith and in fat tissue and for 50 cells in precartilage in the tadpole of *Bufo*. In the elder pith the cells tend to be in orderly arrangement in columns, but in fat and precartilage the cells, with the same number of facets, seem piled in lawless confusion. A reconstruction shows 16 cartilage cells, with an average of 14·1 facets, which had 12–21 facets each. The author adds a surmise concerning nerve cells and neuroglia, pointing out that these two types of branching cells arise out of the primitively uniform cells of the medullary tube. Since cells formed around nuclei distributed at random are on the average 14-hedral, it may be assumed that the primitive cells of the medullary tube are of this character. He suggests that the nerve cells imbibe, grow and send out processes ; the neuroglia cells become relatively shrunken. The processes of the nerve cells, one axone and the dendrites, would grow out along the lines of least resistance, extending from the corners of the cells as shown in a model, but with the regression of the neuroglia the intracellular spaces would become large and the dendrites would not preserve their angular kinks.

Primulas in Bhutan. A very interesting account of a botanical tour in Bhutan, a State between India and Tibet, appears in No. 87 (vol. 18) of *Notes from the Royal Botanic Garden, Edinburgh* ("Botanical Tours in Bhutan, with Special Reference to the Occurrence of the Genus *Primula*", by Roland Edgar Cooper, pp. 67–118, Nov. 1933). The author visited Bhutan in 1914–15, touring the country extensively. Notes of the general distribution of vegetation are given, but the various members of the genus *Primula* received special attention. Several new species or forms are described in the paper under review, and seventeen out of the thirty-two sections of the botanical genus occur in Bhutan. The species are all described according to the classification of Smith and Forrest (1928), and are extremely useful in providing information about the natural habitats of many garden primulas.

Fungi causing Sooty Moulds. Several European mycologists have, in time past, described various fungi which produce a black, powdery mould upon the leaves of various plants. The idea that this condition was due to infection by two or more fungi had been growing, but proof is now forthcoming ("The 'Sooty Moulds' of some Australian Plants", by Miss E. E. Fisher, *Proc. Roy. Soc. Victoria*, 45, N.S., Pt. 2, 1933, pp. 171–203). Sooty moulds on plants of *Bursaria spinosa*, *Leptospermum* spp., *Myroporum insulare* and *Melaleuca* sp. have been investigated. On some hosts the mould consists of two fungi, but usually there are three types : a perithecial stage, which is often a species of the genus *Teichospora*, a pycnidial stage, and an open conidial stage. The fungi of each stage which appear upon the hosts mentioned above are described in minute detail, both as they occur in Nature and as they behave upon culture media.

Observations on a Tropical Cyclone. The *Marine Observer* of October 1933 contains an account of a particularly violent hurricane through which the S.S. *Phemius* passed on November 5–9, 1932, when on a voyage from Savannah to Colon. The description is by the observing officer, Mr. H. Nicholas. It does much to correct the impression of symmetry and simplicity sometimes conveyed by accounts of tropical cyclones in meteorological textbooks. Four barometric minima were experienced, and on one day—November 6—two lulls with phenomena characteristic of the calm 'eye' of a storm were experienced at about 2 a.m. and 4 p.m., each of which lasted about an hour. The *Phemius* lost her funnel and had derricks, lifeboats and bridges wrecked by the force of the wind, the speed of which was estimated as two hundred miles an hour, and for a long time the ship was carried by the storm in an unmanageable state. The lowest barometric minimum occurred at

8 p.m. on November 5, this being the first of the four minima, which followed a continuous and very rapid fall of pressure. The reading fell to 914·6 millibars (27·01 in.), which is 4·3 millibars (0·13 in.) lower than the previous lowest verified barometer reading recorded in a tropical cyclone, namely, in the hurricane of September 19, 1885, which passed over False Point, River Hooghly. The ship's barometer, it may be noted, had only recently been supplied by the Meteorological Office, and had been certified by the National Physical Laboratory during the previous year. On emerging into fair weather, the *Phemius* was taken in tow by a salvage steamer, and the hurricane continued northwards to cause much damage on Grand Cayman Island.

Pipe Heaters and Coolers. The report by Dr. Ezer Griffiths and Mr. J. H. Awbery on the measurements they have made at the National Physical Laboratory under the auspices of the Engineering Committee of the Food Investigation Board on the heat transfer between metal pipes and a stream of air was read by the authors before the Institution of Mechanical Engineers on December 15. It supplies more definite information than has been available hitherto on the effects of the speed and temperature of the air, the size and temperature of the pipe and its position with respect to neighbouring pipes, on the interchange of heat between air and pipe. For dry pipes the interchange is the same for the same two temperatures whether the pipe is hotter or colder than the air. If ice or snow form on a cold pipe but remain dry, the abstraction of heat from the air is the same as from a bare pipe of the diameter and temperature of the outer surface of the covering, but if water is dripping from the ice or snow the heat abstracted is increased 30 per cent. In all cases turbulence in the air stream increases the heat interchange.

Background Noise in Amplifiers. It has long been recognised that some of the background noise in valve amplifiers is due to the inherent properties of materials as they exist. In a paper read to the Institution of Electrical Engineers on December 6 by E. B. Moullin and H. D. M. Ellis, the causes that give rise to the noise are divided into two classes. There is first the spontaneous voltage in the circuit called 'thermal agitation', and there is secondly the inherent mechanism of thermionic conduction within a valve which is called the Schrott effect. The experimental work described in this paper is a continuation and amplification of the pioneer work done by other scientific workers. All the component portions of an amplifier produce spontaneous fluctuations of voltage and those harmonic components which are inside the acoustic range disclose themselves by making background noise. This noise is always a scratchy hissing noise, but the general level of the pitch rises with the frequency of the circuit. The experimental results given verify the theory. It is shown that bare wire is unsuitable for use in the early stages of a high magnification amplifier as it exhibits curious effects when it carries a current. The electric current passing from the filament to the anode of a thermionic valve is now considered to be a stream of individual electrons. The pattering of these electrons on the anode maintain it at a fluctuating potential. Since these electrons come to rest in the space charge at random intervals of time, they arrive at irregular times and so participate in the general Schrott effect. According to the authors' view, the Schrott voltage is due essentially to the anode circuit receiving current by discrete charges, and must always occur.

Collisions of Neutrons with Atomic Nuclei. Feather (*Proc. Roy. Soc.*, A, Nov.) has carried out further cloud-chamber investigations on the collisions of neutrons with light atomic nuclei. The neutrons were derived from a polonium-beryllium source and the tracks were studied in oxygen, an oxygen-hydrogen mixture and a mixture of acetylene and helium chosen to have suitable properties for the working of the expansion chamber. A frequency curve of the ranges of the oxygen recoil atoms is similar to the curve for nitrogen collisions, obtained from previous work and presented here in a revised form. Few oxygen recoil atoms have a range greater than about 2·8 mm. of air. Using data of Blackett and Lees to correlate range of recoil atom with velocity and assuming that the collisions of the neutron are elastic, most of the neutrons are found to have an upper energy limit of about $4{\cdot}5 \times 10^6$ volts. It is not clear whether the neutrons form a homogeneous group or a continuous distribution, since the distribution curves of the recoil atom energies are in any case continuous. The interpretation of the tracks obtained in the mixtures is complicated. The distribution curve for the acetylene-helium mixture shows a pronounced change in slope at 46 mm. range; this may be ascribed to helium or to carbon. In the former case, it would indicate the appearance of a group of neutrons of energy about 1·1 million volts—presumably produced by resonance disintegration, and in the latter case it would indicate the presence of neutrons of more than 10 million volts. The study of the brightness variation of several individual tracks indicates that they ought to be ascribed to carbon nuclei, and gives some evidence in favour of the existence of high velocity neutrons. In addition to the elastic collisions, disintegrations were observed in oxygen, and ascribed to the capture process $O^{16} + n \rightarrow C^{13} + He$, the energy relations requiring the production of a high energy γ-ray. The disintegration of carbon is very rare, if existent, only one case being found in more than two thousand photographs.

Temperature Data of Metals. Sir Robert Hadfield and the Research Department of his firm, Messrs. Hadfields, Ltd., Sheffield, have recently published a new edition of a temperature chart extending from −273·05° C. up to the temperature of the electric arc, which they give as 3,700° C. (T.6165. 1*s*.). The melting and boiling points of various materials are tabulated, the greatest care having been taken to ascertain the latest and most reliable data. An interesting, and unusual, feature of this chart is that the degree of accuracy with which the temperature is known in any particular case is indicated by the manner of its presentation. Thus, up to a temperature corresponding with the melting point of copper, 1083·0° C., the temperature is regarded as being reliable to within ±0·1° C., whilst at the melting point of molybdenum, 2615° C., the degree of accuracy is regarded as ± 5° C. In addition to the data for the pure results, the melting points of various refractory materials, the temper colours of steel and other industrial temperatures of importance, are recorded. The purpose of the chart is stated to be: "To present to those concerned, in convenient form, various temperature data of general interest", and in this the producers are singularly successful.

Reference Chart for the Apparent Motions of the Sun, Moon and Planets

By DR. B. K. VAIDYE, Indian Institute of Science, Bangalore

THE apparent motions of the sun, the moon and the planets during the course of a year can be represented very conveniently by plotting on a single sheet of paper the right ascension of these bodies corresponding with each day of the year. The planetary chart prepared in this way gives a picture of the sky for the whole year, so far as the principal members of the solar system are concerned, and besides, it shows at a glance all the planetary phenomena and the days when they occur.

Fig. 1 shows such a chart for the year 1934. It is not possible to include in the diagram the variations in the declinations of the objects, but this need cause little interference, as the movements considered here lie within the comparatively narrow region around the ecliptic. Along with the right ascension hours on the ordinate are given the names of twelve stars in the zodiacal constellations. These stars are placed at a distance of approximately two-hour angles in succession, and lie at points which are very near the ecliptic. They serve to locate the positions of the planets, the sun and the moon at any desired day of the year.

The most interesting types of curves are described by the two inferior planets, Mercury and Venus. Their motions lie alternately above (eastern elongation) and below (western elongation) the sun's line of motion, corresponding to the periods when they appear as the evening and morning stars, respectively. The greatest elongations are reached on the days when their distances from the sun line are a maximum. When their paths intersect the sun line during a forward motion they are in superior conjunction with the sun, while during a downward or retrograde course they pass through an inferior conjunction at the point of intersection with the sun line. The proper dates and periods for these and other phenomena are read off on the abscissa.

In other respects the chart is self-explanatory. The dates for the mutual conjunctions of the planets and for their conjunctions with the sun and the moon are given by various points of intersections. The stationary points at the two extremities of a retrograde path are marked *S*. The time of opposition to the sun is marked by the appropriate symbol. The moon's path, with the four principal phases, is shown by a number of slanting lines crossing the whole of the diagram. The solar and the lunar eclipses are marked by the letter *E* near a new moon or a full moon. The times of the equinoxes and the solstices are indicated by the conventional zodiacal symbols.

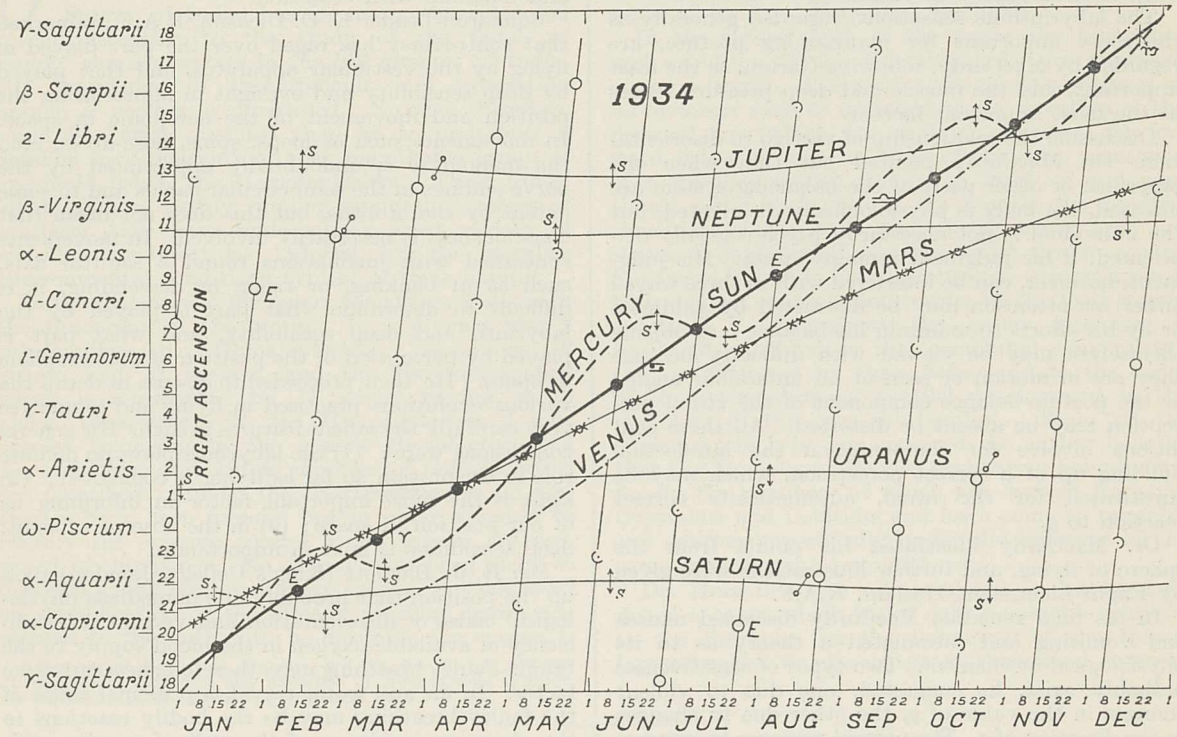

FIG. 1.

The time of the rising or the setting of a planet on any particular day may be ascertained by finding its distance from the sun on the day in question. This distance gives directly the duration in hours for which the planet would be visible above the horizon, after the sunset or before the sunrise according to its position above or below the sun line. Thus it may be seen from the diagram that at the end of January 1934 a remarkable phenomenon occurs when the sun is closely followed by the four planets, Mercury, Venus, Saturn and Mars, the first three of these setting about half an hour and the last about an hour after the sun.

Disorientation and Vertigo

SECTIONS I (Physiology) and J (Psychology) of the British Association discussed on September 7 at a joint meeting the problems of disorientation and vertigo. Dr. J. T. MacCurdy (Cambridge) was the first speaker. He said that the most universal type of physiological orientation is the reaction to gravity. When the effective value of g is varied, there is an increase or decrease in the tension of the muscles which withstand the drag. When the direction of g is changed, there are reflex movements of the trunks and limbs which re-orient the body to g, the so-called righting reflexes. Any disturbance of these balancing reactions would upset the bodily orientation, if there were no accessory means of judging the direction of g. Such a means exists in vision.

The labyrinthine sensations, regarded generally as the most important for maintaining posture, are regarded by MacCurdy, following Garten, as the least important, and the muscle and deep pressure senses as the most important factors.

Discussing the relationship of vertigo to disorientation, Dr. MacCurdy pointed out that when the labyrinth or other parts of the balancing system are diseased, the body is physiologically disoriented, but the individual is not necessarily psychologically disoriented, if his judgment remains intact. His judgment, however, can be interfered with in three ways : either his attention may be distracted by giddiness or by his efforts to maintain his balance ; or objects themselves may be viewed with difficulty because they are in motion or seen at an unfamiliar angle ; or the posture-balance component of the visual perception may be absent or distorted. All these conditions involve for compensation the intellectual building up of a correct perception, which may be substituted for the usual, automatically correct reaction to g.

Dr. MacCurdy illustrated his points from the sphere of flying, and further illustrations were given by Flight-Lieutenant Haslam, R.A.F.

In his final remarks, MacCurdy discussed nausea and vomiting and formulated a theory as to its physiological mechanism. Two types of sensitiveness probably exist, he suggested, one due to violent changes in the value of g, the other due to changes in the direction of g. The normal response to increase of g is tension in the extensors and rigidity of the abdominal walls. If this is ineffective, a diaphragmatic tug ensues. Dr. T. G. Maitland (Cunard Steamship Co., Ltd.) agreed that the diaphragmatic pull is important, but only as an auxiliary cause of nausea.

Dr. Maitland pointed out that the vestibule and the semi-circular canals are the chief receptors of imposed movement. They have been evolved to meet only certain modes of such movement. When they encounter movements of another order, the reflexes they evoke not only fail to maintain equilibrium, but also actually disturb it. The sensory receptors of the muscles, tendons and joints, and the skin of the supporting structures, are excited by these reflexes. These muscles give a false orientation and so vertigo is caused which is an 'emotive and hallucinatory reaction'. Vertigo, of course, may also arise from other causes.

It is not certain what part the semicircular canals, primarily receptors for rotatory movement, play in rectilinear movement, though both rotatory and rectilinear movements excite vertigo. Although evidence from experiments is conflicting, various facts suggest that rectilinear movements do affect the semi-circular canals, but not when the deviation is slight. Dr. Maitland also directed attention to the fact that the conditions of the vertigo excited by descending rectilinear movement are the reverse of those of the vertigo excited by angular rotatory movement. In the former case, the vertigo is pronounced at the inception of the movement, reaches its maximum with acceleration, diminishes with retardation, and disappears with cessation ; whereas in the latter case, it is absent at the inception or acceleration of the movement, slight with retardation, and maximal with cessation.

Squadron-Leader E. D. Dickson, R.A.F., remarked that controversy has raged over the part played in flying by the vestibular apparatus, and that played by deep sensibility and eyesight in appreciating the position and movement of the aeroplane in space. In movements such as loops, spins, nose-dives, etc., the manœuvre is undoubtedly appreciated by the nerve-endings in the semi-circular canals and to some extent by the otoliths, but this does not mean that consciousness is necessarily involved. In movements concerned with inclinations round a sagittal axis, such as in banking, or rising or descending, it is difficult to determine what part is played by the labyrinth and deep sensibility, and what part is played by perception of the position of the aeroplane in space. He then proceeded to discuss in detail the various evolutions practised in flying and to analyse very carefully the salient features in each. His general conclusions were : (1) the labyrinth plays no definite rôle in orientation so far as flying is concerned ; (2) sight is the most important factor in informing us of our position in space ; (3) in the absence of sight, deep sensibility is next in importance.

Mr. R. J. Bartlett (King's College, London) took up the position that probably one immediate physiological cause of disorientation and vertigo is insufficiency of available oxygen in the blood supply to the brain. Faulty breathing may, therefore, be a causative factor. In air and water travel, a principal cause of the faulty breathing may be the bodily reactions to the changing incidence of the pull of gravity with the rolling or pitching of boat or aeroplane. Bartlett finds that the effects of land and ocean travel can be induced in suitable subjects by vibration without any rolling, pitching or translatory movement. The subject sits in a chair attached to a box containing a motor loaded eccentrically and run at speeds from twelve to twenty revolutions per second. Changes in the frequency of the vibration and certain critical frequencies are found to be particularly effective ; pneumograph records show the marked effect on the breathing of susceptible subjects. When it is difficult or impossible to keep the vibration and the breathing in harmony, discomfort is experienced.

Dr. R. S. Creed (Oxford) stated that in vertigo there must be : (1) false sensations of movement, or perhaps sometimes only of position ; (2) a tendency to make compensatory movements jeopardising balance ; and (3) consciousness of the falsity of the sensations, causing a feeling of uncertainty and unsafeness whence arises mental confusion and distress. The first two of these may occur alone, resulting in some degree of disorientation, and the subject may fall to the

ground, but without any of the unpleasant feelings associated with the word giddiness.

In people who are particularly susceptible, vertigo accompanied even by nausea and vomiting may easily be brought about by kinæsthetic impulses or by moving visual stimuli. But that the labyrinth is by far the most usual and important sense organ from which vertigo is aroused, and probably the only one concerned in sea-sickness, is now firmly established. James, Kreidl and Myginol have all commented on the immunity from sea-sickness of deaf-mutes in whom the labyrinths were deficient. The experiments of Dreyfuss on guinea-pigs and of Kreidl on dogs, cats and pigeons pointed in the same direction. Decerebration, decerebellation, or section of both vagi leaves sea-sickness unaffected, but removal of both labyrinths or section of both eighth nerves results in complete immunity. The most likely explanation of the vomiting seems to be that it is caused by spread of excitation from the vestibular nuclei to the neighbouring medullary 'vomiting centre'.

As a result of the interest aroused in the discussion, a joint research committee of the Sections of Physiology and Psychology has been set up to investigate the conditions of vertigo and its relation to disorientation.

Fishes of Mountain Streams

DR. SUNDER LAL HORA, of the Zoological Survey of India, has for many years devoted special attention to the study of the fauna of rapidly running waters in the hill streams of India. His knowledge of this difficult and interesting branch of zoology is unrivalled. No one, therefore, could be better qualified than he to undertake a detailed investigation* of that remarkable group of cyprinoid fishes, the Homalopteridæ. These fishes, inhabitants of swiftly running mountain streams of southern Asia, have undergone a great variety of adaptive modifications induced by the peculiar environmental conditions typical of their habitat.

In the first part of his report the author deals with the taxonomy of the group. It is divided into 2 sub-families—the Homalopterinæ, comprising 6 genera and 31 species, and the Gastromyzoninæ which is represented by 11 genera having in all about 16 species. In the Homalopterinæ 4 new species belonging to the genera *Homaloptera* and *Lepturichthys*, and 2 new varieties of *Balitora brucei* are described. Among the Gastromyzoninæ no new species have been found; but in order properly to classify the existing species 5 new genera are proposed in this paper. No attempt has been made to describe in full each and every species, but wherever an amplification of the already existing description seemed to the author to be desirable the species is either redescribed or a note is inserted concerning some of its most important features.

In the second part of the paper the bionomics and evolution of the Homalopteridæ are discussed at some length. The most characteristic features of its members such as flattened shape, insertion of the pectoral fins (which are used for adhesion) far forward below or even in front of the eyes, possession of a peculiar rostral groove in front of and continued along each side of the mouth, the peculiar structure of the hard and strong lower jaw, are shown to be definitely correlated with the three most important factors in the environment—strong current, high oxygen content, and nature of the food supply available. Throughout the paper attention is repeatedly directed to the 'communal convergence' that is exhibited by these fishes and to the series of characters showing parallel development in the members of the two sub-families. From all the evidence which he has acquired the author believes that the Homalopteridæ are probably a polyphyletic family the members of which are derived from the Cyprinidæ and Cobitidæ and have come to resemble one another superficially under the influence of the same environmental conditions.

Dr. Hora is to be congratulated on having produced a paper which is not only a valuable addition to the literature on the taxonomy of the Homalopteridæ but is also of great theoretical interest.

G. A. S.

* *Memoirs of the Indian Museum*, vol. 12, No. 2, pp. 263–330. "Classification, Bionomics and Evolution of Homalopterid Fishes". By Sunder Lal Hora. Calcutta; December, 1932.

Geological Reconnaissance by Aeroplane in Australia*

IN 1932 the Royal Australian Air Force made flights over many of those areas in Australia which are deemed to be worthy of investigation from the point of view of the discovery of oil. Dr. W. G. Woolnough, who was present as observer and geologist, has now detailed the results obtained in a report which gives valuable information regarding the function and importance of aerial work in assisting and expediting geological survey. The object was to determine the disposition of strata and especially to locate dome structures, the investigation being made partly by visual observation and partly by the study of the photographs taken from the air. Much experience is required before the utmost can be achieved by these methods, and Dr. Woolnough states that he scarcely began to appreciate the significance of details seen from above until he had completed one hundred hours of flying.

From July until September, a circuit of Australia was made—also a visit to Tasmania, atmospheric conditions on the whole being favourable. Over Melville Island observation was hindered by a tribal fight, as part of the strategy consisted in the lighting of extensive bush fires, the smoke of which provided nuclei for the condensation of moisture and the development of clouds. The orientation of the photographs and the elevation of hills and scarps above the surrounding country can be determined by noting the direction and lengths of shadows—provided the time of exposure is accurately known.

In those regions where the rocks are well exposed and where topographical forms are the direct result of the differential erosion of beds, the main tectonic features are easily seen, and examination of the photographs reveals where the detailed ground investigation which is essential to the full elucidation of the structure should be undertaken. Most valuable is the clearness with which the true disposition and

* Commonwealth of Australia. Report on Aerial Survey Operations in Australia during 1932. By Dr. W. G. Woolnough. (Canberra: Government Printers.)

continuity of strata can be made out from the bird's-eye view of country in which the ground worker is baffled at close quarters by the confusion of detail resulting from erosion, accumulations of detritus, and the presence of false dips due to local and superficial collapse of strata. The observer is warned against reading 'strike' into a banding due to the parallel alignment of superficial sand dune accumulations; furthermore, where dips are slight, it is often impossible to determine in which of the two possible directions they lie, and for this ground-levelling is required.

It was in bare featureless plains devoid of rock exposures that the most remarkable results were obtained. Sometimes it was possible to detect geological structures of great importance where the absence of outcrops presents an insurmountable obstacle to ground survey. Here a pattern can be discerned which the geologist can recognise at once as that of a geological map, and in one case the proved structure of an area with abundant outcrops was followed into adjacent lowlands the geological structure of which has hitherto remained hidden. Such pattern is due to the different appearances of soils to the 'actinic eye' of the camera. Clearly these soils have developed from the weathering of the rocks beneath them, the disposition of which they thus reveal. Pattern may be seen through thin parched grass but it is lost with a fresh luxuriant growth, and the survey must be made when the conditions are favourable.

Some success was achieved in gleaning information regarding the geology of heavily forested regions, and much may be expected from the further development of this line of attack on a type of country which is the despair of the investigator on the ground.

L. H.

University and Educational Intelligence

LONDON.—The following appointments to University readerships have recently been made: botany (Birkbeck College), Dr. F. C. Steward, since 1929 assistant lecturer in botany in the University of Leeds; epidemiology and vital statistics (London School of Hygiene and Tropical Medicine), Dr. A. B. Hill, who since 1923 has been carrying out investigations and research at the School.

The title of emeritus professor of eugenics in the University has been conferred on Prof. Karl Pearson, on his retirement from the Galton chair of eugenics at University College, and that of emeritus professor of Egyptology in the University on Sir Flinders Petrie, on his retirement from the Edwards chair of Egyptology at University College.

The following degrees have been awarded: D.Sc. to B. F. Barnes (Birkbeck College) for ten published works on botany; D.Sc. to J. C. F. Hopkins (King's College) for ten published works on plant pathology.

MR. THURKILL COOKE, a member of the General Committee of the British Association, has offered to present to the universities of England a collection of works on nautical science. The first presentation under the offer has been made to the University of London. Librarians of English universities desirous of receiving such accessions should communicate with the Assistant Librarian, British Library of Political Science, Houghton Street, W.C.2.

Science News a Century Ago

Royal Society, January 9

The portrait of the late president, Davies Gilbert, painted by Thomas Phillips, R.A., at the solicitation of several members, was, by their request, presented to the Society. A paper was read on 'The Empirical Laws of the Tides in the Port of London'. By the Rev. William Whewell, F.R.S., Trinity College, Cambridge. The author regards existing tide tables as extremely imperfect; the mathematical solutions of the problem founded on hypotheses remote from the real facts. The Earl of Tyrconnel was elected into the Society.

The Royal Medals of the Royal Society

The January issue of the *Gentleman's Magazine* in 1834 contained an excellent notice of the anniversary meeting of the Royal Society. The Duke of Sussex made a statement relative to the Royal medals placed at the disposal of the Society by His late Majesty in 1828. Mr. Chantrey, in conjunction with Sir Thomas Lawrence, was appointed to prepare a design. Either from indecision, or that procrastination for which the late president of the Royal Academy was characterised, the design was never furnished, although it was a frequent and favourite theme of conversation. After an inquiry, steps were taken, however, to redeem all the pledges made by George IV to the Royal Society. The *Gentleman's Magazine* records the awards of ten medals to the following, and the reasons: Dr. Dalton, to whom was owing the development of the atomic theory; although at the eleventh hour, it was gratifying to know that he was acknowledged as its author both at home and abroad; to Mr. Ivory, the first English philosopher who introduced to Great Britain the beautiful and refined discoveries of Laplace, Lagrange and other foreign astronomers; to Sir Humphry Davy and Dr. Wollaston in testimony of services in science; to Prof. Struve, for researches respecting double stars; and to Prof. Encke, the greatest, perhaps, of modern astronomical calculators, and the discoverer of the comet which bears his name. The Duke of Sussex alluded to Sir John Herschel as one who had terminated his European labours; and a rich harvest was to be expected as the result of his labours in the ample field of a new and unexplored heaven.

The *Mechanics' Magazine*

The issue of the *Mechanics' Magazine* for January 4, 1834 opens with a reprint of a paper by Dr. Robert Hare, then professor of chemistry in the University of Philadelphia, on a galvanic rock-blasting apparatus, in which the use of electricity is advocated for mining. This is followed by a reprint of a paper by Mr. Sang, of Edinburgh, on the relation of a machine to its model. Next there is correspondence on canal improvements, and on the performances of the steam carriages of Hancock and Maceroni, followed by a note on isometric projection and a letter from John Ericsson on his caloric engine. Of considerable interest are the notices of the activities of two societies. The Marylebone Literary and Philosophical Society, it was stated, was in a very flourishing condition and had bought 17 Edwards Street, Portman Square, where it was proposed to erect a lecture

room to hold six hundred persons. Sir Anthony Carlisle, Dr. Lardner and John Phillips, the geologist, were all vice-presidents of the Society, before which many eminent men lectured. Another society flourishing then was the Brighton Literary and Scientific Society, the president of which was Mr. Ricardo. The president, so the *Mechanics' Magazine* states, had just concluded a series of lectures on railways. In the course of these lectures he had read a communication from George Stephenson in which it was said that a speed of forty miles per hour had been attained on the Liverpool and Manchester Railway and that "an engine might be constructed to run 100 miles within the hour although at that rapidity of motion the resistance of the atmosphere would be very considerable indeed".

Literary and Scientific Institutions

A correspondent contributes the following statement to the *Gentleman's Magazine* of January 1834 :— The number of Literary and Scientific Societies has been greatly on the increase. The Royal Society numbers 750 members; the Antiquarian, 300; Royal Society of Literature, 271; Zoological, 2,446; Horticultural, 1,875; Royal Society of Arts, 1,000; Royal Institution, 758; Geological, 700; Linnæan, 600; Asiatic, 560; Geographical, 520; Astronomical, 320. The members constituting the London Medical, Westminster Medical, Medico-Chirurgical, Medico-Botanical, Phrenological and Entomological Societies, the College of Physicians and Surgeons, and Institution of Civil Engineers, cannot be short of 1,700 persons. Next follow the London, Russel, Western and Marylebone Institutions, whose proprietary and yearly subscribers may be estimated at 1,500. Here are in the whole 13,000 names (some it is true frequently repeated) supporting 26 Associations in London, founded for the sole purpose of promoting the interests of learning and science and diffusing useful knowledge. And, for the immediate benefit of the operative class, the Metropolis possesses a Mechanics' Institute which is said to have 1,000 members.

Investigations of Terrestrial Magnetism

About 1834 great activity prevailed in the investigation of the earth's magnetism, and magnetic observations were being made not only on land but also on exploring ships. On December 19, 1833, Commander J. C. Ross described before the Royal Society his expedition to the north magnetic pole, which he reached on June 1, 1831, and his measurement of the dip as 89° 59′. This determination was made with great care, and was as accurate as was then possible. Improvements of the magnetic instruments and the elimination of errors were being actively sought. On January 6, 1834, Mr. W. Snow Harris read before the Royal Society of Edinburgh a paper "On the Investigation of Magnetic Intensity by the Oscillations of the Horizontal Needle", in which he closely examined many real and supposed disturbing factors. He showed that light had no effect on the oscillations, but that they were susceptible to disturbance by slight air currents, and the instruments must therefore be enclosed, preferably in a vacuum. He also investigated methods of suspending magnets, the effects of changes of temperature and the determination of changes in the constants of magnets.

Darwin in Patagonia

For the greater part of 1832 and 1833, H.M.S. *Beagle*, under Capt. FitzRoy, had been on the east coast of South America, and Darwin had been able to make several expeditions inland from ports such as Buenos Aires and Monte Video. Leaving the Rio de la Plata on December 6, 1833, the vessel visited Port Desire on December 23 and then sailed for Port St. Julian farther south.

Here, on January 9, 1834, Darwin records : "Before it was dark the *Beagle* anchored in the fine spacious harbour of Port St. Julian, situated about one hundred and ten miles to the south of Port Desire. We remained here eight days. The country is nearly similar to that of Port Desire, but perhaps rather more sterile. One day a party accompanied Captain FitzRoy on a long walk round the head of the harbour. We were eleven hours without tasting any water and some of the party were quite exhausted. From the summit of a hill (since well named Thirsty Hill) a fine lake was spied, and two of the party proceeded with concerted signals to show whether it was fresh water. What was our disappointment to find a snow-white expanse of salt, crystallised in great cubes ! . . . Although we could nowhere find, during our whole visit, a single drop of fresh water, yet some must exist ; for by an odd chance I found on the surface of the salt water, near the head of the bay, a Colymbetes not quite dead, which must have lived in some not far distant pool. . . . A good sized fly (*Tabanus*) was extremely numerous, and tormented us with its painful bite. The common horsefly, which is so troublesome in the shady lanes of England, belongs to this same genus. We here have the puzzle that so frequently occurs in the case of mosquitoes—on the blood of what animals do these insects commonly feed ? The guanaco is nearly the only warm-blooded quadruped, and it is found in quite inconsiderable numbers compared with the multitude of flies." ("Journal of Researches.")

Societies and Academies

LONDON

Physical Society, October 20. A. F. DUFTON : Graphic statistics. The plotting of frequency-distributions is discussed. In comparing for different populations the frequency-distributions of a particular variate, it is sometimes convenient to take one population as standard and to represent its distribution by a straight line. The method of plotting individual points described by Hazen is incorrect.

December 1. H. DENNIS TAYLOR : The image-distortion and other effects due to the glass-thickness in lens systems. The optical influence upon distortion of image, or departures from correct pictorial representation, caused by the considerable thicknesses of glass involved in the construction of high-class photographic lenses of projectors having a large angular field of view is discussed. H. CARMICHAEL : The tilted electrometer. A detailed description is given of the construction and performance of a new evacuated critically damped quick-reading quartz-fibre electrometer. The sensitivity obtainable is limited only by the Brownian motion of the fibre. The minimum potential change

that can be measured (with the usual convention that the corresponding deflection of the system be not less than four times the root of mean square of the deflections of the Brownian motion), is of the order of 0·0001 v. when the period (undamped) is 5 sec. and 0·0005 v. when the period is 1 sec. The range of approximately constant sensitivity is adequate for most purposes. A. S. RAO and K. R. RAO: Spectra of bromine v, vi and vii. The vacuum spark spectra of bromine have been investigated under different degrees of excitation in the region λ 1400 to λ 400, by means of a Siegbahn spectrograph. From a careful scrutiny of the plates the lines have been assigned to the different stages of ionisation of the element. With the aid of these the principal members of the spectra of bromine v, vi and vii, involving the low-lying terms, have been identified. E. B. MOSS: An automatic photoelectric photometer. A precision photoelectric photometer based on principles capable of wide application and operated from A.C. mains is described. It is a flicker instrument, but the simple shutter is on the spindle of a synchronous motor driven from the same supply as an alternating current valve bridge. This is connected to an emission type photocell, and gives a directional output which automatically moves the neutral density wedge to the position of balance, which is shown by a pointer. The wedge position is controlled electrically, being mounted on a galvanometer movement devoid of mechanical control. G. D. WEST: A mechanical wave model illustrating acoustic and electrical phenomena. The model consists of a series of equal masses suspended on equal lengths of straightened watch-spring from a rigid bar. Through holes bored in the masses, which are equally spaced, is threaded a piece of elastic. One end is fixed, and the other can move with a simple harmonic motion communicated by means of a rocker arm attached to a small motor. Wave-transmission along the system takes place only if the frequency falls within a certain range. Very high and very low frequencies are not transmitted.

DUBLIN

Royal Dublin Society, November 28. J. H. J. POOLE: Some difficulties in current views on the thermal history of the earth. In a discussion of various theories of earth history it is shown that, although the conditions necessary for the truth of the cooling-earth theory may now be satisfied, it is improbable that the primitive crust would have satisfied them. In consequence we must conclude that partial re-melting of the original crust has occurred during some stages of geological history. Some points in Holmes's convection current theory of earth history are also considered, including the condition necessary for the existence of a permanent convective layer in the earth. It appears that the presence of such a layer will lead to shearing stresses in the crust, owing to the greater radioactivity of the continents and the consequent distortion of the geotherms. H. H. POOLE and W. R. G. ATKINS: Some measurements of the brightness of various parts of the sky by means of a rectifier photoelectric cell. The measurements were made in Dublin in June and July 1933 with approximately uniform skies of various degrees of clearness, the sun's altitude being 45°–60°. The minimum brightness recorded was about 0·6 metre candle per square degree for a clear blue north sky altitude 45° to 60°, and the maximum 11·8 metre candles per square degree for sky covered with light cirro stratus cloud about 12° below the sun. The effect of haze, and to a greater extent of light cloud, is to (*a*) increase the brightness of all parts of the sky, (*b*) cause the brightness to increase with altitude instead of decreasing, as for a clear sky, and (*c*) increase the relative importance of regions near the sun.

EDINBURGH

Royal Society, December 4. J. M. STAGG: The British Polar Year Expedition to Fort Rae, Canada. After a brief account of the activities in 1882–83 and an explanation of the ideas leading to last year's repetition, the aims of the British Party to Rae were given. The methods adopted to obtain the required information in the various fields of observation were described and some indication given of the problems to the solution of which the records brought home by the Expedition will be applied.

PARIS

Academy of Sciences, November 20 (*C.R.*, 197, 1161–1256). PAUL DELENS: Isothermal congruences. S. COHN-VOSSEN: The total curvature of open surfaces. PAUL DIENES: The deformation of subspaces in a space with general linear connexion. SIXTO RIOS: The singular ensemble of a class of Taylor's series which presents gaps. M. FEKETE and S. MARSHAK: Certain conditions necessary for the regularity of a function in a point of the circle of convergence. RAPHAËL SALEM: Fourier's series of functions of summable square. ANDRÉ MARCHAUD: Fields of semi-right lines and differential equations of the first order. GEORGES BOULIGAND: A problem of the theory of potential. JULIUS WOLFF: The conjugated harmonic function of a limited harmonic function. MAURICE FRÉCHET: Remarks on the communications of M. Minetti concerning a space composed of holomorph functions. CHR. FOUSIANIS: A theorem of Carathéodory and Féjer. W. M. ELSASSER: The polarisation of diffused electrons. ALBERT TOUSSAINT: The corrections to be applied to the aerodynamical characteristics of a supporting wing under experiment in a rectangular wind tunnel, partly guided by the walls, parallel to the spread of the wing and to the velocity of the wind. PIERRE DIVE: Distributions of masses producing the same potential in a common interior region. JEAN CHAZY: The capture of comets by the solar system. MLLES. RENÉE CANAVAGGIA and MARIE LOUISE FRIBOURG: The constants of motion of the *G*, *K* and *M* stars. L. NÉEL: Calculation of the [magnetic] susceptibility of nickel in the neighbourhood of the Curie point. ION I. AGARBICEANU: The absorption of iodine vapour in the presence of foreign gases. Experimental study of the absorption spectrum of iodine vapour mixed with oxygen or nitrogen, under pressures varying from 1 mm. to atmospheric. Existing lines were enhanced, but no new ones appeared. A. COUDER: The use of inclined lenses as a means of producing pure astigmatism in spectrographs. Suggestion for eliminating more completely the effect of the grain in the photographic emulsion. PIERRE BRICOUT: The photometric study of the irregularities of density of photographic plates. JEAN SAIDMAN: The technique of the measurement of the thermal radiation of the skin. A description of a robust form of apparatus, capable of being carried to the bedside of a patient, and of giving more accurate results than the apparatus in current use.

Some practical applications are indicated. VÉRON : Rectilinear wings with uniform calorific flux. RENÉ ARDITTI : The system cadmium sulphate, sulphuric acid, water. The physical properties (solubility, density, refractive index, viscosity, electrical conductivity) of this system have been studied : results are given as curves. MLLE. SABINE FILITTI : The oxido-reduction potential of the system hypoxanthine, uric acid. PARISELLE : The influence of the strength of bases on the formation of the aluminotartaric complexes. MICHEL MAGAT : The energy of dissociation of water by symmetrical vibrations and the products of this dissociation. AUGUSTIN BOUTARIC and MARIUS PEYRAUD : The capillary rise of hydrosols and of solutions of colouring matters. The influence of the concentration and of electrolytes. LOUIS MÉDARD and MLLE. THÉRÈSE PETITPAS : The Raman effect of solutions of ammonium nitrate in nitric acid. E. BURLOT : The tendency to destruction of explosives by inflammation in a vacuum. A study of mercury fulminate and lead nitride (hydrazoate). It was found that there is a limiting pressure below which the destruction of the explosive is not propagated throughout the mass of the explosive. In both of these detonants there is a phase of slow combustion preceding detonation. This phenomenon is easy to observe with mercury fulminate ; under special conditions described it can also be seen in lead nitride. MARCU ROTBART : Some arylfatty β-oxyacetals and their products of hydrolysis. CH. COURTOT and T. Y. TUNG : Studies in the aryl thionium series. D. IVANOFF and G. PCHÉNITCHNY : Syntheses with amides of the type R.CH = CH. CH_2CO_2H and mixed organomagnesium derivatives. ALEXIS CHERMETTE : New geological observations in Bas-Dahomey. P. LEBEAU : The peranthracites and the true anthracites. On the basis of work described in earlier communications, the author has proposed a classification of anthracites into true anthracites and pyroanthracites, the name peranthracites now being suggested for the latter. This classification is based on the volumes of gas evolved on heating to 1,000° C. Further work shows other differences between the two groups : composition of the gas evolved at 1,000° C., temperatures of inflammation, decrepitation on heating, behaviour towards chemical reagents, and electrical conductivity. Peranthracites are practically conductors of electricity whilst anthracites have a very high resistivity. JACQUES FROMAGET : The Trias formations of western Tonkin. P. IDRAC : A curious phenomenon of the solfatara of Pouzzoles. JACQUES BOURCART : An attempt at the reconstitution of the history of the fluvial network of the Haut Atlas to the east of Marrakech. P. AUGER and L. LEPRINCE-RINGUET : Study of the variation of the cosmic radiation between the latitudes 45° N. and 38° S. The action of the earth's magnetic field on the cosmic rays should serve to discriminate between the two theories of their origin, electromagnetic or corpuscular. The experiments described and summarised in a graph show that the cosmic radiation is sensible to the action of the terrestrial magnetic field, at least for distances of the order of the earth's radius. J. BRANAS and J. DULAC : The mode of action of copper mixtures : the rôle of desiccation. A. DEMOLON and E. BASTISSE : The influence of the anions on the fixing and mobilisation of phosphoric acid in soils. The hydrosol of silica and humic acids play an important part in the mobilisation of the passive forms of phosphoric acid in cultivated soils. PAUL CHABANAUD : A new type of fish of the family of Gobideæ, *Syrrhothonus Charrieri*. Description of a fish caught off the coast of Tangiers by Henri Charrier. R. LEGENDRE : The presence of *Anotopterus pharao* in the stomach of *germons*. POLACK : The anomalies of colour vision. The classical trichromatic theory cannot define or place the anomaly of the Rayleigh type. The author's theory, which characterises chromatic vision by two factors, the position of the luminous maximum in the spectrum and the extent of the unitonal regions, gives a precise definition and forms a continuous series with normal chromatic vision and its various anomalies. G. SANDOR, A. BONNEFOI and J. J. PÉREZ : The precipitation of the proteins by neutral salts. The precipitation of natural proteins by neutral salts is not due to an isoelectric precipitability. The solubility passes through a maximum at the isoelectric point *p*H 6 for the globulins and is still very high at the isoelectric point *p*H 4·8 for the albumins.

VIENNA

Academy of Sciences, Oct. 19. JOSEF LINDNER and ALOIS TORGGLER : Convallarin. W. J. MÜLLER and W. MACHU : Theory of passivity phenomena (23). The most important results of the earlier study of the passivity phenomena in lead are confirmed. OTTO BRUNNER and GERTRUD WIEDEMANN : Components of hornbeam bark. The resinol found by Zellner and others in hornbeam bark has been purified and proves to be identical with the betulin of birch bark. OTTO BRUNNER and ROLF WÖHRL : *p*-Methoxy- and 3 : 4-dimethoxy-phenylurethanes. The higher aliphatic alcohols yield well-crystallising urethanes suitable for characterising these alcohols. KARL PRZIBRAM : Relation between contraction and pressure for salts and metals. RICHARD BIEBL : Action of α-rays on the cells of *Bryum capillare*. When sufficiently intense, α-rays kill the cells of this moss, the time required being almost inversely proportional to the strength of the preparation. ELISABETH KARA-MICHAILOVA : Measurement of strong polonium preparations in the large plate condenser. The advantages of this method are pointed out and curves of equal degrees of saturation for preparations of 2400–50000 electrostatic units are given. FRITZ ASINGER : Nitration of 3 : 5-dichlorobenzaldehyde and 3 : 5-dichlorobenzoic acid. At 0°, fuming nitric acid converts the aldehyde almost quantitatively into its 2-nitro derivative, and at 60°–70° the same acid nitrates 3 : 5-dichlorobenzoic acid to give the 2-nitro compound in about 80 per cent yield. ERICH TSCHERMAK-SEYSENEGG : (1) Intermediate inheritance and chromosome addition with species-bastards of *Triticum villosum*. (2) Size- and colour-dimorphism of the grains of wild and culture forms of rye and wheat. KARL MAYRHOFER : Convergency principles with systems of ordinary differential equations. ZACHARIAS DISCHE : Formation of a triosephosphoric ester from hexosephosphoric esters by hæmolysed red blood corpuscles. FRANZ WERNER : Results of a zoological study and collecting expedition to the islands of the Ægean Sea. Descriptions of two new species, *Rhacocleis emmœ* and *Rh. anatolica*, and of *Platycleis sporadarum*, Brunner v. W. ALFRED BRUKL and KARL ZIEGLER : Rhenium oxybromides. The properties of the trioxybromide and the dioxybromide —the only known oxybromides of rhenium—are described. MARTIN GUSINDE and VIKTOR LEBZELTER : Craniometric investigations on skulls from Tierra del

Fuego. ALEXANDER ROLLETT and RUDOLF PETTER: β-Amyrin from Manila elemi resin (6): Resins and resin substances (9). ROBERT MÜLLER, H. KUMPFMÜLLER, E. PINTER and B. v. SEEBACH: Electrochemistry of non-aqueous solutions (9): Measurement of the E.M.F. of Ag–$AgNO_3$ concentration cells in nine organic solvents and comparison with the values calculated from conductivity measurements. ELFRIEDE ALMOSLECHNER: Yeast-growth substances in *Boletus edulis* and in urine. RUDOLF SIEBER: Palæobiological investigations on the fauna of the Rötelwand-Riff mass in the northern Osterhorn group.

Oct. 26. GUSTAV ORTNER and GEORG STETTER: Use of pure nitrogen for ionisation chambers. The use of nitrogen offers advantages over that of hydrogen or of the rare gases. GEORG KOLLER and KARL PÖPL: Capraric acid. The compound $C_{20}H_{18}O_9$ obtained by the alcoholysis of capraric acid is found to be identical with cetraric acid. KASIMIR GRAFF: Colorimetric review of the stars up to magnitude 5 between the north pole and 40° south declination. ANTON E. MAYER: Construction of the seven neighbour-regions (*Nachbargebiete*) on the torus. OTHENIO ABEL: Further contributions to the explanation of the creep-traces in the Greifenstein sandstone of the Wienerwald.

Forthcoming Events

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

Monday, January 8

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Capt. Guy Dollman: "African Antelopes".*

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—J. T. Sanderson: "An Expedition in British Cameroons".

Tuesday, January 9

PHARMACEUTICAL SOCIETY, at 8.30—(at 17, Bloomsbury Square, London, W.C.1). Prof. I. M. Heilbron: "Isoprene as a Fundamental Unit in the Synthesis of Plant Products".*

Thursday, January 11

UNIVERSITY COLLEGE, LONDON, at 5.30.—Prof. C. H. Best: "The Rôle of the Liver in the Metabolism of Carbohydrates and Fat" (succeeding lectures on January 15 and 18).*

Official Publications Received

GREAT BRITAIN AND IRELAND

Proceedings of the Royal Irish Academy. Vol. 41, Section B, No. 16: The Geology of North-Eastern Tyrone and the adjacent Portions of County Londonderry. By J. J. Hartley. Pp. 217–285+plates 13–18. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 3*s*. 6*d*.

Royal Society of Arts. Report on the Competition of Industrial Designs. Pp. 40. (London: Royal Society of Arts.)

Proceedings of the Royal Society of Edinburgh, Session 1933–1934. Vol. 54, Part 1, Nos. 1, 2: i. On Fitting Polynomials to Weighted Data by Least Squares; ii. On Fitting Polynomials to Data with Weighted and Correlated Errors. By Dr. A. C. Aitken. Pp. 16. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 1*s*. 6*d*.

Economic Advisory Council: Committee on Locust Control. The Locust Outbreak in Africa and Western Asia in 1932. Survey prepared by B. P. Uvarov. Pp. 74+11 maps. (London: H.M. Stationery Office.) 3*s*. net.

Transactions of the Royal Society of Edinburgh. Vol. 57, Part 3, No. 31: Studies on the Reproductive System in the Guinea-Pig; Post-Partum Repair of the Uterus, and the Associated Appearances in the Ovaries. By Thomas Nicol. Pp. 765–775+2 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 2*s*. 3*d*.

University of Bristol. Annual Report of Council to Court, 1932–33. Pp. 47. (Bristol.)

OTHER COUNTRIES

Bernice P. Bishop Museum: Occasional Papers. Vol. 10, No. 2: The Lizards of the Marquesas Islands. By Karl P. Schmidt and Walter L. Necker. (Pacific Entomological Survey: Publication 5.) Pp. 11. Vol. 10, No. 3: Cypraeacea from Hawaii. By F. A. Schilder. Pp. 22. Vol. 10, No. 4: Lysimachia, Labordia, Scaevola and Pluchea; Hawaiian Plant Studies, 1. By Harold St. John. Pp. 10. Vol. 10, No. 5: Cryptochirus of the Central Pacific. By Charles Howard Edmondson. Pp. 23. Vol. 10, No. 6: New Species of Amastridæ. By C. Montagu Cooke, Jr. Pp. 27+2 plates. Vol. 10, No. 7: Some Aliis of the Migratory Period. By Bruce Cartwright. Pp. 11. Vol. 10, No. 8: Notes on Pteralyxia. By Edward L. Caum. Pp. 24. Vol. 10, No. 9: The Exotic Birds of Hawaii. By Edward L. Caum. Pp. 55. (Honolulu.)

Obras Completas y Correspondencia Científica de Florentino Ameghino. Vol. 10: Mamíferos Fósiles de Patagonia y otras Cuestiones. Dirigida por Alfredó J. Torcelli. Pp. 870. (La Plata.)

Memoirs of the Geological Survey of India. Vol. 55, Part 2: The Geology of the part of the Attock District West of Longitude 72°45′ E. By Dr. G. de P. Cotter. Pp. viii+63–161+xvi+plates 11–19. 5.4 rupees; 8*s*. 6*d*. Vol. 64, Part 1: Barytes in the Ceded Districts of the Madras Presidency, with Notes on its Occurrence in other Parts of India. By A. L. Coulson. Pp. viii+142+xii+5 plates. 3.14 rupees; 6*s*. 6*d*. (Calcutta: Central Book Depot; Delhi: Manager of Publications.)

Whangpoo Conservancy Board. General Series, Report No. 10: The Hydrography of the Whangpoo. Fourth edition. Pp. v+80. (Shanghai.) 3 dollars.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 1: Mathematics, Astronomy, Physics, Chemistry. Vol. 2, Part 9: Sur la théorie du corps de classes dans les corps finis et les corps locaux. Par Claude Chevalley. Pp. 365–476. 1.40 yen. Section 3: Botany. Vol. 4, Part 2: Systematic and Anatomical Studies on some Japanese Plants. 2 (Juncaceæ). By Yosisuke Satake. Pp. 131–223+4 plates. 1.80 yen. (Tokyo: Maruzen Co., Ltd.)

The British South Africa Co. Publication No. 2: Mazoe Citrus Experimental Station Report for Period ending 31 December 1932. Pp. xx+192. (Mazoe: Citrus Experimental Station; London: British South Africa Co.)

The Bashford Dean Memorial Volume. Archaic Fishes. Edited by Eugene Willis Gudger. Article 5: The Natural History of the Frilled Shark *Chlamydoselachus anguineus*. By Eugene W. Gudger and Prof. Bertram G. Smith. Pp. 243–319+5 plates. (New York City: American Museum of Natural History.)

Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verhandelingen No. 24: Regenval in Nederlandsch-Indie (Rainfall in the Netherlands Indies). Door (by) Prof. Dr. J. Boerema. Deel (Vol.) 4: Kaarten van den gemiddelden jaarlijkschen en maandelijkschen regenval op Celebes (Maps of the Mean Annual and Monthly Rainfall in Celebes). 13 maps. (Batavia.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service: Fisheries Research Directorate. Notes and Memoirs, No. 1: Mémoire sur l'organisation des recherches des pêcheries. Par Dr. Hussein Faouzi. Pp. iii+16. Notes and Memoirs, No. 3: An Examination of Plankton Hauls made in the Suez Canal during the year 1928. By Dr. R. Macdonald. Pp. 11+1 plate. Notes and Memoirs, No. 4: Report on Fish Eggs and Larvæ taken during 1931. By Dr. R. H. Whitehouse. Pp. 22. Notes and Memoirs, No. 5: The Pharynx and Intestinal Tract of the Egyptian Mullets—*Mugil cephalus* and *Mugil capito*. Part 1: On the Food of Mullet from Egyptian Waters. By F. M. Ghazzawi. Pp. ii+18. Rapport sur les pêcheries d'Egypt en 1931. Par Dr. Hussein Faouzi. Pp. vii+119. (Cairo: Government Press.)

Japanese Journal of Astronomy and Geophysics. Transactions and Abstracts, Vol. 11, No. 1. Pp. ii+66+20. (Tokyo: National Research Council of Japan.)

Proceedings of the Imperial Academy. Vol. 9, No. 8, October. Pp. xxi–xxiii+347–460. (Tokyo.)

Conseil Permanent International pour l'Exploration de la Mer. Bulletin statistique des pêches maritimes des pays du nord et de l'ouest de l'Europe. Rédigé par D'Arcy Wentworth Thompson. Vol. 21: Pour l'année 1931. Pp. 79. (Copenhague: Andr. Fred. Høst et fils.) 3.00 kr.

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