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An Imperial Research Committee.

MOST of Britain's tropical possessions were acquired by accident rather than by design. The home government has never exhibited any particular anxiety to undertake the obvious initial responsibilities of the administration of new territories. It has left to poorly paid local administrative officers the task of meeting expenditure on the essential services out of taxation of the populations committed to their care. The efficiency of these officers is measured by the home authorities, not by the development of the potential resources of a country, not by the happiness, health, and growth of the native populations, not by any enterprise they display in fostering the introduction of new varieties of economic crops, but solely by their success in balancing their budgets. As a general rule, the governors have been "safe" conventional-minded men, unable even in a crisis to stir the home authorities into action.

The result of this attitude of conventional indifference to progress, to the possibilities of the applications of science to the development of the vast potential resources of Nature, is nowhere more strikingly exemplified than in British tropical possessions. After thirty years of British occupation, the agricultural implements principally used by the natives of East Africa are the stick and the hoe. In a country hungry for motor-spirit, the whole of the bye-products of an immense colliery are wasted. In territories where the distances between centres of administration are great, and the difficulties of maintaining telegraph wires are many, no attempt is made to establish wireless communication.

Years elapse before discoveries made in one territory regarding the new treatment of a human disease, yaws, for example, are communicated to the neighbouring administration. Although it appears to be definitely established that the shifting cultivation practised by the native populations, involving as it does the destruction by burning and ring-marking of the primary forests, is responsible for the impoverishment of the soil and the progressive desiccation of Africa, no serious attempt has yet been made to put a stop to the practice of grass-burning. In certain territories, cotton has been introduced and its cultivation fostered, but no adequate safeguards have been taken to prevent the distribution of dirty seed to the natives, with the result that preventable diseases have been introduced. In others, where richer cattle food would vastly improve the quality and efficiency of draught oxen, cotton seed is being burned for fuel at ginneries and molasses from local sugar factories is being wasted, both of which are valuable ingredients in cattle food.

The sudden enthusiasm of an administration for the increase of a particular economic crop might, by restricting the area under food crops, bring about a disastrous famine. This kind of enthusiasm might easily result also in the crops being planted in wholly unsuitable soils. The decision to raise taxes on a commodity might, as in the case of the salt tax in India, result in such a reduced consumption of a vital commodity that the efficiency of the population be greatly reduced.

Many other problems arise in dealing with the native populations. The sudden change in the traditional habits of a tribe, for example, the restriction of their freedom of movement from one site to another, might easily be responsible for an appalling outbreak of disease. Pastoral tribesmen, encouraged to work in factories and mines, are particularly subject to tuberculosis. The incidence of taxation on a tribe which is too remote from the transport system of the country to make the production of economic crops a practical proposition results too frequently in the male members of the tribe being forced to seek work in districts far removed from their homes. This has not only a bad effect on the birth-rate of the tribe, but results also in the introduction of disease on the return of the men to their homes. Even the prevention of tribal warfare is not an unadulterated blessing. The cessation of tribal warfare has led to a marked deterioration in the domestic stock of the natives, due largely to the lack of knowledge of animal husbandry among the natives. Then again, if natives from a grain-eating district migrate in search of work to a district where the natives subsist on ox-blood and milk or bananas, there is a great deal of debility due to digestive troubles.

It can safely be said that these and many other problems and possibilities are only just being realised by the administrations in our various tropical possessions; and we are further from the solution of most of the problems than we are from the appreciation of the possibilities of the economic development of the territories.

The recent announcement, therefore, by the Prime Minister, in a characteristically eloquent speech in which he paid a tribute to the enthusiasm of the late Lord Milner for research, that in appointing the Earl of Balfour as Lord President of the Council he was giving the people of Great Britain an earnest of the intention of the Government to see that the matters of co-operation and co-ordination in scientific work throughout the Empire should be regarded as the first work of a man peculiarly fitted for the responsibility, is particularly welcome. This announcement, moreover, was followed by another by Lord Balfour himself a few days later. In the course of the debate in the House of Lords on Kenya Colony on May 20, the Archbishop of Canterbury, referring to the scientific chapters of the "brilliant Report" of the East African Commission, pleaded for the "scientific inquiry into all the conditions of climate, soil, fauna, flora and population in all these [East African] areas" as recommended in the Report, and suggested that a certain percentage of the 10,000,000*l.* loan recommended for the development of the transport system of the territories should be "definitely devoted to such preliminary inquiries on a large and really worthy scale by competent men." In replying for the Government, Lord Balfour gave a clearer indication of its intention with regard to Imperial research.

Referring to the Report of the East African Commission, he asked, was it not clear from a study of that document that what was wanted was some machinery by which the larger problems which we now saw were presented to us by the vast area in East Africa, and other problems from other parts of the Empire, could be conveniently considered in their entirety? He stated that the Government is of the opinion that an institution bearing a resemblance to the Committee of Imperial Defence should be set up for dealing with the purely civilian problems which become more and more insistent in connexion with Imperial development. This body is to be the direct creation of the Prime Minister. It will advise the Cabinet, it will provide machinery for examining problems with which there is at present no Departmental method of dealing, and, having examined them and formed an opinion, the Cabinet will then have to decide upon the applicability of its recommendations to the necessities of the case and practical possibilities of carrying them out.

This sudden resolve of the Government, for which the scientific member of the East African Commission, Major Church, must be given no little credit, is made none too soon. The eyes of the civilised world are focussed on the British overseas territories. The attitude of dispossessed Germany and of certain of our commercial rivals is severely critical, and not without justification they consider that we have undertaken vast additional responsibilities with which our existing machinery of government is unable to cope. They consider also that among these responsibilities is that of developing the vast natural resources of the countries in our keeping.

The advantages of an Imperial Research Committee are obvious. Only those who have visited the colonies, and adjacent territories in a tropical country, can fully appreciate the isolation of the scientific workers in those territories, so complete that discoveries or activities in one territory are absolutely unknown in those adjacent to it. Then again, as is clearly indicated in the Ormsby-Gore Report, some administrations have not yet sufficiently understood or formulated their problems

to realise the services which their solution demands. Furthermore, there is no real existing over-riding authority which can effectively enforce the co-operation of the various administrations in a campaign against a common menace, be it tsetse-fly, pink boll-worm, rinderpest, or venereal disease. There are other advantages also. Unless Major Church had been a member of the East African Commission, very few of the local scientific workers would have been given the opportunity to express their views on the problems arising in the development of their respective territories. There is virtually no committee existing at the Colonial Office which acts at all adequately as a liaison and advisory body to colonial scientific officers. Still less is the present Colonial Research Committee in a position on its own initiative to make proposals embodying a research programme to the Secretary of State. It is true that the Imperial Institute does act as a consultative body to the Crown Colonies and some of the British Dominions, and that it gives advice when asked for it. But it is clear that what is envisaged, and what is needed, is an authoritative body which shall be in a position to formulate a policy and programmes for research without waiting necessarily for a stimulus from abroad.

From another point of view the proposal is most gratifying to the general body of men of science. In essence, it is a recognition of the all-important rôle of the scientific worker, not only in the development of the Empire, but also in the life of any community. We may eventually reach the stage in human development when workers in pure and applied science are at the top of the pillar of public esteem, when the fact is appreciated that science rightly used, and the scientific outlook, may not only save us from social disasters and material wants, but also lift us to hitherto unimaginable heights of life and illumination.

If the Imperial Research Committee is formed, and if it fulfils its proper functions, we shall be travelling a stage further along the road of progress. It is essential, therefore, that those of us who guard the interests of science and believe in the worth of scientific knowledge should watch with jealous care the selection of this Committee. We do not hesitate to suggest that included in this august body, charged with such grave responsibilities, should be the member of the East African Commission, to whose labours, in the main, the project is due. The Report of the Commission is made particularly distinctive from our point of view by its treatment of the scientific aspects of the problem of development of the promising territories surveyed, and the spirit of this statement is exactly what is wanted to inspire the work of an Imperial Research Committee.

River Regulation.

Regulation of Rivers without Embankments: as Applied in the Training Works at the Headwaters of the Rangoon River, Burma (locally known as the Myitmaka Training Works). By F. A. Leete, assisted by G. C. Cheyne. Pp. xii + 122 + 36 plates + 10 maps. (London: Crosby Lockwood and Son, 1924.) 30*s.* net.

THE practice of the science of river training and regulation is beset by so many difficulties, and success has often to be achieved in the face of obstacles and impediments of so intractable a character, that the suggestion that a river may be left to effect its own training is, at first sight, a little startling. One may even experience a slight feeling of incredulity in glancing at the title of the book forming the subject of this notice, which will be intensified, indeed, when it is found that the author includes within the term "embankments" all artificial aids to bank formation, with the exception of certain sticks of bamboo. At the same time, it must be observed that as the object of training works is to produce embankments of a permanent character, the signification of the word in the title is particular and limited.

Obviously, the title chosen is, in a sense, paradoxical, but the book certainly indicates a novel and ingenious method of river training, which is clearly demonstrated to be of the highest value and utility in the cases in which it has been employed. Before dealing with the limitations of its application, we will briefly describe the method itself.

The scene of the operations described is in Burma, among the headwaters of the Rangoon River. These streams, principally used and, in normal condition, highly serviceable for the transportation of logs of teak from the uplands to the coast, are fed by hillside torrents taking their rise in the range of mountains known as the Pegu Yomas, which form the eastern boundary of the watershed of the river Irrawaddy. These hills have an extreme altitude of about 2500 feet, and they are composed of very friable sandstones and shales. The rainfall varies from 60 to 120 inches, and during the monsoon period, when the precipitation is a maximum, the hill streams come down in high flood at frequent intervals, carrying immense quantities of sand and clay in suspension. Spreading themselves out, on reaching the foot of the hills, in a network of shallow and interlacing channels, the flood waters are dispersed over the plain, submerging the paddy fields and producing a series of swamps and *lahas* (the native term for tracts inundated annually). For log transportation, such a regimen is in the highest degree a source of trouble and expense. Before regulation was undertaken, very few logs found their way to the main

Rangoon River (locally known as the Myitmaka) without assistance; most of them were left stranded in the shallow channels, or scattered over the rice fields. Some were lost, others abandoned, and many were only retrieved at considerable labour by dragging them for long distances by means of elephants (Fig. 1).

FIG. 1.—Dragging of logs through mud by elephants. From "Regulation of Rivers without Embankments."

The condition of affairs appeared to be so hopeless in 1910, that sanction was given to a project for stopping the logs at the railway line and sending them on to Rangoon by rail.

It is superfluous to follow closely the history of the attempts at regulation. High embankments, successful enough but costly to construct, were succeeded by low embankments, also with satisfactory results, until the inspiration came, in 1917, that no artificial embankments at all were necessary. Observing the effect produced on the silt-laden stream by stranded logs and other debris, round which deposits accrued, the trial was made of a fencing of bamboo stakes along the desired line of embankment. The result fully justified the expectations which had been formed. The stakes became embedded in deposit, which

FIG. 2.—Bamboo stake fencing; usual type adopted since 1917. The stakes seen in picture originally stood 3 ft. out of the ground. From "Regulation of Rivers without Embankments."

gradually accreted to heights ranging up to 9 or 10 feet, or even more. Natural embankments were thus formed, completely defining the channel and keeping the stream within bounds.

For a fuller and precise description of the preliminary measures, we quote Mr. Leete's own words:

"The line along which it is desired to form the new channel is pegged out, and usually follows more or less the natural depression. All jungle growth to a width of 150 feet on each side of the line is cut down flush with the ground, and burned or cleared away. One hundred feet on each side of the line, simple bamboo fences are made. These consist of pointed bamboos, 5 to 6 feet long, driven into the ground about 9 inches apart, with their tops dressed to a steady slope and about 3 feet above ground level. These stakes are lashed to a horizontal rail, with coir rope, about 6 inches from their tops, to hold them in position (Fig. 2). Where this fence crosses side channels, the bamboos naturally stand higher out of the ground, and must be strutted to withstand the additional pressure at these points. Bad bends are eliminated by short cuts, protected by additional strutted fencing.

"During the early rises . . . the water tends to spread out over the country. It is at this time that the fences do their best work. They catch up the many kinds of small rubbish brought down on every jungle rise, and form a barrier checking the flow of the water. The check to the current causes it to deposit the heavier particles of sand on the stream side of the fence, the finer particles being carried beyond it. In this way, each rise serves to heighten the banks now forming, as well as to raise the level of the surrounding country."

In a very short time it is found that the stakes are completely embedded in the deposit which forms around them and spreads out over the area on both sides, so that considerable tracts are reclaimed for cultivation. When the first row of stakes are buried, a second row may be driven, but this is not often necessary. The river banks continue to accrete until the stream has formed for itself a channel large enough to contain practically the whole of its normal flood water (Fig. 3).

Although eminently successful under the conditions obtaining in Burma, it obviously does not follow that such training methods are of universal application. There are manifest limitations to their serviceability. They are essentially suitable in the case of streams originating as hillside torrents, and heavily charged with detritus and sandy silt; and then, chiefly, in their upper reaches. Considerable variation in water level and frequent overtopping of banks in the early stages are features of the course of channel formation, and when these characteristics are lacking, the method cannot be utilised, or, at any rate, not so effectively or with such striking results.

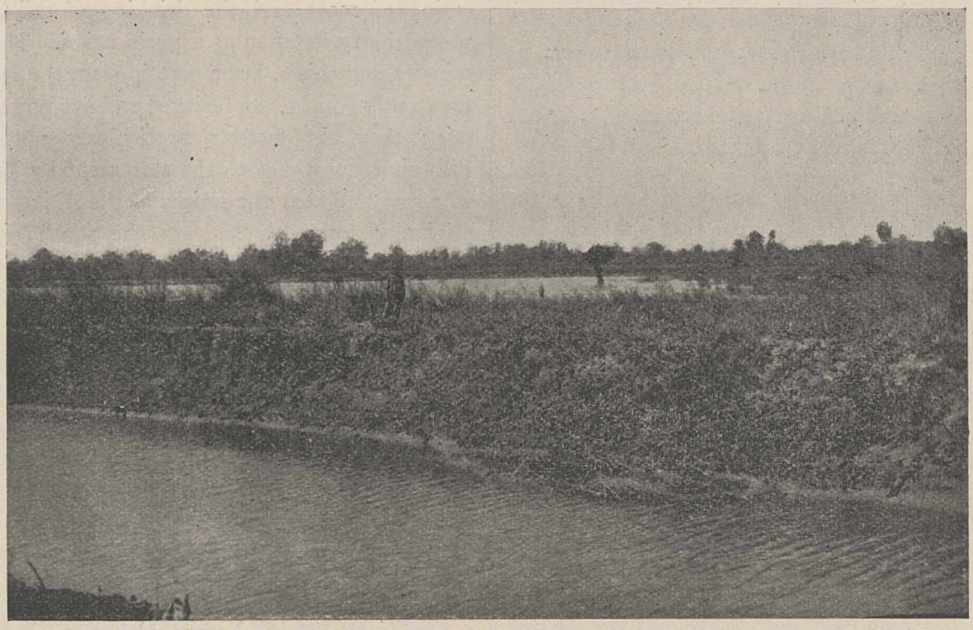

FIG. 3.—Shwele stream. 8 ft. banks only 3 years old. *Laha* water can be seen behind.
From "Regulation of Rivers without Embankments."

The process is, however, certainly a notable step in the development of the science of channel training, and further experience in its use will be watched with interest. The volume which we have had under review gives much local information of a helpful character to river engineers desirous of employing the method elsewhere, under conditions similar to those obtaining in Burma. There are ten maps, nine diagrams, and an abundance of photographs.

BRYSSON CUNNINGHAM.

Anthropology of African Tribes.

(1) *The Vanishing Tribes of Kenya: a Description of the Manners and Customs of the Primitive and Interesting Tribes dwelling on the Vast Southern Slopes of Mount Kenya, and their Fast Disappearing Native Methods of Life.* By Major G. St. J. Orde Browne. Pp. 284+16 plates. (London: Seeley, Service and Co., Ltd., 1925.) 21*s.* net.

(2) *On the Trail of the Bushongo: an Account of a Remarkable and hitherto Unknown African People, their Origin, Art, High Social and Political Organisation and Culture, derived from the Author's Personal Experience amongst them.* By E. Torday. Pp. 286+16 plates. (London: Seeley, Service and Co., Ltd., 1925.) 21*s.* net.

(3) *Fresh Tracks in the Belgian Congo: from the Uganda Border to the Mouth of the Congo.* By Hermann Norden. Pp. 303+30 plates+2 maps. (London: Witherby and Co., 1924.) 18*s.* net.

THE three books under notice all indicate the extraordinary rate of change that is taking place in Africa. Though Mr. Norden may be inclined to see "a step towards Utopia" in a Belgian industrial plantation, most thoughtful observers are alarmed by the effect of industrialism on black Africa. Mr. Norden noticed that, whereas his belongings had never been pilfered in the wilder parts of the Congo, when he approached "civilisation" locks became necessary. That, of course, is nothing when compared to the break-down of tribal custom and belief, with its accompanying loss of control which follows so quickly on contact with Europeans. Major Orde Browne is acutely aware of this grave danger, so that his book, (1) "The Vanishing Tribes of Kenya," will be of value to all who have to deal with natives either as government officials, missionaries, or settlers. What he has to say on the brideprice, initiation, trial by ordeal and government, is all eminently sound. His book is a careful, though not exhaustive, study of the tribes on the south-east slopes of Mt. Kenya, the Embu, Emberre, Mwimbe, and Chuka; all these tribes have suffered much influence from and admixture with the Meru, Akikuyu, and Akamba, but the Chuka are the most distinct stock and the least touched by foreign influence. As this is a serious anthropological study, it is to be regretted that a summary of the physical measurements taken has not been given in the book.

In some ways the Chuka seem to be a curiously negative people. They do not remember their own genealogies and have very little knowledge of their history. These two deficiencies are accounted for by their customs and beliefs. They have no chiefs, the government being vested in councils of elders similar to those of the Masai, though war leaders, through their personal prowess, may gain considerable eminence. Major Orde Browne says that there is no belief in a survival of any kind after death; he records no trace of ancestor worship; and corpses are left to be devoured by hyenas. Considering the importance of the ancestral spirit in every department of life among the Akamba and the Akikuyu, and assuming that Major Orde Browne has not been misled, this negative side of Chuka belief may be due to their Meru ancestry. The Meru are related to the Masai, among whom ancestral spirits appear to be relatively unimportant, and only the chiefs are buried. Like the Masai, the Chuka drink blood and milk mixed, but three months must elapse between the eating of meat and the drinking of milk, unless a special berry is taken as a purification. There are no rain-making chiefs, but a certain clan, the Ithaga, who are mostly smiths, are believed to have power over the rain; they also possess particularly potent curses. This gives substance to the statement by Mr. Hobley, who was told that the smiths of the Akikuyu all came originally from Ithanga, on the south side of Mt. Kenya ("Bantu Beliefs and Magic," p. 167). Akikuyu smiths can also inflict powerful curses. The system of *thahu*, ceremonial uncleanliness, which pervades Chuka life, is essentially the same as that of the Akikuyu. A man may become *thahu* for a variety of reasons, many of which seem trivial to the European; in spite of this there is no doubt that tribal morality is dependent on this system, for the most potent weapon of the council of elders is their curse, which renders a man *thahu*. This book is of value and deserves a better index.

(2) Mr. Torday's book will appeal both to the general reader and to the anthropologist. There is plenty of adventure, gaily told; there are stories of cannibals, pigmies, gorillas, and natives who, not having met Europeans before, seemed to have no desire to make their acquaintance. Mr. Torday, however, was of a different mind; he wanted to know the various natives of the Congo, and succeeded in great measure. About fifteen years ago he was the first white man to stay in the Bushongo capital. He made friends with the king, prime minister, and other court officials, including the official historian. His researches into the history of these people disclosed a list of 121 successive kings, and the fact that, during the reign of the 98th, there had been an eclipse of the sun, enabled him to fix the date of that reign at 1680.

The account of these highly organised, peaceful, and industrious people is fascinating; their arts and crafts are probably the finest in Africa. Tall individuals with refined Hamitic features are conspicuous among the aristocrats in general, and especially those of the

royal clan, the Bambala, forming a contrast to the common Bantu population. Tradition relates that the first Bushongo king came from a far country in the north, and that in the journey to their present home the Bushongo crossed four great rivers. Mr. Torday has produced considerable evidence to show that this tradition is correct, and further, that Hamitic invaders from the neighbourhood of Lake Chad came south some time in the sixth century, conquered the Bantu inhabitants, who were closely akin to the Baluba, and founded the Bushongo nation. Mr. Torday saw reason to suppose that, between the Kasai and Loange rivers, he would find among the Bakongo and Bashilele a people similar to the original Bambala, before their admixture with the Baluba. The country had never been visited by white men before and was hostile to strangers; his adventures in this region make good reading, but, on account of the hostility and suspicion aroused, ethnological work was scarcely possible, and he failed to discover the evidence he was seeking. He was, however, rewarded by finding a high percentage among the Bashilele with Hamitic features.

(3) Returning to Mr. Norden's book, we learn that the author travelled from Lake Tanganyika to the Atlantic, and that he stayed in government stations, plantations, missionary stations, mining centres, and native villages, upon all of which he makes remarks with an extreme naïveté. Whereas he was able to make first-hand observations on the government's servants, missionaries, and traders personally, his comments on the natives are culled either from these former, or from the explanations of his boy, Pierre, and suffer accordingly. Thus, of the Bushongo, he states that the Lukango is the king, but the Nyimi is the supreme judge. As a matter of fact, there is no trace of such a division of function, both of which are held by the Nyimi; Lukango is the Balabu title for the Nyimi. The government of this nation was fully investigated by Mr. Torday and published in his "Notes ethnographiques" (Bruxelles, 1910), and it is to be regretted that Mr. Norden has failed to add to our knowledge of these interesting people.

BRENDA Z. SELIGMAN.

Schools of Psycho-Analysis.

Sigmund Freud: his Personality, his Teaching, and his School. By Fritz Wittels. Translated from the German by Eden and Cedar Paul. Pp. 287. (London: G. Allen and Unwin, Ltd., 1924.) 10*s.* 6*d.* net.

THIS critical history of the psycho-analytical movement, as seen from within by Dr. Fritz Wittels, is of necessity, and admittedly, biassed by his own temperament. He describes how five years of friendship with Freud was followed by an estrangement, which, however, has not prevented Freud from acknowledging the merits and pointing out the drawbacks of the book in a letter from which extracts are reproduced as an introduction. A biography is combined with a running criticism of Freud's views as their development is described, and the personal conflicts are traced that led in turn to the secessions of Jung, Adler, and Stekel, for the last of whom the author expresses an admiration which obviously influences his own opinions. The picture he draws of the faithful disciples who will recognise no other authority than Freud, and of the dissentients who became outcasts from the fold, has few likenesses in the history of science. The pioneer psycho-analysts were surely not like other people, and for this a glance at the history of the movement offers explanations. The contumely and abuse that fell upon them ensured the selection of those careless of the opinion of the herd, whilst the slighted herd instinct demanded in turn the formation of a defensive sect. The absence of effective criticism free from emotional bias aided the isolation from, and contempt for, the outer world of science and medicine.

That psycho-analysts have resigned themselves to this condition of affairs is perhaps the most unfortunate outcome of the position. Wittels notes the resemblance between the schisms of the psycho-analytical schools and those of the early Christian sectaries, and in himself carries the resemblance a stage farther. Nothing matters to him except these schisms; no opposition to Freud exists but from the seceders; the world consists of believers and dissenters on one hand, and of Turks, infidels, and heretics on the other, and the latter do not count. That Freud himself did not willingly accept the position is shown by his remarks during the Nuremberg congress in 1909: "It is absolutely essential that I should form ties in the world of general science. I am getting on in years, and am weary of being perpetually attacked."

For the ordinary reader of this book—which gives an outline of Freudian theory as approved by Dr. Wittels—there will be difficulty in separating science from art, observation from deduction, accepted theory from individual speculation, and it is indisputable that the same difficulty will meet him in many books on psycho-analysis. Yet it is desirable that psycho-analysis should be subject to the canons of science, and on p. 54 the author indicates a starting-point at which scientific judgment may be applied. He declares that the psycho-pathologist can find in the unconscious an adequate cause for neurotic anxiety and can demonstrate it to others. The statement is definite, and there are many psycho-pathologists who will support it; that

the primary basis of anxiety is the sex instinct in some pathological development is likewise a question that may be scientifically approached in an atmosphere free from the dust of prejudice. The barrier that Dr. Wittels accepts as part of the natural order of things must be broken down in the interests of science and medicine as well as of psycho-analysis. M. C.

Our Bookshelf.

Bituminous Substances: Scientific Progress of Practical Importance during the last Fifteen Years. By Dr. Percy Edwin Spielmann. Pp. xvi+206+8 plates. (London: Ernest Benn, Ltd., 1925.) 15*s.* net.

BITUMINOUS substances are here interpreted as "asphalt" in its varied form and utilisation, but the treatment of the subject is essentially physico-chemical, wherein this volume differs as a text-book from its predecessors.

The complexity of the chemistry of petroleum, more particularly its products of high boiling point and molecular weight, is well known, but the chemistry of asphalt is the least understood of all. For this reason it was a bold effort to compound in a small volume the essence of our knowledge, so far as it has progressed, of the constitution, properties, effects of heat, ageing and solvents, critical physical and chemical tests and behaviour under diverse experimental and practical conditions, of this remarkable substance. From the earliest times (according to the author, 12,000 years ago) there are isolated references to the utilisation of bitumen in the service of man, chiefly as an adhesive material; history further shows that throughout the progress of civilisation, man availed himself of this natural product without in the least understanding its true nature and composition. To-day we recognise extended uses of bitumen, but theory still lags far behind practice, and our knowledge of its chemistry, as indeed our methods of investigating it, are mainly empirical, if not actually arbitrary.

In "Genesis of Petroleum" the author revealed his knack of extracting successfully the pith of published work from many sources (often inaccessible to most people), and of presenting it in the form of a coherent summary of progress; in the present work he does much the same thing, supplementing data thus obtained with results of personal research and that of his former colleagues. One cannot but welcome a book of this description, even though it must be regarded as an interim report and be subject to the limitations of such publications. H. B. M.

Money Scales and Weights. By T. Sheppard and J. F. Musham. Pp. vi+221. (Hull: A. Brown and Sons, Ltd.; London: A. Brown and Sons, Ltd.; Spink and Son, Ltd., 1924.) 10*s.* 6*d.*

THE versatile curator of the Hull Museums has collated in this volume the notes on coin scales and weights—mainly with reference to the unique collection in his charge—which have appeared during recent years in the *Numismatic Circular*, together with a few addenda. Mr. Musham has added a descriptive catalogue of the comprehensive series of English coin weights collected by him and acquired by the Hull Corporation. The result should be of interest to the collector and the antiquary. As a reference work, however, its usefulness would be much enhanced by the addition of a general index and a bibliography and by a careful editorial revision. One would expect the scales to be grouped according to their principles of construction, whereas the *fundamentum divisionis* that has been selected is the structure and decoration of their cases. The descriptions of the various scales are disparate and contain much needless repetition. Dates are sometimes assigned without any apparent evidence; the balance described under No. 151 is given the date 1765, but the patent for it was not granted until 1774. The word "crescentric" is persistently used for "crescentic."

A chat with a practical scale-maker would have facilitated clearer description and obviated, for example, the use of the term "oil-caps" for balance bearings (pp. 75, 79, etc.). The importance of the nature of these bearings does not seem to have been grasped, nor is investigation made as to the probable degree of accuracy with which the instruments may have fulfilled their functions. The illustrations are copious and good, but the explanatory diagram on p. 31 suffers from excessive reduction.

Text-book of Cellulose Chemistry: for Students in Technical Schools and Universities as well as for Cellulose Experts. By Prof. Emil Heuser. Translated from the second German edition by Clarence J. West and Gustavus J. Esselen, Jr. Pp. xi+212. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 12*s.* 6*d.* net.

THE literature of the chemistry of cellulose is prodigious in quantity and very variable in quality, and bits of it may be found in anything from treatises on tropical agriculture to the prospectuses and reports of limited liability companies. Attempts have been made to collect it all between one pair of covers, but these have mostly resulted in tomes for reference rather than in books for students. With the development of technical education it has apparently been found necessary to teach students connected with the textile, paper, and other industries something about the chemistry of their common raw material—cellulose—and hence the demand for a text-book such as that under review.

Bearing in mind the extent and character of the literature to be dealt with, Prof. Heuser has been remarkably successful in bringing the data into some sort of order and compressing them into reasonable compass. British chemists will, however, be somewhat surprised to find how small a part the British contribution to knowledge of the chemistry of cellulose, both on the scientific and the technical sides, plays in Prof. Heuser's story. This feature of the book seems to have struck the translators, and in the chapter on the constitution of cellulose they have felt it necessary to insert a note describing some of the very important work on this subject done by Hibbert in the United States and by Irvine and his collaborators in Great Britain. Work on cellulose esters is so voluminous that the author is perhaps not unreasonable in devoting 47 pages to it and only 8 to cellulose ethers, though the latter may be much more important in their bearing on the constitution of cellulose than the former. T. A. H.

The Psychology of the Unadjusted School Child. By Dr. John J. B. Morgan. Pp. xi + 300. (New York: The Macmillan Co., 1924.) 9*s.* net.

THIS is a valuable addition to the literature of the psychology of education and should be read with great profit not only by professional psychologists and teachers, but also by every one who is interested in that most artistic of the arts—character-building. The work is, in a sense, a study of individual differences that are emphasised almost to the point of being abnormalities, and an attempt to trace these to their causes.

After a section discussing the nature of mental disturbances, five sections follow in which various ways of adjustment or mal-adjustment with reality are lucidly, simply, and accurately sketched out. There is the direct struggle and compromise with reality in its various forms. This is treated in some detail, and always with practical and useful suggestions for the teacher or parent as to how the growing mind should be helped in its process of adjustment, and not hindered, as is often the case—even up to the point of fostering mal-adjustment—by the treatment it receives at their hands. Section vii. contains a chapter upon the prevention of abnormalities of character. This is not, and cannot be in the present state of our knowledge, final or exhaustive; but it is all on the right lines, and follows such principles as have already been established by psychology.

The main conclusion which is reached by Dr. Morgan is that, since education is not merely the imparting of information, but also the formation of character, it is not the technique of teaching, but an understanding of human nature which can only be obtained by studying mal-adjustments that is needed by the teacher. Conflicts begin early in life; and mal-adjustments take root and grow readily. To prevent them, or to root them out before they have had time to consolidate themselves, is really the highest privilege of the teaching profession, a privilege which the teacher should understand how to exercise.

Fundamentals of Vocational Psychology. By Prof. Charles H. Griffitts. Pp. xiii + 372. (New York: The Macmillan Co., 1924.) 12*s.* net.

THE problem of vocational guidance is that of ascertaining the special aptitudes of any individual for a given trade or profession. Accordingly its solution lies in a study of individual differences in such a way that they may be practically determined in any given case. Much attention has been given by psychologists to this matter of late, and Prof. Griffitts' book contains an excellent presentation of vocational psychology so far as it has been yet worked out. Physiognomy is discussed at great length as an indication of aptitudes; but the conclusion is reached that inferences from it are of little validity, and the interview is emphasised as the best guide in the selection of employees and, generally, in vocational advising. The psychological aspects of the interview are carefully presented, and rating scales with regard to character dealt with. As supplementary to the interview, tests are recommended as "devices which under certain conditions give results which are valuable to the interviewer."

It will be seen that the author is not one of those who expect everything from tests in the present immature state of this department of applied psychology. Indeed, he recommends great caution in their use. A number of tests are given in detail as to methods and technique; but the reader is reminded that there can be no applied psychology without a background of sound theory; and, in consequence, general psychological principles are emphasised throughout.

Rejuvenation: the Work of Steinach, Voronoff, and Others. By Norman Haire. Pp. 223 + 2 plates. (London: G. Allen and Unwin, Ltd., 1924.) 7*s.* 6*d.* net.

THE author set himself the task of writing a book that should make the subject of rejuvenation intelligible to the educated layman and yet be sufficiently technical to satisfy the medical reader in search of a general statement of the subject. He has succeeded in his attempt. The book can be recommended to those to whom it is addressed. A layman seriously seeking information will find in it a fair statement of the facts concerning the operative methods by which rejuvenation is attempted and a trustworthy analysis of the results of the work that has already been done in this particular field. Its great value to the medical man is that it gives a review of the whole subject and guides one to deeper reading.

A very complete list is given of the recorded cases, both in animals and man, and the relative merits of vasoligature, gonad implantation and irradiation are discussed. The American and Continental literature has been well searched and the records tested against the author's own case-histories. The author points out that the earlier reports emphasise specially the sexual rejuvenation, and maintains that in the human beings this is by no means the most important or most striking result of the operation.

The Extra Pharmacopœia of Martindale and Westcott. Revised by Dr. W. Harrison Martindale and W. Wynn Westcott. Eighteenth edition, in 2 vols. Vol. 1. Pp. xxxviii + 1163. (London: H. K. Lewis and Co., Ltd., 1924.) 27*s.* 6*d.* net.

THIS book is well known to all British pharmacists and medical men, and the frequency with which new editions have to be issued is sufficient indication of its trustworthiness as a work of reference to the enormous number of drugs, chemicals, and ingenious combinations of these now used in medicine. It is more than four years since the last edition was published. In the interval, many advances have been made in the treatment of disease, and the authors have shown their usual skill in selecting from the pharmaceutical and medical literature that accumulates during such a period those items that are likely to be of permanent value. While full attention is given in the new edition to such important subjects as the use of insulin in diabetes, the treatment of syphilis with preparations of bismuth, new synthetic remedies for trypanosomiasis, and new methods of dealing with leprosy, the numerous small advances in medicine and pharmacy by which constant progress of a less striking character is being made, are not neglected.

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.*]

Ether-drift and the Relativity Theory.

THE brief messages in the daily press with regard to Prof. D. C. Miller's experiment have aroused much interest and bewilderment; it is therefore of great value to have Dr. Silberstein's authoritative account in NATURE for May 23. Comment on the experiments themselves would be out of place until the details are published; but it may not be premature to point out that the surprising hypothesis of ether-drift, by which it is proposed to account for the results, is disproved in advance by the daily measurements at astronomical observatories. These measurements constitute a test for differential ether-drift much more delicate than the Michelson-Morley experiment.

According to Dr. Silberstein's summary, the ether is gliding over the earth at a speed which increases from about zero at ordinary ground-level to 10 km. per sec. at the summit of Mt. Wilson. There is thus a rapid rotational motion of this part of the ether. So early as 1845, Sir George Stokes showed that in order to conform with the astronomical facts of aberration the motion (if any) of the ether must be *irrotational*.

The difficulty is seen vividly if we consider the curvature of a ray of light coming to us from a star, taking account of this ether-flow. A ray which is vertical at the summit of Mt. Wilson will on reaching sea-level have an inclination of 7″. Thus observations of absolute star-position at mountain observatories and at sea-level will be discordant by amounts of this order. An error of the order 7″, variable according to the time of day, would play havoc with fundamental astronomy.

The Michelson-Morley experiment was originally performed because it was thought—mistakenly, as we now realise—that it would measure *absolute* ether-drift. For many years it was in sole possession of this field of inquiry. In the new application to *differential* ether-drift it is invading a field in which the facts have long been established by delicate observations, and it is difficult to regard it as a serious competitor.

A. S. EDDINGTON.

Observatory, Cambridge,
May 25.

The Faraday Benzene Centenary.

IN a recent letter (NATURE, April 18), I ventured to counsel chemists to go back to the land—to study Faraday. Since then, in the *Times* (May 16), I have urged that Faraday's great discovery of benzene, one hundred years ago, should henceforth be commemorated on June 16, the day on which it was communicated to the Royal Society of London. Surely we should make this a saint's day in our chemical calendar. The public has its Saint Lubbock's days, for the mere purpose of resting from its labours—in days when labour is beginning to be regarded as a work of supererogation. Why not a chemists' rest-day for the purpose of contemplation: to give emphasis to our recognition of the importance of Faraday's discovery and its astounding consequences: more particularly, as an outward and visible sign of our belief in the method we wield in our search for truth?

As an analytical achievement and as an astounding demonstration of the power of the human intellect to penetrate into the mysteries of matter, the great benzene chapter in organic chemistry, built upon the foundations Faraday laid, may be ranked above all others. It is for chemists to show that our science of chemistry has a mission in society—to make, at least, its simple principles understood. This we must do, if workers in any way believe that the method they wield is of moral significance and not a mere means of dissecting Nature.

It is clear that the politicians are not with us and that even industry has but a half-hearted belief in our ability to serve it. That the public do not understand us is certain. Our nation is behind other nations in appreciation of the work done by the scientific inquirer and its value to society. An occasion like the approaching centenary would command wide sympathy abroad but ordinary engagements will come before it with our politicians. We owe it to ourselves to break down the barriers of ignorance, there in large measure because of our constant disregard of opportunity and our failure to cultivate public attention and appreciation.

At whatever effort, chemists are called upon to give proof, at the approaching centenary celebrations, that they, at least, can appreciate the spirit in which Faraday led the way in the battle against ignorance, as an exponent of the laboratory method and as a philosopher. The advice he tendered, best studied in his writings and in the striking biography we owe to Bence Jones, is of incomparable value. It were well if we had a book of excerpts of his sayings, to guide us in our moments of weakness and keep us in the straight and ever narrow path of scientific rectitude. The poets have their anthologies: why not the philosophers?

Let us, at least, now show that we are not wanting in public spirit in our own cause.

HENRY E. ARMSTRONG.

Depth-recording with Plankton-nets.

THE concise account given by Mr. F. S. Russell in NATURE of April 25, of the behaviour of ring-trawl nets when towed, enables an attempt to be made to solve the paradox of his diagrams. The shape of the warp during each haul may be compared with an imaginary catenary of reference. For this purpose the resistance of the net may be replaced by a horizontal force acting at the lowest point of an imaginary warp constituting a true catenary, and use may be made of Mr. Russell's observation that it is the practice to keep the angle of entry of the warp into the water constant at 40° With a constant angle of 40°, the ratio of *bight* to *dip* of a true catenary is 5·4954, and the ratio of *span* to *dip* is 4·9955, bight and span being measured between supports at a common level. In terms of these two constants, and of the particulars of the wire-rope, may be calculated the tension at the winch, the tension at the lowest point of the catenary, and the resistance of the warp through the water. Moreover, from the given particulars of the net an estimate may be made of its resistance for any required speed. Then, by equating the expression for this resistance, to the tension at the lowest point of the catenary, the speed through the water may be estimated. At high speeds there would be disturbances; but as Mr. Russell states that the engine was run "dead slow," there is sufficient probability of an approach to a solution that will not encroach too far into the region of piscatorial credulity, to justify this method of interpretation.

From the dimensions given on p. 603, the resistance of the net may be judged to be about 68 K^2 lb., and the resistance of the 2-in. steel-wire rope to be about 0·76 K^2 lb. per fathom, where K is knots. In the table, the results of the calculations are arranged in the same order as the hauls in Mr. Russell's diagrams, Figs. 1, 2, and 3 here repeated.

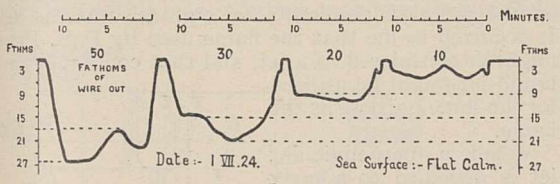

FIG. 1.

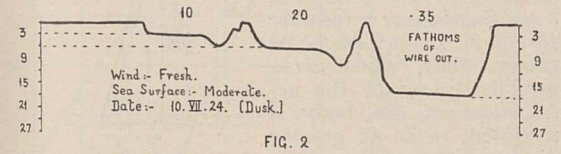

FIG. 2

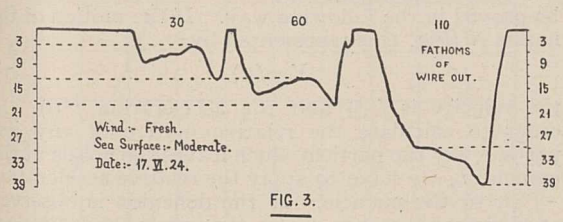

FIG. 3.

FIGS. 1, 2, and 3 are tracings of records obtained during three series of hauls. Each haul, represented by a curve, is of ten minutes' duration (time of "shooting" and "hauling" not included). The net enters the water on the right-hand side of each curve. Above the curve for each haul is inserted the length of wire used, in fathoms.

instrument for recording depths was working perfectly. Consequently the anomalies referred to by Mr. Russell are to be attributed primarily to variations of speed throughout a haul. At low speeds these changes of speed are probably large compared with the speeds. There were also changes of angle. Column 10 is only a rough estimate, but the general character of the warp-resistance is demonstrated.

If further tests are carried out, it might be possible to obtain direct measurements of tension at the winch for comparison with Column 6. A note on speeds would also be useful for comparison with Column 8. It would be an easy matter to prepare tables in a similar manner for a useful range of angles and lengths of warp. ROLLO APPLEYARD.

April 30.

The Origin of Adaptations.

LAST December, before the American Society of Zoologists, Prof. M. F. Guyer delivered an admirably lucid and well-reasoned address entitled "Soma and Germ." Near the end he says (*American Naturalist*, March-April, 1925):

"The fact is that biologists have never yet hit upon an explanation of the marvellous adaptedness of organisms to their environment which does not put a tremendous strain upon our credulity. And when we view it with unprejudiced eye it seems to me that the theory which would attribute adaptation to the mere accumulation of such chance variations as happen to be favourable is the most incredible of all. Time and again in the past, according to paleontologists, whenever new possibilities for existence occurred, forms of life admirably adapted to those conditions have come to occupy the new habitat. In some way the environment has moulded these new inhabitants to its bounds, and it takes more faith than I personally possess to believe that it has all been done by the negative method of killing off, generation after generation, the non-conformists—those in which the happy accidents, or rather the innumerable interrelated series of accidents, has not occurred."

(1) Length of Warp.	(2) Whole Bight of Catenary.	(3) Calculated Dip. $\frac{\text{Bight}}{5\cdot495}$.	(4) Observed Dip. From Figs. 1, 2, and 3.	(5) Calculated Whole Span of Catenary. $4\cdot995\times$ dip.	(6) Calculated Tension at Winch. $t=10\cdot25\times$ dip.	(7) Calculated Tension at lowest Point of Warp. $t_0=7\cdot86\times$ dip.	(8) Calculated Speed. $K=\sqrt{\frac{t_0}{68}}$.	(9) Calculated Resistance of Net. $68\ k^2=t_0$	(10) Calculated Resistance of Warp. $0\cdot76\ K^2L$.
L. Fathoms.	Fathoms.	v Fathoms.	Fathoms.	Fathoms.	lb.	lb.	Knots.	lb.	lb.
10	20	3·64	1·5 to 7	18·2	37·3	28·6	0·65	28·6	3·2
20	40	7·28	9 to 11	36·4	74·6	57·2	0·92	57·2	12·8
30	60	10·9	15 to 21	54·5	112	85·7	1·12	85·7	28·9
50	100	18·2	18 to 27	90·9	187	143	1·45	143	80·0
35	70	12·7	18	63·4	130	99·8	1·21	99·8	39·3
20	40	7·28	6 to 9	36·4	74·6	57·2	0·92	57·2	8·5
10	20	3·64	3 to 7	18·2	37·3	28·6	0·65	28·6	3·2
110	220	40·0	29 to 39	199·8	410	314	2·15	314	387
60	120	21·8	13 to 19	108·9	223	171	1·58	171	115
30	60	10·9	5 to 13	54·5	112	85·7	1·12	85·7	28·9

Comparing columns 3 and 4, the calculated dips are seen to be in agreement with the corresponding average of the observed dips, except in the third haul, which happens to be also the one singled out by Mr. Russell as an example of a "bad" result. Fortunately, the tenth haul is identical with the third in length of warp, and in this instance the dip indicated by the imaginary catenary, Column 3, is fairly representative of the observed average, Column 4. It may be inferred that the Admiralty

Without disputing the extraordinary importance and interest of Prof. Guyer's researches we may, I think, present certain considerations which should qualify his conclusions. Presumably it is agreed that alterations in the germ-plasm, which find expression in heritable variations, are caused in some manner—that is to say, are part of a connected sequence of events. The question is, whether the causative agents, whatever they may be, are purposeful in the sense of being directly related to the

functional significance of the resulting changes. Prof. Guyer appears to think so, because in his view the development of adaptations in so many organisms and in such diverse ways makes any other view too great a strain on credulity.

Many others have held similar opinions. The distinguished entomologist, the Rev. Wm. Kirby, wrote in 1800 :

" This visible world, by types indeed and symbols, declares the same truths, as the bible does by words. To make the naturalist a religious man, to turn his attention to the glory of God, that he may declare his works, and in the study of his creatures see the loving kindness of the Lord, may this in some measure be the fruit of my work."

Because scientific men are no longer accustomed to use such phraseology, they overlook the fact that such writers as Kirby were not expressing mere conventional piety, but were stating what they regarded as profound truth properly deducible from their researches. The contrary view, that things happened by " chance," was as difficult for them to believe as it is for Prof. Guyer. No one who thinks deeply can altogether escape convictions of this sort, and the mind is wholly baffled in attempting to connect the higher flights of the human intellect with the ordinarily understood products of metabolism. But while thus confessing sympathy with Prof. Guyer, and no less with the Rev. Wm. Kirby, it may be well to consider " with unprejudiced eye " what are the real findings of palæontology.

The recent work of the physicists has enormously increased our estimates of geological time. The significance of this for biology has not yet been fully grasped. Evolution has been a process of extraordinary slowness. Modern work on extinct animals and plants, as shown by their remains, emphasises the amazing permanence of structures. Consider first the limited number of fundamental tissues which go to make up animals. Then, when we study fossil insects, plants or molluscs, we find indeed great numbers of species, but these developed largely by a sort of shuffling of characters, with surprisingly little that is new even in millions of years. Mammals have evolved much more rapidly, yet we who contemplate the results are always prone to speed up mentally the process, after the fashion of the cinema. Palæontology also teaches that innumerable forms have failed to become adapted, and have died only locally or entirely. In short " admirably adapted " species have *not* appeared " whenever new possibilities for existence occurred," but have developed here and there, during vast periods of time, naturally accumulating on the earth and filling it with beings whose origin baffles our imagination. In the long run, and at the sacrifice of innumerable lives, Nature scores an amazing success, but our impatient thought cannot tediously follow the process. The contrary view, that the germplasm is permanently altered as easily and significantly as Dr. Guyer seems to postulate, is the one which strains our credulity, because it should apparently give us modifications far more rapid and purposeful than the observed facts indicate.

T. D. A. COCKERELL.

University of Colorado,
Boulder, March 17.

The Jet-wave Accelerometer.

IN the issue of NATURE of April 11, p. 530, Prof. Paul Kirkpatrick has, under the heading " Absolute Seismometry : a New Method," described a device in which a liquid jet is used for the recording of the motion of a body.

A similar apparatus, the jet-wave accelerometer, has during the last year been studied in my laboratory. I think I may, therefore, be able to throw some light on the subject in question, and especially on the problem : What is actually recorded by the jet ? I may mention that it was a paper by Prof. K. Prytz, " L'accélération mesurée au moyen d'une flamme " (*Le Journal de Physique et le Radium*, Sér. 6, 4, 1923), which caused me to take up the investigations on the jet-wave accelerometer eighteen months ago. It occurred to me that the flame used by Prof. Prytz might be considered as a jet, and that consequently a liquid-jet might be utilised for the same purpose as the flame.

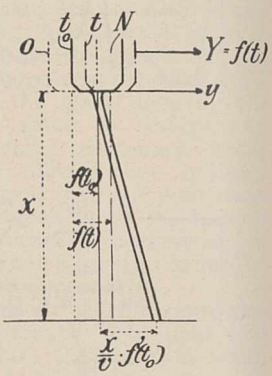

FIG. 1.

When a perpendicular jet is attached to a body moving to and fro in a horizontal direction, we may ask, *What is recorded by the relative deflexion of the jet at a certain distance x from the jet-hole ?* It may easily be shown that, when x is sufficiently small, the *acceleration* of the body is recorded, while at greater distances the *velocity* of the body is traced.

The first statement may be proved in the following way. If the motion of the nozzle N (Fig. 1) is represented by

$$Y = f(t) \quad . \quad . \quad . \quad . \quad . \quad (1),$$

the velocity is $f'(t)$ and the acceleration $f''(t)$. In order to calculate the relative motion of any jet-particle, say the particle which leaves the nozzle at the moment t_0, we have to apply the relative acceleration $-f''(t)$ to the particle. If the deflexion is observed at so short a distance x from the nozzle that $f''(t)$ does not alter essentially in the time used by the particle to travel through x, then the deflexion y is determined by

$$\frac{d^2y}{dt^2} = -f''(t_0) \quad . \quad . \quad . \quad . \quad (2),$$

from which we get

$$y = -\tfrac{1}{2}(t-t_0)^2 f''(t_0) = -\tfrac{1}{2}\left(\frac{x}{v}\right)^2 f''\left(t-\frac{x}{v}\right) \quad . \quad (3),$$

v being the velocity of the jet. Thus, y records the acceleration with a delay of x/v, *i.e.* the time for the particle to move from the nozzle out to the distance x.

The second statement above is directly verified by an inspection of Fig. 1. From this figure it is seen that the deflexion at any distance x is given by

$$y = \frac{x}{v} f'(t_0) - [f(t) - f(t_0)] \quad . \quad . \quad . \quad (4).$$

When the deflexion is due to a vibratory motion, the quantity $[f(t) - f(t_0)]$ will ultimately, as x increases, become insignificant compared to $\frac{x}{v} f'(t_0)$, and then the deflexion may be written

$$y = \frac{x}{v} \cdot f'(t_0) = \frac{x}{v} f'\left(t-\frac{x}{v}\right).$$

The deflexion thus records the velocity $f'(t)$ with a delay x/v.

In Fig. 2, θ denotes the variation with time of the angular deflexion of a pendulum, with a period of about 3·3 sec., while y represents the relative deflexion of a water-jet attached to the pendulum and *sheltered* against the air-resistance. The deflexion was considered 9 cm. below the nozzle, and the level of the

water in the reservoir was 2 cm. above the nozzle. The y-curve was calculated from all the relative accelerations acting on the jet, *i.e.* the radial, the tangential, and the Coriolis acceleration. By means of a device which cannot be described in this paper, the moment of the passing through zero of the jet and the amplitude of the oscillations of the jet could be observed with a fair degree of certainty. The observations fell within the intervals indicated in the figure

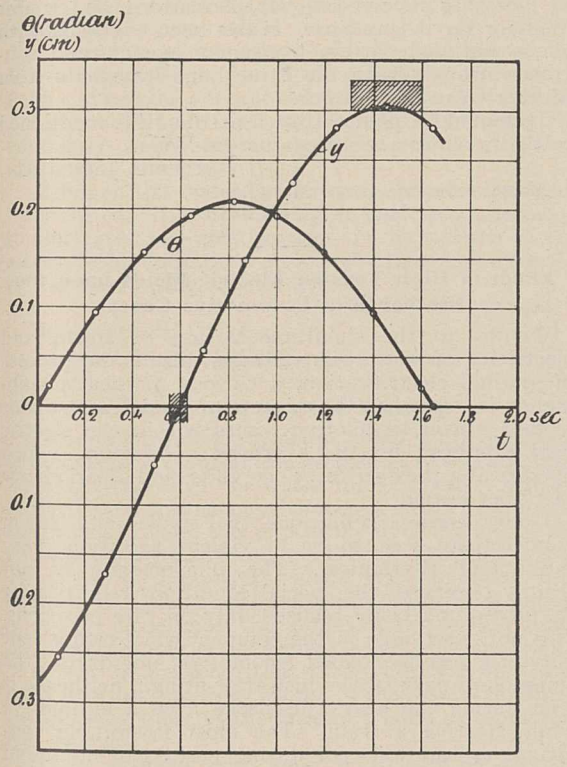

FIG. 2.

by hatching and thus closely confirm the theory. It should especially be noted that the observed amplitude agrees with the calculated. This means that the jet-wave recording the acceleration does not show any damping, a fact which was anticipated from earlier experiences with the jet-wave.

JUL. HARTMANN.

Physical Laboratory II.,
The Royal Technical College,
Copenhagen, April 16.

The Origin of the Continents.

DR. R. H. RASTALL'S interesting article in NATURE of May 2, p. 646, raises what is perhaps the most difficult problem or group of problems that geophysicists have yet to solve. In considering the origin of the continents, the essential points to be explained are the restriction of the continental blocks to little more than one-third of the earth's surface and the marked asymmetry of their distribution. The formerly popular "tetrahedral" hypothesis, apart from its descriptive inadequacy, has hitherto failed hopelessly when confronted with the principle of isostasy. It clearly implies a process of lateral differentiation whereby the earth's store of granite could become strongly concentrated at the corners and along the edges of the alleged tetrahedron, leaving the interior of the faces, corresponding to the oceanic areas, substantially free from granite. Otherwise the tetrahedral form would be unstable and therefore temporary. No one, however, has succeeded in devising any workable process arising out of the earth's contraction which would lead to such lateral concentration of the continental rocks.

The absence of a granitic crust from two-thirds of the earth's surface has often been correlated vaguely with the separation of the moon from the earth, but generally on the assumption that before separation took place the granitic crust not only existed, but was also uniformly distributed. Even if the earth lost two-thirds of its crust to the moon, the part retained would not remain in one hemisphere. Jeans has shown conclusively that if a thin crust floating on a liquid interior had ever been restricted to one side, it would break up and spread until the blocks were evenly spaced over the whole surface.

It is, however, highly improbable that a granitic crust ever existed as such while the more basic underlying materials were still liquid. It is much more in accordance with modern petrological ideas to consider that the constituents of granite (together with a large proportion of the water of the existing oceans) would remain fluid for some time after the bulk of the basic material beneath had solidified. On this alternative assumption I recently put forward the following suggestions in an attempt to explain the initial restriction of the continents (*Mining Magazine*, February 1925, p. 95). It seems most probable that the first solid silicate material to form would have the composition of peridotite and would accumulate at a great depth. Lying beneath it would be, presumably, the immiscible metallic core; and floating above it the still fluid magma from which more ultrabasic material and the whole of the basaltic and granitic materials were yet to be differentiated. After the separation of the moon the core of the earth would be relatively displaced to one side, and the magmatic ocean would therefore become deeper on one hemisphere than the other. At a later stage, when basaltic material had solidified, the residual magma would be granitic in composition, and this would continue to be confined to one hemisphere, provided that the viscosity of the interior had been high enough to prevent the displaced core from becoming central within the time then elapsed since the birth of the moon. If, finally, the granite solidified before the core attained a stable position, then a permanent departure from sphericity would be established. The earth would thus have had from the first a depressed heavy "Pacific" area, and a broad continental area standing high in virtue of the lower specific gravity of its rocks.

Dr. Jeffreys tells me that if the internal viscosity had been sufficiently high to retard the recovery of the displaced core to the extent required by the above suggestions, then it becomes increasingly doubtful whether the moon could have separated according to the resonance theory. It is possible, however, that an alternative mode of origin for the moon may be found, and that it may not be necessary to abandon the possibilities arising from a displaced core.

It will be noticed that neither the "stripping off" nor the "displaced core" hypothesis gives a distribution of the continental masses corresponding to that which now exists. The one distribution is too dispersed, the other too circumscribed. But in neither case need this alone be regarded as a necessary defect. Interest in the Wegener hypothesis of continental drift has made familiar the conception of lateral movements, and that these may be intermittently possible must now be seriously considered in view of Joly's theory of a periodic fusion and solidification of sub-crustal magma due to the accumulation of

radio-thermal energy. The actual distribution of the continents may therefore be the result of their geological history. Their lateral restriction presents a more fundamental problem, and if it cannot be correlated with the birth or former proximity of the moon, it will be difficult to discover any other external constraint capable of providing an explanation.

ARTHUR HOLMES.

Department of Science,
University of Durham,
South Road, Durham.
May 5.

The Cresswell Engravings.

THE account in NATURE of May 2, p. 658, of the excavations at Cresswell Crags, and the discovery of engraved bones, calls for some comment from me as being the first to cast doubt on the authenticity of the engravings. Some time ago, and before the meeting, I expressed the opinion to my fellow cave-worker, Mr. A. Leslie Armstrong, that the markings

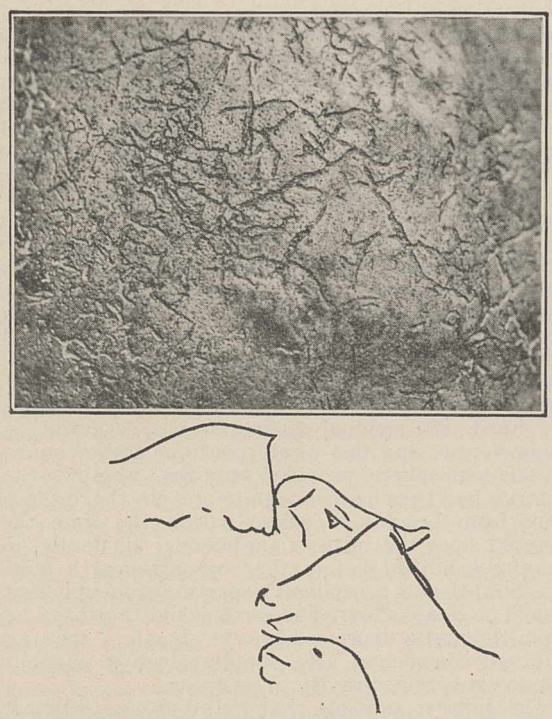

FIG. 1.—Portion of an eroded human skull, with (below) tracing made to show animal heads by outlining some of the eroded grooves.

on the three bone fragments from Mother Grundy's Parlour were due to the action of roots. I also told him it was a mistake to outline the figures in chinese white. At a later date the bones were submitted to Sir William Boyd Dawkins and he brought them in to me for an opinion. I was able to convince him, by means of similarly marked bones in the Manchester Museum from excavations of various dates, that, beyond the two convergent incised lines on the "rhinoceros" piece, the markings on the three bone fragments were due entirely to root-action and were not of human origin.

The most convincing piece of evidence is a human skull from a tumulus near Holyhead. The outer surface of this skull is scored in all directions by characteristic half-tunnels formed by the action of roots, and it is quite easy by following certain of the grooves to make animal figures of them. The accompanying photograph (Fig. 1) shows a small portion of this eroded surface, slightly above natural size. I cannot see the slightest difference between the markings on this skull and those on the three Cresswell bones. The misinterpretation placed upon the markings on the latter mars what is otherwise an important piece of work. I can speak with some knowledge about Mr. Armstrong's skill as a cave-digger.

The Pin Hole example is a genuine artifact and is of ivory, as reported to Mr. Armstrong and to Sir William Boyd Dawkins. It has been engraved with a conventional pattern by human agency, and contrasts strongly with the three bone fragments from Mother Grundy's Parlour.

It should be pointed out that the Mills mentioned in the previous account should be Mello.

J. WILFRID JACKSON.

Manchester Museum, Manchester,
May 12.

Effect of High Tension Electric Fields upon the Discharge of Locomotive Gases.

OWING to the simultaneous use of steam and electricity on the Swiss railways during the process of gradual electrification, a curious physical phenomenon is seen when the mixture of smoke and vapour from a steam locomotive comes within the electric field produced by the overhead conductors, which operate at a pressure of 15,000 volts, and a periodicity of 17 per second.

Under certain conditions the smoke and steam particles are seen to be in violent agitation, very rapid and rhythmical. The phenomenon is not readily observed, the special conditions requisite for its production being realised only on rare occasions. It is not observable in the compact white clouds sent out by a heavily loaded locomotive, nor during the emission of dark smoke just after firing; neither is it seen during the heavy discharge from a locomotive while starting a train. The most favourable conditions appear to occur during periods of minimum discharge of steam and smoke, when the singular palpitation suddenly appears and just as quickly disappears.

Owing to the fugitive nature of the phenomenon it is difficult to count the number of palpitations, but they are certainly of the same order as the alternations in electric tension. This and the requisite attenuation of the water droplets seems to indicate an essentially electric origin for the phenomenon. On the other hand, it is evident that the appearance is in no way connected with electrical discharge of the kind frequently seen between clouds in a thunderstorm, because the palpitation is invisible at night.

During the day-time the palpitation is seen most clearly when the discharge from the locomotive appears "dark grey" against a bright background of sky, or when it appears as a white cloud against an overcast sky. Both these conditions point to an alteration in opacity and, correlatively, an albedo of the cloud mass, caused by a series of alternate condensations and re-evaporations occurring in synchronism with the variations in electric field. Apparently, under certain conditions of saturation, a positive charge will favour the formation of drops, whereas a negative charge leads to their disappearance by evaporation in the warm gases.

In order to test the above explanation I attempted an experimental laboratory verification, using a Klingelfuess induction coil which was controlled by a Roget helix dipping in mercury, and breaking the circuit 10 or 12 times per second. The pressure at the terminals reached about 40,000 volts. The spark

gap plate was extended by a metal rod, extending to within a few centimetres of a narrow orifice, through which issued a jet of water vapour from a small boiler. The boiler was heated electrically in order to avoid the production of disturbing ions through combustion.

The steam remained almost invisible so long as the induction coil remained inoperative, but, as soon as the helix interrupter was started and the intermittent electric field established around the metallic rod, the appearance of the steam jet changed, its visibility fluctuating in synchronism with the dipping of the Roget interrupter and with the polarity of the electric field. When the vertical rod was positively electrified the phenomenon was strongly marked, but when the conductor was charged negatively the results were not readily observable.

Although this simple experiment did not reproduce fully the conditions obtaining on the electric railway, it illustrates and corroborates the hypothesis of the alternate condensations and rarefactions being caused by the alternating electric field.

P. L. MERCANTON.

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Intensities in Band Spectra.

THE correspondence principle alone is not sufficient to determine accurately the intensities of spectral lines for small values of the quantum numbers. But, as recent investigations have shown, it seems that, in the case of multiplets, this is possible with the aid of the rules found by H. C. Burger and H. B. Dorgelo (*Zeit. f. Phys.*, 23, p. 258, 1924), which state that the sum of the intensities of the lines coming from (or going to) a certain level must be proportional to the inner quantum number (= statistical weight) of this level.

It is to be expected that these rules will also hold good for band spectra. Some of the results obtained by applying them to the lines of a band are summarised below.

(1) In a band with only a P- and R-branch without fine structure the intensities are, if the statistical weights a priori are $2m-1$, proportional to:

$$\left.\begin{array}{rcl} m \to m+1 & : & me^{-E_m/kT} \\ m+1 \to m & : & me^{-E_{m+1}/kT} \end{array}\right\} \quad . \quad . \quad . \quad (1)$$

For small rotational quantum numbers the intensities are symmetrical with respect to the missing zero line.

(2) The P-branch is somewhat more intensive than the R-branch, the quotient for the two maxima being $e^{\sqrt{2\sigma}}$, if the rotational energy can be represented by $E_m = \frac{h^2}{8\pi^2 J} m^2$, and we put $\frac{h^2}{8\pi^2 JkT} = \sigma$.

(3) If the band lines are non-resolved doublets as, for example, in the CN-bands, the intensity distribution must be another one, as in the case of true simple lines. With the interpretation of the fine structure given by A. Kratzer (*Ann. d. Phys.*, 71, p. 72, 1923), or an alternative one proposed by the present writer (*Physica*, 5, 1925), the factor m in (1) must be changed by $2m-1$.

(4) In such bands as the CN-bands, one or more lines in the neighbourhood of the zero line are simple instead of unresolved doublets. Such lines are not weaker than would be expected from the neighbouring lines, but have the normal intensity.

(5) There are some possibilities which give alternating intensities, as observed, for example, in the nitrogen and hydrogen bands.

Equation (1) is the same as that found by E. C. Kemble (*Phys. Rev.*, 25, p. 1, 1925) in removing the degeneration of the two rotational degrees of freedom by an external field and applying the correspondence principle to the non-degenerated system. Such a procedure gives a better approximation to the true intensities also in the case of a multiplet, as was shown by E. Fermi (*Physica*, 4, p. 340, 1924), but it remains an approximation. Besides, it is necessary to know how the system behaves in an external field, and as to molecules we know nothing certain about this point.

Accurate quantitative measurements of intensities of band lines do not exist. The results are, however, in good qualitative agreement with the observations. If an application of the rules of Burger and Dorgelo to band lines is justified, intensity measurements will be of very great value in determining the structure of band spectra.

A more detailed account will be given elsewhere.

G. H. DIEKE.

Instituut voor theoretische natuurkunde,
Leyden, April 27.

The Word "Australopithecus" and Others.

IT has been stated by several critics that the word "Australopithecus" is a hybrid (Latin-Greek) term. I am indebted to my colleague Mr. T. J. Haarhoff, professor of classics in the University of the Witwatersrand, for the information that *pithecus* was a recognised naturalised Latin word in Rome. It was used by Cicero's own secretary Tiro and by other accredited writers, and more than a century before Cicero's time Plautus employed the diminutive *pithecium*. It is, therefore, not surprising that both of these words are to be found in a standard Latin dictionary, such as that of Lewis and Short. The still commoner *cercopithecus* is found in Pliny, Varro, Juvenal and Martial, to the last-named of whom (Book xiv. Epigram 202) we owe one of the most pleasing examples of the indiscriminate juxtaposition of the two words used by polished Romans for a monkey:

> Callidus emissas eludere simius hastas
> Si mihi cauda foret cercopithecus eram.

"A monkey, cunning to avoid darts, hurled at me (the charge that)
I should be a tailed ape, had I a tail."

With regard to Homosimiidae versus Hominisimiidae, surely the word is parallel with any other double nominal term such as Pithecanthropus or Anthropopithecus. In defence of the introduction of the term Homosimiidae instead of Australopithecidae little need be said since the group intermediate between true apes and true men must have been man-apes and not all necessarily, much as one may anticipate the discovery, southern-apes.

RAYMOND A. DART.

Photo-electric Cells for Colour-matching.

I NOTICE in your description of the exhibits at the Royal Society Conversazione in NATURE of May 23, p. 820, a brief mention of the method of colour-matching lamps by means of alkali photo-electric cells, shown by the National Physical Laboratory. As stated in the programme of the Conversazione, this method of colour-matching was first developed by the staff of the Research Laboratory of the General Electric Co., who kindly made for us the cells used, which are now being shown in the Royal Society's exhibit at the British Empire Exhibition. I shall be glad if you will allow me the opportunity of making this acknowledgment in your columns.

J. E. PETAVEL,
Director.

The National Physical Laboratory,
Teddington, Middlesex,
May 26.

The Cooling of the Earth.[1]

By Dr. HAROLD JEFFREYS, F.R.S.

THERE are strong reasons for believing that the earth was wholly fluid at an early stage of its history. My present topic is the manner in which such a fluid earth would solidify and afterwards cool to its present state.

The best known account of the solidification of the earth is that given by Kelvin. Most of the rocks that constitute the crust contract when they solidify. According to Kelvin, then, the first stage in solidification was the formation of a thin solid shell on the outside. But this shell was denser than the liquid interior, and therefore was unstable when floating on it. The shell therefore broke up and the pieces sank. A new shell then formed on the outside and the process was repeated, until the liquid was replaced by a sort of honeycomb; the cells filled with magma might become the seats of later vulcanism.

This account requires to be modified to allow for two facts. Pressure raises the melting point, and also the temperature of a rock material. Also the earth is not composed of a single material, but of several with widely differing densities and melting points. We wish to know how far these facts will modify the mechanism described by Kelvin.

Taking the former effect first, let us consider what would be the actual course of events in the solidification of an earth composed of a single rock material and cooling by radiation from the surface. Matter cooling at the surface would thereby contract and become denser than that underneath, and therefore would sink, its place being taken by other matter from below. Thus the whole would be continually stirred up. But when the matter descends it enters regions of greater pressure, and consequently is heated. The rise of temperature is estimated by L. H. Adams, of the Geophysical Laboratory at Washington, as somewhat less than 1° C. per kilometre of depth. So long as the earth remained fluid, then, the temperature in it would decrease downwards at this rate.

Now pressure raises the melting point of rocks to the extent of 3° C. for the pressure due to the weight of a kilometre of rock, much more than the effect of pressure on the actual temperature of a specimen of fluid. Thus, while the earth was fluid, the difference between the temperature of the fluid at any depth, and the melting point at the same depth, was greatest at the surface and least at the bottom. The temperature therefore reached the melting point first at the bottom, and solidification started there (at the centre of the earth, that is, since we are considering an earth of uniform composition). Cooling and agitation continued at higher levels, and the solid layer gradually thickened until it reached the surface. Thus the honeycomb structure would not be produced.

Coming now to the differences of material within the earth, we can exhibit the principal constituents in the accompanying table.

The materials are here arranged in order of increasing density. They probably form fairly continuous layers in the earth, the denser at the greater depths. The first four are frequent at the surface, but the Femi is known only in deep-seated intrusions, and the nickel-iron alloy is only believed to occur deep down in the earth because some such material is necessary to account for the high mean density of this planet. The names Sal, Sima, Femi, and Nife are due to Suess; each combines in abbreviated form the names of two characteristic constituents of the material.

Layer.	Typical Rock.	Specific Gravity.	Melting Point.	Chief Constituents.
Air	..	10^{-3}	−200°	..
Water	..	1	0°	..
Sal	Granite	2·66-2·72	600°-1000°	SiO_2, Al_2O_3
Sima	Diabase, Basalt	3·0	1200°	SiO_2, FeO, CaO, MgO
Femi	Peridotite	3·3	1400°	SiO_2, MgO (in excess), Fe_2O_3, Fe_3O_4
Nife	Nickel-Iron	8·2	?	Ni, Fe

One of the first events in the formation of the earth was the settlement of the Nife to the centre. We know from the theory of the figure of the earth that its boundary is about 1400 km. down, so deep that it can have had no important effect in the evolution of the upper layers.

If the water of the ocean was originally in the atmosphere, in the form of steam, the pressure of its vapour at the earth's surface would be of the order of 300 atmospheres. It is known by experiment that at such a pressure melted granite and water mix freely. It is therefore probable that nearly all the water was initially within the crust, dissolved in the rock magmas. It is more doubtful whether the principal rock types could mix with each other when fluid. Experimental evidence shows that they could in some conditions, but their present mode of occurrence indicates that at some stage in the development a certain amount of separation took place. It is probable that a gradual solidification of the denser and less fusible rocks led to a concentration of the water in the granitic layer, and that much of it was extruded from the last itself when it solidified.

The solidification would start either with the Nife or at the bottom of the peridotitic layer, and would extend upwards as was described for a homogeneous earth. The liquid above would remain in adiabatic equilibrium until no further femic material remained liquid. The temperature anywhere in the solid portion would evidently be the melting point at the depth considered. Hence the rate of upward transmission of heat by conduction in the solid layer is calculable: it would be about $1{\cdot}5 \times 10^{-7}$ cal./cm.^{2} sec. But the rate of loss of heat from the outside by radiation would be more like 1 cal./cm.^{2} sec. Thus the liquid layer would go on cooling by radiation almost as if no heat was being conducted into it from below, until the temperature at its base reached the melting point of Sima, when the rocks of this type began to solidify. When the Sima was solid, further cooling led to the solidification of the Sal layer; at some stage of the process the water separated and an ocean formed.

As soon as the earth was solid at the outer surface, the great excess of the heat lost by radiation over that

[1] Based on a lecture delivered before the London Mathematcial Society on April 23.

conducted from the interior would ensure that the temperature of the surface rapidly fell until the loss of heat from the surface nearly balanced that received from the sun. The sun was at that time probably radiating about as intensely as at present, so that the equilibrium temperature of the surface would also be nearly the present temperature. Thus the primitive solid earth would have much the same surface temperature as now, but a temperature equal to the melting point of peridotite was reached at, or a little below, the top of the femic layer, perhaps 40 kilometres down. Cooling to this stage probably took some thousands of years from the formation of the earth.

The cooling of the earth, from the stage just described, down to its present condition, was a much slower process. So long as the outer layer was liquid any cooling on the outside would lead to turbulence, and therefore the whole of the liquid layer would cool equally fast. But when the earth had become solid, conduction became the only agency available to redistribute its heat, and conduction is very slow. The beginnings of a quantitative discussion of the point were made by Fourier, who showed that if we have a uniform rod, infinite in both directions, and with initial temperature $f(x)$ at distance x from a fixed point of the rod, the temperature at time t is given by

$$V=\frac{1}{\sqrt{\pi}}\int_{-\infty}^{\infty} f(x+2qh\sqrt{t})e^{-q^2}dq,$$

where h^2 is the thermometric conductivity. In the earth the region is not infinite in either direction; but it is found to be a good enough approximation to suppose it infinite downwards and to treat the flow of heat as one-dimensional, since the depth where cooling is considerable is a small fraction of the radius. The other boundary condition is that the temperature at the surface is maintained constant. Lord Kelvin made the first important contribution to this problem, as to that of the method of solidification, though in this case also his discussion has needed much revision to bring it into accordance with later experimental knowledge. He supposed the temperature at all depths, o to infinity, to be uniform and equal to S, the melting point. The difficulty of the constant surface temperature was met by replacing the earth by a solid infinite in both directions, the temperature being antisymmetrical with regard to the surface. Thus subsequent conduction would keep the surface temperature constant, and Fourier's solution could be applied as it stood.

Kelvin's solution was

$$V=S\ \mathrm{Erf}\ \frac{x}{2h\sqrt{t}},$$

the symbols having the meanings already given. Erf is the Error function, defined by

$$\mathrm{Erf}\ \lambda=\frac{2}{\sqrt{\pi}}\int_0^{\lambda} e^{-q^2}dq.$$

Differentiating this and then putting x zero, he found

$$\left(\frac{\partial V}{\partial x}\right)_{x=0}=\frac{S}{h\sqrt{(\pi t)}}.$$

This equation was used by Kelvin to estimate the age of the earth. The left side is the rate of increase of temperature downwards at the present time, determined from observations in mines and borings. With modern data this is $32^\circ\times10^{-5}$/cm., and with S equal to 1400° and h as 0·084 c.g.s., the equation makes t equal to 27 million years.

The increase of temperature downwards would alter this equation slightly: its effect is to introduce into the temperature a term of the form mx, which does not change with the time. Allowing for this we find that the estimate of t needs to be increased to 33 million years.

These estimates, however, were found to need drastic alteration soon after the discovery of radium. Radioactive matter was discovered to be universally present in rocks, to such an extent that in an average granite it is generating $10{\cdot}1\times10^{-13}$ cal. per c.c. per second; the amount for a basalt is $2{\cdot}7\times10^{-13}$ cal. per c.c. per second. These amounts appear small, but then so is the loss of heat from the surface. The latter is about $1{\cdot}6\times10^{-6}$ cal. per square centimetre per second. Thus a layer of average granite 16 kilometres thick would account for all the heat leaking out of the earth. This remarkable result was obtained by the present Lord Rayleigh. That it demanded careful reinvestigation of the theory of the cooling of the earth was obvious; and some writers went so far as to deny that the earth is cooling at all. The situation, however, was never so serious as this. Either the total radioactivity is less than that of 16 km. of granite, or it is greater. If it is less, the earth is cooling to some extent, though less than the simple Kelvin theory indicates; if it is greater, it is impossible to explain why the amount of heat being conducted out of the earth is as small as it is, for the heat generated must be going somewhere.

A way out of the impasse was found by Dr. Arthur Holmes, in a series of papers in the *Geological Magazine* for 1915 and 1916, which have not yet attracted from physical writers the attention they deserve. Taking the extreme case of no cooling, so that the temperature within the earth is now everywhere steady, he worked out the depths of rock of various types needed to give the observed surface temperature gradient, and hence the temperatures at various depths. He found that if the radioactive layer was average granitic rock, the temperature within the crust could nowhere exceed that at the surface by more than 300°. Such a temperature is quite inadequate to explain the occurrence of volcanoes and igneous intrusions within the continents, and points definitely to another source of heat, which it is natural to refer to the primitive store.

Holmes therefore assumed a cooling earth, with radioactivity falling off exponentially with the depth; the mathematical solution of this problem had been given by Ingersoll and Zobel, but not applied to the actual conditions of the earth. If the rate of generation of heat per unit volume is Ae^{-ax}, it was found that

$$\left(\frac{\partial V}{\partial x}\right)_0=m+\frac{S}{h\sqrt{(\pi t)}}+\frac{A}{ak}\left(1-\frac{1}{ah\sqrt{(\pi t)}}\right).$$

This equation contains now two unknowns, t and a. Thus it can no longer be used for finding t; but that does not matter, because radioactivity gives us an independent determination of t. The disintegration of uranium produces lead at a known rate, and hence the analysis of a uraniferous rock makes it possible to estimate the time elapsed since that rock crystallised.

By this method the age of the oldest rocks known has been determined as 1400 million years, and it is probable that the whole age of the earth is about 1600 million years. With this extra datum we can find a. It turns out that radioactivity at a depth of 13 km. must be $1/e$ (that is, 0·37) of what it is at the surface, that at 26 km. $1/e^2$, and so on. On this basis it is found that the differences between the present temperatures at various depths and the melting points of peridotite at the same depths are as follows:

Depth (km.):												
0	37	74	111	148	185	222	259	296	333	370	444	518	592
Temperature differences (degrees C.):													
1400	940?	830	710	600	510	420	340	280	210	170	95	50	25

Below 600 km. or so the cooling is inappreciable. The cooling at depths of 200 to 300 km. is not so great as to forbid occasional softening of the more fusible constituents of the Femi, so that the existence of vulcanism is consistent with these estimates.

I have performed the corresponding calculations for another hypothesis differing as far as possible from that of Holmes; namely, I supposed the radioactivity uniform down to a finite depth and zero below that depth. The effect of the change is not great: the cooling at all depths is increased by about 16 per cent.

The above calculations are based on numerical data differing somewhat from those used by Holmes, and also from those used by myself in previous work. Previously I used as the primitive surface temperature the melting point of basalt, 1200°, seeing that it was the deep-seated rocks whose initial temperatures would have the greatest influence in determining present temperatures. But L. H. Adams,[2] in a recent rediscussion of the whole matter, has pointed out that I did not go far enough, and adopts 1400° as his standard melting point; this datum has been used above. At the same time he has made an allowance for the difference between the conductivities of rocks at different depths. The effect is to increase the amount of radioactive material and reduce the cooling, but the general trend of the results is not violently changed.

[2] Jour. Wash. Acad. Sci., 1924.

The Royal Academy Exhibition.

IN a little book on "The Revolutions of Civilisation," with abundant illustrations of the arts of many ages, Sir Flinders Petrie has sketched out a sequence of rise and decline of civilisations in eight periods from the dawn of history, six of them between 6000 B.C. and A.D. 2000. It is through the arts that the sequence is manifest: the several arts keep an order of precedence, they reach in turn a maximum of development; and in turn decay. In each period sculpture is the first of the arts to reach its maximum phase, followed by pictorial arts and then in turn by literature, mechanics, and finally by wealth. So also, in each period, the first signs of decay are manifest in sculpture; the decay of pictorial arts comes next. Medieval civilisation developed its maximum phase of sculpture in the thirteenth century, of painting at the end of the fourteenth, of literature at the end of the fifteenth; we are now in the maximum phase of mechanics, and all we have in prospect before our period goes out and the ninth becomes dominant is a maximum of wealth.

Suppose a visitor properly imbued with these ideas of revolutionary civilisation should find himself among the Royal Academy pictures of 1925, with room to see, and leisure to think about, the fourteen hundred items of the exhibition, what impression would he get? What would he think of sculpture which already showed signs of decadence four centuries ago? It is represented by reliefs, as 1273, *The Late Bishop of Hereford* for his Cathedral, by Allan Wyon, recumbent statues of *Lord Kitchener* in marble (1381) for St. Paul's, W. Reid Dick, and *The Late Bishop of Coventry* in bronze for his Cathedral (1377), by Sir Hamo Thornycroft, R.A., many figures, busts and statuettes, and some really convoluted animals, *Wild Swans* (1222), *Eagle, Lynx, and Hare* (1223), by the Danish sculptor Holger Wederkinch. Is a recumbent statue the imitation of a bygone habit of centuries ago or a step in the progress of the realisation of an art which also strives to represent action, as in a bronze *Atalanta* (1414) by Sir Bertram Mackennal? After he had assigned the position of sculpture, between the failing light of the eighth period and the dawning of the ninth (making what allowance is necessary for "copying," with which Sir Flinders Petrie declines to concern himself), what would he think when confronted with 477, *Sir Donald MacAlister of Tarbet*, as portrayed by Maurice Greiffenhagen, R.A., or 79, *A Street Accident*, by Glyn W. Philpot, R.A., or 340, *The Soul's Journey*, according to Mrs. A. L. Swynnerton, A.? How would he relate them to the golden age before the cinquecento? What, anyway, could the student of civilisation have said if 160, *Man Versus Beast (Paris)*, Sir William Orpen, R.A., happened to have been unearthed from an Egyptian tomb instead of being exhibited as a novelty in a London gallery?

It is a well-arranged exhibition: the oil paintings, which number only 631, are hung within comfortable view, mostly in not more than double rows. These are supplemented by 407 water colours, miniatures, drawings, engravings or etchings in the South Rooms, 174 architectural drawings and 207 sculptures.

One gets the impression of alternations of portrait and landscape with very few historical or subject pictures, more uniformity of excellence and fewer striking exceptions than usual. There are, once more, a number of examples of brilliance of illumination by La Thangue obtained by juxtaposition of light and shade: 42, *Amalfi Vines*; 84, *A Provençal Flock*; 141, *The Thorn*; and 175, *The Trout*. There are some efforts of a similar character not nearly so successful: 305, *Jack, Jill, and Peter*, Dorothea Sharp; 407, *A March Morning*, Harry Fidler; and better than these 537, *Eucalyptus Avenue*, Mary H. Carlisle. There are also striking examples of moonlight brilliance by the juxtaposition of iridescent colours; 14, *Silver Moonlight*, and 129, *The Ebbing Tide*, Julius Olsson, R.A.

For the spectator, whose days belong to science and to whom the technique of art is a mystery, the landscapes naturally afford more food for reflection than the portraits; and the comparative uniformity easily leads to thinking about the colour schemes of Nature, as expressed by different artists. There is a whole gamut of variation between the blue middle distance and

red background of 150, *Evening Glow on Rosengarten*, by Adrian Stokes, R.A., and the colourless grey whiteness of sheep in 252, *A Blizzard*, by Joseph Farquharson, R.A.

All Adrian Stokes's pictures are indeed notable for their colour scheme; 7 and 18 present beautiful contrasts of yellow and crimson foliage with the blue vistas of distance in Italy, whereas in 229, *Green Haunts*, an English forest, green is everywhere, only relieved by patches of sunlight on a somewhat ruddy path. One can indeed classify the landscapes by their blueness, their redness, or their whiteness, and can speculate as to how far any differences are due to idiosyncrasies of colour vision or to a true appreciation of the fact that clouds of the very smallest kind of particle in the atmosphere are blue to look at, but red to look through; while clouds of larger particles are white to look at and grey to look through. So, in Italy, as already noticed, or in Spain, 570, *Among the Mountains*, Christopher Williams, where particles are very small, made perhaps of the finest dust or of wood smoke, distance is blue and setting suns are red, whereas in the Western Highlands, where particles which are not considerable water drops are scarcely to be found at all, distance is colourless and sunsets are practically white. Even in Spain, 117, *Bridge at Toledo*, Oliver Hall, A., the grey is scarcely to be called blue.

The Exhibition offers many suggestive examples of these various points of view. As white or grey pictures, 8, *Morning Light*, Clewin Harcourt; 12, *Waterloo Bridge, November Dawn*, Algernon Newton; 39, *Blythburgh from Henham*, B. Priestman, R.A.; 51, *On the Eastern Rother*, P. H. Padwick; 52, *The Bathers' Pool*, Algernon Talmage, A.; 111, *The Woodland Way*, W. W. Ouless, R.A.; 169, *Evening, Trepied, Pas de Calais*, Sir H. Hughes-Stanton, R.A.; 187, *Kilchurn Castle, Loch Awe*, Sir D. Murray, R.A.; 240, *King George V. Dock*, W. L. Wyllie, R.A.

There is blue but grey blue, very true in tone, in 69, *The Farm on the Hill*, Arnesby Brown, R.A.; 275, *Himalayan Snowfield*, C. W. Bion, has grey blue; 472, *A Bule Hill Far Away*, Sir D. Murray, R.A., a very grey blue. There are blue distances in 292, *Blossom Time*, F. F. Foottet; 293, *Hoar Frost*, W. H. Adams; 631, *The Valley of Clitunno*, Freda Marston. So blue becomes more pronounced until 553, *The Blue Lake*, Sydney Lee, A., is almost incredibly blue. 110, *The Fountain of Neptune*, by the same artist, has the deepest of blue for a background; so has 130, *Miss Pearl Hood*, a portrait by Greiffenhagen. 596, *Almost Night, Venice*, Terrick Williams, A., is all blue; that must presumably be a question of colour vision. J. C. Moody, in 92, *Into the Sun's Reflections*, colours the nearest black post blue; that must also be similarly classed if the blue of blue smoke is what physicists suppose it to be.

Red is more rare: it is the most transient of atmospheric colours except the green of the departing sun; such examples of red as there are are not very convincing.

Painters are still inappreciative of certain proprieties about clouds; some types are appropriate to early morning and others to afternoon and evening. A lapse in this respect, 159, *A Summer Morning*, George Clausen, R.A., gives the impression of restlessness that one feels before a thunderstorm, always a restless phenomenon. A similar feeling comes from the sky and lighting in 618, *The Bathers, Pas de Calais*, and other pictures. Something impels an artist to throw some sort of action into the sky, hence one finds thunderstorms "standing where they ought not." On the other hand, there is a beautiful English restfulness about 58, B. Priestman's *Lock Pool*.

Of the portraits the stark apparition of Sir Donald MacAlister has already been hinted at; an easily recognisable portrait of *Lord Rayleigh*, 211, by Melton Fisher, R.A., is not far on one side from a less easily recognisable portrait of the Master of Sempill and his wife; or, on the other side, from one of *Lady Rayleigh*, 556, by W. W. Russell, A., not quite so reposeful. *Sir Humphry Rolleston*, 260, by George Henry, R.A., comes freshly before us as the new Regius professor at Cambridge. The president of the Institution of Civil Engineers is there, 186, by Stanhope Forbes, R.A., the Deputy Master of Trinity House, 245, by R. G. Eves, and a number of portraits of doctors of various academic faculties. That brings us back to wondering where in the sequence of the revolution of civilisation clothes ought to be put. Are fine clothes or no clothes a sign of civilisation or are they not? And if they are, have we reached the zenith? Are we approaching it or have we passed beyond it to a period of decay? Neither sculpture nor painting in the Academy will give a conclusive answer in the year 1925, though both may give cause for thought about it. Without doubt, if they are not mere echoes of a loftier age and are, indeed, real flowers of the artistic genius of the twentieth century, 139, by Sir William Orpen, R.A., and 102, by Sir Arthur Cope, R.A., and not a few others, will suggest to anthropologists that the sartorial art of the eighth period must be at least very near its climax, for even Solomon in all his glory was not arrayed like some of these.

The University Celebrations at Pavia.

(FROM A CORRESPONDENT.)

WHEN is a university not a university? That is the riddle set to the philosophic historian by the spirited claim of Pavia to be the oldest university of Europe. The answer mostly given is *not* before the twelfth century, if it was then when the name *Universitas, i.e.* of students from different nations and of different subjects, began to displace the older term of *Studium Generale*, which lingered on in Italy for many centuries. But the distinguished writers on medieval law and history who have made Pavia well known in recent years, especially the present Rector, Prof. Arrigo Solmi, seem to be justified in maintaining that when a summons is issued by a great monarch, the greatest of his day, to a number of towns in a wide area, to centralise their efforts in all studies beyond school-level in a single spot under the direction of one eminent teacher and his colleagues, whom the said monarch has expressly invited and established, it becomes a question of name rather than fact whether we call the result a university or no.

History, in fact, has repeated itself many times in such matters. When Napoleon had freed Piedmont from the Austrians, he invited to Pavia in 1805, at the advice of a scholarly nobleman of Milan, a number of eminent professors, of whom Alessandro Volta, a founder of electrical science, was the greatest; but in doing so he only did for Pavia in his day what the Emperor Lothair, whose throne and title Napoleon claimed, had done by his famous proclamation, or *Capitulare* as he called it, in the year 825; for in that year Lothair established the well-known Irish monk Dungall in Pavia and bade all the chief cities of the western half of North Italy, including Genoa, Turin, and Milan, to send their students and teachers to Pavia. The curious may read of Dungall and his far-seeing letter in answer to Charlemagne's question about certain eclipses of the sun, in the "Dictionary of National Biography"; and that Pavia has worthily maintained the tradition of liberal and progressive study which he there set up, cannot be questioned.

The debt which Pavia owed to Ireland, she repaid to England in the person of the great divine and lawyer Lanfranc, who, beginning as a student and teacher of Pavia, became head of an abbacy in Normandy and was chosen by the Conqueror as his chief adviser in England, and made the first Archbishop of Canterbury under Norman rule. His work there reflected, we learn, the conspicuous service which Pavia itself rendered to European progress, in combining and harmonising the established principles of Roman and Canon Law with the comparatively barbarous but deeply rooted customs of northern Europe; a fusion of which the Feudal system had been itself a product. The central ceremony of this "eleventh centenary" of the University of Pavia was the unveiling by the King of Italy of a monument to the memory of Lanfranc in one of the courts of the University. This is a seated bronze figure of a robust and shrewd-looking but also beautiful damsel holding a scroll labelled LEX, personifying Lanfranc's contribution to the civilisation of Europe.

This spirit of conciliation and harmony between friends, neutrals, and even former enemies, from without and from within, was conspicuous in the recent festival. Germany, Hungary, and Turkey, no less than Switzerland, Spain, Holland, and Scandinavia, sent representatives to join those from the allied countries, Czecho-Slovakia, Poland, France, Belgium, Esthonia, the United States, and a particularly numerous contingent from the British Empire (among them Sir Martin Conway, Prof. Edmund Gardner, Prof. Alfred Parr, and Prof. Moffat of Madras). But from the Italian point of view the harmony of different sections of Italian feeling was new and most remarkable. A new university banner presented by ladies of the town was blessed by an archbishop and a cardinal who conducted a special Mass; a proceeding which could scarcely have happened in any Italian university since Napoleon's time. This same cardinal is a rugged and noteworthy personality, Archbishop Maffi of Pisa, whose general support of the present government has been varied by his courageous and dignified protests against ill deeds like the murder of Signor Matteotti, for which it is generally assumed that some section of the Fascisti was responsible. Yet he appears on the same platform with the Minister of Education who bore Mussolini's express good wishes, and expressed a lively interest in the record of the University, the work of jurists like Buonfiglio and Bagelard, Latinists like Laurenzo Valla, and men of science from Volta to the venerable physiologist, the Nobel prizeman, Prof. Golgi, who was present at the ceremony.

The admirable address of the Rector was a model of precision and enthusiasm, tracing in the work of Pavia the combination of "Scienza" and "l' Idealità," scientific method and humane ideals. Only one detail must be here added, significant of the many-sided activity of the University. Practically all the wine of the district, wine of many qualities and colours, but all (by common consent of the visitors) excellent in their kind, is produced by a co-operative union of some 3000 cultivators; and the chairman of the union is the professor of botany. He was also until recently an anti-Fascist member of the Italian parliament; and some of his supporters expressed to the present writer a pleased surprise that he was allowed to continue unmolested both his professorial and his agricultural work. It may be foretold with some confidence that the immediate future of Italy has many such pleasant surprises in store; for the spirit of the now renascent Italy is precisely that which has governed and inspired the celebrations at Pavia.

Obituary.

SIR WILLIAM FLETCHER BARRETT, F.R.S.

THE death of Sir William Barrett, F.R.S., on May 26, at eighty-one years of age, removes one who dates back to a period in physics long antecedent to all the recent advances—the period of Wheatstone and Balfour Stewart and Tyndall. He never pretended to follow the recondite mathematical and dynamical investigations of last century, typified by the great names of Stokes and Thomson and Tait. The original discoveries in physics which he himself made concerned such things as—sensitive flames, which he first observed while working in the 'sixties on sound in Tyndall's laboratory at the Royal Institution; some alloys of iron, especially a useful one called stalloy, which he claimed to have announced in 1899; and the odd behaviour of iron at or near the magnetic critical point. In this last phenomenon, a hot iron wire under longitudinal strain not only suddenly expands but also rises in temperature, giving a momentary glow which he called calorescence, since he regarded it as an example of a rise in the refrangibility of emitted radiation—presumably by molecular or atomic rearrangement—in contrast to the lowering of refrangibility (or what we now call frequency) so well elaborated by Sir G. G. Stokes under the name fluorescence.

As a popular lecturer and teacher in the experimental phenomena of physics Barrett was very successful, and he must have often contributed welcome information at meetings of the Royal Dublin Society.

His first and only academic chair was at the Royal College of Science in St. Stephen's Square, Dublin, which he assumed in 1873 and vacated in 1910, during

which period it may be safely said that the College which he faithfully and effectively served underwent several threatenings, if not vicissitudes, thereby causing him anxiety which he did not hesitate to express.

The main interest of Barrett's middle and later life lay in the exploration of obscure human faculties, such as were not receiving attention from the majority of scientific men and were often cold-shouldered as mere surviving superstitions. He felt that in this unlikely milieu there lay hidden a grain of truth, which he set himself pertinaciously to find and enthusiastically to exhibit to others. He was in frequent touch with such other explorers in unpopular regions as Alfred Russel Wallace and William Crookes, and he never doubted that between them they had unearthed some genuine phenomena, which, though sometimes bizarre and apparently incredible, would ultimately be accepted by science, and might, he hoped, prove of moment to mankind. It was in this faith that he worked, and stimulated work in others. How far he was justified, posterity will know better than we. It must be made quite clear that many men of science deny all these asserted phenomena, and apparently do not consider them worthy of serious examination. That care and caution is necessary in such a region is well known, but even now there are several who have little or no doubt that a faculty of communion or communication between individuals exists which is independent of the recognised organs of sense; and of this faculty Barrett considered that he might hereafter be regarded as perhaps the chief discoverer. So far as I know he had no theory on the subject; he was content with observing and recording the facts, observed under what he considered adequate precautions against deception. He read a paper to the British Association at Glasgow in 1876 on what was later called telepathy, but the feeling of improbability about the reality of such a faculty was so strong that its publication was suppressed. He did, however, get a letter published in NATURE for July 1881, shortly before the foundation of the Society for Psychical Research.

Another inquiry, which he carried out in Dublin, related to the asserted Reichenbach phenomena, *e.g.* the sensitiveness of certain people to magnets. These experiments, though carefully conducted, led to no conclusive result, when all opportunity for suggestion and all normal clues were eliminated.

On yet another faculty he became quite an authority, namely, the faculty for finding water or other things by means of an unconscious physiological reaction, demonstrated usually by the twisting of a rod held in the hand. The possession of such a faculty can be pretended or imagined, but Barrett came to the definite conclusion that in certain persons it was real, and could be utilised.

Finally, Barrett enlisted the interest of many distinguished scholars, both in the British Isles and in the United States, in the search for unrecognised but traditional human faculties; and he had a stimulating hand in founding the Society for Psychical Research in London, with a branch in Dublin; and also a somewhat similar society in America, the latter being at one time presided over, no doubt in a reasonably incredulous spirit, by no less a person than Simon Newcomb; who probably held the opinion that everything might legitimately be explored, and if necessary condemned, in the interests of truth.

On the personal side it must be admitted that some people found Barrett's quick eager manner unrestful, but every one recognised the transparent honesty and simplicity of his character, and could not help admiring the keenness with which, right up to the end, he was ready to undertake any labour to get phenomena properly observed and recorded. Correspondents from all over the world must have sent him tales of extraordinary happenings, and a winnowed selection of these he contributed from time to time to the Proceedings of his special Society. With its slow and cautious methods he was often impatient, urging greater enterprise and activity, but he accepted its presidency for a year, and continued on its Council to the end.

Barrett's domestic life was of the simplest. Through most of the years his sister kept house for him, until 1916, when, to his extreme happiness and content, he married the distinguished surgeon and gynæcologist Mrs. Florence Willey, M.D. It was at her house that he died, through heart failure, in full possession of his faculties except his sense of hearing. He loved life, but, as his books show, he regarded the continuance of existence, in some still personal form, as almost if not finally demonstrated. Death did not seem to him an interrupter of mental continuity.

So has passed over one who served truth to the utmost of his ability, whose researches brought him into personal contact with all sorts and conditions of men, one who was not deterred by ridicule or opprobrium from following such clues as he could find; yes, and if his chief interest is ever universally recognised as well founded, one who will be hailed and respected by posterity as a pioneer. OLIVER LODGE.

FATHER A. L. CORTIE, S.J.

FATHER ALOYSIUS LAURENCE CORTIE, S.J., who died on May 16, was born in London on April 22, 1859. He had thus attained the age of sixty-six years. His cheery genial ways left the impression of his being a much younger man, and he will be mourned by a wide circle of friends who enjoyed his companionship in his merry moods and valued it in his more serious moments. He was educated at Stonyhurst, and having joined the Society of Jesus at Roehampton in 1878, he was ordained priest in 1892. For thirty years, with but little intermission, he was on the staff of Stonyhurst College teaching physics and mathematics, and he was also director of music for nineteen years. He was a very popular teacher, and the hold which he gained on the affection of the boys was maintained throughout his life, for he continued by correspondence in touch with his old pupils in all parts of the world. No Stonyhurst gathering was considered complete without Father Cortie. His songs and his quaint stories were equally welcome. His quick sense of humour enabled him to pick out many a local episode, which he would recount in the Lancashire dialect to the great amusement of his hearers. He was in great demand as a popular lecturer on astronomical subjects, and as his humorous touches seemed to give almost as much amusement to himself as to his audience, his call on their interest and sympathy was irresistible and met with immediate response.

Father Cortie took a large share in the work of the Stonyhurst College Observatory during the directorship of Father Sidgreaves (1890–1919), and he became director in 1919 on the death of Father Sidgreaves. His astronomical work was in large measure connected with the relation between the phenomena of sunspots and terrestrial magnetism, and he contributed many papers to the Royal Astronomical Society and to the *Astrophysical Journal*; among them were a number relating to stellar spectra, a subject to which Father Sidgreaves had devoted much attention.

Father Cortie, carrying on a tradition started by Father Perry, took part in several expeditions to study the phenomena presented in total eclipses of the sun. He travelled to Vinaroz (Spain) in 1905, to Vavau, Tonga Islands, in 1911, and to Hernösand (Sweden) in 1914, to make observations of eclipses. He had but poor luck in the earlier expeditions, but in Sweden he observed the eclipse "in absolutely perfect weather conditions" and obtained not only valuable spectroscopic observations but also beautiful photographs of the corona, one of which is well reproduced in the Report of the Stonyhurst College Observatory for 1914.

In 1891 Father Cortie was elected a fellow of the Royal Astronomical Society, and for many years he served on the council of the Society. He was an active member of the British Astronomical Association, which he joined in 1894; for eleven years (1900–1910) he was director of the Solar Section of the Association, and in that capacity he was responsible for many reports on solar work. He was president of the Manchester Astronomical Society since 1911. In 1922 he was made a member of the International Astronomical Union's Committee on the Solar Atmosphere and attended the meeting of the Union at Rome in that year. After the meeting he received an honorary degree at Padua on the occasion of the seventh centenary of the foundation of the University. Quite recently he had been elected president of the Manchester Literary and Philosophical Society.

WE regret to announce the following deaths:

Dr. A. G. Butler, late senior assistant keeper of the Natural History Museum and distinguished as an entomologist and ornithologist, on May 28, aged eighty years.

Dr. John Mason Clarke, State geologist and palæontologist and director of the State Museum and Science Division of the Education Department, New York, a fellow of the National Academy of Sciences, Washington, and foreign member of the Geological Society of London, sixty-eight years of age.

Prof. Giovanni Battista Grassi, Senatore del Regno, distinguished for his work on the transmission of malaria, on May 4, aged seventy-one years.

Prof. C. K. Wead, an examiner in the United States Patent Office and formerly professor of physics in the University of Michigan, who was known for his work on physical and musical acoustics, aged seventy-six years.

Current Topics and Events.

THE Rowett Research Institute, Aberdeen, for the investigation of problems of animal nutrition, has been fortunate in receiving funds from private sources. Two years ago Mr. W. A. Reid, of Aberdeen, endowed the Library and Statistical Department. The Institute has now received a gift of 10,000*l.* from Mr. Duthie Webster to support the work of an experimental stock farm. Mr. Webster, who is an Aberdeenshire farmer, is the nephew of the late Mr. William Duthie, of Collynie, who earned world-wide fame as a breeder of beef cattle. The farm is being established in accordance with recommendations made by Prof. T. B. Wood, Director of the Animal Nutrition Institute at Cambridge, and Dr. J. B. Orr, Director of the Rowett Research Institute, in a joint report which, at the request of the Agricultural Council, was drawn up and submitted to the Ministry of Agriculture and the Board of Agriculture for Scotland. One of the sections of that report emphasised the desirability of having in Great Britain one or more experimental stock farms where the results of research work, which appeared of probable economic value, could be tested on a large scale, under practical conditions. In the report it was recommended that such a farm should be established in connexion with the Rowett Research Institute.

THE scheme, which is now being carried out at the Rowett Research Institute, makes provision for departments dealing with milk cows, beef cattle, pigs, sheep and poultry, and it is intended that each department will have as its head a worker who, after having been trained in research in nutrition, will devote himself entirely to the study of practical problems connected with the nutrition of the kind of farm animals in his department. The establishment of this experimental stock farm in connexion with the Rowett Research Institute is an important development in the scheme of research in agriculture, promoted by the Development Commission some years ago. It will enable the results of work, the full significance of which can only be understood in scientific circles, to be presented in a form intelligible to those engaged in the industry of animal husbandry. The results of large scale-feeding experiments carried out under practical conditions, should be of interest not only to stock breeders but also to those engaged in research, whose experimental work has to be confined of necessity to tests with small laboratory animals.

THE recent Conference on the Standardisation of Plate Testing Methods, inaugurated by the Royal Photographic Society, appointed an influential committee to consider its work in detail and to draw up a report for submission to the coming Paris International Congress on Photography. The report of the Committee is published in full in the Society's Journal for June. The Committee recommends a standard illumination of 4-metre candles obtained by the use of a 15-20 c.p. standardised metal filament lamp used at a colour temperature of 2360° K., this having the same colour as the Eastman Kodak acetylene flame. For exposure it recommends a non-intermittent exposure mechanism and a time scale, intensity remaining constant. When uniformity in the developer is desirable, it recommends the pyro-soda formula of Hurter and

Driffield, but of three-quarters the strength prescribed by them. The Committee recommends development in a dish, and the use of a brush to produce an efficient turbulence over the whole surface of the plate. For measuring the densities it advises the use of a definite instrument and a definite opal glass in contact with the density being measured. The pieces of opal glass should be standardised at some such institution as the National Physical Laboratory. For the interpretation and statement of results a set of curves plotted in the usual way for at least three periods of development is recommended. The effect of fog needs further investigation. The under-exposure portion of the curve should be given separately, and an illumination of $\frac{1}{100}$ m.c. is advised for work in this region, and it may be obtained from the standard light source by reflection from a magnesium oxide screen. It is hoped that these conclusions may form a basis for the standardisation of plate-testing methods as discussed at the Paris Congress.

PROF. F. A. F. C. WENT, professor of general botany in the University of Utrecht, lectured on "Modern Conceptions of Light Stimuli in Plants" at the Imperial College of Science and Technology, South Kensington, on May 25. In the course of his address, Prof. Went stated that investigations which have been carried out during the last twenty years in Holland and elsewhere had cleared away many of the old conceptions concerning phototropic curvatures of plants. The work of Blaauw, Arisz, and Koningsberger were worthy of mention in this regard. It was discovered by Blaauw that a certain quantity of light—expressed in metre-candle-seconds—is necessary to obtain a curvature in oat seedlings or the sporangiophores of Phycomyces. Arisz made exact measurements of light-quantities and brought evidence against the view commonly held that perception and reaction are distinct processes. Moreover, he showed that when a plant is illuminated from two different sources, the curvature resulting is determined by the addition or subtraction of the two separate reactions. From this it seems probable that the so-called "tonus" is a question of the summation of reactions, not of perception. Blaauw's well-known explanation of growth curvatures as due to the light-growth-reaction has been confirmed by Koningsberger by means of a very accurate recording auxanometer. In future it will be necessary to work with light of which the energy value is much more accurately measured than in metre-candle-seconds. It is probable that in phototropic responses some substance of the nature of a hormone, such as has been demonstrated in relation to geotropic curvature, will later be detected. It is doubtful whether the use of the word "stimulus" is now of much value in phototropism.

A NEW development at the Royal Botanic Gardens, Kew, is a house for the display of plants of botanical and educational interest. The special display at present consists of Calceolarias. *C. cana* is a small hoary-leaved species from Chile with violet-scented flowers, and the hybrids which have resulted from it show the hoary leaves of *C. cana*, while the flowers show a wide range of colours from white through yellow to a deep purple red. The South American Calceolarias have the characteristic pouched flowers, but there are four exceptional species, with open helmet-shaped flowers, two of which occur in South America, *C. violacea* and *C. punctata*, and two in New Zealand, *C. Sinclairii* and *C. repens*. An exhibit of Petunias has also been arranged showing the development of the garden Petunia from the two wild species from the Argentine and Uruguay, namely *P. integrifolia* (syn. *P. violacea*) and *P. nyctaginiflora*. *P. integrifolia* is better known as *P. violacea*, and was received as such by the Glasgow Botanic Gardens during 1831, seed being sent by John Tweedie, then resident at Buenos Aires, and a hybrid with *P. nyctaginiflora* was raised during 1834. It was lost to cultivation for many years until 1916, when Kew reintroduced it, after several failures, through the kind offices of the late Mr. C. E. R. Rowland, then Vice-Consul at Monte Video. An interesting new South African Composite, *Venidium Wyleyi*, is also exhibited, which has been raised at Kew from seed received from Miss Wilman of Kimberley, a well-known South African botanist. The exhibits will be changed from time to time throughout the year.

SHOWERS of fish have from time to time been reported, and the following account of one that occurred in the Hardoi district of Oudh, as given in a letter from the Deputy Commissioner of that district, has been forwarded to us by Mr. C. A. Silberrad: "The local calamity was of a new type. It happened in an area 200 yards wide and three miles long in the northern part of this district. One evening in April 1924 a whirlwind rose in a small area. It advanced to the east, and as it advanced it increased in velocity and force. All the trees—big huge trees—were uprooted and carried long distances, not dragging on the ground but flying overhead. Fish in a 'tank' [*i.e.* reservoir or large pond] which came in the way were blown out and two villages were destroyed. About 45 men were killed or injured, and 150 cattle destroyed." A similar occurrence is recorded in the April-June issue of the *Australian Museum Magazine*, where it is stated that the Director of the Australian Museum, Sydney, recently received a bottle containing three small fish, which, according to the accompanying letter from Mr. F. Richards, of Gulargambone, New South Wales, "were found in the gutters and on the streets here, with hundreds of others after recent heavy rain." Examination of the fish showed they were small freshwater gudgeons (*Carassiops klunzingeri*), which are very common in streams and water-holes in western New South Wales and Southern Queensland.

AN interesting illustrated account by T. W. Jones of the life and work of Dr. Thomas Beddoes appears in April issue of *Science Progress*. Beddoes' greatest discovery was Humphry Davy, who was the first medical superintendent of his "Medical Pneumatic Institution" at Clifton. Beddoes was born at Shifnal in Shropshire in 1760, and at the time of

graduation in classics at the age of nineteen, he had acquired considerable manipulative skill in pneumatic chemistry and was conversant with the work of Priestley, Cavendish, Lavoisier, and Scheele. He studied medicine and anatomy in London and, later, in Edinburgh. After a continental tour, in which he met Guyton de Morveau and Lavoisier, he accepted the post of reader in chemistry at Oxford. Beddoes became very popular here and spent the happiest years of his life; rash political views, however, caused him to resign in 1792. He had published translations of Bergman's "Elective Attractions" and Scheele's "Chemical Essays," amongst many other things, and also a digest of the work of Mayow. Beddoes now set up a practice, still continuing, however, his private research. His published work of this period is voluminous; most of it is medical in nature, but there is a 'classification of chemical substances according to their principles," which he proposed. Much of Davy's earlier work was inspired by Beddoes, and was carried out under the latter's direction, *e.g.* the work on nitrous oxide which brought about Davy's promotion to the Royal Institution.

METEOROLOGICAL reports by wireless telegraphy for Great Britain and the countries of Europe and North Africa are dealt with by the Meteorological Office, Air Ministry, in a new edition of official publication, M.O. 252. The third edition of the work now issued consists of 134 pages, which, compared with 84 pages in the first edition issued in 1922, illustrates the immense development of wireless now in progress. A frontispiece shows the area covered by wireless weather messages employed in the Daily Weather Service of the British Isles, from which messages are regularly received by the Meteorological Office of the Air Ministry. The area embraces nearly the whole of the northern hemisphere. To obtain observations from the entire network of observing stations, most or all of the national issues must be intercepted, but the whole area may be approximately covered by utilising only the international collective messages issued by Great Britain, France, Germany, and Russia. Most issues can be received in the British Isles by the use of quite modest receiving apparatus. Details of the meteorological messages transmitted by each country are given on a uniform plan. The reports and times of the messages are made perfectly clear. The international codes are given of reports from land stations, reports from ships at sea, abbreviated reports giving a synopsis of the meteorological situation over the continent, with much detailed information of general application for weather study. Details of the particulars of the messages from different countries are given up-to-date according to information available on February 14 of the current year, and emending notices will be issued as alterations are required. Such notices will be issued free until a new edition is ready, on application to the Director of the Meteorological Office. The work is published by H.M. Stationery Office, price 3*s*. 6*d*. net.

IN order to study the possibilities of routes through central Africa, particularly between French Equatorial Africa and the East coast, Citroën Cars Limited has sent a large motor expedition across the continent. From Algeria the expedition crossed the Sahara to the Niger river, and then by Lake Chad to Banghi on the Ubanghi, a tributary of the Congo, which form the southern frontier of French Equatorial Africa. After a deviation to the little-known north-eastern part of the Ubanghi-Shari territory, a return was made south to Stanleyville on the Congo. From there the route was north-east through the Haut-Uele district, and eventually to Kasenyi on Lake Albert, which was crossed to Butiabwa. The route then lay south-east to Entebbe, across Lake Victoria and to Tabora. At Kampala one party branched off for Mombasa, and at Tabora another party turned west to cross Lake Tanganyika, and ascended the Lualaba valley through the Khatanga region and Rhodesia to Cape Town. The main expedition from Tabora was to proceed by Lake Nyassa and Blantyre to Beira. All the parties were to reunite at Mayunga on the west coast of Madagascar and cross the island by Antananarivo to Tamatave. Thus the whole of French Africa will have been traversed by motor car.

AT the annual general meeting of the Institute of Physics, held on May 25, Sir William Bragg was elected president in succession to Sir Charles Parsons, whose term of office expires on September 30. Major C. E. S. Phillips was elected to succeed Sir Robert Hadfield as treasurer. The annual report gives the total membership as 515, which includes 293 fellows and 135 associates. There is stated to be unlimited scope for further applications of physics in the arts, industries, and public services, and therefore for the increased employment of highly-qualified physicists, and during the past year there has been a fair demand for young honours graduates in physics with two or three years' research experience. Seven lectures have so far been given in the series on "Physics in Industry," and they have been published in three volumes by the Oxford University Press. Much of the report is devoted to the *Journal of Scientific Instruments*, the second volume of which is now appearing. Editorial control has been brought into closer touch with the scientific instrument industry, and steps have been taken to procure more descriptions of workshop devices and methods. Action has been taken in conjunction with the Institute of Chemistry in urging upon the Board of Trade the desirability of defining, in the public interest, the qualifications that should be required of Gas Examiners appointed by local authorities under the provisions of the Gas Regulation Act, 1920. In this connexion a deputation from the two Institutes waited upon the Board of Trade. In reply to the deputation it was stated that the changes in the method of appointment of Gas Examiners suggested by the deputation indicated the necessity for further statutory powers.

THE Ladies' Conversazione of the Royal Society will be held in the Society's rooms on the evening of Wednesday, July 22.

THE summer meeting of the Newcomen Society for the Study of the History of Engineering and

Technology is to be held on June 17–20 at Gloucester. The meeting includes visits to works and places of antiquarian interest in the neighbourhood. Particulars can be obtained from the honorary secretary of the Society, Mr. H. W. Dickenson, Science Museum, South Kensington, London, S.W.7.

THE Science Museum at South Kensington, being too crowded on public holidays for the ordinary lectures to be given in the galleries, an experiment was made on Whit-Monday by Engineer-Capt. E. C. Smith, the official guide lecturer, giving short lectures on ships, locomotives, and aeroplanes in one of the new demonstration rooms. The lectures were illustrated by slides, models, and sketches, and drew large audiences. The experiment may be regarded as entirely successful, and we hope these holiday lectures will become a permanent feature of the work of the Museum.

WE learn from *Science* that the Barnard Medal for Meritorious Service to Science, awarded by the trustees of Columbia University on the nomination of the National Academy of Sciences, has been given to Dr. Niels Bohr, professor of physics at the University of Copenhagen, in recognition of his researches on the structure of atoms. Previous recipients of the Barnard Medal are: Lord Rayleigh and Sir William Ramsay (1895); Prof. W. K. von Röntgen (1900); Prof. Henri Becquerel (1905); Sir Ernest Rutherford (1910); Sir William Bragg and Prof. W. L. Bragg (1915); Prof. Albert Einstein (1920).

IT is a hundred years since John Phillips, afterwards professor of geology in King's College, London, in the University of Dublin, and in the University of Oxford, was appointed the first keeper of the Museum of the Yorkshire Philosophical Society. In the recently issued annual report of the council of that Society, Dr. W. E. Collinge, the latest successor of Phillips, takes occasion to give an interesting account, illustrated by a good portrait, of the great geologist of Yorkshire. He suggests that a John Phillips Geological Department would form a fitting memorial. The council, however, seems to be concentrating on an extension of the Museum to accommodate the Roman antiquities.

AFTER the death of Dr. Peringuey in February 1924, and pending the appointment of the new director, Mr. E. Leonard Gill, who assumed office on January 1 of this year, the work of the South African Museum was under the supervision of Mr. K. H. Barnard, who is responsible for last year's report. The much-needed whale shed was completed during the year, and the whale skeletons re-erected therein, proving a great attraction to the public. Several short talks on matters connected with the Museum have been broadcast. The excellent custom of employing members of the staff on collecting expeditions and surveys was continued, though somewhat interfered with by the administrative changes. The chief acquisitions by this means were in plants, insects, and arachnids.

AN interesting paper on the early Bristol glasshouses appears in the March issue of the Journal of the Society of Glass Technology. It contains historical details of the fortunes of many glass-making firms, and is based mainly on contemporary newspaper accounts. The earliest record of glass-making in Bristol occurs about 1651, when Edward Dagney (or Dagnia), an Italian, had a glasshouse, of which the master was John Williams. The trade rapidly grew; in 1698 there were six glasshouses for bottles and four for flint glass; in 1761 there were fifteen, and in 1792 "about twelve" (probably concerns or firms). The Bristol industry began to decline during the early part of the nineteenth century, owing to the remoteness of coalfields and Irish competition.

THE most recent Catalogue (No. 68) of Messrs. Watson and Sons (Electro-Medical), Ltd., consists of Part I., dealing with X-ray generators and radium, and Part II. with X-ray accessories. In about three hundred pages a brief descriptive account is given of radiological apparatus covering the field of radio-diagnosis and radio-therapy. We notice a description of the Gaiffe-Gallot and Pilon constant tension apparatus which Messrs. Watson are authorised to manufacture in Great Britain. One of the most attractive features of the catalogue is the conciseness of descriptive details concerning apparatus, combined with excellent illustrations.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: A veterinary lecturer at the Midland Agricultural and Dairy College, Sutton Bonington, Loughborough — The Principal. An assistant lecturer in chemistry at King's College for Women (Household and Social Science Department), Campden Hill Road, W.8—The Secretary (June 12). A junior scientific assistant in connexion with Admiralty Research—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1 (June 16). Some appointments in connexion with the physical and chemical survey of the national coal resources—The Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (June 17). The professorship of zoology at King's College, London—The Academic Registrar, University of London, South Kensington, S.W.7 (June 19). An assistant entomologist at the Imperial Forestry Institute, Oxford—The Secretary (June 20). A junior lecturer in biological chemistry in the department of physiology of Bedford College for Women—The Secretary (June 20). An assistant in the Herbarium, Royal Botanic Gardens, Kew—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (June 22). The professorship of electrotechnics in the University of the Witwatersrand—The Secretary, High Commissioner for the Union of South Africa, Trafalgar Square, W.C.2 (June 25). A senior lecturer in chemistry and physics at the Gordon College and the Kitchener School of Medicine, Khartoum—Dr. A. F. Joseph, 51 Kings Avenue, Muswell Hill, N. (July 14). A biology demonstrator at the Royal Grammar School, Worcester—The Headmaster.

Research Items.

ARCHÆOLOGICAL EXPLORATION IN INDO-CHINA.—Dr. R. Verneau describes in *L'Anthropologie*, T. 35, Nos. 1-2, the results of excavations in the caves of Bac-Son, Tonkin, by Dr. Mansuy and Mlle. Colani of the Geological Service. Some years ago Dr. Mansuy demonstrated by excavations at Pho-Binh-Gia that the neolithic culture characteristic of Indo-China—the only type known until then—was preceded by a more archaic culture. Three skulls associated with this early phase were found to differ entirely from the modern population. Further investigations, covering a large number of caves, have revealed a stone culture, apparently general over the area of excavation, of which the implements are of early palæolithic type—Acheulean. No fossil remains are present, and the animal bones found in the archæological deposits are all those of existing species. This, coupled with the absence of any of the stages intermediate between the implements of Acheulean type and the polished neolithic implements of the later culture, points to an antiquity of no great degree such as might be inferred from the form alone of the early implements. It is suggested that a primitive culture lingered on until overwhelmed by the incursion of races acquainted with the art of polishing stone. Two skeletons were found; one skull was sufficiently well preserved to admit of measurement; but whereas the skulls from the earlier excavation mentioned above were of a pure Indonesian type, this one is Melanesian; while another skull recently found in the cave of Minh-Cam in Annam presents the characteristics of a Negrito.

EARLY ART IN THE EUPHRATES VALLEY.—The light thrown upon Sumerian Art and its affinities by the discoveries at Tel el Obeid is discussed by Dr. Leon Legrain in the *Museum Journal* (Philadelphia), vol. 15, No. 3. A foundation tablet of Ur-Engur suggests the identification of El Obeid with the city of Kesh and a connexion with Elam, from which tamed bulls and cows probably were first brought to Sumer. The details of the dairy scene in the copper relief from the oldest temple at El Obeid help to explain archaic pastoral scenes from Susa, Tello, and Nippur. A text of Gudea of Lagash dealing with the organisation of the household of the god Ningirsk, refers to a dairy. It also in its ritual details suggests the old mythology of Elam. But while the Elamite was a hunter the Sumerians were farmers. The Elamites represented the gods as composite monsters; the Sumerians adopted the same forms, but in Sumer the god soon assumes the appearance of a king seated on his throne, the ancestor animal surviving as his servant and emblem. A number of known monuments may be compared with the art of Tel el Obeid. These, taken together, seem to bridge over the gap between the pre-Sargonic and pre-Elamite periods. Similar objects have been found by the French at Susa, Tape Mussian, and Bandar Bushir. The pre-Elamite period, represented by the painted wares and engraved seals, seems to be the oldest. The Tel el Obeid art is not so primitive but is to be set apart from, and before the pre-Sargonic period, constituting a new period of art.

THE BIOLOGY OF WHITE MUSTARD.—This subject in the hands of F. Boas and F. Merkenschlager has given results of great scientific interest and of considerable practical bearing. Their results are published in the *Biol. Centralblatt*, 45, pp. 40-53, 1925. That white mustard had some peculiarities had long been known; thus since 1913 the great difficulty of growing the plant in water culture has been on record, and there are also reports as to its failure to develop in soils previously sterilised by heat. In both these cases, growth could be improved by adding strongly adsorbing substances to the culture medium. Attacking the problem from this angle, these authors now supply very good experimental evidence that these peculiarities are due in the main to the ready penetrability of the plant's tissue by anions. If, for example, roots of mustard seedlings are placed in a 0·5 per cent. solution of ferrous sulphate, within 15-20 minutes the roots are covered with yellow-brown flecks of the hydroxide of iron, other plant roots remaining clear white for hours in such a solution. The root systems of old flowering plants do not show this peculiarity to such a marked extent, but leaf-stalks and hairs show this same ready penetrability to anions. As *Sinapis arvensis*, charlock, has the same peculiarities as *S. alba*, though perhaps to a less degree, this seems to be the phenomenon underlying the practice of destroying charlock by spraying or dusting.

MAIZE IN SOUTH AFRICA.—The increasing importance of the maize crop in South Africa has led to an inquiry into the economics of its production in connexion with the capital required in maize farming, the equipment and labour necessary, the yields and returns obtained, the relation of yield to cost and other points of importance to maize growers. Incidentally, weak points in the system of farming have been exposed, providing valuable information to the farmers. The report on the Cost of Production of Maize Investigation for 1921–22 (by E. Parish, Orange Free State) sets out the means employed in obtaining information and the method of calculation adopted. Costs for native labour, ox labour, and overhead charges were estimated on a comprehensive basis including such incidentals as perquisites, veterinary attendance, and the cost of stalk grazing and husks consumed. The range of costs per bag, including transport, on the thirty-nine farms investigated in a poor season was from 4*s.* to 1*l.* 14*s.* 11*d.*, the greatest number of results lying between 7*s.* and 9*s.*, but in a normal season the costs would be lower. The crop yields showed a similarly wide range, from 0·43 to 8·0 bags per acre (1 bag =203 lb.), and comparison shows that the relation between yield and cost is very close. Compared with similar figures for several states in U.S.A. the cost of manual labour in South Africa is greater per acre of maize, but land is relatively cheaper and ox labour is less expensive than horse labour. The cost per bag of maize may be brought down by adequate methods of farming, and suggestions are made for obtaining increased yields.

EARTH MOVEMENTS IN CALIFORNIA.—A most comprehensive scheme of research is now being carried out in California with the object of investigating from every possible point of view the alarming disturbances to which the earth's crust is subject in that region. A valuable summary of progress is outlined by Dr. A. L. Day in *Science*, vol. 61, March 27. The U.S. Coast Survey and the Hydrographic Office have triangulated the land and contoured the adjoining ocean floor, and have thus provided a trustworthy system of co-ordinates upon which future displacements can be accurately plotted. The Geological Survey and the universities in California are studying

the geology in adequate detail. The California Institute of Technology, the Mount Wilson Laboratory, and the Geophysical Laboratory of Washington have devised apparatus and established stations for the more systematic recording and study of local earthquakes. It is not surprising that great faults are found along the Californian coast, for the Sierra Nevada rise to more than 14,000 feet on the east, while to the west the ocean floor drops sharply to a depth of 12,000 feet. High temperature gradients and hot springs, and unusually great anomalies of gravity, show further that the region is one of exceptional instability. The danger zones of structural weakness are being carefully mapped, and in future the known directions and magnitudes of the creeping and tilting movements that occur along them as the stresses accumulate will lead to definite predictions of the place or places where earthquakes are likely to occur. Unfortunately, there is no certainty that prediction of the time of rupture is yet a problem that can be usefully attacked.

ABYSMAL SUBMARINE VOLCANOES.—The soundings made by the *Challenger* expedition have been investigated by M. J. Thoulet, *C.R. Acad. d. Sci., Paris*, March 16. In the oceanic depths he has found that, in some cases, the curves of submarine density, instead of continuing regularly to the bottom, begin to show a sudden increase in density, the amount of material in solution becoming suddenly greater than before. This appears to be due to the existence of basins, without outlet horizontally, containing submarine volcanoes, which give out materials which dissolve in the water. This increase of density at the bottom of the ocean is not general. In regions in the North Atlantic known to be volcanic, the proportion of bottom densities greater than 1·0280 is 84 per cent.; in the South Pacific it is 37 per cent.; in the South Atlantic, 24 per cent.; Indian Ocean, 13 per cent.; and North Pacific, 2 per cent. M. Thoulet has specially studied certain regions, partly from the point of view of submarine topography and microlithology, and partly with regard to the density of the water. He expresses the view that it may be possible in this way to locate the position of abysmal volcanoes, and perhaps to evaluate the degree of their activity.

SUBSTITUTES FOR PETROLEUM.—In his presidential address to the Mining and Geological Institute of India (published in the Transactions, vol. 19, 1924), Dr. E. H. Pascoe dealt with the development of the oil industry, and paid considerable attention to the question of vegetable and other products as substitutes for petroleum. Practical experiments have been made with palm oil in the Belgian Congo, where, under tropical conditions, it has been found possible to run a two-cycle semi-Diesel motor on this fuel, resulting in the development of 10 h.p. at 500 revolutions per minute. The calorific value of palm oil is, however, 20-25 per cent. less than that of crude petroleum, so that even if it could be used satisfactorily under temperate conditions, the greater consumption unit for unit would have to be balanced by low cost to make it an economic proposition. Castor oil has already been successfully used as a fuel for internal-combustion engines, though, as with pea-nut, soya-bean, and coconut oils, its value for human consumption is great, and any application as fuel would involve the oil industry in serious competition with the food-stuffs and drugs industries. Tetralin is a tetra-hydro-naphthalene manufactured from coal-tar in Germany; this substance was used satisfactorily during the War in that country, when supplies of petrol were short, but it suffers from the same disadvantages as benzol, namely, rapid carbonisation and difficulty in starting the engine on it from the cold. The prospect of an extended use of tetralin is doubtful. Alcohol is probably the most promising of all the liquid substitutes for oil, chiefly because of the variety of raw materials from which it can be manufactured, *e.g.* molasses (sugar waste), maize, potatoes, sawdust, sulphite liquors (from paper manufacture), artichokes, sorghum, various wild fruits and berries, peat, corn-stalks, garbage and other waste products. Dr. Pascoe concluded his address by urging attention to efficient carbonisation of coal, not only as helping to solve future fuel problems, but also owing to a growing demand for metallurgical coke. The problem of the conversion of cellulose into fermentable material by simple and economic chemical or bacteriological processes is likewise one worthy of thorough investigation, and in commending this and other researches having a similar end in view to Indians for the benefit of posterity as much as their own country, he voiced a plea deserving of world-wide notice and support.

THE INITIAL VELOCITIES OF α RAYS FROM POLONIUM.—The α rays emitted by the same radio-active body have been found to have very nearly the same velocity; Geiger, using radium C, finds this to be true to within 0·5 per cent. Mlle. I. Curie, using polonium, found that the ranges of its α rays differed a little more than was to be expected by the theory; and in a paper in the *C.R. Acad. d. Sci., Paris*, March 16, she describes measurements made by the magnetic deviation method, to find the amount of difference in the velocity of these rays on emission. The rays were passed through two parallel slits before being deviated, and the width of the line formed on the photographic plate depended in part upon the relation between the velocity of the different rays emitted. Other factors affecting this width were investigated, various possible distributions of velocity were considered, and it is shown that it is necessary to measure the ratio between the intensity at the middle of the line and that at its edges. The final result is that there is no indication of any difference in the initial velocities; if it is assumed that the velocities are distributed uniformly between two limits, the extreme difference cannot be more than 0·3 per cent. If, on the other hand, the velocities are assumed to be distributed about the velocity V according to the probability law, 75 per cent. of the rays have velocities which differ by less than 0·3 per cent.

THE THERMAL EXPANSION OF HALIDES OF THE ALKALI METALS AT VERY LOW TEMPERATURES.—A series of measurements, carried out in collaboration with Frl. H. Krüger and Messrs. H. Wiens and J. Hähnel, is described by Frl. A. Henglein in the *Zeitschrift für physikalische Chemie* of February 25. The densities of sodium and potassium chlorides, bromides, and iodides were determined by the pyknometer method at 0° C. and −79° C., and it was found that salts prepared by fusion have a higher density than those crystallised from aqueous solution. The density was also determined with a gas volumometer at room temperature, 0° C., −70° C., and −184° C., the accuracy attained being about ±0·5 per cent., using about one gram of salt. The densities are tabulated, those of sodium chloride together with the values of ν, the distance between the centres of unlike ions of this substance and the mole volumes being given in the following table:

Temp.	Density.	$\nu \times 10^8$ cm.	Mole Volume.
0	2·168	2·813	26·97
−79°	2·186	2·805	26·74
−184°	2·208	2·796	26·48
−273°	...	2·793	26·41

Grüneisen's law (atomic heat/coefficient of expansion is a constant for all temperatures) holds, so that it is possible to calculate the moleculer volume at absolute zero, and so find ν at that temperature. The percentage alteration of the molecular volume from 0° to absolute zero is for sodium chloride, 2·1; potassium chloride, 2·1; potassium bromide, 2·3 per cent., or nearly the same number. When the cation remains the same, the coefficient of expansion increases with increased atomic weight of the anion; when the anion is the same, the coefficient diminishes with increased atomic weight of cation.

ALTERNATING CURRENTS AND OVER-VOLTAGE PHENOMENA.—S. Glasstone, in the April issue of the Journal of the American Chemical Society, records some observations on the effect of small alternating currents on cathodic and anodic over-voltage for a series of metals in normal acid and alkali. The results indicate that only in a limited number of cases does alternating current of small amplitude reduce the polarisation at such electrodes. A possible explanation of this reduction is discussed.

ATOMIC SPACING IN ORGANIC COMPOUNDS.—The results of X-ray investigations on saturated aliphatic ketones and hydrocarbons are recorded in the March number of the Journal of the Chemical Society. The work, which was carried out by W. B. Saville and G. Shearer in the case of the ketones and by A. Müller and W. B. Saville in the case of the hydrocarbons, shows that a study of the X-ray spacing gives an indication of the number of carbon atoms in ketones, and a consideration of the intensity distribution enables the position of the carbonyl group to be located within fairly narrow limits. All the (normal) hydrocarbons which were examined exhibited two typical sets of spacings, one, relatively large, increasing linearly with the number of carbon atoms in the molecule, and the other very nearly independent of this number. The increase per carbon atom of the long spacing is too large to be accounted for by the longest of the tetrahedral chains; some additional variable must be introduced to explain the behaviour. Octadecane, $C_{18}H_{38}$, and eicosane, $C_{20}H_{42}$, appear to exist in two crystalline modifications.

VISCOSITY AND ALLOTROPY OF GLASS.—The March issue of the Journal of the Society of Glass Technology contains a paper on the viscosity and allotropy of glass, by H. le Chatelier. M. le Chatelier gives a theoretical discussion of the work of Washburn and Shelton and of English, and finds that the results of these workers may be expressed by the relation $\log(\log \eta) = M(t - 1000)/1000 + N$, where η is the viscosity, M the rate of variation of η as a function of temperature t, and N is the viscosity at 1000°, *i.e.* in the middle of the working zone of glass. The greater N is, the harder is the glass; the smaller the value of M, the more extensive is the range of fusibility of the glass. No definite relation has been found between the chemical composition of glass and its range of fusibility, but a connexion definitely exists between composition and viscosity. Glass exhibits an allotropy phenomenon similar to sulphur, with the difference, however, that in the case of glass changing its state, only the law of variation of viscosity as a function of temperature is altered, not the absolute value. There is some uncertainty as to the temperature at which the transformation takes place.

COBALT.—An account of the production and uses of cobalt, by T. H. Gant, appears in *Chemistry and Industry* for February 13 and 20. The chief sources of supply are Canada and Australia, the main ores being smaltite, cobaltite, and asbolite. The latter is a mixture of metallic oxides and may contain up to 30 per cent. cobalt oxide. In Canada, the ores are worked for the small quantities of precious metals which they contain, the cobalt being recovered as a by-product. The ore is smelted with a flux (*e.g.* lime if the ore is siliceous), a certain amount of iron being allowed to enter the speiss, or crude arsenide, which is formed. Its presence prevents the passage of cobalt into the slag in any appreciable quantity. The slag is re-smelted; the speiss is then calcined, the arsenic driven off being collected and sold. The roasted speiss, which contains about 10 per cent. of arsenic, is treated with hot hydrochloric acid and allowed to settle. The filtered mother liquor is nearly neutralised with lime, when nickel hydroxide and ferric arsenate are precipitated, enough iron having been added to convert all the arsenic to this compound in the acid treatment stage. The remaining arsenic and copper are removed by sulphuretted hydrogen, or, in the latter case, electrolytically. The solution now contains only cobalt and nickel chlorides; the former is precipitated by adding just the correct quantity of lime and the nickel solution, after separation, is precipitated by adding further quantities of lime. This method of separation of these metals has a very interesting history. The metal is obtained from the oxide by mixing the latter with a starchy material and heating to a high temperature in a retort. The principal and oldest use of cobalt oxides is in the ceramic industry; they are used as stains, either body stains, glaze stains, or under-glaze stains. Certain salts (*e.g.* hydroxide, borate, oleate) are finding use as driers; certain organic salts of cobalt are the most efficacious and convenient driers known. Cobalt, in the form of smalt, is also used for colouring enamels blue, and the oxide is used to neutralise any yellow colour in a white enamel caused by iron oxide. Electroplating with cobalt solutions seems to be more satisfactory than with nickel; the plating occurs much more rapidly and a lesser weight of hard cobalt deposit offers the same protective coat as a greater weight of the softer metal.

INDUSTRIAL ILLUMINATION.—Within recent years much attention has been directed to the rapidity with which operations involving vision can be accomplished under various intensities of illumination. The General Electric Co. of America has published in the Journal of the Franklin Institute for April a paper on this subject by P. W. Cobb, who is a psychologist, and F. K. Moss, who is a physicist. A large number of experiments were carried out and definite curves connecting brightness with mechanical precision were obtained. Extreme values of brightness were not used, so the problem is not complicated by the introduction of glare. The results of this investigation prove that for accurate mechanical work the brightness must exceed a definite value. They can consequently be applied directly to many industrial operations. When the output is on a quantity production basis and the various operations follow one another at fixed and predetermined intervals, the gain in accuracy shown by the laboratory experiments in increasing the brightness to the definite value would be realised in practice. It has been objected that the better illumination induces the workers to function their eyes at an unnatural rate and so they would be more fatigued at the end of the day. The evidence, however, does not support this objection. Eye fatigue is not generally experienced in daylight, where the illumination is generally several hundred times that of present artificial lighting.

The Fat Soluble Vitamins and Irradiation in Nutrition.

OUR knowledge of the properties and effects of those elusive accessory food factors, usually designated by the term "vitamins," is gradually being extended by the labours of a large number of research workers: a short account of some of the more recent work on the fat soluble vitamins may prove useful, both from its intrinsic scientific interest and also from the influence it may have on the practical problems of human and animal dietetics. No discussion of this subject nowadays would be complete without mention of the effect of irradiation with ultra-violet rays as a substitute for, or a generator of, the fat soluble vitamins, or of the influence of these factors in the prevention and cure of rickets.

The animal organism is dependent for its supply of fat soluble vitamin-A upon the vegetable world: two most important sources are the fresh green leaves of many plants and the liver of fishes, where the vitamin obtained from the food is concentrated in association with the fat (cod liver oil). Now its presence in green leaves and the effects of irradiation to be considered later have suggested that its synthesis may be effected only or chiefly in the presence of light, but Ethel M. Luce and Ida S. Maclean (*Biochemical Journ.*, 1925, vol. 19, p. 47) have concluded that it can be formed by yeast cells in the absence of sunlight: it can easily be extracted from the dried yeast by ether.

Vitamin-A is characterised by being associated with the fats of both plant and animal tissues, but it frequently happens in modern life that it is precisely these two types of foodstuffs which fail to reach the consumer in a fresh or natural condition. Appropriate sources of the vitamin for human consumption are green leaves, milk and butter, and cod liver oil: but the leaves are frequently cooked, the milk may contain little of the vitamin to start with, and still less after the treatment it may undergo before consumption, margarine may replace butter in the diet, whilst raw cod liver oil is unpalatable without further treatment. What factors may destroy the vitamin and how may this destruction be avoided? How may an adequate supply be ensured in the human diet?

It is known that the fat soluble factor is easily oxidised, especially at a high temperature: but in an atmosphere free from oxygen it will withstand a temperature of more than 100° C. without much loss of its activity. S. S. Zilva (*ibid.*, 1924, vol. 18, p. 881) has shown that the hardening of cod liver oil in the absence of oxygen does not result in the destruction of the vitamin: this fact may have an important bearing on the preservation of the factor in margarine, which is largely made from hardened oils. Most often, however, the vegetable oils used contain little or none of the vitamin before the hardening process takes place. Storage alone, for example of cod liver oil, does not result in complete destruction although the activity of the oil gradually becomes less: the presence of the vitamin in a sample thirty years old has been detected by E. Poulsson (*ibid.*, 1924, vol. 18, p. 919).

Since animals do not form vitamin-A, it is important to see that animal products used as food should come from animals which have had an abundant supply of the vitamin in their diet. The most important products in this connexion are undoubtedly milk and its derivatives. Ethel M. Luce (*ibid.*, 1924, vol. 18, p. 1279) has compared the effects of sunlight and a diet rich in vitamin-A in producing a milk rich in this factor. At this point we must digress for a moment to mention that the methods of testing for the presence of the vitamin by feeding animals on a diet deficient in the factor supplemented by the product under test have led to the conclusion that there is probably more than one fat soluble vitamin in existence: one is concerned with the *growth* of animals whilst the other keeps this growth in normal channels; the former may be called the *growth* factor (or vitamin-A) and the latter the antirachitic factor. Luce has found that cow's milk only contains the growth factor when it is present in the food of the cow, but that exposure of the animal to sunlight whilst on a diet deficient in vitamin-A increases somewhat the content of the antirachitic factor in the milk; the amount of this latter factor is, however, increased much more by the presence of fat soluble vitamins in the cow's diet. The quantity and fat content of the milk are not apparently increased by a diet rich in vitamin-A, from some experiments on goats by E. T. Sheehy (Proc. Roy. Dublin Soc., 1924, vol. 17, p. 333).

The study of experimental rickets has shown the importance of the fat soluble vitamins in the etiology of this disease, but it is probable that other factors are concerned as well. The question is complicated by the fact that rickets is a disease of growth and may not be developed if the animals are on a diet from which fat soluble vitamin-A has been excluded, the animals on this diet ceasing to grow. If the diet is simply deficient in the vitamin, so that growth does occur, then rickets will also appear. S. S. Zilva, J. Golding, and J. C. Drummond have recently shown this to be true also in the case of young pigs (*Biochem. Journ.*, 1924, vol. 18, p. 872). On the other hand, if young animals are fed on a diet which, besides being deficient in fat soluble vitamins, is badly balanced as regards the proportion of its mineral elements, or deficient in calcium or phosphorus, rickets can be produced fairly easily, although growth may be also retarded. This conclusion shows that it is essential to consider not only the vitamins but also the other elements of the diet, especially the minerals, in connexion with this disease.

Attention must be directed to a further factor which influences the development of rickets. The animal body seems able to store a supply of the fat soluble vitamins, so that until this store has been exhausted, exposure to a deficient diet will be without effect. The amount in this store will obviously depend on the diet given before the experimental period commenced, and it has been found that the diet of the mother during pregnancy and lactation has a marked influence in this respect, a conclusion which has an obvious practical bearing on human dietetics. Thus V. Korenchevsky and Marjorie Carr (*Biochem. Journ.*, 1924, vol. 18, pp. 1308, 1313, and 1925, vol. 19, p. 112) have shown that if the mother's diet is deficient in fat soluble vitamins during pregnancy and lactation, the young (rats) placed on a deficient diet at weaning develop rickets more easily than those whose mothers had been fed on a rich diet during corresponding periods. An excess of calcium in the mother's diet, provided that the fat soluble vitamins are in excess also, still further improves the resistance of the young to the development of rickets afterwards. If the parent rats of either sex are fed on a deficient diet before mating, the animals are less fertile, and the young born are weaker than normal, but there is no sign of any deficiency of calcium in their skeletons; thus the mother draws on her own reserves for the sake of her young.

Once rickets has developed on a deficient diet, it has been of interest to determine whether any

other factors besides the replacement of the missing vitamins will have any influence on the course of the disease. The addition of more calcium or phosphorus to the diet has little effect, unless these elements are already deficient; but V. Korenchevsky and M. Carr (*ibid.*, 1925, vol. 19, p. 101) have found that the subcutaneous injection of calcium glycerophosphate may improve the calcification of the animals on the deficient diet; the injection of sodium phosphate alone was almost without effect. Apparently only a certain maximum amount of calcium can be absorbed from the digestive tract; but that this is probably not due to the absence of the vitamins from the diet is shown by the results of some experiments by Katharine M. Soames (*ibid.*, 1924, vol. 18, p. 1349); the intraperitoneal injection of cod liver oil in rats afforded some protection against rickets; presumably these vitamins exert their influence on the tissues after absorption and do not facilitate the absorption of other elements of the diet. The same author in collaboration with R. Robison (*ibid.*, 1925, vol. 19, p. 153) has investigated further the cause of the deficient calcification of the bones in rickets. They find no deficiency in the blood of the phosphoric ester hydrolysable by the bone enzyme or of the enzyme itself in the bones. The administration of cod liver oil has no effect on this ester or on the enzyme, but increases the organic phosphorus present in the blood. It only influences the inorganic phosphorus of the blood when the diet is deficient in this element. The inference from their results is that the deficient calcification on a diet deficient in the fat soluble factor alone is due to a deficiency of calcium ions; deficiency of phosphorus only plays a part when the diet is deficient in this factor also.

A further factor in the cure or prevention of the effects produced by a diet deficient in fat soluble vitamins has been found within the last few years in the influence of ultra-violet rays. In the earlier observations children suffering from rickets were exposed directly to the source of light, with the result that the bone lesions were healed; the subject was taken up experimentally later and it was found that the growth of rats could also be stimulated by ultra-violet light when the animals were fed on a diet deficient in fat soluble vitamins. Later work has suggested that the ultra-violet rays may cause a synthesis of the antirachitic factor, but only a mobilisation of the body's store of vitamin-A without a true synthesis. This agrees with the results of Luce and Maclean mentioned above, who conclude that light plays no part in the formation of vitamin-A. Some of the other effects of irradiation have recently been referred to in these pages (December 20, 1924, p. 901, and May 2, 1925, p. 642).

A further step from this work was the examination of the effects of the ultra-violet rays upon the *food* given to the animal; and S. J. Cowell (*Brit. Med. Jour.*, 1925, vol. 1, p. 594) has tried the effect of feeding irradiated milk to rickety children; his paper also gives a brief account of some of the earlier work on irradiation. He has found that the irradiated milk has produced a great increase in the calcification of the bones of two children with rickets, whilst a third fed on the same milk without irradiation showed very much less improvement. It appears then that the antirachitic factor can be synthesised outside the body under the influence of ultra-violet light; this conclusion is of great importance, since it implies that a further method is available for the improvement of a ration which we may suspect to be deficient; it also opens up the way to a knowledge of the chemical constitution of the antirachitic factor and possibly its supply in some convenient and more palatable form than cod liver oil.

Further information as to the use and effects of light treatment in disease, together with accounts of the physiological actions of ultra-violet radiations, may be found in articles by J. H. Sequeira and W. J. O'Donovan (*Lancet*, 1925, vol. 1, p. 909) and F. H. Humphris (*ibid.* p. 912).

Power Alcohol from Root Crops.

THE third memorandum of the Fuel Research Board on fuel for motor transport [1] deals with the production of power alcohol from tuber and root crops in Great Britain. Potatoes, mangolds, and Jerusalem artichokes are the only practicable raw materials which could be grown for this purpose, but it seems unlikely that potatoes would prove of economic value in this respect. One ton of potatoes produces 20 gallons of 95 per cent. alcohol, so that every pound sterling it costs to grow a ton of potatoes is equivalent to 1*s.* on a gallon of alcohol for raw material alone. Co-operation between the potato grower and distiller has been suggested as a means of utilising the distillery residues for cattle-feeding, and so reducing the net cost of the power alcohol. In the southern counties the mangold is superior to the potato in that it is easier to grow, harvest, and store, and is less liable to disease and failure, while the manufacture of alcohol from it is simpler as the carbohydrates are in the form of sugar. The comparative cost per gallon for the raw material works out at 7*s.* for potatoes and 3*s.* 9*d.* for mangolds. The latter cannot, however, be grown in the north of England and Scotland owing to its susceptibility to frost. The distillation residues would appear to have considerable value as an ingredient in a feeding material rich in carbohydrates but poor in protein.

The Jerusalem artichoke will grow in almost any well-drained soil, and as it is difficult to clear the ground completely when harvesting, no replanting is needed for many years when once a plot is well established, the cultivation being thus reduced to a minimum. The crop yields are very variable, probably being about 10-12 tons per acre in England, and 15-25 gallons of 95 per cent. alcohol per ton of tubers have been produced. Experiments also indicate that by using an organism of the *Bacillus butylicus* group, about 12 gallons of mixed butyl alcohol and acetone can be obtained. The simultaneous fermentation of the tubers by yeast and the same organisms yielded a liquor consisting of 70 per cent. of ethyl alcohol, 10 per cent. of acetone, and 20 per cent. of butyl alcohol. The sun-dried artichoke stalks can be so treated as to give a pure resistant cellulose at the rate of about $\frac{1}{3}$ ton per acre, of a type that would be very suitable for certain purposes.

The memorandum concludes with a series of tables setting forth the results of cultivation experiments together with various analytical figures.

[1] Department of Scientific and Industrial Research: Fuel Research Board. Fuel for Motor Transport: Third Memorandum. Power Alcohol from Tuber and Root Crops in Great Britain. Pp. vi+37. (London: H.M. Stationery Office, 1925.) 9*d.* net.

Ascent of Beerenberg, Jan Mayen.

THE island of Jan Mayen in the Greenland Sea has been known at least since the early seventeenth century, when it was much frequented by whalers, and was the site of the Austrian meteorological station of 1882–83. The Austrians made an unsuccessful attempt to reach the summit of the volcanic peak of Beerenberg, being foiled by bad weather. In the summer of 1921, the Norwegian meteorological service sent an expedition to Jan Mayen to erect a wireless station. This afforded a passage to Dr. P. L. Mercanton, who was anxious to climb Beerenberg. He was joined by Mr. J. M. Wordie, Mr. T. C. Lethbridge, and three other Cambridge men. In *Écho des Alpes*, No. 8 (Lausanne), 1924, Dr. Mercanton gives an account of the successful climb.

The mountain arises at the north-east end of the small island, and although records occur of volcanic activity on the island in 1732 and 1818, there is no evidence that the main crater has been active during historic times. Certainly there is no sign of recent lava flow. The party ascended the mountain from the south-west by Ekerold Valley over barren ground strewn with volcanic tombs, and passing to the west of Esk or Vogt crater, reached the frontal moraines of the summit glacier at about 2770 feet. The route was then over a gentle ice slope without crevasses to a prominent nunatak at 5249 feet. This was marked by a cairn probably erected by the Austrians as a survey mark. Higher up, a crevassed surface was encountered, but the only real difficulty seems to have been when the bergschrund was reached. At 7448 feet the rim of the ice-filled crater was reached. This crater is about half a mile across, and from a gap on its northern side the Weyprecht glacier falls to the coast.

Beerenberg has two peaks, of which the higher is on the western side of the gap. This was reached along a snow *arête*. Dr. Mercanton gives the summit height as recorded by aneroid as 7661 feet (2335 metres). The figure obtained by the Austrians by theodolite measurement was 8350 feet (2545 metres). This may be compared with Mr. Wordie's figure of 8090 feet, which was also obtained by aneroid reading. The discrepancies between these figures are considerable, but the Austrian figures are not without doubt, largely because they worked with a very small angle. The paper is illustrated by a number of excellent photographs of the mountain and a reproduction of the Austrian map.

University and Educational Intelligence.

BRISTOL.—Their Majesties the King and Queen will open the new wing of the University on June 9. The new buildings are the gift of Sir George Wills and the late Mr. H. H. Wills, in memory of their father, and consist of an imposing tower and a building housing the administrative departments of the University, the main library of the Faculty of Arts and the medical works presented by the Bristol Medical and Chirurgical Society, as well as a number of lecture rooms. The provision of new accommodation for the Faculty of Arts releases a number of rooms adjoining the geological and biological departments, which will thus be afforded much-needed space for expansion.

CAMBRIDGE.—A grant of 25*l.* has been made from the Balfour Fund to Mr. J. T. Saunders, Christ's College, for an investigation of the diurnal movements of the zooplankton of the Swiss lakes. Dr. H. S. Pruthi, Peterhouse, has been nominated to use the University Table at the Zoological Station at Naples for one month.

Mr. D. Keilin, Magdalene College, has been appointed University lecturer in parasitology. Mr. J. A. Carroll, Sidney Sussex College, Assistant Director of the Solar Physics Observatory, has been appointed University lecturer in astrophysics.

The following grants have been made from the Worts Fund:—100*l.* to G. E. Barton, Gonville and Caius College, towards the expenses involved in a visit to Sumatra and elsewhere to complete a study of limestone denudations and other subjects; 100*l.* to A. B. Deacon, Trinity College, towards the expenses involved in a visit to the New Hebrides for ethnological study; 40*l.* to W. G. East, Peterhouse, for a visit to Vienna to inspect certain Foreign Office documents in connexion with historical research; 30*l.* to J. Needham, Gonville and Caius College, for researches on the oxidation-reduction potential of the cell-interior to be carried out at Roscoff in Brittany.

LONDON.—The three following courses of free public lectures have been arranged: "The Biological Aspect of Hydrographical Work," by Dr. J. Schmidt, at University College, at 5.30 o'clock, on June 8 and 9; "Blood and Circulation from the standpoint of Physical Chemistry," by Prof. L. J. Henderson, at University College, at 5.30 o'clock, on June 10, 11, and 12; and "Cardiology," by Prof. J. Hay, at University College Hospital Medical School, at 5 o'clock on June 11, 12, 18, and 19.

OXFORD.—An election to a fellowship in physiology at New College will take place in October. Particulars and the necessary form of application may be had from the Warden, to whom the completed form must be returned not later than June 15.

ST. ANDREWS.—The University Court has appointed Mr. David Jack, at present associate professor in the Carnegie Institute of Technology, Pittsburgh to be an assistant in the Department of Natural Philosophy.

THE Carnegie Trust for the Universities of Scotland will announce in July next the allocation for the five years 1925–26 to 1929–30 of grants to universities and extra-mural colleges. For the quinquennium now expiring these grants amounted to 224,600*l.*, including 25,000*l.* for libraries, 156,000*l.* for new buildings and permanent equipment, and 43,000*l.* towards endowment of lectureships and other general purposes. Special additional grants were made last year towards the equipment of two hostels for women students at Glasgow (5000*l.*) and for the furnishing and equipment of a women students' union at Aberdeen (1500*l.*). Grants in 1923–24 for post-graduate study and research, including fellowships, scholarships, and grants-in-aid, amounted to 18,287*l.* Assistance for students (average 12*l.* each) amounted to 54,000*l.* and voluntary refunds to 1126*l.* A table of refunds since 1901 shows that the maximum (1623*l.*) was reached the year after the War.

APPLICATIONS are invited by the London County Council for two Robert Blair fellowships in applied science and technology, each tenable for one year and each of the value of 450*l.* The fellowships are for advanced study or research, tenable in the dominions, the United States or other countries. They are open only to British subjects. Further information and the prescribed application form (T.2.a 300) may be obtained from the Education Officer (T.2.a), The County Hall, London, S.E.1, upon receipt of a stamped addressed envelope. Completed forms must be returned by June 30.

In our issue of February 21, p. 284, announcement was made of the foundation, by the Commonwealth Fund, New York, of twenty fellowships for British graduates. The fellowships are tenable for two years in American universities and are each of the annual value of about 600*l*. The committee of award has now issued the first list of appointments. The distribution of the new fellows among British universities, including two institutions where a fellow has worked at two, is as follows: Oxford 6, Cambridge 4, Edinburgh 4, St. Andrews 3, Durham 2, and Belfast, Leeds, London, Manchester, and University College, Swansea, one each. Grouping the new fellows according to subject studied, the following are included: economics, geology, mathematics, medicine, chemistry and physics, two each, and engineering chemistry and botany, one each. The American universities to which the fellows will go are Harvard, Yale, Princeton, Columbia, Johns Hopkins, Cornell, and the universities of Pennsylvania, Chicago, Wisconsin, Minnesota, and California.

On Saturday, Principal W. M. Childs, speaking at University College, Reading, upon the occasion of the annual conferment of the associateship of the College, announced that a letter had been received from the Clerk of the Privy Council stating that the Lords of the Committee of Council, after considering the further petition of the College for a charter under the title of the University of Reading, were prepared to recommend the grant of a royal charter by His Majesty in Council, subject to an assurance by the petitioners that they would take all possible steps to relieve the College of indebtedness and to increase still further its present income. The announcement was received with great enthusiasm by a large and representative audience. Speaking afterwards at a luncheon to the newly enrolled associates, the Principal stated that already, since the petition of the College was forwarded in January last, the income of the College had been substantially increased.

On Tuesday, May 26, Sir Robert A. Falconer, President of the University of Toronto, delivered a lecture at the University of Edinburgh on "The United States as a Neighbour—Manners of Life and Thought." This was one of the lectures for 1925 of the Sir George Watson chair of American history, literature and institutions. Sir Robert Falconer discussed the effect of the environment of the new world and instanced the struggle which the settlers had in the new conditions of life, out of which issued virtues which have been reproduced in their descendants who kept moving out into the unknown regions of the West. The common school has been from early days one of the most powerful influences for the moulding of the character of the American people, among whom there is a deeply rooted conviction that the freedom of their democracy depends upon their education. On the whole, however, there is less freedom of speech than in Britain. The common school system in Canada took much from the practice and organisation of the schools of Massachusetts and New York, but was adapted so as to meet local requirements. In secondary education also Canada has adopted the American system, but Sir Robert stated that the results are not altogether satisfactory; pupils enter upon their high school work some two years too late, so that those who go on to the University at eighteen do not possess the liberal training necessary for recruits to the learned professions. The tie of a common language he considered to be the greatest and best of all influences moulding the life of Americans and Canadians to similar issues.

Early Science at Oxford.

June 7, 1687. A letter from Mr. Humphrey to Mr. Lloyd, dated Lhandowhyn May 26, 1687. giving an account of some Natural Curiosities from Anglisy was communicated.

Mr. Molineux his letter to Dr. Plot desiring some accompt of the great fall of Thames near London Bridge on May the 10th, which occasioned the Doctor to inform the Society that himself saw horses and also boys of 12 or 14 years of age pass ye River; that three parts of ye Channel was without water. The manifest cause of which was ye violence of the Winds which then blew at S.W.

Nux de Bhen, yeilding an oyl much used by painters, and Semen Macalep, used in perfuming of gloves both from E. Indies, were communicated by Dr. Plot.

June 8, 1686. A Letter from Dr. Bagley to Mr. Musgrave was read; giving an account of the *Dissections* of four bodys.

Dr. Plot shewed the Society, the Curiosities following: A peice of Corktree nine foot long, and about five inches diameter, which grew in Cambridgeshire; A small stone changing colour according to the different reflections of light, appearing green and sometimes blackish; Oyl of Camphire made with water; A Liquor distilled from some bituminous strong scented earth digged at Hogsdon in Midlesex; *Labdanum liquidum* of a greenish colour.

June 10, 1684. Dr. Plot acquainted ye Society, that, haveing put some of ye *Natrôn* into a glass about a month since, he observed, that, at ye beginning of June, it was somewhat encreased in weight. He presented ye Society with a spirit of this salt mixed with salt of tartar; it was very volatile, urinose, and had something of an oiliness in its tast. He mentiond severall other experiments, which he had tried on this salt, but haveing not as yet put his last hand to them, he was desired to prosecute them, as he shall thinke fit; and bring in an account of them, when completed.

Dr. Plot also brought in an account of ye *weather* ye last month here at Oxon, taken according to Dr. Lister's Scheme: if this design be carried on, in ye severall quarters of ye land, it will inform us more particularly as to ye coasting of winds, and how rains etc depend on them. He also presented to us a pattern of a very rich *Gold-ore* from Hungary, lately presented him by Mr. Lawson, a Dane; it was of that sort, which is termed *Aurum statim suum*; it needs no refining, but may easily be separated from ye alabastine substance, with which it is mixed, barely by powdering.

Dr. Smith communicated, and read, a discourse *de Longitudinum differentiis inveniendis*, composed many years since, by Dr. John Bainbrigg, formerly Savilian Professor in this University.

June 12, 1688. A Certificate from Mr. Morgan Jones a Minister, dated at New York Mar. 10th 1685–6. was read concerning some Natives of the West Indies near Cape-Ahas that understand the British Tongue.

A letter from Mr. Hillyer to our President dated Jan. 3. 1687–8. was read, which gave a large account of the country of Cape Corse in Guinea and of some customes of the natives there.

Dr. Plot communicated a stone that was brought out of Cornwall called the Soap-stone.

Mr. Musgrave gave an account that a very good sort of Vinegar is made thus; put 2 lb. of the best Mallaga Raisons cleansed into a gallon of spring water in an earthen jar covered with a slate and set in the sun for about two months in the heat of summer, or till it is sharp enough, then draw it off with a syphon without jogging.

Societies and Academies.

LONDON.

Royal Society, May 28.—R. J. **Ludford**: (1) Cell organs during secretion in the epididymis. The Golgi apparatus hypertrophies and assumes different forms, according to the degree of secretory activity. There occur nucleolar extrusions, nuclear budding, and a differential staining of the nucleolus, while the mitochondria increase in number at the onset of secretory activity, and decrease during the course of secretion. Variations observed in the secreting cells in different tubules of the epididymis are probably indicatory of variations in the degree of intensity of the secretory process. Secretory activity is maintained by the elimination of waste products, which is effected by nucleolar extrusions from the nucleus, and by amitosis followed by the discharge of a nucleus and part of the cytoplasm into the lumen of the tubule. Reconstruction of exhausted cells also occurs during a resting phase, while cells completely worn out are replaced, principally by the basal cells. (2) Nuclear activity in tissue cultures. The nucleoli of fibroblasts of the rat's kidney perform during life slow amœboid movements. Occasionally a nucleolus approaches the inner surface of the nuclear membrane, and part of it is discharged into the cytoplasm, where it disintegrates. Also, a portion of the nucleus itself may be budded off, persist for a time, and then diffuse into the ground cytoplasm. These processes probably represent phases in the normal metabolic activity of the cell.—J. **Needham** and Dorothy **Needham**: The hydrogen-ion concentration and the oxidation reduction potential of the cell interior: a micro-injection study. Subject to certain assumptions, the cell-interior of *Amœba proteus* has a hydrogen-ion concentration of approximately P^H 7·6, and an oxidation reduction potential of between *r*H 17 and 19.—F. W. R. **Brambell**: The oogenesis of the fowl (*Gallus Bankiva*). The Golgi apparatus, type 1, of the oocyte is demonstrated for the first time. It is shown to surround the centrosphere. An intrusion into the oocyte of Golgi apparatus, type 2, from the follicle cells takes place. The former, and possibly the latter, break up into fine granules and become dispersed throughout the cell during oogenesis. These granules probably persist as such, and produce the Golgi apparatus of each embryonic cell by a process of condensation. The mitochondria increase in number in the oocyte and form the *mitochondrial cloud*. The transitory *mitochondrial yolk-body* differentiates in the middle of this cloud. At a certain stage between the third and sixth week after hatching, a number of oocytes in the ovary of the chick enter upon a period of precocious growth, exhibiting remarkable abnormality in behaviour of their cytoplasmic inclusions and finally becoming atretic. This may represent the final degeneration of the primordial germ-cells.

The Optical Society, April 16.—J. **Guild**: The geometrical solution of colour mixture problems. Starting from the experimental fact that any colour can be uniquely expressed by a trichromatic equation, provided negative coefficients may enter, all problems of colour mixture are amenable to an exact system of geometrical calculation. The methods used obviate the introduction of stereographic projection and other geometrical complications. This simplification is effected by conducting the actual colour mixture part of any calculation in the quantity units of one trichromatic system, leaving the relative magnitudes of the various systems of units, where more than one system is involved, to be accounted for by the introduction of suitable coefficients in the purely arithmetical part of the work.—J. W. **Gordon**: "The double square"—a new optical appliance based upon the "optical square." The optical square is a well-known arrangement of two mirrors for deflecting an optical axis through a right angle and obtaining an erect image. The double square is formed by the addition of a third mirror, which gives an inverted image and is so disposed with regard to the first two as to enable the image to be seen in adjacent but concentric fields, the one image simply reversed and in juxtaposition to the other. Such a combination may be used as an artificial horizon in the taking of altitudes or as a gun sight and is applicable to the sextant and the range-finder.—F. Van **Neck**: (1) The Hahn Goerz workshop microscope. This instrument is a shortened prism microscope giving an erect image of the object. A magnification of between 35 and 55 diameters is obtainable, the variation being effected by extending the ocular tube. An open sight is provided, by means of which the microscope can easily be directed to any particular spot. The microscope is carried on a horizontal bar which can move up and down on a vertical pillar, and movement in any direction is possible. The instrument can be used for examining objects of any kind which cannot be brought on to the stage of an ordinary microscope.—(2) The "Artisol" mirror arc lamp. This lamp is specially intended for the projection of cinema films. The carbons are at right angles to one another, the crater being directly exposed to the parabolic glass mirror. The light reflected from the mirror is collected by a large plano-convex lens. The arrangement of the carbons and the combination of glass mirror and large condenser ensures a much higher illumination per unit of current than in the ordinary pattern lamp.

Linnean Society, April 23.—R. J. **Chittenden**: Primula hybrids. The F_1 between *P. acaulis* and *P. Juliæ* has a pink corolla, while those between *P. Juliæ* and *P. elatior* and between *P. Juliæ* and *P. officinalis* have the corolla yellow. A dominant colour inhibitor seems to be present in *P. elatior* and *P. officinalis* and absent from *P. acaulis*. These facts suggest that the garden Polyanthus may have risen from *P. acaulis* and *P. officinalis* or *P. elatior* hybrids by recombinations of their various factors.—M. A. C. **Hinton**: A vole from Montenegro, discovered in December 1921 by Dr. V. Martino. Martino's vole is a large species (head and body 130 mm.; tail 101; hind-foot 25·4; ear 18·5), long tail. In colour it is brownish-grey above when adult, bluish-grey when young, whitish below. Its feet are white and its tail conspicuously bicoloured, dark brown above, white below. It is referred to the genus Dolmys, described and hitherto only known from the Upper Pliocene of Hungary; Martino's vole is named *Dolomys bogdanovi*. The remarkable external characters and the extreme brachyodonty are generalised features of an archaic form which has managed to linger in Balkan seclusion.—John **Parkin**: A unique feature in the petal of Ranunculus, and its bearing on the phylogeny and taxonomy of the genus. Möbius, forty years ago, explained the cause of the high polish exhibited by the petals of yellow buttercups as follows: The upper epidermis of the petal has a perfectly smooth external surface, and its cells hold the yellow pigment in solution as a kind of oil. Below the epidermis is a layer of cells densely packed with minute starch grains. The whole structure is like a mirror. The epidermis with its clear yellow liquid acts as the gloss, and the starch layer as the reflector. This is substantially correct Species with

glossy petals form a natural group, and most seem to have yellow flowers. The presence of starch in a few of the non-glossy species presents a difficulty in phylogeny. Perhaps starch in the mature plant is, as a primitive feature, retained and used as an adaptation in the species which have developed glossiness. The high polish of the petal of the yellow buttercup has been of advantage in attracting insect visitors to the flower, and thus been partly responsible in making this section of the genus, in contrast to the white group, cosmopolitan.—Kenneth **Rees**: Previous investigations into the distribution and ecology of marine algæ in Wales.

Faraday Society, April 27.—E. A. **Ollard**: Adhesion of deposited nickel to the base metal. This work was undertaken to endeavour to measure the adhesion of deposited nickel to mild steel. A special method was evolved, the result of which shows an adhesion probably greater than 19 tons to the square inch.—H. **Sutton**: The brittleness of zinc-plated steel. Stream-line wires are embrittled by zinc plating. A deposit of zinc of not more than 0·0005 in. affords good protection against corrosion and permits the easy removal of the brittleness. Both cyanide and sulphate baths may be used, but the former is preferred on account of the superior protective qualities of the deposit. In either case the wires should be heated to 100° C. for thirty minutes. A rough surface before plating leads to severe embrittling and impairs the recovery.—W. A. **Naish**: The partition of silver between lead and zinc. Melting was carried out in clay cylinders in a metal bath, heated electrically and with adequate stirring and temperature measuring arrangements, the cylinders being quenched in mercury. In dilute solution there is a distribution ratio $\left(\frac{\text{Per cent. Ag in Zn}}{\text{Per cent. Ag in Pb}}\right)$ of approximately 302 at 550° C.; this is independent of the concentration of silver or the relative proportions of lead and zinc, but is dependent on the temperature, the deviation at higher concentrations than about 5 per cent. silver being probably due to the formation of compounds.—H. J. **Poole**: The elasticity of gelatin jellies and its bearing on their physical structure and chemical equilibria. The strain produced in gelatin jellies by the application of a steady stress is not a function of that stress alone but is governed by a time factor. The study of this time factor or "creep" suggests that the jellies are two-phase (solid-liquid) bodies. The creep is mainly due to a reversible flow of the liquid phase in the interstices of the solid phase and, to a lesser extent, to an irreversible plastic deformation of the solid phase. The solid phase is thought to have the form of a mesh of cylindrical fibrils or threads, and the material of these threads is in dynamic equilibrium with the water of the liquid phase, as a result of either a reversible hydrolysis or hydration, whereby the ratio of gelatin in the solid phase to that in the liquid phase becomes progressively less with rising temperature.—D. B. **Macleod**: (1) On some physical properties of water. The gain in volume, assumed to be due to association of the molecules in water, and the loss of free space, bear a simple relation to the change of association, and these two facts are used to explain all the anomalies of water connected with volume, compressibility, and viscosity. (2) On the relation between the viscosities of liquids and their molecular weights. Previously the author has shown that the viscosity of a liquid is inversely proportional to the free space within the liquid. The viscosities of liquids at a condition of equal amounts of free space relative to the total volume are now compared and show that viscosity can be interpreted as a simple function of the molecular weight. Divergence from normality is ascribed to different degrees of molecular complexity.—E. K. **Rideal**: A note on the reduction potential of dicyanquinhydrone. The quinhydrone was prepared from equimolecular proportions of the quinhydrone and hydroquinine and the e.m.f. of the cell determined. The reduction potential was found to be 0·9712 volt at 25° C.

DUBLIN.

Royal Irish Academy, April 27.—E. L. **Hirst**, A. K. **Macbeth** and D. **Traill**: The action of hydrazine on the halogen derivatives of malonamides and of acetoacetic esters. Monochloro-, monobromo-, and dibromo-malonamides are reduced by hydrazine hydrate at laboratory temperature, and the halogen derivatives of substituted malonamides react on warming. The case of dibromomalonamide is of interest as the final reaction product is the hydrazone of mesoxalamide. The α-chloro- and α-bromo-derivatives of ethyl ethyl-, propyl-, and benzyl-acetoacetates give as final products 3-methyl-4-ethyl-5-pyrazolone, 3-methyl-4-propyl-5-pyrazolone, and 3-methyl-4-benzyl-5-pyrazolone respectively, but halogen derivatives of ethyl acetoacetate give mixed products; the low percentage of evolved nitrogen in the last case is traced to this cause. The preparation of ethyl α-chlorobenzoylacetate and its conversion into ethyl aminothiazolecarboxylate were described.

PARIS.

Academy of Sciences, April 27.—Jean **Tilho**: The order of magnitude of the variations of depth and extent of Lake Chad. — A. **Bigot**: The presence of Trilobites and Archæocyathideæ in the Cambrian layers in the neighbourhood of Carteret (Channel).—Gaston **Julia**: Quasi-analytical functions and integral functions of zero order.—M. T. **Huber**: The bending of a flanged plate.—P. **Chofardet**: Observations of Orkisz's comet (1925 *c*) made at the Observatory of Besançon with the *coudé* equatorial. Positions given for April 19, 22, and 23. On April 22 the comet was estimated to be of the 8th magnitude, showing as a circular nebulous cluster, about 8′ diameter, with a strong central condensation.—H. **Eyraud**: The theory of the electromagnetic field and atomic radiation.—Léon **Brillouin**: Surface tension: the intepretation of the Eötvös relation.—C. E. **Guye**, P. **Mercier**, and J. J. **Weiglé**: The explosive potential in carbon dioxide at high pressures. The experimental results of several years' work are given, showing the explosive potential in volts for pressures between 1 and 20 atmospheres and for distances between the electrodes varying between 0·5 and 5 mm.—R. **Forrer**: An artificial magnetic anisotropy of nickel. The phenomena of discontinuity.—E. **Estanave**: Contribution to the realisation of integral photography.—H. **Ikeuti**: The beta rays produced in air by homogeneous X-rays of short wave-length. Measurements of the lengths of the trajectories of the two types of beta rays, photo-electrons, and fish tracks (C. T. R. Wilson). The results are in general agreement with those of Wilson and Compton.—Albert **Arnulf**: The ionisation of potassium vapour under the influence of visible light. Experiments showing that under the influence of ordinary (not ultra-violet) light a small number of electrons and positive ions are set free.—Roger **Grandgérard**. The "Bertillonnage" of modern pictures by radiography. A radiograph of a picture furnishes an exact proof of identity. It is suggested that a radiograph of a picture, taken under certain prescribed conditions, should be deposited officially, a duplicate being

retained by the artist. This would suffice to decide any question of authenticity in the future.—H. **Forestier** and G. **Chaudron**: The transformation points of solid solutions of alumina or chromic oxide in ferric oxide.—W. **Mestrezat** and Mlle. Y. **Garreau**: Experimental contribution to the study of the transport of electrolytes. The mobilisation of the ions by intermolecular exchanges.—Georges A. **Le Roy**: A medieval weapon damascened with tin. Ancient weapons, inlaid with gold or silver, are well known, but inlaying with tin during medieval times in Europe has not hitherto been noted. The epée examined by the author was found to be inlaid with tin.—Raymond **Charonnat**: The potassium chlororuthenates. The brown chlororuthenate of Claus and Rutbier and the red salt obtained by Lewis Howe have been accepted as a case of isomerism not in agreement with Werner's theory. It is shown that these two salts are not isomers, since ruthenium is tetravalent in the brown salt and trivalent in the red salts. This removes a supposed case of isomerism incompatible with the theory of Werner.—Max and Michel **Polonovski**: The oxyeserenic derivatives.—Const. **Dosios** and Theod. **Tsatsas**: The nitro products of diphenylglycollic ether.—Raymond **Delaby** and Jean Marc **Dumoulin**. The isomerisation of the vinylalkylcarbinols $CH=CH-CH(OH).R$ into ethyl-alkylketones $C_2H_5.CO.R$. Vinylethylcarbinol is converted by copper at 296° C. into the isomeric diethylketone. The next two higher homologues are similarly converted into the corresponding ketones.—F. **Kerforne**: The contact of the Vilaine sheet with its substratum.—C. E. **Wegmann**: A delayed phase of the Scandinavian Caledonian chain.—A. **Goris** and M. **Metin**: The chemical composition of a hybrid of *Aconitum Anthora* and *Aconitum Napellus*. The alkaloids peculiar to each species (anthorine and aconitine) are found together in the hybrid.—Paul **Gillot**: The characteristics of some oils from Euphorbiaceæ. Mercurialis and Euphorbia are not only characterised by their botanical affinities, but also by the similar physical and chemical characters of the oils extracted from their seeds. These oils are very similar to linseed oil.—E. and G. **Nicolas**: Observations on the influence of urea, thiourea, and allylthiourea on the higher plants.—Edouard **Fischer**: The constitution of the green gland of the crayfish.—Lucien **Semichon**: The action of alcohol on the selective faculty of yeasts in the fermentation of grape musts.—Léon **Blum** and Maurice **Delaville**: Researches on the mechanism of acidosis.—L. **Panisset** and J. **Verge**: The presence of spirochætes in dogs attacked with hæmorrhagic gastro-enteritis.—Yves **Kermorgant**: The etiology of mumps.

ROME.

Royal Academy of the Lincei, March 15.—T. **Levi-Civita** and U. **Amaldi**: Conditions for the ensurance of the independence of the arguments in the Hamiltonian expression for varying action.—Leonida **Tonelli**: Singularity of the solution of an ordinary differential equation.—F. **Zambonini** and G. **Carobbi**: Lanthanum thallous sulphates. The three compounds, $La_2(SO_4)_3$, $4{\cdot}5Tl_2SO_4$; $La_2(SO_4)_3$, $3Tl_2SO_4$; and $La_2(SO_4)_3$, Tl_2SO_4, $2H_2O$, are found to exist.—Secondo **Franchi**: Fundamental stratigraphical and palæontological data for the secondary age of the calc-schists and the hypothesis of a great overthrust of the mass of these rocks in the Franco-Italian Alps.—Achille **Russo**: Impure gametogens, impure gametes, and accessory conjugations in *Cryptochilum echini* Maupas.—Enrico **Bompiano**: A theorem of comparison and a theorem of singularity for the differential equation $y'=f(x, y)$.—Letizia **Onali**: A theorem on the surface of the minimum order passing through an oblique curve.—D. J. **Struik**: Mathematical work of Paul of Middelburg.—Emilio **Oddone**: The resistance offered by the earth's surface to movements of the air.—G. **Carobbi**: Synthetic praseodymiferous chlorovanadinite: Reference to Prandtl and Grimm's recent work on element No. 61. The author's failure to justify the assumption that praseodymium exists in a quinquevalent form isomorphous with quinquevalent vanadium furnishes no support for the arrangement of the rare earths given in Prandtl and Grimm's periodic system.—U. **Sborgi**: An electronic theory of the anodic behaviour of metals, especially of those exhibiting phenomena of passivity.—U. **Pratolongo**: Alkaline chlorosis of the vine. The results of preliminary experiments indicate no causal connexion between the high alkalinity of the soil or its tendency to produce chlorosis and the presence, abundance, or fineness of the calcium carbonate it contains.—Antonio **Cavinato**: Studies on quartz: Quartz crystals from Val Maggia and their interesting pseudo-hemimorphic habit.—Enrico **Clerici**: Fusion mixture for isopyknomeric analysis. Mixtures of thallium formate and fluoride give liquids of specific gravity 4·20 at 20° C., 5·38 at 100° C., and 5·40 at 110° C.; such mixtures exhibit marked fluidity and pass rapidly through filter-paper.—Renato **Santucci**: Contribution to the study of the post-embryonic development of the Scyllaridea of the Mediterranean.—P. **Pasquini**: First formation of the pectin in the development of the eye of *Gallus domesticus*.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 11, No. 3, March).—G. L. **Clark** and W. **Duane**: The relative intensities of fluorescent and scattered X-rays. The scattered and tertiary radiation due to tungsten X-rays, for secondary radiators of atomic weight near that of molybdenum, are extremely weak compared with the fluorescent radiation. The source of the powerful radiation found in earlier experiments is unknown.—W. **Duane**: Note on the quantum theory of the reflection of X-rays. The assumption that only the total fluorescent radiation from an atom quantises its momentum with the crystal leads to results not justified by experiment.—G. N. **Lewis**: A new principle of equilibrium. Corresponding to every individual process there is a reverse process, and in a state of equilibrium the average rate of every process is equal to its reverse process. This is termed the Law of Entire Equilibrium. In a state of equilibrium, there is no essential difference between backward and forward direction in time; time thus loses its unidirectional character.—J. C. **Walker**: Studies on disease resistance in the onion. So far as smudge and neck-rot are concerned, immunity appears to be related to the presence of flavone or anthocyan colouring matter in the outer scales. Black mould attacks both coloured and uncoloured varieties.—W. J. **Luyten**: Notes on stellar statistics; (iv) on the relation between the mean values of the v and τ components of proper motion.—Cecilia H. **Payne**: Astrophysical data bearing on the relative abundance of the elements. The temperature of disappearance of a line in stellar spectra is a function of the relative abundance of the element in question (Fowler and Milne). Assuming among other things that stellar atmospheres are uniform and that the effects of nuclear fields are negligible at stellar pressures and temperatures, computations from a homogeneous collection of spectra indicate that the relative abundance of atomic species in the stars and in the earth's crust is of the same order. Zinc is an exception, and the stellar figures for hydrogen and helium are improbably high.

Official Publications Received.

Nyasaland Protectorate. Annual Report of the Geological Survey Department for the Year 1924. Pp. ii+8. (Zomba.)

Board of Education. Report for the Year 1924 on the Science Museum. Pp. 20. (London: H.M. Stationery Office.) 9*d*. net.

Board of Education. Report of an Enquiry into the Conditions affecting the Teaching of Science in Secondary Schools for Boys in England. Pp. 28. (London: H.M. Stationery Office.) 3*d*. net.

Rapport annuel sur l'état de l'Observatoire de Paris pour l'année 1924 présenté au Conseil dans sa séance du 27 février 1925. Par B. Baillaud. Pp. 23. (Paris.)

Department of the Interior: Bureau of Education. Bulletin, 1924, No. 37: Land-Grant College Education, 1910 to 1920. Part 2: The Liberal Arts and Sciences, including Miscellaneous Subjects and Activities. Edited by Walton C. John. Pp. v + 108 + 4 plates. (Washington: Government Printing Office.) 25 cents.

The British Mycological Society. Transactions, Vol. 10, Part 3. Edited by Carleton Rea and J. Ramsbottom. Pp. 129-232. (London: Cambridge University Press.) 7*s*. 6*d*. net.

Forest Research Institute, Dehra Dun (U.P.), India: Economic Branch. Tests of Indian Timbers in Structural Sizes: Scheme of Operation No. 1 for Project No. 2. By L. N. Seaman. Pp. iii+16+5 plates. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10*d*.

Seale-Hayne Agricultural College, Newton Abbot, Devon: Department of Plant Pathology. First Annual Report for the Year ending September 30th, 1924. (Pamphlet No. 16.) Pp. 31. (Newton Abbot.)

Instituts scientifiques de Buitenzorg. "'s Lands Plantentuin." Treubia: Recueil de travaux zoologiques, hydrobiologiques et océanographiques. Vol. 7, Livraison 1, février. Pp. 84+3 Tafeln. (Buitenzorg.) 2.50 f.

Memoirs of the Indian Meteorological Department. Vol. 24, Part 9: Correlation in Seasonal Variations of Weather, IX. A further Study of World-Weather. By Sir Gilbert T. Walker. Pp. 275-332. 2.12 rupees; 4*s*. 9*d*. Vol. 24, Part 10: Correlation in Seasonal Variations of Weather, X. Applications to Seasonal Forecasting in India. By Sir Gilbert T. Walker. Pp. 333-345. 8 annas; 9*d*. (Calcutta: Government of India Central Publication Branch.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 14, Part 1: (1) On the Chemical Constituents of Malt-rootlets with special reference to Hordenine; (2) On the Hemicellulose of *Allium Cepa*, L. By Yoshitaka Hashitani. Pp. 63. Vol. 14, Part 2: Über die Kultur von *Aspergillus niger* mit besonderer Rücksicht auf das Puffervermögen der Nährlösung. Von Prof. Tetsu Sakamura. Pp. 65-128. (Sapporo.)

Diary of Societies.

SATURDAY, JUNE 6.

ROYAL SOCIETY OF MEDICINE (Otology Section), at 10.30 A.M.—General Discussions: Methods of Drainage of Brain-abscesses.—Artificial Aids to Hearing.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (Southern District) (at Town Hall, Reading), at 11 A.M.—Discussion on Tests on the Air-Ejector Sewage System at Gosport.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Rev. Dr. E. M. Walker: Democracy in the Ancient World (III.).

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Annual Congress) (at Folkstone). (*See June 3 for programme.*)

MONDAY, JUNE 8.

FARADAY SOCIETY (jointly with Iron and Steel Institute) (at Institution of Civil Engineers), at 3.30.—The Physical Chemistry of Steel Making Processes:—Sir Robert Hadfield, Bart.: Introductory Address.—A. McCance: Balance Reactions in Steel Manufacture.—J. B. Ferguson: Equilibria in Systems involving Ferrous Oxide.—P. MacNair: Slag Reactions.—T. P. Colcough: A Study of the Reactions of the Basic Open Hearth Furnace.—J. H. Whiteley: The Function of Ferric Oxide in the Acid and Basic Open Hearth Processes.—F. T. Sisco: The Chemical Reactions in Basic Electric Process.—W. J. Rees: The Micro-examination of Steel Making Refractories.—A. L. Field: Physico-Chemical Phenomena from Melt to Ingot.

ROYAL IRISH ACADEMY, at 4.15.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Principal Sir Alfred Ewing: A Ball and Tube Flowmeter (with experiments).—Général G. Ferrié: L'Entretien des pendules au moyen de cellules photoélectriques.—Prof. W. Peddie: A Colour Vision Spectrometer.—J. Forrest: Magnetic Quality in Crystals; Discrimination of, and Stability in Molecular Lattices.—W. L. Ferrar: On the Cardinal Function of Interpolation Theory.—Dr. D. A. Fairweather: The Electrosynthesis of *n*-Duotriacontane Dicarboxylic Acid.

BIOCHEMICAL SOCIETY (at St. Thomas's Hospital), at 5.—J. Patterson: The Carbohydrate Content of Normal Urine.—H. P. Marks: Some Observations on the Testing of Insulin.—Prof. R. H. A. Plimmer and J. L. Rosedale: (*a*) Study of Van Slyke's Method of Analysis of Proteins; (*b*) Experiments on Nutrition.—Prof. R. H. A. Plimmer: The Action of Nitrous Acid upon Amides and some Amino Compounds.—W. J. N. Burch: Some Esters of Phosphoric Acid.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—Miss Mary Chadwick: The Education of the Educationist.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—A. H. Hannay, Prof. T. P. Nunn, and Prof. H. Wildon Carr: Symposium: The Subject-Object Relation in Historiography.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (Annual Meeting) (at Chemical Society), at 8.15.—Dr. A. E. Dunstan, F. B. Thole, and W. H. Thomas: Colloidics of Petroleum.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Col. C. H. D. Ryder: The Demarcation of the Turco-Persian Boundary in 1914.

TUESDAY, JUNE 9.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 4.30.—The Rt. Rev. Bishop Whitehead: Anthropology in the Mission Field.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. S. A. K. Wilson: Disorders of Motility and of Muscle Tone, with special reference to the Corpus Striatum (Croonian Lectures) (I.).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—C. B. Williams: Exhibition of Cinematograph Films illustrating Method of Fumigating Citrus Trees in Egypt.—A. Gibson: Exhibition of Films showing Methods of Combating the European Corn-borer in Canada.—Capt. E. W. Shann: Exhibition of Films taken on board the *Salpa* at Plymouth.—Prof. J. P. Hill and A. Subba Rau: Exhibition of Developmental Material of the Slender Lemur (*Loris gracilis*) recently obtained from South India.—A. Subba Rau: Contributions to our Knowledge of the Structure of the Placenta of Mustelidæ, Ursidæ, and Sciuridæ.—Prof. D. M. S. Watson: The Structure of certain Palæoniscids and the Relationships of that Group with other Bony Fish.—Dr. H. H. Woollard: The Anatomy of *Tarsius spectrum*.—J. R. Baker: A Coral Reef in the New Hebrides.—Dr. J. Stephenson: Oligochæta from various Regions including those collected by the Mount Everest Expedition, 1924.—C. R. Narayana Rao and B. S. Ramanna: Note on the Conus Arteriosus of some Genera of Engystomatidæ and certain Examples of *Rana* and *Bufo* (Batrachia).

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Khan Bahadur Dr. Jivanji Modi: Paper.

RÖNTGEN SOCIETY (at British Institute of Radiology), at 8.15.—Dr. R. Knox: Investigation of the Heart Movement by the Use of the Slit Diaphragm.

INSTITUTION OF ELECTRICAL ENGINEERS.—Summer Meeting at South Midland Centre.

WEDNESDAY, JUNE 10.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. E. Spencer: On some Occurrences of Spherulitic Siderite and other Carbonates in Sediments.—L. R. Cox: Exhibition of Fossils and Lantern-slides illustrative of the Fauna of the Basal Shell-bed of the Portland Stone (Isle of Portland).

RADIO SOCIETY OF GREAT BRITAIN (Informal Meeting) (at Institution of Electrical Engineers), at 6.—W. K. Alford and others: Discussion on the Application of the Supersonic Method of Reception to Ultra-short Wave-lengths.

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting at South Midland Centre).

THURSDAY, JUNE 11.

ROYAL SOCIETY, at 4.30.—Prof. W. Magnus: Animal Posture (Croonian Lecture).

LINNEAN SOCIETY OF LONDON, at 5.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. S. A. K. Wilson: Disorders of Motility and of Muscle Tone, with special reference to the Corpus Striatum (Croonian Lectures) (II).

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—E. F. Fincham: The Changes in the Form of the Crystalline Lens in Accommodation.—Prof. C. V. Raman and K. Banerji: The Optical Properties of Amethyst Quartz.—The Thermal Syndicate, Ltd.: Exhibition and Description of Samples of Fused Transparent Silica, suitable for Optical and other Purposes.—Dr. R. S. Clay: Exhibition and Description of Lucernal Microscope.

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting at South Midland Centre).

FRIDAY, JUNE 12.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Brig.-Gen. Sir Percy M. Sykes: The Heart of Asia and the Roof of the World.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Dr. G. Temple: Mass and Energy.—E. Tyler and E. G. Richardson: The Characteristic Curves of Liquid Jets.

MALACOLOGICAL SOCIETY OF LONDON (at Linnean Society), at 6.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir William J. Pope: Faraday as a Chemist.

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting at South Midland Centre).

SATURDAY, JUNE 13.

PHYSIOLOGICAL SOCIETY (at Manchester).

FREE PUBLIC LECTURES.

MONDAY, JUNE 8.

UNIVERSITY COLLEGE, at 5.30.—Dr. J. Schmidt: The Biological Aspect of Hydrographical Work. (Succeeding Lecture on June 9.)

WEDNESDAY, JUNE 10.

UNIVERSITY COLLEGE, at 5.30.—Prof. L. J. Henderson: Blood and Circulation from the Standpoint of Physical Chemistry. (Succeeding Lectures on June 11, 12.)

THURSDAY, JUNE 11.

ST. MARY'S HOSPITAL (Institute of Pathology and Research), at 5.—Prof. J. Joly: Radiology.

UNIVERSITY COLLEGE HOSPITAL MEDICAL SCHOOL, at 5.—Prof. J. Hay: Cardiology. (Succeeding Lectures on June 12, 18, 19.)

CHELSEA PHYSIC GARDEN (Chelsea Embankment, S.W.), at 5.15.—Sir A. Daniel Hall: The Sources of the Fruit and Vegetable Supply of London (Chadwick Lecture).