NATURE

SATURDAY, NOVEMBER 4, 1922.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

NO. 2766, VOL. 110]

Primitive Custom and Administration.

THE Report of the Tanganyika Territory for the year 1921, which has been issued as a White Paper (Cmd. 1732), contains much matter of interest relating to native affairs. It is evident that the Administration by sympathetic treatment and by a patient hearing of tribal grievances is winning the confidence of the native population, while every opportunity is being seized to remove hardships which have been inflicted on them by the excessive alienation of land under the German colonial system. As a census taken in April last shows that there is a native population of 4,107,000, the responsibility for the regulation of native affairs is not light. It is satisfactory, therefore, to note that a good beginning has been made towards establishing sympathetic relations with the tribes. In the interests of the Territory, it is vital that the administration should be conducted with due regard to native customs and institutions. It is even more important that the native should have an opportunity of development along lines in harmony with his own culture, and ultimately, it is permissible to hope, of incorporation as an essential and responsible element in the community.

In this connexion a reference in the report to native beliefs assumes a significance which might, perhaps, be overlooked. It is stated that in the Mwanza region the reigning chief has lost his authority through having failed to live up to his father's reputation as a rain-maker, and that witch-doctors are losing their hold over the younger generation. These statements do more than throw an interesting light on the religious beliefs of the people. The combination of function of chief and rain-maker is not uncommon throughout Africa. It is one of the marks of "the divinity that doth hedge a king" among primitive peoples. Its special significance lies in the fact that not only is the person of the king or chief sacred, but his authority also rests upon his power as a sacred being, of which rain-making is one of the manifestations. The magic of the witch-doctor or medicine-man, like that of the king, is on the side of law and order, notwithstanding the, to us, sinister character of certain of his activities. Some of the great secret societies of West Africa, which are essentially religious in character, have, as one of their more important functions, the policing of their respective districts and the punishment of any transgression of the moral or social code. It follows, therefore, that any change in attitude towards the religious beliefs which form the basis of authority cannot fail to have a harmful effect on the discipline of the community. Any indication of a weakening in the regard

which the natives of Tanganyika have for the magic powers of their chiefs and witch-doctors must cause misgiving. It indicates a decay of custom which may effect the most vital elements in native culture and social organisation.

A part of the Empire far distant from Central Africa affords a striking example of a decay of custom similar to that now taking place in Tanganyika. Over the greater part of the South Seas the sacrosanct character of the chief is, or was, the basis of the whole social order. The sacred power of the chief was the sanction of the law, and in virtue of it he punished offenders. Contact with civilisation has proved fatal. The white man does not recognise the sanctity of the chief, nor does he discriminate in this respect between the chief and the ordinary members of the tribe. When he commits, without fatal consequences, acts which the native regards as tabu, the sacred character of the chief is impaired and his authority undermined. As the laws of morality, of the sanctity of married life, and of property rest on the principle of tabu, of which the chief is the supreme manifestation, not only is the authority of the chief to punish offenders questioned, but the whole social order is also disintegrated. The results can be studied in Melanesia, and particularly in the New Hebrides, where contact with the white man has led to the discrediting in this way of the authority of the chief and of the elders of the community.

The social disintegration which has followed this result need not be considered here in detail. It has been detrimental to the native, and, by depleting the supply of labour, will ultimately have a serious effect on the development of the resources of the islands. Those who would pursue the subject further will find it well and impartially discussed in "Essays on the Depopulation of Melanesia," [1] which has recently been published on behalf of the Melanesian Mission. In this instructive, and indeed valuable little book, a number of essays by missionaries, an anthropologist, and administrative officials such as Sir William Macgregor and Mr. C. M. Woodford, deal with various aspects of the question. All concur in attributing much importance to the decay of custom as a cause of the depopulation which is undoubtedly taking place in this area.

The adjustment of custom when civilised and primitive meet must inevitably give rise to difficulty. It should be the aim of the ruling power to secure this adjustment with as little harm as possible to the social organisation of the subject population. It is unnecessary to urge that certain practices cannot be tolerated under the rule of a civilised power. Human sacrifice, for example, is a case in point. It has been usual to forbid such practices entirely, as was done in the case of suttee in India. Frequently, however, total suppression entails consequences entirely unforeseen. As our knowledge of primitive peoples grows, it becomes increasingly apparent that it is difficult to interfere with one element in custom without affecting the whole. In Melanesia, head-hunting and intertribal wars have been suppressed. The results have been serious. It is not merely that these forms of activity have disappeared, but with them has gone a whole group of dependent social activities which filled the life of the Melanesian. A head-hunting expedition entailed the performance of a prolonged ritual of preparation, extending over many months, which began with the building of canoes, and included at different stages many feasts and the preparations for them. A whole group of interests, many of practical utility apart from their main object, has thus been eliminated from the lives of the natives.

The late Dr. W. H. R. Rivers, in an interesting essay which he contributed to the work mentioned above, gave it as his opinion that the most important factor contributory to the depopulation of Melanesia was psychological, and, in fact, that it was due to the lack of interest in life which followed as a consequence of the suppression of certain customs. It is interesting and significant to note, as an indication of the importance of this side of the subject, that it has led even a missionary to regret the suppression of intertribal war. It might well be worth while in such cases to endeavour, by substituting some harmless element, such as, for example, an animal instead of a human victim, to avoid total suppression of a custom embodying some objectionable features. This suggestion was put forward by Dr. Rivers; but something of the same nature is already in operation in districts in New Guinea, where the head-taking propensities of the native have been turned to account among animals which played havoc with the women's plantations.

The whole question is one of extreme difficulty and complexity. To those who realise our responsibilities to subject populations and the importance of the part the native should play in the development of tropical and subtropical lands, any suggestion of change in custom, such as that reported from Tanganyika, is big with possibilities of disaster. As a result of past experience, it is clear that each case must be dealt with on its merits and as it arises; but the general principle is equally clear that it is only by close and sympathetic study of native custom that it will be possible to avoid action which may undermine authority and destroy a social fabric upon which depends the continued existence of a primitive people.

[1] "Essays on the Depopulation of Melanesia." Edited by Dr. W. H. R. Rivers. Pp. xx+116. (Cambridge: At the University Press, 1922.) 6s. net.

Applied Electricity.

A Dictionary of Applied Physics. Edited by Sir Richard Glazebrook. Vol. II. *Electricity.* Pp. vii+1104. (London: Macmillan and Co., Ltd., 1922.) 63*s.* net.

IT is interesting to compare the second volume of Sir Richard Glazebrook's "Dictionary of Applied Physics" with the electrical portions of older dictionaries. For example, in Barlow's "Dictionary of Pure and Applied Mathematics" (1814) it is said that "the science of electricity became a general subject of conversation" after the discovery of the "Leyden Vial." In Nichol's "Cyclopædia of the Physical Sciences" (1860) we learn that electrical science "has spoken for itself to the world as no other has." "Witness the simultaneous discovery of the Leyden Phial and the Electric shock." Three practical applications of electricity are given, namely, the lightning-conductor, the electric telegraph, and electroplating. The last is specially commended as being "so conducive to the comforts and elegancies of life." An examination of the volume under review will show how greatly our knowledge has been widened during the last sixty years. We were sorry, however, not to have seen the "Leyden Jar" mentioned.

The plan of the dictionary follows to a certain extent that adopted by Nichol, but the important sections are much larger. In fact, quite substantial books could be made of the sections written by some of the contributors. Besides the important contributions there are a few short articles and many definitions of electrical quantities, machines, instruments, and methods. The absence of an index makes it difficult to find out whether any subjects have been omitted or not. There is a very elaborate name-index, but this will be little help even to the older physicist or electrician, as many of the names will be unknown to him. We think that the younger physicist will have considerable difficulty in finding out what he wants. Doubtless, this will be remedied when the final volume is published. We have not noticed anything about electric traction, electric ship-propulsion, electric vehicles, lightning-conductors, rotary and frequency converters, electrostatic machines, the attraction between electrified spheres, or the fixation of nitrogen. We take it that atmospheric electricity will come under meteorology in the next volume.

We were glad to notice that the contributors had not been handicapped by being compelled to adopt a rigid nomenclature and an invariable set of symbols. As a rule, those agreed on internationally have been adopted. Although considerable use has been made throughout of elementary vector analysis, there is little demand made on the reader's knowledge of mathematics. Academical subjects, like spherical harmonics and the perennial "electrified ellipsoid," have been omitted.

Dr. Rayner has written a useful section on alternating-current instruments and measurements. He has made a happy selection of the best modern measuring instruments. His description of the electrostatic watt-meter is specially good. Occasionally his straining after conciseness leads him into inaccuracy; as when he says (p. 11) that the torque is equal to the square of the volts instead of being merely proportional to that quantity. There is a misprint also in the equation on this page. The articles on primary batteries, accumulators, and cables are good, but the last could have been expanded with advantage. The assumption on p. 94 that the thermal emissivity is independent of the radius of the wire is certainly not true, and we doubt whether the formulæ given on p. 95 are of general application.

Mr. Albert Campbell contributes a valuable article on electrical capacity and its measurement. He generally refers to capacity as "capacitance," which is the name the Americans now use, and he calls the capacity between two conductors the "working capacity." He clearly recognises the difference between two of the various kinds of capacity and calls them by different names. In other parts of the volume, however, which capacity is meant is not so clear. For example, under units (p. 948), we read that a conductor which had a capacity of 1 farad "even though composed of plates very close together, would be very large." It looks as if conductor were a misprint for condenser. The various kinds of capacities have been clearly defined by nomenclature committees of the Physical Society and of the Institution of Electrical Engineers. On p. 107 formulæ for the capacity between two circular plates and the capacity to earth of one of them are given; the formulæ are only approximations and no limitations to their accuracy are given. Their value is therefore doubtful. We note misprints in formulæ (27), (50), (54), and (55).

T. Gray's results for the dielectric strengths (now usually called the electric strengths) of air at different thicknesses are given. We think that this is a misleading way of interpreting the experimental results. If we consider spherical electrodes in air, the disruptive voltages are computed in everyday work from their distance apart and their radii, with a maximum inaccuracy of about 1 per cent. From these experiments we would conclude that the assumption that the electric strength of air was 27·4 kilovolts per cm. at 25° C. and 76 cm. pressure, whatever the thickness of the layer might be, would lead to very approxi-

mately correct results in nearly every case. We notice that the author adopts Kennelly's names for the absolute unit of electric quantity, capacity, and pressure. We thus get the abcoulomb, the abfarad and abstatfarad, and the abvolt. As they have never been recognised, even in America, by any technical society or institution, they are "technically irregular." It has to be remembered, however, that all good new names are introduced in this way.

We do not like the phrase "dielectric constant"; it surprises, at least mathematicians, to find that this "constant" varies with temperature. Many excellent methods of measuring capacity are given, but beginners would appreciate some little guidance as to which one to adopt in special cases.

Dr. Rayner's article on dielectrics will be appreciated by engineers, and Mr. Melsom's article on direct-current indicating instruments will be most helpful in the test-room of every factory. Mr. F. E. Smith writes an authoritative article on systems of electrical measurements which will be of great value for reference by subsequent writers. Dr. Allmand gives a concise and excellent description of the technical applications of electrolysis. Any one reading the fascinating account of the electron theory and its application to spectrum analysis, by Sir William Bragg, will find it difficult to believe that Rutherford and Bohr's theories of the atom are not substantially correct. In his description of "electrons and the discharge tube" Dr. Crowther is also very convincing.

Mr. F. E. Smith gives an illuminating account of galvanometers, including very helpful rules for choosing a galvanometer for a particular purpose. Mr. Butterworth writes a valuable account of the formulæ used for measuring inductance and gives an excellent table for computing the mutual inductance between coaxial circles. We miss, however, his own formula and that of Mr. H. L. Curtis for computing the high-frequency inductance of parallel cylindrical wires. Mr. Campbell gives a very complete account of methods of measuring inductance and gives some 200 references to papers on the subject. The method of compensating for the inductance of a coil shown on p. 402 is not as accurate as the author states, a term having been left out in the algebraical reduction shown on this page. Mr. Dye, in "Magnetic Measurements and Properties of Materials," has produced a very complete account of modern methods.

The General Electric Company gives a very brief account of "incandescence" lamps, which is excellent so far as it goes. Most readers would like to have had further data on tungsten vacuum and gas-filled lamps. The Americans are not so reticent. We note that the temperature of the tungsten filament is about "2300° K." We take it that this is in the absolute Centigrade scale and that the K. refers to Kelvin. This is "technically irregular"; but there is a real demand by engineers and by some physicists that the absolute Centigrade scale, which is the one they use, be called the Kelvin scale, and we hope that this nomenclature will be adopted.

Prof. Honda gives a thoughtful article on the molecular theories of magnetism, and we have an account of Ewing's latest model. Dr. Chree writes a thorough and interesting account of the observational methods used in terrestrial magnetism, and Dr. Chapman describes some of the theories of terrestrial magnetism and how far the solar agent is responsible for magnetic storms and auroræ. Positive rays are described by Dr. Aston. A description is given of his mass-spectrograph and typical mass spectra are shown.

The lengthy article on radio-frequency measurements by Mr. Dye will be appreciated by workers in many research laboratories, as these methods are often of great value. We are doubtful whether it is legitimate to assume that the capacity of a coil can be represented by supposing that the coil has no capacity and that a condenser of a certain size is placed across its terminals. The formula for the high-frequency resistance of a round wire at an infinite distance away from other wires is given, but the formulæ found recently for more practical cases are not given.

Very complete accounts are given of switch-gear, telegraphy, and telephony, which will be appreciated by electrical engineers. We have only space to mention the valuable articles on vibration galvanometers, wireless telegraphy, and thermionic values, by Mr. Campbell, Dr. Eccles, and Prof. Fortescue. Finally, the articles by Prof. Richardson and Dr. Wilson on thermionics, Mr. Smith-Rose on the use of thermionic valves, Mr. Melsom on direct-current meters, and Dr. Crowther on X-rays, are of great value.

Under units it is stated that, at the International Electrical Conference held in Paris in 1900, the Gauss was defined to be the C.G.S. unit of magnetic force, and the Maxwell was defined as the practical unit of magnetic induction. It is also stated that if we take the permeability of air to be unity and to be a pure number, the value of the Maxwell is the same as that of the Gauss. But the Maxwell is not the unit of magnetic induction density. Hence we should read in this case that a Maxwell per square centimetre is the same as the Gauss. There are several definitions of self-inductance given: that appearing on p. 727 is wrong, as the self-inductance is the linkage of the magnetic induction, and not the magnetic force, with the current. In no case is it explained how the linkages inside the conductor have to be computed. We have

noticed a few other slips and misprints. They do not appreciably detract, however, from the value of this volume, which will be welcomed by all physicists and engineers.

Spitsbergen and its Wild Life.

Amid Snowy Wastes: Wild Life on the Spitsbergen Archipelago. By Seton Gordon. Pp. xiv+206, 2 maps and 114 illustrations. (London: Cassell and Co., Ltd., 1922.) 15*s.* net.

ALTHOUGH the Spitsbergen Archipelago is only six hundred miles from the north pole, yet, owing to its accessibility, due to the influence of the Gulf Stream drift which reaches its western shores, it has been much visited in the summer months by naturalists and sportsmen, with the result its bird-life is better known than that of a number of continental countries. Its ornithology is encrusted in a remarkable literature dating from 1598, which comprises no less than 150 contributions, and includes Prof. Koenig's "Avifauna Spitzbergensis," which from the beauty of its meisenbach pictures of scenery, and its excellent coloured plates of birds and their eggs, is entitled to rank among the most attractive of bird-books, while its letterpress exhausts the historical aspect of the subject down to the year of its publication, 1911.

The latest expedition was organised by the University of Oxford, and visited the archipelago in the summer of 1921 under the leadership of the Rev. F. C. R. Jourdain. Mr. Gordon accompanied the party in the capacity of photographer, and hence the main attractions of his book lie in the wealth and nature of its illustrations, about one hundred in number. These are supplemented by a series of pleasantly written chapters wherein he relates his personal observations and experiences. The scientific results of the expedition, however, will appear in due course; those relating to ornithology are being prepared by Mr. Jourdain, who is an eminent authority on the subject.

The most interesting pictures and chapters of Mr. Gordon's book are devoted to the pink-footed goose, Brent goose, long-tailed duck, purple sandpiper, grey phalarope, glaucous gull, and various nesting colonies. The chief captures made by the expedition were a number of eggs of the Bernicle goose, concerning the nesting habits of which no trustworthy information was forthcoming until 1907, when the first eggs were found at Spitsbergen by Prof. Koenig. Five nests and twenty eggs were obtained in 1921, but for some unexplained reason the nest of this bird—not yet depicted—does not appear in Mr. Gordon's series, though a chapter is devoted to it.

An interesting account is given of the coal-mining

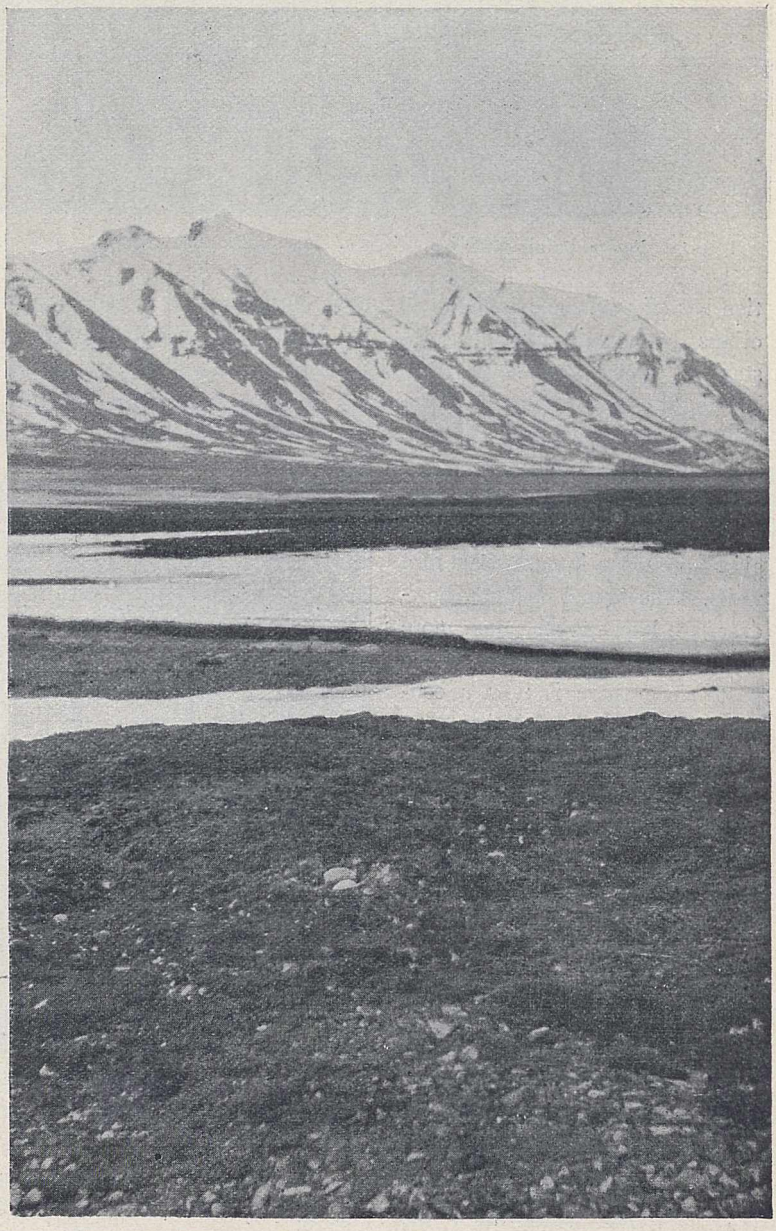

FIG. 1.—Nesting ground of the Pink-footed Goose. From "Amid Snowy Wastes."

industry, which has been developed during recent years in Spitsbergen and now finds employment for some 1300 miners, 1000 of whom, some of them with their wives and families, remain through the winter. This colonisation has effected some remarkable innovations, among others the establishment of no less than eight wireless stations whence messages may be despatched to Britain at a rate of fourpence per word!

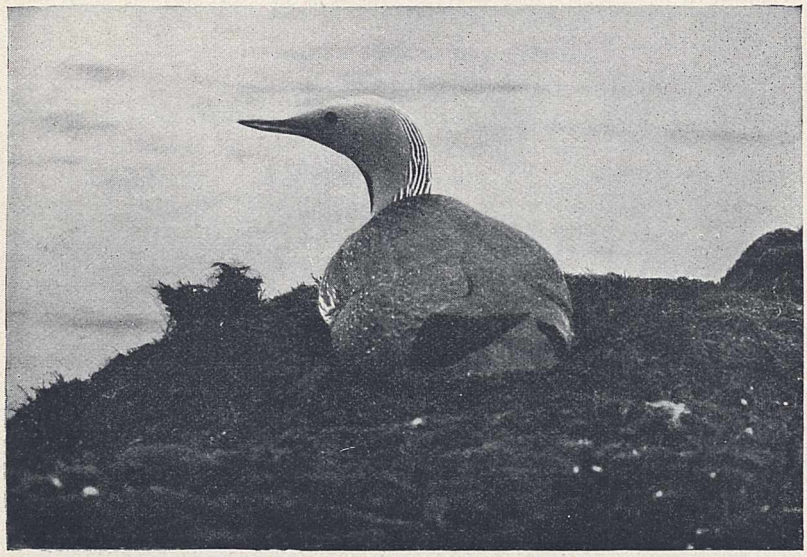

FIG. 2.—Red-throated Diver on its nest. From "Amid Snowy Wastes."

The larger mammals, such as the Polar bear, walrus, and right whale, once extremely numerous, have long ago been exterminated, and now only stragglers appear at intervals as rare waifs. The faunal changes, however, are likely to be much more rapid in the future than in the past, since there is now a considerable human population—one that will doubtless soon be considerably increased—and Spitsbergen being a no-man's-land, no protection can be imposed, and its animal life will suffer accordingly. There are three characteristic animals in the archipelago which are likely to become extinct, namely, the reindeer (*Rangifer platyrhynchus*), which is endemic, the fox (*Canis spitzbergensis*), and the ptarmigan (*Lagopus hyperboreus*). The deer, once very numerous and still unsophisticated, has been ruthlessly slaughtered in recent years. The fox since the advent of the Norwegian hunter, with his traps and poison, has been almost exterminated in places where it once occurred in hundreds. There is only one species of fox in Spitsbergen, the two species alluded to by Mr. Gordon being colour-phases due to season or age.

Special efforts were made by the expedition to find the ptarmigan, the only resident land bird, but without success, though all their likely haunts were visited, including a valley where Mr. Gordon tells us in 1920 no less than fifty brace were shot in a single afternoon by members of the Scottish Spitsbergen Syndicate. These birds must afford poor sport, for Dr. van Oordt tells us they are so tame that they can easily be killed with stones.

The eider is another bird that is rigorously and systematically persecuted. Enormous numbers of its eggs are annually taken for food and down is collected from their nests—both for sale in Norway. Mr. Gordon relates that one sloop, which had already 15,000 eggs on board, was still engaged in adding hundreds of eggs daily to the hoard. It is to be hoped that the rarer and more interesting species alluded to are also natives of the eastern isles of the Archipelago, which are so beset with ice that they are little known, and that thus they may escape extinction.

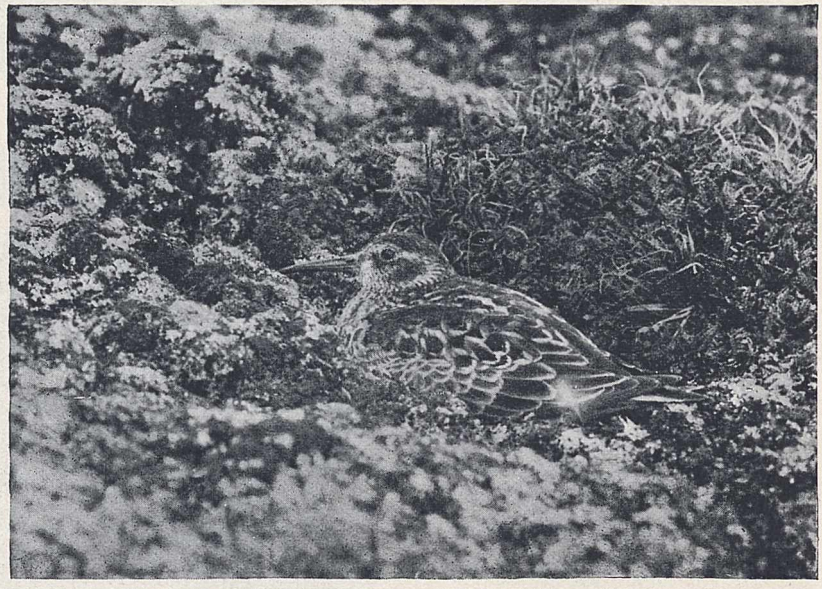

FIG. 3.—Purple Sandpiper on its nest. From "Amid Snowy Wastes."

W. E. C.

The Reopening of Europe.

Frequented Ways: A General Survey of the Land Forms, Climates, and Vegetation of Western Europe, considered in their Relation to the Life of Man; including a Detailed Study of some Typical Regions. By Dr. Marion I. Newbigin. Pp. xi+321. (London: Constable and Co., Ltd., 1922.) 15*s.* net.

A LARGE part of Europe is again open to the traveller. Dr. Newbigin, president of the Geographical Section of the British Association this year, does well to direct attention to the frequented ways, and her book asks those who follow them to adopt an appreciative outlook, casting off the insularity bred among our western isles. Insight into the relations of nature and man in Switzerland is not to be gained by selecting hotels where an English chaplain is on the staff. Dr. Newbigin has evidently suffered in this matter, and she remarks (p. 165) that the Catholic religion has the advantage "that no particular form of dress is imposed upon the worshippers." Her appreciation of the unconventional might have made her more tolerant (pp. 1 and 163) of "the superior person" who has been driven from anglicised Grindelwald to Japan or the New Zealand Alps. If she thinks that these fields are reserved for the prattling millionaire, let her consider Mr. Ralph Stock's exquisite little book on the voyage of "The Dream Ship" (1922), and see how the spirit of the Elizabethans may still carry our island-folk, both male and female, across the viewless seas.

Dr. Newbigin rather overlooks the value of a continuous traverse of a land-surface by the pedestrian, the cyclist, and the new users of highways that have not been so frequented since my lord and my lady took their own carriage into France. Automobilists are not always mere diffusers of dust and lubrication-odours; thousands are ready to respond to a training in history and geography. Dr. Newbigin conducts us inevitably by railway, and it may be noted that her information as to lines in the Eastern Alps is not entirely up-to-date. If, moreover, she prefers Basel, with good reason, as a place-name, why does she write Berne, St. Gothard, and the purely English Botzen, which should now, we presume, become Bolzano? She goes so far as to discuss (pp. 37 and 42) the merits of various tunnels through the mountains; these, after all, are the frequented ways. The *Gazette of the Cyclists' Touring Club* for August 1922 will show her, however, that even the Arlberg road is not forsaken. Again, in her essay on the Scottish Highlands, we should like to hear more of the pedestrian who travels across the glens as well as down them, in his attempt to realise their "relation to the life of man."

The author seems carried away at times by a certain vigour of self-expression, as if she had been caught in the swirls of "the revolt against civilisation." On p. 48 she writes, "latitude is only one of the factors which influence climate," and styles this "current geographical slang." Three pages on, she tilts against "latent heat," surely a very innocent antagonist. Again, has geographic environment moulded "the ferocious individualism of the Scot" (p. 261), which causes him to charge as much as 2*s.* 6*d.* for a belated breakfast on a winter's day? Is not this seeming lack of hospitality to be ascribed to the advent of tourists from the south, by way of Edinburgh, into the quiet of his ancestral wilds? Do we not remember how a cotter's wife was on the look-out for us one morning with a gift of oatcake, lest we should go hungry on a twenty-mile track under the Paps of Jura; or how a poor fisherman forced a tepid meal upon us, with the remark, "I should not like you to pass this house"? This is how the loneliness of moor and island have really affected the Gael of the old stock, despite the clan-animosities intensified by seclusion in the glens. Dr. Newbigin is at her best, and thus at a high level, in dealing with the influence of climate and land-forms on European vegetation. Had our military organisers known as much geography as is compressed into p. 55, the "mediterranean climate" would not have wrecked a band of gallant men sent up into the snows from Salonika.

Dr. Newbigin's photographs are a change from too familiar scenes. She gives us, for example, the vine-clad pergolas of Domo d'Ossola and the deforested slopes above La Grave. She certainly did not reach the latter spot by railway. In the Italian chapters, while seeking to be moderate, she cannot conceal a genuine hate of Venice; and, when she justly charms us with Ravenna, she elaborates a contrast that cannot be entirely sustained. Did the Goths consciously embrace the creed of Ulfilas because his homoiian views provided a religion for "free men"? We are puzzled by the intricacies of p. 292, and are not going to allow so good a geographer to entrap us in the maze of Alexandrian controversy, or into a discussion of the Virgin enthroned with angels in Sant' Apollinare of Ravenna. It is more profitable to note that the explanation given (p. 231) of phenomena at the Solfatara confirms a suggestion recently made in NATURE (vol. 109, p. 559).

Dr. Newbigin's reliance on the railways leads her to call (p. 309) the Assisi–Foligno–Orte loop "an easy route" to Rome. The alluvial infilling seems to have made her forget that she is running upstream past Monte Subasio, and that clever engineering was required to get back from Spoleto by the gorge of

Narni to the Tiber. Bertarelli's "Guida itineraria del Touring Club italiano," route 180, puts the true aspect of this dissected country before the geographic tourist. Such tourists will receive much encouragement from the broad views of western lands provided in the book before us. Perhaps in another volume the author will show how intensive studies of equal value may be carried on by easy deviations from frequented ways. The piazza of Todi, 1350 feet above the sea, Foix on the Ariège, guarding one of the few passes into Spain, or Radstadt, tinkling with cattle-bells, on the high pastures of the Tauern, may serve as epitomes of their regions and of the reaction of environment on man. But Dr. Newbigin certainly does not need suggestions.

GRENVILLE A. J. COLE.

History of Astronomy.

Histoire de l'Astronomie. Par E. Doublet. (Encyclopédie scientifique.) Pp. 572. (Paris: G. Doin, 1922.) 17 francs.

IN his first chapter the author passes in review the principal works on the history of astronomy, beginning with Weidler's book and ending with the great work by Duhem on the cosmical systems. Of the valuable books of Grant and R. Wolf, only the titles are given, and several others are omitted altogether. Of monographs, only Schiaparelli's first two papers are mentioned. This is natural enough, since there is plenty of evidence that the author is quite unacquainted with the rich literature of memoirs and short papers on the history of astronomy which has appeared within the last fifty years. Whenever a fact is not mentioned by Delambre, Duhem, etc., it will be looked for in vain in M. Doublet's pages, and whenever fresh light has been thrown on any subject since they wrote, he is not aware of it. Take, for example, the paragraph on Hipparchus. We are told that his diopter was in the Middle Ages called a Jacob's staff; in reality the former had a cursor with a round hole in it, and was used only for measuring small angles such as the diameters of sun or moon, while the latter was shaped like a cross, with the shorter arm movable (on p. 152 the invention of the baculus is correctly attributed to Levi ben Gerson of Avignon, as Duhem had also done). The star of Hipparchus is compared to the new star of 1572, whereas there can be no doubt that it was nothing but the comet of 134 B.C. The star-catalogue of Hipparchus is said to contain 1025 stars and to have been handed down to us by Ptolemy, but it has been shown by Boll that the catalogue probably contained only about 850 stars, while it is now universally recognised that Ptolemy's catalogue is not a mere reproduction of that of Hipparchus. Next it is stated that Hipparchus put the solar parallax equal to 3′; it was Ptolemy who did that, whereas Hipparchus said that it was at most a minute and a half. On the same page we read that Hipparchus determined the principal lunar inequalities with admirable precision. Hipparchus knew only one inequality, the equation of the centre; but that is, perhaps, a slip, as it is elsewhere (p. 110) mentioned that Ptolemy discovered the evection.

The most valuable part of Duhem's work is his account of Latin astronomy in the later Middle Ages, as he was able to make use of many manuscript sources. M. Doublet has done right in quoting him largely; but here, as everywhere else, the consequences of never referring to the original sources are evident. Duhem gives a very unsatisfactory account of the planetary system of Al Betrugi, which was very much discussed in the thirteenth century both at Paris and at Oxford. The account of it by M. Doublet similarly misses the most important part of the system. In the same way, the account of King Alfonso and his Tables reproduces all the old misstatements which have been refuted long ago. The tables were *not* published at the time of the King's accession, but some twenty years later, and *no* change was made in them as regards precession; they were *not* prepared by a "numerous commission," for it would have been necessary to raise the dead, since the alleged members of that Royal Commission lived long before King Alfonso's time. The "Libros del Saber" were never translated into Latin, and were quite unknown until they were at last printed some sixty years ago, and the last edition of the tables was not printed then, but in 1641.

The author's account of the progress of astronomy from the end of the Middle Ages to the time of Newton does not differ much in extent or quality from the earlier chapters. We have only space to direct attention to a misunderstanding on p. 255, with regard to Kepler's work on Mars. What produced errors of 8′ was not the use of the Tychonic system (for that, of course, made no difference whatever, being merely the Copernican system with the origin of co-ordinates transferred to the earth), but the use of an excentric circle with "bisected excentricity," after the manner of Ptolemy.

Having found the first two-thirds of the book rather disappointing, we are glad to say that the chapters on French astronomers in the eighteenth and first half of the nineteenth century are very interesting and pleasant to read. They do not go into details as to the work of these astronomers, any more than do the earlier chapters, but they tell a good deal about the Cassinis, the Maraldis, etc., down to Arago and Leverrier, which will be new to most readers.

J. L. E. D.

Our Bookshelf.

How to Measure in Education. By Prof. W. A. McCall. Pp. xiii+416. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1922.) 15*s.* net.

IN the work under notice an attempt is made to show that everything in education must submit to statistical measurement or be condemned as worthless. Fourteen theses in praise of measurement are blazoned in large type at the outset. One of them states, "To the extent that any goal of education is intangible it is worthless"; as this is given not only the dignity of capitals but also the embellishment of inverted commas it presumably conveys some meaning to the author. Education in this book means a few of the elements of instruction, such as reading, writing, and the mechanical parts of arithmetic and composition. An elaborate analysis is given of how to diagnose defects in reading, and ignoring the analysis, we are told that "there are more failures due to failure of interest than the world dreams of." The schoolmaster who has important tasks in education other than those of teaching mechanical elements would greatly value some help in measuring the interest of his pupils, but will ask in vain. The importance of carefully framed instructions in giving tests is rightly stressed, but we are told that such "instructions should equalize interest." To accomplish this the pupil must, apparently, be told how important it is to do well in a test. If he is refractory, or keen on other things in school besides tests, the advice may not be effective. Masters, however, are in a worse plight, for the tests are used not only to measure the pupils, but also the teaching and the teachers; and that form of measurement is said to be of most service "which does not require a previous acquaintance with the pupils."

The most valuable part of the book is that concerned with "scaling the test," as it shows the large amount of statistical treatment necessary to prepare a suitable test of skill. A useful suggestion is made for fixing a single common unit of measurement for all mental scales for elementary schools, namely, some function of the variability of pupils of twelve years. The standard deviation of pupils of sixteen years is also suggested as a unit for measuring older scholars.

The final section of the book deals with tabular, graphic, and statistical devices. Each part has a useful students' bibliography, but it is strange to note the omission, in a work of this nature, of all reference to the writings of Udny Yule, from whom the student of statistical methods will derive more real help than from any of the authors quoted.

Fruit Farming: Practical and Scientific for Commercial Fruit Growers and Others. By C. H. Hooper. Second edition, Revised and Extended. Pp. xxiii+212. (London: The Lockwood Press, 1921.) 6*s.* net.

WITHIN the limits of two hundred pages Mr. Hooper has aimed at the production of a text-book of fruit farming under English conditions. After a brief introductory section on the training of the prospective grower, he deals in succession with the capital required, the selection of suitable land, the law in relation to fruit farms and market gardens, the laying-out of plantations and orchards, and the cultural details and costings of the more important hardy fruits of this country. The later chapters are concerned largely with the more scientific aspects of the subject, such matters as soils, manuring, insect and fungoid pests, and spraying and other forms of disease-control in turn receiving attention. Also included are brief histories of many of the well-known varieties of apples, pears, plums, and cherries. The numerous interesting and economically important problems relating to pollination and fertilisation and the setting of fruit are briefly considered and the author is able here to provide data from his own investigations. The volume is completed by several sections dealing with special points of a purely commercial character, as, for example, the marketing of fruit and book-keeping.

Many chapters have been contributed by specialists and present in an abbreviated form the results of recent research. A large part of the volume has in fact been re-written since the first edition and brought up-to-date. With these alterations and some useful additions the second edition justifies its appearance.

In a work of so small a compass, which seeks to stand as a text-book of its subject, the selection of matter for inclusion calls for careful discrimination. It is open to some criticism in this respect and also for occasional repetition. Printers' errors are not infrequent in certain chapters. Much of the information given on economic points is not readily accessible elsewhere, and it is in this direction probably that the volume will prove to be of most service to its readers.

First Lessons in Practical Biology. By E. W. Shann. Pp. xv+256. (London: G. Bell and Sons, Ltd., 1922.) 5*s.*

MR. SHANN'S endeavour to provide a course of biology suitable for lower fifth forms, and within the means of the average school, is not entirely satisfying. Rightly he relies on plants for the experimental work, and on both plants and animals, employing them in alternate chapters, for the observational. But experiments on plant physiology are not reached until chapters 16 and 17; and by that time the preceding lessons have incidentally given the very information which the experiments should surely be intended to enable the pupils to discover for themselves. There are good chapters on variation and heredity, soils, insect pests, and other topics of general biological interest; but neither with plants nor with animals does the author make the best use of his material as a means of education and of training the powers of observation and reasoning. If he disapproves of the heuristic method, he should at any rate indicate the evidence on which conclusions as to homologies are based, and not be content with mere statements.

Apart from general considerations, sentences are in several instances faultily composed; and there is a large number of actual errors: *e.g.* "false" fruits are wrongly defined; rose-hips *will* germinate without passing through the digestive tract of an animal; rose stamens are peri-, and not epigynous; *Urtica urens* has *not* a creeping stem; the biramous appendage is *not* the primitive form of crustacean appendage; the telson is *not* a segment; the abdomen of Blowfly does *not* exhibit respiratory movements; the embryo in a

seed is not simply the plumule and radicle, but includes also the cotyledons—we have not exhausted the list of inaccuracies.

Many of the illustrations are the work of boys at Oundle School and are of creditable draughtsmanship; but for teaching purposes we prefer outline with a minimum of shading in order that significant features may receive due emphasis.

The Discovery of the Circulation of the Blood. By Dr. Charles Singer. (Classics of Scientific Method.) Pp. x+80. (London: G. Bell and Sons, Ltd., 1922.) 1*s.* 6*d.* net.

THIS is the first of a new series entitled "Classics of Scientific Method," and whets our appetite for its successors. The series aims at providing in convenient form reproductions of the great masterpieces of science, together with an account of the action and re-action of ideas which, through process of time, led up to the crucial experiments carried out and described by some great master. This account of Harvey's discovery of the circulation of the blood is excellent. The first chapter, in language freed so far as is possible of technical terms, describes the structure and function of the circulatory system as we now know it—a modification of the paragraph on p. 8 dealing with the relation of carbon dioxide and hæmoglobin seems desirable—and contains a clear diagram. The subsequent chapters set forth in words and by illustrations the ideas held by the ancients regarding the vascular system, and how the Renaissance of the fifteenth century and the work of such men as Leonardo da Vinci, Servetus, and others, culminated in Harvey's great discovery, of which a detailed and most interesting account is given.

Laboratory Exercises in Inorganic Chemistry. By Prof. J. F. Norris and Prof. K. L. Mark. (International Chemical Series.) Pp. x+548 (every second page blank). (London: McGraw-Hill Publishing Co., Ltd., 1922.) 10*s.* net.

THE first question which must be considered in connexion with a book of this kind is the class of students for whom it is intended. The preface indicates that it contains a first year's course for students who have had "a good training in chemistry in the high school." It is unsuitable for such students in England, as many of the experiments would already have been done at school, and many of the remainder would be regarded as too difficult for Intermediate students. The "International" character of the book is therefore open to question. Although the book is not suitable as a students' manual in English colleges, it should be very useful in suggesting experiments to teachers, both for lectures and for laboratory work. Many of the directions are given in unnecessary detail for students of average intelligence: how to light a Bunsen burner, for example, and there is a good deal of repetition. The blank pages are included in the pagination.

A Text-book of Organic Chemistry. By Dr. A. Bernthsen. New edition, revised to date, by Prof. J. J. Sudborough. Pp. xvi+908. (London and Glasgow: Blackie and Son, Ltd., 1922.) 12*s.* 6*d.* net.

BERNTHSEN'S text-book, in its English translation, has proved of great value to students. It is therefore satisfactory to note that the new English edition has been carefully revised and large sections dealing with important recent advances in the science added, as well as numerous small supplementary paragraphs in the old text. For a book of this character the minor errors noted are surprisingly few, and are obvious to the reader. One important omission may be noted: on p. 78 it is stated that methyl alcohol "acts as an intoxicant like ethyl alcohol," without a word as to the very deleterious physiological action of methyl alcohol. The printing and get-up are excellent, but the binding is too weak for students' use. The moderate price of the book, as well as the clear and accurate character of its contents, will ensure its continued popularity among students. The very full references to physical properties make it also a handy book of reference in the laboratory.

Plumbers' Handbook. By Samuel Edward Dibble. Pp. ix+629. (New York and London: McGraw-Hill Book Co., Inc., 1922.) 20*s.*

THE author of this handbook has had the co-operation of several well-known American professional men, and the result is a very valuable compendium relating to plumbing, sanitary arrangements, gas-fitting, heating, etc. The book is equally suitable for the practical man engaged in carrying out schemes, and the student who is learning his business. Of special interest to the British reader is Section 14, dealing with codes, or byelaws, as we should call them. These are extremely suggestive, and if carried out systematically in the United States will excite the envy of many British workers who have still to endure primitive sanitary conveniences. There is so much of value in this section that it is impossible to quote any of the points in a short review.

Science is not neglected in this volume, and there are sections dealing with metallurgy and chemistry. There is also a section on elementary mathematics; we think that the arithmetical rule for cube root (p. 511) might have been omitted, especially as logarithms are dealt with on pp. 508 and 509. The book can be strongly recommended to all connected with sanitation.

Diptera Danica: Genera and Species of Flies hitherto found in Denmark. By William Lundbeck. Part VI. *Pipunculidæ and Phoridæ.* Pp. 447+137 text-figs. and index. (Copenhagen: G. E. C. Gad; London: Wheldon and Wesley, Ltd., 1922.)

ALL students of the order Diptera will welcome the continuance of this wholly admirable treatise. It is a model of what a faunistic work should be and, unlike so many volumes of a similar nature, it also includes a useful summary of existing knowledge of the metamorphoses and habits of the insects with which it deals. The author has also wisely added the dates of capture of the various species: elementary facts of this kind are so often omitted from faunistic works that the reader is usually left with no idea as to when a particular species is likely to be met with. Of the two families dealt with in the volume before us, the Pipunculidæ include 25 Danish species out of about 75 palæarctic representatives, and the Phoridæ include 210 Danish species out of a total of about 335 from the whole of Europe. The work is well printed, clearly illustrated, and written in excellent English.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Action of Cutting Tools.

PROF. F. G. COKER has been good enough to send me a copy of his paper on the above subject, together with the discussion which followed its reading before the Institution of Mechanical Engineers. I will (with your permission) take this opportunity of thanking him and of adding a few remarks to my letter to NATURE of August 26 of this year.

I had not, when that letter was written, a copy of the Proc. R.S. paper of 1881 at hand, and was not certain as to how far the experimental processes

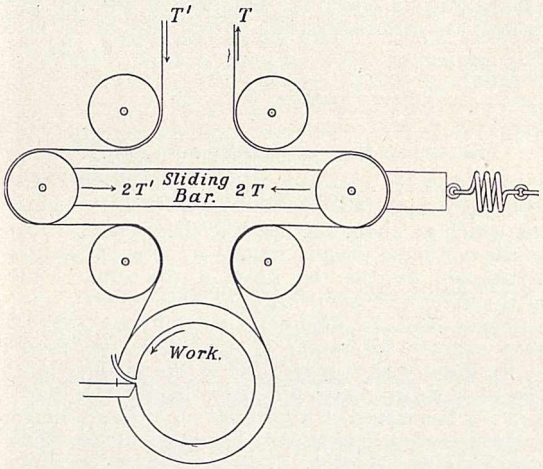

FIG. 1.—Diagrammatic sketch to show the action of dynamometer used for measuring the force on tool, T and T' being the tensions of the two parts of the driving belt. The force acting on the sliding bar is 2(T – T'). This is balanced by the extension of the spring. Hence the movement of the bar, in conjunction with the known diameter of the work, gives (when corrected for the friction of the pulley, etc.) a measure of the force acting on the tool.

preceding its production were described. On re-reading, however, I see that the experimental part was omitted, and I may here state that the force on the tool was measured by a dynamometer of the type shown diagrammatically in Fig. 1, and that it was found that for cuts of similar section the force required was very nearly proportional to the cross-section of the strip removed. This of course is equivalent to the statement that the same amount of work will remove the same volume of material whether the shavings are thick or thin, provided that they are similar.

This dynamometer, which recorded the force automatically on paper moving with a velocity proportional to that of the cut, worked satisfactorily when the cutting speed was suitably chosen, though I should not use the same pattern were I again to embark on such investigations.

The materials on which the experiments were made included, besides the ordinary metals, others easier to deal with in a lathe worked by foot, and of these clay was found to be the most useful, for, according to the state of dryness to which it was brought, its behaviour under the action of the tool could be made to resemble that of any sort of metal, hard or soft, and at the same time cuts of easily measurable thickness could be taken with comparatively small forces.

While referring to the subject of material, I may mention a matter which seemed to me rather surprising. I wished to see whether it would be possible to face up a speculum casting in the lathe in order to save time in the preliminary grinding. Speculum metal, as is well known, is very brittle, but by taking a broad cut of extreme thinness with a dead-hard steel tool, continuous shavings were produced which looked like ribbons of grey satin. It was only while the edge of the tool was perfect that the cut was satisfactory, and this condition rarely lasted long enough to cover a speculum two inches in diameter.

With regard to Prof. Coker's paper, the only objection I have to make is that it has no reference to the action of cutting tools. The polarised-interference bands are evidence of elastic strain. They might be maintained indefinitely when the tool was stationary if the applied force was just insufficient to produce further rupture, and would disappear when that force was removed.

The elastic deformation, though interesting, has nothing to do with the special action of the tool, the essential function of which is to cause destructive strain throughout a small region near its edge while having no permanent effect on the body of the work.

The real interest in the action of a cutting tool is confined to the plane AB (Fig. 2) along which destructive shear takes place and a very short length of the material which forms the shaving —together with that part of the tool in contact with it.

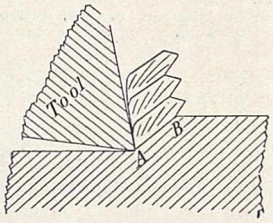

FIG. 2.—Action of a cutting tool, showing the principal and secondary planes of cleavage.

The internal structure of a shaving closely resembles that of slate, the principal plane of cleavage being parallel to AB of Fig. 2, and the angle which this plane makes with the direction of the cut is modified by, and may be said to depend on, the angle which the face of the tool makes with the same direction and the mutual coefficient of friction between the tool and the material on which it operates.

The action of the tool is always discontinuous and quasi-periodic, the period being determined by the travel required to extend the destructive shear from A to B. The period, therefore, is proportional (among other things) to the depth of the cut.

From this it may be seen that, in addition to the principal planes of cleavage, secondary and slightly differently inclined cleavages occur before the shearing across AB is complete. This was well shown in the polished and etched sections [1] referred to in the 1881 paper, and can also be recognised in the accompanying photographs (Figs. 3 and 4), though not quite so clearly.

The normal force on the tool during each period tends to expand (like rivet heads) the base of the strata which press against it, and this action causes the shaving to curl: the frictional force (parallel to the face of the tool) tends, on the other hand, to drag the base of strata towards the cutting edge, and thus to keep the shaving straight.

The shape of the cross-sections of a shaving is often rather peculiar, but is a definite function of the shape of the tool and of the properties of the material from

[1] The earliest application of "etching" for the purpose of rendering the structure of a metal visible was, I suppose, the "crowning" of twisted gun-barrels, etc.

which it is cut. It may be defined shortly as the projection on the plane of the section of the line bounding the area of destructive shear. This line will be in advance of the face of the tool by a distance

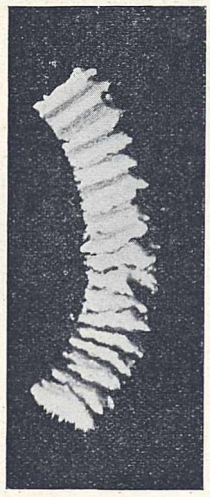

FIG. 3.

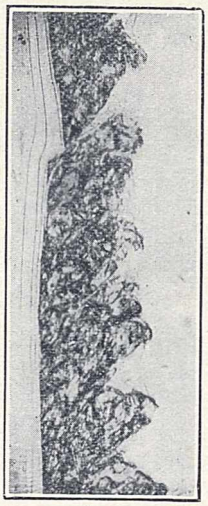

FIG. 4.

FIG. 3.—Shaving from a block of paraffin. At the temperature at which the cut took place, the paraffin behaves much like a sample of cast iron.

FIG. 4.—Longitudinal section of a similar shaving. The paraffin shaving was embedded in soap, sectioned in a microtome, and mounted in castor oil.

proportional to the thickness of the cut at the point under consideration (see Fig. 5).

The shaving is always shorter than the length of the cut from which it was taken, and if α and β are respectively the angles which the principal plane of cleavage and the face of the tool make with the normal to the surface of the cut, it is easy to see that the ratio of the lengths is $\cos\alpha/\sin(\alpha+\beta)$.

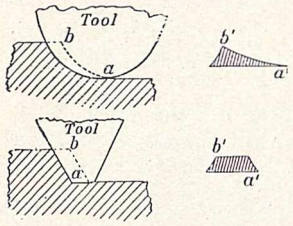

FIG. 5.—Relation between the cross-section of the cut, *ab*, and that of the shaving produced, *a'b'*.

Lubrication has an extraordinary effect in the cutting of certain materials. With brass and gun-metals no lubrication is required, but for steel, and also for such metals as soft copper and pure aluminium, clean cutting is impossible without it. Glass cutting with steel tools also requires a lubricant, for which purpose turpentine or petroleum are generally chosen.

I remember, in a correspondence with Sir G. G. Stokes on this subject, mentioning that even the presence of turpentine vapour had a noticeable effect. There can, I think, be little doubt that films of lubricant (of molecular thickness it may be) pass not only over the active part of the tool, but also penetrate along the planes of cleavage in the shaving itself.

A. MALLOCK.

9 Baring Crescent, Exeter.

One Possible Cause for Atmospheric Electric Phenomena: A Reply.

IF Sir Oliver Lodge will turn up his copy of NATURE for January 21, 1904 (Vol. 69, p. 270), he will find that I made there the identical suggestion for the origin of the earth's negative charge which he makes in NATURE of October 14, p. 512. The explanation is, however, unsatisfactory for a number of reasons, the chief of which may be stated shortly as follows:

To maintain the current from the earth into the atmosphere, it would be necessary for 2000 negative electrons to be shot into each square centimetre of the earth's surface every second. But beta rays ionise the air through which they pass, and according to recent theoretical work it appears that beta rays, no matter what their velocity may be, produce more than 40 pairs of ions along each centimetre of their path in air at atmospheric pressure. Thus in each cubic centimetre of air near the earth's surface 80,000 pairs of ions would be produced per second. But we know from actual measurements extending from the equator to the polar regions that only 4 or 5 are so produced and all these can be accounted for by known radiations.

Sir Oliver suggests that "the beta particles would be magnetically inveigled towards the poles, where they might descend with down currents." This suggestion has been made previously, and it is easy to show that it offers no way out of the difficulty although the demonstration is too long to be given here.

G. C. SIMPSON.

October 17.

The Green Ray at Sunset and Sunrise.

IN NATURE of October 14, p. 513, Prof. Alfred Porter maintains that there are two distinct phenomena which go under the name of the green flash, and that the one most usually seen is an after image in an eye fatigued by the red light of the sun. I have seen the green ray many times in this country and in the tropics, and the phenomenon as I have seen it is always exactly the same; I am quite convinced in my own mind that it is not due to eye fatigue, for the appearance at sunrise is precisely the same as that at sunset; I have seen it a number of times at sunrise, and the first time I ever saw it was at sunrise when I was not looking out for it. I have, moreover, examined the setting sun with binoculars and with a telescope; when the sun has very nearly set, but before the appearance of the green ray proper, the upper edge has a very irregular shape owing to refraction effects, sometimes resembling flames; the tops of these "flames" gradually become bright green and the colour spreads downwards till the whole of the minute remaining part of the disc becomes green. To any one who has examined the green ray with a telescope at sunset, and has seen it with the naked eye at sunrise, it seems inconceivable that it can be due to eye fatigue.

C. J. P. CAVE.

Stoner Hill, Petersfield,
October 21.

As the green segment continues to be debated, permit me to put a few facts on record. I have often in Egypt watched the sunrise light descending the western hills, and when the edge of the shadow reached me, turned to view the sun. The first appearance of the sun is a blue segment, changing to green, and then to white. This is exactly the converse of the colours of the sunset segment; as the rising light cannot be due to an after-image, no more is the setting light. Moreover I have never seen the green light shift about, as an after-image does, by movement of the eye; it is always exactly on the segment.

Further, I often have protracted the sunset blue by walking up a slope, and so keeping it in view, on and off, as long as I go upward. The least distance

of horizon that is effective is about two miles, at which the change of colour is just visible. The "second phenomenon" of Prof. Porter is the only one which I have seen with open eyes.

W. M. FLINDERS PETRIE.

A Broadcast "Rainbow."

ON Friday, September 16, I witnessed an atmospheric phenomenon sufficiently unusual, I believe, to merit a record. Standing on Ogmore Down near Bridgend in this county (Glamorgan) at 2.30 P.M. and looking northwards across the broad vale towards the Maesteg hills, there appeared to me a broadcast rainbow colouring, stretching east and west for several miles along the vale. The day was exceptionally fine, with brilliant visibility and no trace of mist. The clouds were small and scattered, with a distant bank of cumulus beyond the hills, while the colours were clear and unmistakable, covering, from red in the west to blue in the east, an angle of about fifty degrees. The height of my point of view was about 300 ft. above the sea, and the whole apparition hung, like a veil of pure, immaterial colour, at about the level of my eyes, covering the distant hills but without screening their smallest particular. R. C. MCLEAN.

The Botanical Department,
University College,
Cardiff, September 19.

Colour Observations of the Moon.

I WISH to place on record a few observations I have made of the lunar surface seen through colour filters, which point to the presence of coloured light of various shades reflected from different parts of the moon.

The light values of various points of the moon's surface were fixed by means of a photometer shaded by colour-screens, corresponding to similar screens fixed to the eye-piece of the telescope.

Owing to the two different sources of light, electric light in one case and the lunar rays in the other, and also owing to atmospheric changes, the two sets of filters had to vary considerably in colour, in order to produce the identical colour impression on the eye.

For the telescopic eye-piece I used the following colour screens throughout these observations:

1. Red of approx. 6563 "Tenth-metre" wave-length (absorbing practically all but red rays and a little yellow).
2. Green ,, 5173 wave-length (absorbing all but green and blue rays).
3. Violet ,, 4420 wave-length (only absorbing yellow rays).

For the photometer I used varying colours (according to atmospheric conditions), averaging

1*a* of approx. 6120 wave-length.
2*a* ,, 4922 ,,
3*a* ,, 4550 ,,

The area examined was the vicinity of Clavius. I determined the light value of the brightest spot in the neighbourhood (A) through the three screens, and in the same way a number of other spots; B, the eastern inside wall of Clavius; C and D, the floor of the crater plain; E, the great valley to the west of Clavius; F, the southern slopes of Maginus.

The result of the two observations, No. I. on August 31, No. II. on October 1, 1922, was as follows, reducing the figures to percentages, the brightest spot (A) being taken as 100 per cent. in each case:

	A.	B.	C.	D.	E.	F.	
Red screen	100%	I. 46·0 II. 9·1	I. 1·2 II. 0·66	I. 3·6 II. 0·85	I. 10·0 II. 2·2	I. 15·7 II. 9·1	% %
Green screen	100%	I. 4·2 II. 22·2	I. 0·7 II. 0·3	I. 1·3 II. 0·46	I. 14·0 II. 2·5	I. 49·0 II. 22·2	% %
Violet screen	100%	I. 30·0 II. 5·4	I. 3·3 II. 1·7	I. 8·4 II. 2·0	I. 15·0 II. 2·8	I. 21·4 II. 5·4	% %

In examining the above list it will be noticed that there is a discrepancy regarding the point B, which may be due to the dazzling brilliancy of this area during the first observation. All the remaining figures, however, agree remarkably well, considering the extreme simplicity of the instruments I employed.

The experiments tend to show that (1) the floor of Clavius (also of Longomontanus, which I observed on October 1) is of a mauve colour. These areas may be basaltic and not unlike some Hawaiian crater plains of solid lavas. (2) The Terra Photographica to the west of Clavius has most probably a mottled surface of brown areas on a blue background such as copper sulphate. (3) The southern slopes of Maginus are intense green, probably streaked with areas of the same substance and colour of the crater valleys recorded.

It would be of great interest to survey accurately in this manner districts such as the crater Linné. Later tests would then clearly show if any change could be recorded in these debated areas, at least so far as coloration is concerned. A. F. WARTH.

109 Sandford Road,
Moseley, Birmingham.

The Local Handbook of the British Association.

IN NATURE of October 21, p. 539, a reviewer states that "the ideal handbook in connexion with the annual visits of the British Association has yet to be written." A Committee of the Association might well be appointed to draw up a scheme. Meanwhile, I venture to offer the following suggestions:

1. The book should above all be portable, and for this purpose it should be divided into separate pamphlets, each tucked under a separate tape in a cloth-covered binding, common to the series. One could then select one's pamphlet and leave the rest in one's hotel.

2. Every handbook should have a complete index for facilitating rapid consultation.

3. There should be a map of the district on the half-inch or quarter-inch scale.

4. There should be a geological map.

5. The compilers should take a lesson from Baedeker and give practical details: population, railway stations, hotels, cab-fares, post office; short list of the chief features—museums, art galleries, libraries, churches of architectural interest, and other guide-book information—in two or three pages, with street in which situated, times of opening, etc., with an asterisk indicating the most noteworthy.

6. Unless the handbook can be sent by post in advance to members (they might pay the postage) it is of little use writing long-winded articles, as visitors—attending sections in the morning, scientific excursions in the afternoon, and addresses in the evening—have no time to read them. BERNARD HOBSON.

Thornton, Hallamgate Road, Sheffield,
October 20.

The Early History of the Land Flora.[1]

By Dr. D. H. SCOTT, F.R.S.

I.

IN these articles the "Early History" of the land flora is understood to cover the Devonian and Lower Carboniferous periods. Before the beginning of the Devonian the records of land plants are too scanty and doubtful to demand much consideration; on the other hand, the flora of the Upper Carboniferous is so rich and so well known that to include it would unduly extend the limits of this brief survey.

Concerning the question of the beginnings of a land flora, the position has wholly changed of late, owing chiefly to the Rhynie discoveries. A few years ago we had no clear knowledge of any early Devonian plants, and such imperfect data as we posesssed were commonly ignored or discredited. Nothing definite was known of any really simple fossil land-plants; it could even be asserted that the Devonian plants, though different in many ways from those of the present day, were about on the same general level of organisation.

Now we have learnt, from the Rhynie investigations, that, in the earlier Devonian flora, plants existed of quite surprising simplicity, with a mere thallus, leafless and rootless, like that of some very ordinary seaweed, but yet vascular in structure, and obviously adapted to sub-aerial conditions.

The crude simplicity of some of the Rhynie plants even suggested the question whether we might not at last be on the track of the original transmigrants from the sea, of those Thalassiophyta whose conquest of the land has been so vividly pictured by Dr. Church.[2] No doubt, the Devonian period was altogether too late for the transmigration he describes, but still some of the plants then living might have retained transmigrant characters.

The Rhynie fossils are now fairly well known to the botanical reader, and it is perhaps less necessary to insist on their importance than to suggest a warning that we may possibly expect too much from them.

The flora is extremely limited and local; our knowledge of the plants, owing to the unsurpassed skill and judgment with which they have been worked out by Dr. Kidston and Prof. Lang,[3] is exceptionally perfect, but there are very few of them and they are all from one old peat-bed.

We may shortly recapitulate the leading facts. The Rhynie species of vascular plants are four in number: *Rhynia Gwynne-Vaughani*, *R. major*, *Hornea Lignieri*, and *Asteroxylon Mackiei*. Rhynia and Hornea constitute the family Rhyniaceæ, remarkable for its extreme simplicity of structure; Asteroxylon is a much higher plant, and is placed in a distinct family.

Both the Rhynias are rootless and leafless plants, with a branched underground rhizome, and a vertical aerial stem, also branched; the whole plant was eight inches or more in height. On the rhizome there are absorbent hairs, while the aerial stem possesses a few perfectly typical stomata. Otherwise there is little differentiation between the subterranean and sub-aerial parts. The whole may be called, without hesitation, a thallus. Both stem and rhizome are traversed by an extremely simple vascular strand.

Rhynia major is considerably the larger plant of the two, but *R. Gwynne-Vaughani* is somewhat the more differentiated, for its aerial stem is studded with hemispherical outgrowths, from which, in some cases, additional branches arose, and often became detached, serving no doubt as a means of propagation. Both outgrowths and adventitious branches are absent from *R. major*, where the stem is merely forked.

It was at one time supposed that the outgrowths of *R. Gwynne-Vaughani* might represent very rudimentary leaves, but later observations have shown that they were developed late in life, usually in connexion with the stomata, and thus formed no part of the original equipment of the plant. They may even have been traumatic in origin.

The reproductive organs are spore-sacs (sporangia) borne on the ends of branches. In *R. major* the sporangia are large—nearly half an inch long; they have a fairly complicated wall, and are filled with well-preserved spores, often still grouped in fours, and in all respects like those of the Higher Cryptogams now living.

The second genus, Hornea, has a tuberous rhizome comparable to the protocorm often found in young Club-mosses, but the stem is like that of *Rhynia major*, on a smaller scale, and just as simple. The sporangia are the most remarkable feature; they are terminal on the branches, as in Rhynia, but in Hornea each spore-sac has a central column of sterile tissue (the columella), over-arched by the spore-bearing layer, exactly as in the capsule of the Bog-Moss, Sphagnum, at the present day. This moss-like feature is very suggestive and has given rise to a good deal of speculation. Another peculiarity of the spore-sac is that its walls are scarcely differentiated from the ordinary tissues of the branch, and that where the branch forks the sporangium forks too. Here, then, it is evident that the sporangium is not an organ *sui generis*, as modern botanists have generally taught, but just the end of a branch, set apart for spore-production.

The Sphagnum-like structure of the spore-sac in Hornea is not without analogy, for just before the Rhynie discoveries, Halle had described, from the Lower Devonian of Norway, a fossil which he named Sporogonites. This is remarkably like the stalked capsule of a Moss in external appearance, and internally (though imperfectly preserved) it proved to have a columella of the same form as that subsequently observed in Hornea. Thus the Rhyniaceæ are not only the simplest vascular plants known; they likewise suggest analogies with the Bryophytes. They have in fact been placed by different botanists in three different sub-kingdoms: in the Pteridophytes, the Thallophytes, and the Bryophytes, on grounds which will be evident from the facts already given. Possibly they may represent a basal group, related at once to the Vascular Cryptogams and the Moss phylum, while at the same time retaining some of the old characters of an Algal stock. But we cannot regard so interesting

[1] Based on a course of lectures given last spring at University College (University of London).

[2] A. H. Church, "The Thalassiophyta and the Sub-aerial Transmigration," Oxford Botanical Memoirs, III, 1919.

[3] Kidston and Lang, "On Old Red Sandstone Plants, showing Structure, from the Rhynie Chert-bed, Aberdeenshire," Transactions of the Royal Soc. of Edinburgh, Part I., vol. 51, 1917; Parts II. and III., vol. 52, 1920; Parts IV. and V., vol. 52, 1921.

a conclusion as established until we are satisfied that the surprisingly simple organisation of the Rhyniaceæ was really primitive.

We can scarcely feel sure that a certain amount of reduction may not have already been undergone, even by this early race of land-plants. The presence of stomata of the familiar type proves that the plants must long have been adapted to a sub-aerial life; at the same time the small number of these organs suggests xerophytic modification, which is quite consistent with a peat-habitat. In fact the habitat warns us that the Rhynie plants may not have been quite typical representatives of the flora of their time. A comparison with the Saltwort (Salicornia) of our mud-flats has even been suggested! Such a plant, however, bears obvious marks of reduction which are wanting in the Rhyniaceæ.

We can do no more than leave the question open. Probably we are justified in accepting Rhynia and Hornea as members of a relatively primitive race, even though their excessive simplicity may have been in some part due to the peculiar conditions under which they had to live.

The presence of Asteroxylon in the same beds might perhaps be taken as an argument against the theory of reduction, for Asteroxylon was, comparatively speaking, a highly organised plant. It is true it had no roots, but the branched aerial stem was well clothed with leaves, and had very much the habit of a Club-Moss (Lycopodium). The anatomy of the stem was also quite complex compared with that of the Rhyniaceæ, though the rhizome was as simple as theirs, and, oddly enough, bore no hairs. Asteroxylon was a larger plant than the others, and had nothing specially primitive in its external aspect. The leaves were peculiar, however, in having a very imperfect vascular supply, for the strand which ran out from the central stele towards each leaf stopped short in the leaf-base and never entered the blade. This is one of three points which suggest a certain degree of possibly primitive simplicity, the other two being the absence of differentiated roots and the structure of the water-conducting elements (tracheides). Though the wood is well developed and rather complex in form, having a stellate transverse section, all the tracheides are of one kind, namely, spiral.

Unfortunately, our knowledge of Asteroxylon is not quite so satisfactory as in the previous cases, for the fructification has never been found in connexion with the plant. There are peculiar naked branches closely associated with a few of the specimens, and with these branches, again, sporangia are found in association. The sporangia are quite different from those of the Rhyniaceæ, but recall the fructification of some of the Carboniferous ferns. If we assume that the naked branches and the sporangia belonged to the Asteroxylon we get a very remarkable combination of characters, as pointed out by Kidston and Lang. While the anatomy and morphology of the vegetative organs are suggestive of Psilotaceæ (a small tropical and sub-tropical family, of uncertain affinities) and Lycopods, the supposed fertile branches and sporangia would link the plant to the ferns. We cannot, however, lay much stress on this surprising synthesis of diverse characters until the connexion of the parts has been established. At present there is no evidence beyond intimate association.

Kidston and Lang are inclined to identify Asteroxylon with Thursophyton, a Middle Devonian plant, of Club-Moss-like habit, hitherto only known from impressions. The fructification assigned by certain writers to species of Thursophyton is, however, of a Lycopodiaceous character, and totally different from that attributed to Asteroxylon.

Asteroxylon is included, together with the Rhyniaceæ, in the class Psilophytales, of which Sir William Dawson's genus Psilophyton, established in the 'fifties of the last century, is the type. There is now no doubt that Dawson's account of Psilophyton, so long discredited, was substantially correct. The plant had a branched rhizome and a forked upright stem, more or less spiny. The fructification consisted of long terminal spore-sacs, much like those of Rhynia. The morphological nature of the spines is disputed; they may be interpreted as rudimentary leaves or as mere outgrowths, like those of *Rhynia Gwynne-Vaughani*. A general affinity between Dawson's plant and the Rhynie fossils is evident, but the exact relations remain doubtful. The late Dr. Arber regarded Psilophyton as identical with Rhynia; Kidston and Lang, on the other hand, have decided to place it in the same family with Asteroxylon. Neither view is established.

It may be mentioned that a possible Psilophyton has recently been recorded by Prof. Halle from the Silurian (Lower Ludlow) of Gothland, an interesting discovery, if confirmed.

Many plants besides the four species of Vasculares were found at Rhynie. The most interesting is a specimen of Nematophycus (or Nematophyton), a genus hitherto generally regarded as belonging to the Algæ; it has a complex structure of interwoven filaments, and some of the species, from other localities, attained a gigantic size. It is very remarkable that a plant with the structure of a highly organised seaweed should occur in a purely terrestrial flora like that of the Rhynie chert-bed. It may suggest that the Algæ of the period were doing a little transmigration on their own account.

A number of genera of the early Devonian flora have been recorded as impressions, showing little or nothing of the internal structure. Space forbids our describing them here. Some are much like Psilophyton, others resemble Club-mosses, while others again have a curiously Alga-like habit. An excellent summary of our knowledge of the Devonian plants generally will be found in Dr. Arber's little volume.[4]

The earlier (Lower and Middle) Devonian flora was for the most part characterised by comparatively simple types of land plants; in some cases, as we have seen, their simplicity was extreme. Even then, however, there is evidence that very much higher forms existed. Thus the fossil known as *Palæopitys Milleri*, from the Middle Old Red Sandstone of Cromarty, was described by its discoverer, Hugh Miller, as a "Coniferous tree," and really has the structure of a well-organised Gymnosperm. Miller himself fully realised the importance of his discovery, which has scarcely received the attention from botanists which it deserves.[5]

(*To be continued.*)

[4] E. A. N. Arber, "Devonian Floras, a Study of the Origin of Cormophyta," Cambridge University Press, 1921.

[5] Hugh Miller, "Footprints of the Creator," edition of 1861, p. 191.

Solar Radiation and its Changes.[1]

WHEN one reflects upon the wide knowledge gained by astronomers concerning stellar and nebular radiation and variability, it at first seems surprising that variation in the visible radiation emitted by the sun has been discovered only recently and with much difficulty. Not until the second decade of this century could the fact be regarded as established, as a consequence of simultaneous determinations of the "solar constant" made by the staff of the Astrophysical Observatory of the Smithsonian Institution, at two stations so widely separated as Bassour in Algeria and Mount Wilson in California. The solar constant is, of course, the estimated value of the intensity of total solar radiation, in calories per square centimetre per minute, at a point just outside the earth's atmosphere, *i.e.* before suffering absorption in transmission to the earth's surface.

The main difficulty arises from the necessity of making practically absolute determinations of the solar constant, because the sun's proximity to us renders it sufficiently unique and solitary in the daylight sky to prevent that comparison with many and similar neighbours which is the foundation of our knowledge of stellar variability. No real progress towards such knowledge regarding the sun could be made until it became possible to determine and allow for the radiation absorbed in the earth's atmosphere. Failing this, even long series of simultaneous observations of the changes in the solar radiation, as received at different points on the earth's surface, are of little use, because any features common to two stations may arise from some common terrestrial cause. A striking example of this was recorded by the Smithsonian observers during the fifty days on which observations were made both at Bassour and at Mount Wilson. On June 6, 1912, a great volcanic eruption occurred at Mount Katmai in Alaska; on June 19 the sky became slightly turbid in Bassour, and a day or two later also at Mount Wilson. The milkiness rapidly increased till in July and August a thick haze overspread the whole sky and cut off more than 20 per cent. of the sun's direct radiation at noonday; yet after applying properly determined corrections, normal and accordant values of the solar constant were obtained at Bassour and Mount Wilson during the above period.

The variability discovered in the sun's radiation is of two kinds; irregular variations occur over periods of a few days or weeks, amounting to a small percentage of the whole intensity, while small variations of longer period are found, showing some correlation with the periodicity of sunspot activity. Considering how marked are the changes in solar-spottedness, and in the accompanying magnetic and auroral phenomena upon the earth, it is remarkable how small are the variations in the main solar radiation. Many attempts have been made to connect the sunspot cycle with meteorological changes likely to depend on the solar radiation reaching the earth, but with very doubtful success—the terrestrial factors which share in determining the weather and crops are too complicated, and it now appears that the long-period changes in the solar radiation are themselves very small. Hence they were bound to remain undetected till direct methods and appropriate instruments were devised which made possible a frontal attack upon the problem. The method which has proved successful is due to S. P. Langley, and the spectro-bolometer which he invented (in 1880) is one of the chief instruments employed; but many improvements and additions both of method and in the instrumental equipment have been since made, and largely by the staff of the Smithsonian observatory under its director Dr. C. G. Abbot.

Langley's method is, briefly, as follows: Absolute measurements of the total solar radiation reaching the earth's surface are made with an instrument (the pyrheliometer) which indicates the heat energy absorbed by a blackened silver disc exposed to the radiation. It is claimed that the error of a single reading with this instrument is less than 1 per cent., and inter-comparison of pyrheliometers over periods of several years shows that the scale is free from secular changes exceeding 1 per cent. Such absolute observations are made at frequent intervals during a forenoon or afternoon, with the sun at different altitudes from 15° upwards; the measurements vary on account of the varying absorption as the radiation passes through a greater or lesser length of atmosphere.

The correction for the absorption is obtained with the aid of the spectro-bolometer, which consists essentially of a wire on which radiation of a particular wave-length is directed, after passing through a suitable prism. The resulting rise of temperature in the wire is measured by the change in its electrical resistance, and by passing the whole available spectrum over the wire a "bolograph" showing the energy-intensity curve over the solar spectrum is obtained. Such bolographs, corresponding to different successive altitudes of the sun, show the absorption in all parts of the spectrum during the passage of radiation through lengths of the atmosphere proportional to the secants of the sun's zenith distance; their comparison makes it possible to correct each bolograph for the absorption. In certain regions of the energy-curve where powerful selective absorption occurs by water and other atmospheric vapours, it is assumed that the absorption bands are absent outside the atmosphere, the curve being completed by interpolation between adjacent parts of the curve on either side.

While highly sensitive, the bolograph gives relative rather than absolute measures of solar radiation, and the scale of the uncorrected bolograph is obtained by comparing its area with the value of the total radiation as measured by the pyrheliometer. The bolograph corrected for absorption then gives the value of the solar constant. It is estimated that the probable error of an ordinary daily determination of the latter is from 0·2 to 0·3 per cent. as regards the relative values from day to day, *i.e.* omitting the probable error of the pyrheliometer scale value. The whole daily error should therefore be well below 1 per cent. under good conditions, though at times irregular or systematic errors of larger magnitude may occur.

The absolute value of the solar constant, determined from 1244 observations, mainly at Mount Wilson

[1] "Annals of the Astrophysical Observatory of the Smithsonian Institution." Volume iv. By C. G. Abbot, F. E. Fowle, and L. B. Aldrich. Pp. xii+390. (Washington, 1922.)

(1912–20), but also at Calama in Chile (1918–20), is given as 1·946. Dr. Abbot admits, however, a criticism by Kron, to the effect that this value may be 2 per cent. too low owing to a systematic influence tending to magnify the measured atmospheric transmissibility for ultra-violet rays. The error does not affect the evidence for variability in the solar radiation.

The above value is slightly greater than the mean (1·933) for the epoch 1902–12, and it is suggested that the increase is associated with the greater average solar activity during the later period. Whether this be so or not (and the more detailed comparison of values of the solar constant with sunspot numbers scarcely strengthens the evidence for such a connexion), the really remarkable result is the minuteness of the change; the solar agent which affects the diurnal variation of terrestrial magnetism must vary by 20 per cent. or more, instead of ½ per cent. or 1 per cent., as here. There is, of course, a very slight compensation for any general increase of solar emissivity at times of many sunspots, owing to the diminution of emitting surface caused by the presence of the low-temperature spots; if there are also absorbing vapours above the spots, the compensation may not be merely slight; an appreciable drop (about 5 per cent.) in the solar constant coincided with the passage of a very large group of sunspots across the sun's disc in March 1920.

The short-period "solar-constant" variation, of amount from 2 to 10 per cent., has been further confirmed by simultaneous observations at Mount Wilson and at Calama, Chile; these stations are about 5000 miles apart, on opposite sides of the equator, and at different altitudes. Their observations show a moderate degree of correlation (0·491). Attempts have been made by Dr. Abbot and his colleagues to find connexions between the variations of the solar constant and the variations of contrast of brightness on the sun's disc which have been revealed by observations of the distribution of radiation over the sun's surface. Such measures have been carried on now for more than eight years by the Smithsonian observatory. The association between the two phenomena, if real, is very complex, high contrast sometimes accompanying high, and sometimes low, values of the solar constant. A correspondingly complex theory is propounded to account for this, but a much longer series of observations is required to test the theory. Dr. Abbot urges the desirability of other observatories taking up solar-constant work, especially in view of the possibility that variations of radiation have predictable meteorological consequences, as Clayton's studies might suggest.

Various other cognate researches have been made by Dr. Abbot and his colleagues, Messrs. Fowle, Aldrich, Moore, and Abbot, during the period, since 1912, dealt with in the volume of Annals before us. Variations in the solar radiation have been tentatively sought by observing the changing brightness of the planets. The sun's total radiation has also been measured, at various terrestrial altitudes, from sea-level to high mountain stations, and beyond, up to 25,000 metres, by sounding balloons. A new empirical method of determining the solar constant by observations occupying only fifteen minutes in all has been introduced at Calama; this removes one of the chief sources of error in the longer method, namely, real variations in atmospheric transparency during the observations. In the new method the amount and character of the atmospheric absorption at the time of a pyrheliometer observation is inferred from a measure of the brightness of the sky in a zone 15° from the sun, and from the intensity of a particular water absorption band observed by means of the bolograph. Many observations of the brightness and transmissive power of the atmosphere have been made in the course of this and the other parts of the solar-constant work. Laboratory studies have been made on the absorption of long-wave radiation by water vapour, carbon dioxide, ozone, and by many common solid substances. The reflecting power of clouds has been measured by balloon observations at Mount Wilson in 1918; the ratio of reflection found was 78 per cent., independent of the solar altitude. From this the albedo of the earth is estimated at 43 per cent.

On account of over-frequent cloud and haze at Mount Wilson the solar-constant work carried on there since 1915 has been transferred to Mount Harqua Hala in Arizona, and the Calama station in the plain has been removed to Mount Montezuma, a few miles away. For a short time in 1917–18 observations were made at Hump Mountain in North Carolina, but the situation proved too cloudy. It is interesting to note, however, that one excellent observation was made at a lower air temperature than any experienced elsewhere during a complete solar-constant observation; both the hands and feet of the observer with the pyrheliometer were frozen in the course of the measurements!

Obituary.

W. H. WESLEY.

WILLIAM HENRY WESLEY, who died on October 17, at the age of eighty-one years, was appointed assistant secretary of the Royal Astronomical Society in 1875, and continued in that office till his death, a period of forty-seven years. He had excellent qualifications for the post, being most orderly and methodical in all secretarial and editorial work, and having great skill as a draughtsman and engraver, as was exemplified in his engravings of Dr. Boeddicker's drawings of the Milky Way, and the illustrations of the corona in Mr. Ranyard's memoir on solar eclipses. It used to be said that Wesley knew the corona better than any man living, although he had never seen it; however, after an unsuccessful effort in Norway in 1896, the equatorial *coudé* at Algiers was put at his service by M. Trépied in 1900, when he made a detailed drawing in the short duration of totality (64 seconds) and expressed his opinion that the eye was no more efficient than the photographic plate for this work. He made combination drawings from the negatives obtained by the Greenwich staff in the eclipses of 1898,

1900, 1901, 1905, and these will probably be reproduced.

Fellows of the Royal Astronomical Society will long remember Wesley's readiness to help them in their researches, and to put his intimate knowledge of the society's library at their service. He was an original member of the British Astronomical Association, and served as vice-president for many years; on one occasion he delivered the presidential address in place of the late Mr. Green. A. C. D. CROMMELIN.

PROF. C. MICHIE SMITH.

CHARLES MICHIE SMITH, who died on September 27, was born on July 13, 1854, at Keig, Aberdeen. He studied at Aberdeen and Edinburgh, graduating as B.Sc. in 1876. He was appointed professor of physics at the Christian College, Madras, in the same year, and in 1891 became Government Astronomer at Madras. In 1899 he brought out the New Madras General Catalogue of 5303 stars: the low latitude of Madras gives its star catalogues special importance, since they serve to link the northern and southern catalogues.

Michie Smith observed the annular eclipse of 1894, and the total one of 1898 at Sahdol, obtaining some beautiful large-scale coronal photographs. He also observed the Leonid meteors in 1899, including 37 of the first magnitude (Mon. Not. R.A.S., vol. 60), and published an extensive record of meteors seen at Madras from 1861 to 1890. He also observed the Zodiacal light, and wrote the article on this subject in the "Encyclopædia Britannica" (9th edit.).

Regular meteorological observations were made at Madras, and in 1893, Michie Smith published those of the years 1856 to 1861. He also contributed papers to the Royal Society of Edinburgh on the eruption of Bandaisan, the determination of surface-tension by measurement of ripples, and on atmospheric electricity and the absorption spectra of vegetable colouring matters. It was under his initiative that the mountain observatory at Kodaikanal was inaugurated in 1899, which has played such an important part in the extension of our knowledge of solar physics. He presided over the two observatories from 1899 till his retirement in 1911, when he was succeeded by Mr. Evershed.

WE regret to announce the death of the eminent scholar and editor, Dr. James Hastings, at the age of seventy-one years. The various Dictionaries of the Bible published under his control have enjoyed much popularity, combining with the orthodox position the results of modern criticism. But his greatest work was the "Encyclopædia of Religion and Ethics," the publication of which began in 1908 and ended with the twelfth volume in 1921. Like all works of the kind, it is uneven, but to the student of comparative religion, ethics and philosophy, anthropology and folklore, it is of the highest value. Hastings was a model editor, quiet and unassuming, sparing no pains to verify a fact or a reference; he maintained the most agreeable relations with his many contributors, some of whom must have tried his patience sorely. His fault, if it be a fault, was excessive kindness and hesitation in using his blue pencil when he was dealing with men who were recognised authorities on the subjects which they undertook. The war, which interfered with his arrangements with foreign scholars, added much to his anxieties, and the work must have come to a temporary end if he had not been generously supported by his publishers. He had planned a general index of the Encyclopædia, which will add much to its value for the working scholar. It is to be hoped that the scheme for the index was drawn up before his sudden, untimely, and much regretted death.

IN the *Chemiker Zeitung* of September 28 the death is announced on September 15 of Prof. F. Nobbe, of the Forestry Academy of Tharandt, the founder of the research station of plant physiology and the first station for seed control.

WE notice with much regret the announcement of the death on October 26, at sixty-six years of age, of Dr. C. G. Knott, reader in applied mathematics, University of Edinburgh, and on October 28, in his eighty-fifth year, of Prof. A. Crum Brown, emeritus professor of chemistry in the same university.

Current Topics and Events.

MUCH anxiety is felt in this country as to the position and prospects of the Royal College of Science, Dublin, under the Irish Provisional Government. By a sudden decree, the college was closed on October 1—a day before the new session would have opened. It was announced that a bomb had been found in the building, and this provided a plausible excuse for the action taken. No students had, however, been admitted to the college since June 30, and the circulation of the rumour as to the discovery of the bomb was known to be merely a means of suggesting that the college was a centre of disaffection and that in the interests of public safety it should be closed. For a week or two afterwards the teaching was carried on in buildings lent by the National University, but a second decree was made on October 16 ordering the students, about four hundred in number, to enter the National University classes, an arrangement against which both professors and students strongly protested. A compromise may be effected, but meanwhile the Royal College of Science is in the complete occupation of the military, and no one in authority will say that the building will be restored to its original purposes when military necessity ceases. It would be nothing short of a calamity if an institution in which so much valuable scientific work has been carried on for many years should have its activities abruptly ended to serve purely political purposes. The college is unique in Ireland; its equipment cost more than 250,000*l.* and no other

institution or university in that country can offer the same facilities for training. It must be heartbreaking to see the practical equipment and apparatus, the fine electric machinery plant, engineering department, and laboratories generally, used for kitchens and bedrooms and at the mercy of military forces unfamiliar with their significance or value. It is almost impossible to get exact information as to the actual position of things in Dublin, but if conditions are half so bad as have been described to us, men of science and scientific institutions should unite to bring them to the notice of their colleagues in other parts of the British Isles and the world of progressive knowledge in general, in the hope that provision for the scientific instruction and research much needed by Ireland will not be curtailed but extended in the near future.

THE Marquess of Crewe has accepted the invitation of the council of the British Science Guild to succeed Lord Montagu of Beaulieu as president of the Guild. Lord Crewe has always taken much interest in the promotion of scientific research, and it was while he was Lord President of the Council in 1915 that the Government scheme for aiding the formation of Industrial Research Associations was announced by him. The British Science Guild is not directly concerned with the methods and results of research in the same way as are the various scientific and technical societies, but with securing adequate facilities not only for extending scientific knowledge itself but also for using it for national progress. Its relation to such societies is similar to that of the Navy League to the navy; and the need of such a body, watching and intervening on behalf of science, and in the interests of administrative efficiency and national development, is as great to-day as ever it was. We understand that the Guild proposes shortly to make a wide appeal for support to extend its activities and to enlighten the general public as to the significance of scientific work and thought in modern civilisation by means of leaflets, lectures, conferences, and so on. The campaign is a promising one, and for the sake of science as well as for national security, we trust it will be markedly successful.

AMONG the scientific men who lived during the Revolutionary Era in France few were held in higher esteem than Claude Louis Berthollet, the centenary of whose death occurs on November 6. Celebrated for his discovery, in 1785, of the composition of ammonia and, in 1786, of the bleaching properties of chlorine, he was one of the earliest converts to the new ideas of Lavoisier, and with Lavoisier, Fourcroy, and Guyton de Morreau, compiled the "Méthode de Nomenclature Chemique." During the Revolution his organising powers were devoted to maintaining a supply of saltpetre for the making of gunpowder, while with Monge and Clouet he did much to improve and extend the manufacture of steel. He also played a prominent part in the reorganisation of the Academies and the inauguration of the National Institute. Like Monge, he was a favourite with Napoleon and was one of the group of learned men who accompanied the young conqueror to Egypt. Among Berthollet's writings was his "Statique Chimique," published in 1803. He was the founder of the famous "Société d'Arceuil," of which Laplace, Biot, and Gay-Lussac were members.

THE secretary of the Swedish Medical Society has favoured us with the following particulars of the Anders Retzius medal which was awarded recently to Sir Charles Sherrington. The Anders Retzius foundation was given to the society on October 13, 1896, by Mrs. Emilie Retzius in memory of the hundredth anniversary of the birth of her late husband, Prof. Anders Retzius; and it is intended to promote studies of normal anatomy and physiology. From this foundation the Anders Retzius gold medal was for the first time awarded by the society to Albert von Kölliker in the year 1897. It has since been awarded successively on every fifth year to Carl Voit, Gustaf Schwalbe, John Newport Langley, and Oscar Hertwig, alternately in recognition of their prominent anatomical and physiological researches. The medal is sixty-nine millimetres in diameter, was designed by the Swedish medallist E. Lindberg, and represents Anders Retzius's portrait in profile.

MR. W. FRENCH, writing from the Storey Institute, Lancaster, directs our attention to a letter from Prof. A. C. Seward, published in the *Lancaster Observer* for September 22, referring to the state of the tombstone marking the grave of the parents of Sir Richard Owen and appealing to Lancastrians to contribute the comparatively small amount required for its restoration. Mr. French suggests that there may be many scientific men yet living who owe much of their success and inspiration to the writings and teachings of Sir Richard Owen, and would be willing to acknowledge in part their debt to him by contributing to the restoration of the tombstone of his parents. The estimated cost of the project is about 30*l.*, and Mr. French is willing to receive subscriptions and to give any further information that is required. We feel sure that readers of NATURE will share the desire of Prof. Seward and Mr. French that anything associated with the memory of so distinguished a man of science should be preserved and treated with the greatest reverence.

IT has been announced in our columns (September 16, p. 394) that nearly 850*l.* had been subscribed in this country in support of the Pasteur centenary celebrations. This sum has been forwarded to the general treasurer of the fund, M. Th. Héring, who, in his reply acknowledging the receipt of the gift, states that any surplus of funds remaining after providing the monument at Strasbourg will pass to the Pasteur Foundation, which will probably institute Pasteur prizes for needy students. In February next, the Alliance Française, of 41 Fitzroy Square, W.1, is entertaining for a few days MM. Vallery-Radot, father and son, relatives of Pasteur, and Dr. Pasteur Vallery-Radot will give an address on the work of his illustrious grandfather. MM. Vallery-Radot will afterwards be entertained at dinner, probably at the Vintners' Hall.

IN the *Daily Mail* of October 23 appears a note on the discovery of a human skull and bones in an ancient gold-working at Gwanda, Rhodesia. It is based upon an account of the discovery by Mr. Duncan Simpson, by whom the bones were found in July last. They lay under twenty feet of débris, and their position would suggest that the miner was working on the face of the reef when he was killed by a fall of the rock. This is supported by the fact that a large stone hammer lay near by, which, it may be assumed, he was using at the time. The bones are now in charge of Dr. Arnold of the Rhodesian Museum and are to be submitted to expert investigation. It is stated that on a cursory examination they are thought to be those of a Bantu. If, as the circumstances suggest, the remains are those of one of the original miners of the ancient gold-workings, in which this part of Rhodesia abounds, they are the first to be discovered. The confirmation of their Bantu origin would have an important bearing upon the problem of the origin of these gold-workings and of the highly developed ancient culture of Rhodesia which has so often been the subject of controversy. While it is highly probable that the workers were the slaves of a higher race, as suggested in the *Daily Mail* article, the Bantu origin of these early miners, in view of the comparatively late incursion of that race into this area, would preclude a very high antiquity for these workings.

A SNAP of cold and severe weather was experienced over the British Isles during the closing days of October, and temperatures were exceptionally low for so early in the winter season. Bitter easterly winds were prevalent under the controlling influence of a region of high barometer centred over Iceland and an area of low barometer readings situated over France and the Bay of Biscay. In the English Channel and on our south coasts the east winds attained the force of a gale. Snow fell in Cornwall and at many places in the southern counties on Saturday, October 28. According to the reports from the Meteorological Office, the thermometer on October 28 and 29 failed to reach 50° F. in any part of the Kingdom, whilst on October 29 the maximum at Falmouth, Newquay, Lympne, and Hampstead was only 39° F. and at night sharp frost was generally experienced, the exposed thermometer falling to 20° F. in many places. The Greenwich temperature records from 1841 show that in six years, 1859, 1869, 1873, 1880, 1890, and 1895, the maximum day temperature in October failed to attain 40°, on a single day, at least, subsequent to October 20. At Eastbourne the highest temperature on Sunday, October 29, was 42° F., and on three mornings, October 26, 27, and 29, the lowest temperature in the shade indicated a frost. October was generally cold and fairly dry in most parts of England, with a large amount of easterly wind, and was in marked contrast to the warm and bright weather experienced in the corresponding month of last year.

THE anniversary dinner of the Royal Society will be held at the Hotel Victoria (Edward VII. rooms) on St. Andrew's Day, Thursday, November 30.

THE annual exhibition of scientific apparatus organised by the Physical Society of London and the Optical Society will be held on January 3 and 4 next.

AT the first ordinary meeting of the new session of the Royal Geographical Society, to be held on November 13 at 8.30 P.M., at the Aeolian Hall, a paper will be read by Commander Frank Wild on the work of the *Quest*.

THE Huxley Lecture of Charing Cross Hospital Medical School will be delivered at the school on Wednesday, November 8, at 3 o'clock, by Sir Arthur Keith, who will speak on "Evolutionary Tendencies in Man's Body." At 4 o'clock on the same day, at London Hospital Medical College, Dr. Percy Kidd will deliver the Schorstein Memorial Lecture. The subject will be "Forty Years in the History of Tuberculosis."

AT a meeting of the Royal Society of Edinburgh on October 23, the following officers and members of council were elected: *President*: Prof. F. O. Bower. *Vice-Presidents*: Sir J. A. Ewing, Prof. J. W. Gregory, Major-General W. B. Bannerman, Dr. W. A. Tait, Principal J. C. Irvine, Lord Salvesen. *General Secretary*: Dr. C. G. Knott. *Secretaries to Ordinary Meetings*: Prof. J. H. Ashworth, Prof. R. A. Sampson. *Treasurer*: Dr. J. Currie. *Curator of Library and Museum*: Dr. A. Crichton Mitchell. *Council*: Prof. F. G. Baily, Dr. R. Campbell, Prof. J. Arthur Thomson, Dr. H. S. Allen, Sir Robert Blyth Greig, Dr. J. Ritchie, Prof. E. M. Wedderburn, Prof. T. H. Bryce, Prof. J. Y. Simpson, Prof. D'Arcy W. Thompson, Sir James Walker, Prof. E. T. Whittaker.

IN her presidential address, delivered on October 19, to the Society for Constructive Birth Control and Racial Progress, Dr. M. C. Stopes dealt with the ideals and present position of constructive birth control. She stated that the social ideal urgently needed to-day is the revision of our present mistaken tendency to breed from defective stock more than from good and healthy stock. Acting as a motive force is also the individual human commiseration for the sufferings endured by unhealthy, over-burdened slum women, involuntarily the mothers of degenerate stock. Dr. Marie Stopes is of opinion that the Utopian idea is attainable through the use of scientific knowledge in such a way as to secure the increase from the best, and to decrease the population of low-grade human beings.

MESSRS. W. HEFFER AND SONS, LTD., booksellers, Cambridge, have recently purchased the interesting and valuable library of Prof. R. B. Clifton, late professor of natural philosophy in the University of Oxford. They have a catalogue in preparation. A copy will be sent post free on application.

WE have received from Mr. W. Rodier, 327 Collins Street, Melbourne, a letter and some pamphlets dealing with the rat problem as bearing upon the article by Mr. Alfred E. Moore in our issue of May 20 (vol. 109, p. 659). Mr. Rodier's scheme for the extermination of rats, known as "The Rodier System," which consists in liberating all the males trapped, is of course well known and its merits thoroughly appreciated by all interested in the destruction of

the rat. Mr. Moore, to whom we submitted Mr. Rodier's communication, sends us the following comments upon it: "Boelter, who joined me soon after I had initiated the British war on rats and mice, agreed with me that if we could get international, unified, and synchronised war on the rat, then and not till then could we hope to have any success from Mr. Rodier's method; we agreed that our first step must be to get the public fully to appreciate the disastrous nature of the rat menace, but that we could not afford to postpone rat destruction by all and every means until the day when unified effort was forthcoming. If Mr. Rodier agrees to work for an International Commission to bring about a proper understanding of the rat problem and concerted action, then I am sure all of us would gladly co-operate; but until we can get the public mind fully alive to the extent of the issue, I am sure it would be just as reasonable during the fly season to catch as many flies as possible and to liberate all the males: in this instance at any rate we should have a fair chance of seeing the progress of our work."

READERS of NATURE interested in topography may like to have their attention directed to a catalogue of some 230 books, maps, and engravings relating to London and its vicinity just issued by Mr. F. Edwards, 83 High Street, Marylebone, W.1.

THE useful quarterly list of new books and new editions added to Lewis's Medical and Scientific Circulating Library for the months July to September has just been received. Copies are obtainable free of charge from Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1.

MR. W. H. ROBINSON, 4 Nelson Street, Newcastle-upon-Tyne, has recently issued a catalogue of some 300 second-hand books of science. The prices asked seem very reasonable. An interesting item is a copy of the first edition in English of The Anatomical Exercises of Harvey, concerning the Motion of the Heart and Blood; with the Preface of Zechariah Wood, Physician at Roterdam, to which is added Dr. James De Back, his Discourse of the Heart, containing a defence of Harvey's work.

A DIRECTORY for the British Glass Industry is being compiled under the auspices of the Society of Glass Technology. It will contain in classified form the names of all firms, associations, societies, trade unions, educational and research institutions interested in the manufacture and wholesale supply of glass and glass articles, and in the supply of raw materials, plant, and machinery to the industry. It is hoped to publish the volume by the end of the present year.

Our Astronomical Column.

RECENT METEORS.—Mr. W. F. Denning writes that two large meteors were seen at Bristol on October 17 at 7.15 and 10.46. The first of these descended just under the "Pointers" in Ursa Major from 164° +52° to 164° +45°, and moved very slowly. The other meteor traversed an unusually long path of 113 degrees, the flight being from 163° +74° to 330° −6°. The duration was about six seconds, and the meteor threw off a bright streak all along its extended course. The radiant point was near the horizon in 152° +39°, but no further accounts of the object have yet been received.

The October meteoric shower has been fairly well observed this year, a remarkable succession of clear nights having occurred between October 10 and 21. The chief showers have been from Orion and Aries. Mr. Prentice at Stowmarket saw 246 meteors between October 10 and 18 in 34 hours of watching. The chief radiants in activity were determined by him as follows:

α Arietids	31°	+19°	8	Meteors, October	13-15.
ϵ Arietids	41½°	+22°	17	,, ,,	14-18.
υ Orionids	90°	+16°	10	,, ,,	18.
ζ Geminids	98°	+15°	8	,, ,,	14-15.

These various showers are well known at this period of the year. The Arietids are slow-moving, brilliant meteors, while the Orionids and Geminids are swift, streaking meteors.

OCCULTATION OF ALDEBARAN.—On Monday next, November 6, the moon will occult the bright star Aldebaran in Taurus. The disappearance takes place at $10^h\ 8^m$ G.M.T., and the reappearance at $11^h\ 20^m$ G.M.T.

COMETS.—Numerous observations are to hand of the comet discovered by Dr. Baade on October 19. The comet is easily visible in a moderate telescope, and should be observable for some months. It is, however, receding from the sun and earth. The following elements are by Mdlle. Vinter Hansen, from Copenhagen observations on October 22, 23 and 24:

$$\left.\begin{array}{l} T = 1922\ \text{Oct. } 16{\cdot}5701\ \text{G.M.T.} \\ \omega = 114^\circ\ 32'{\cdot}07 \\ \Omega = 219^\circ\ 50'{\cdot}89 \\ i = 51^\circ\ 47'{\cdot}00 \end{array}\right\} 1922{\cdot}0.$$
$$\log q = 0{\cdot}35890.$$

EPHEMERIS FOR GREENWICH MIDNIGHT.

	R.A. h.	m.	s.	N. Decl.	log r	log Δ.	Mag.
Nov. 6.	20	28	4	32° 36′·0			
10.	20	37	43	31 28 ·1	0·3622	0·3035	10·1
14.	20	47	28	30 21 ·4			
18.	20	57	18	29 16 ·2	0·3646	0·3150	10·2
22.	21	7	10	28 13 ·0			

The comet should be looked for high up in the south-west soon after sunset.

The search ephemeris lately given for Perrine's periodic comet did not include perturbations. M. Kasakov of Moscow finds that these are large, and gives the following elements:

$$\left.\begin{array}{l} T = 1922\ \text{Dec. } 25{\cdot}2. \\ \omega = 167^\circ\ 15'{\cdot}21 \\ \Omega = 242^\circ\ 18'{\cdot}53 \\ i = 15^\circ\ 42'{\cdot}56 \end{array}\right\} 1922{\cdot}0.$$
$$\phi = 41^\circ\ 15'{\cdot}63$$
$$\mu = 537''{\cdot}538.$$

EPHEMERIDES FOR GREENWICH MIDNIGHT WITH TWO ASSUMED DATES OF PERIHELION.

	Perihelion Dec. 21.2. R.A. h.	m.	s.	N. Decl.	Perihelion Dec. 25.2. R.A. h.	m.	s.	N. Decl.
Nov. 10.	21	14	5	5° 29′	20	58	7	3° 9′
18.	21	35	11	4 35	21	17	53	2 33
26.	21	59	34	3 52	21	40	32	2 9
Dec. 4.	22	27	1	3 21	22	5	53	1 58

It is some 26° south of the other comet, but considerably fainter.

Research Items.

A LONG BARROW IN BRECONSHIRE.—In the October issue of *Man*, Mr. C. E. Vulliamy describes the results of his excavations of a long barrow at Talgarth in Breconshire, on a foothill of the Black Mountain range. The chamber and its contents had been disturbed, but not in recent times. At an early stage a calcined thigh-bone of a youth was found, but lower down there were abundant human remains, much broken and seldom lying in anatomical relation to each other, but showing no evidence of cremation. Sir Arthur Keith, who has examined the fragments, finds one skull of a man about forty years of age, the cephalic index 70, a very narrow, relatively high, and rather small head, 20 mm. narrower than previously recorded in Neolithic skulls from Wales. Associated with the human remains were bones of the pig, ox, goat, and cat, and quantities of flint flakes and scrapers are scattered over the neighbourhood.

A THIRD-CENTURY BIRMINGHAM.—Preliminary excavations have just been completed on the site of what the *Times* calls "a third-century Birmingham," Ariconium, in the Wye valley between Monmouth and Gloucester, near Weston-under-Penyard, three miles from Ross. Over an area of more than 100 acres the earth is full of smelting refuse; evidently a great iron industry flourished there, the iron ore being brought from the Forest of Dean. The only classical reference to the place is in the Itinerary of Antonius, compiled about 150 A.D., and in the fourteenth century the Benedictine monk Richard of Cirencester refers to it. Some buildings have been found, the walls of which were decorated in column. A large quantity of pottery, fragments of Samian ware, and a coin of Domitian dated 87 A.D. were also discovered. Ariconium seems to have arisen as a halting-place on the Roman road from Caerleon to Silchester in the first century, and it became a busy industrial town in the third. The results of these excavations justify their continuance on a wider scale.

BACTERIOLOGY OF CANNED MEAT AND FISH.—The results of an investigation by Dr. W. G. Savage and Messrs. R. F. Hanwicke and R. B. Calder on the bacteriology of canned meat and fish have been published by the Food Investigation Board as Special Rep. No. 11 (H.M.S.O., price 2*s.* 6*d.* net.). The report is based on the examination of 344 samples, the object being to ascertain the character of bacteria concerned in the spoilage of these canned foods. Moulds and yeasts are of rare occurrence and probably of little importance. Obligate anaerobic bacilli are rarely present in sound tins, but were nearly always associated with obtrusively decomposed conditions in the tin. Sporing aerobic bacilli are frequent in sound samples, and many of them must be regarded as potential causes of decomposition; they are unable to develop in sound tins from which air is excluded and persist as harmless spores. Non-sporing bacilli were found in many samples, their importance depending upon their biological characters. Thus, strains of *B. proteus* are important causes of decomposition. Thermophilic bacteria (*i.e.* bacteria growing best at 55° C.) were searched for and found to be widely prevalent but, being non-proteolytic, are unlikely to cause spoilage. Micrococci are infrequent and as a group cannot be regarded as a cause of spoilage, though they may assist more proteolytic types of organisms. Nearly 62 per cent. of sound tins are not sterile, the worst offenders being crab and lobster. Sterility itself is therefore not a criterion of soundness, and these surviving bacteria do not in any way injure the foods in which they are present owing to their inability to multiply and produce decomposition under the conditions existing. Suggestions are made respecting the process of manufacture so as to reduce spoilage to a minimum.

FLOWER STRUCTURE IN THE LECYTHIDACEÆ.—Prof. McLean Thompson has published a further study of floral morphology in the Lecythidaceæ, a peculiar tropical family with large fruits, related to the Myrtaceæ (Trans. Roy. Soc. Edin., Vol. 53, Part I., No. 13). The present paper is devoted to a study of the flowering and certain stages in the floral development of *Napoleona imperialis*, the first member of the West African genus Napoleona to be described, in 1786, by a French writer. The peculiarities of the flower include so-called inner and outer corollas with a series of petaloid filaments between them. Many interpretations have been placed upon these structures. The floral development indicates that the petaloid filaments and the outer corona have taken the place of the outer cycles of stamens in the Myrtaceous flower, as Bentham supposed. The style is surrounded by a fleshy glandular disc which is considered to be a remnant of an inner stamen-bearing whorl.

HAWAIIAN GRASSES.—A comprehensive account of the grasses of the Hawaii islands, which is based on special collections made by the author in 1906, and on all accessible material gathered by other observers, is provided in Memoirs of the Bernice Pauahi Bishop Museum, Vol. VIII. No. 3 (Honolulu), "The Grasses of Hawaii," by A. S. Hitchcock. The preliminary discussion deals with the distribution from an ecological standpoint, with the chief agritural grasses, and with introduced species. A large number of the grasses of the islands have been introduced, 83 species in all, mostly from Europe, a few from Australia and the East Indies. Many of the 47 native species are endemic, and most of the others have extended northwards to Hawaii from the East Indies and the southern Polynesian islands. Of the 39 endemic species 7 are annuals, all belonging to the genus Panicum. The second part is systematic and gives a full description of each species, the necessary keys being provided; 9 new species are described, together with a new section of Poa, Siphonocoleus sect. nov. The treatise should provide a useful and well-arranged reference work for students of the Graminaceæ.

WEST INDIAN HURRICANES.—An article on the formation and movement of West Indian hurricanes by Mr. E. H. Bowie of the U.S. Weather Bureau appears in the U.S. *Monthly Weather Review*, April 1922. The area of first appearance is described as extending from latitude 10° to 25° N. and from longitude 56° to 95° W. During a period of 35 years, 90 per cent. of the West Indian hurricanes are said to have had their origin within and not without this area. It is asserted that some years pass without hurricane formation, while other years are notable for hurricane frequency. The origin of a hurricane is by no means certain, and the author states it is even now difficult and next to impossible to say which of the many hypotheses is the correct one. The prevalent supposition of the origin is the meeting of adverse currents, having different temperatures, which produce gyratory motions of the atmosphere. Many men of science are of opinion

that tropical cyclones are essentially convectional phenomena. Observations in the free air in and around a tropical cyclone are not available. Dr. V. Bjerknes, in his theory of the polar front, has recently given a new conception of the part that local wind systems play in the formation of cyclones. The author states that it would seem that the cause of the origin of the tropical cyclone may be found in the counter current theory as to initiation of the cyclone centre, while the convective theory accounts for its maintenance after having started. Much information is given on the movement of hurricanes, and there are numerous charts showing the travelling centres in association with the surrounding distribution of atmospheric pressure.

LOCAL OR HEAT THUNDERSTORMS.—The U.S. *Monthly Weather Review* for June gives an interesting and instructive account of the development of thunderstorms by Prof. C. F. Brooks, of the Clark University, which was presented before the American Meteorological Society in April last. The supply and action of the ascending and descending currents of air are explained, as well as the formation and effect of rain in the development of the storm. The physical make-up of the thunderstorm is said to develop quickly into a central descending and outflaring current of cold air, surrounded by a cone of rising warm air, and still farther out by a zone of descending air. A thunderstorm is described as the result of relatively large streams of air in violent convection attended by abundant condensation of moisture. With reference to the rapid rising of air in cumulus clouds that are growing into cumulo-nimbus, the author remarks that on different occasions his rough measurements have shown upward motions of 3, 4, and 7 metres per second in the tops of cumulus clouds. Aviators and aeronauts who have been within active portions of cumulo-nimbus clouds have experienced great bumpiness owing to the strong up-and-down currents. Violent convection is said to be caused by the instability accompanying a large lapse rate in temperature. Abundant condensation of moisture is essential to the start of a thunderstorm. The gist of the communication is the predicting of local thunderstorms, and certain questions are formulated for the forecaster relative to streams of air, convection, and condensation. It is suggested that the conditions be tabulated and that use be made of a + or − answer, the summing up of which will indicate whether local thunderstorms are probable. Important information is given as to where local thunderstorms originate.

THE SPHERE-GAP VOLTMETER.—When it is necessary to measure the maximum or peak voltage of an alternating current from a transformer or induction coil the sphere-gap voltmeter is often used, as its indications are independent of the humidity of the air and of the form of the voltage wave. The following particulars of such an instrument at the National Physical Laboratory, furnished by Dr. E. A. Owen in the October issue of the *Journal of the Röntgen Society*, will prove useful. The spheres, 7·62 cm. in diameter, are mounted on ebonite pillars 21 cm. long, with sulphur rings 5 cm. long let into them for additional insulation. One sphere is fixed and the other supported on a slide which can be moved towards the fixed sphere by means of a screw. A scale on the slide gives the distance apart of the spheres at their nearest points. The spheres are connected to the supply and are moved slowly towards each other till a spark passes. The peak voltage is then deduced from the distance apart by the following data: 1 cm. 32·7 kilovolts; 2, 60; 3, 86; 4, 196; 5, 124; 6 cm. 141 kilovolts.

OZONE.—Prof. E. H. Riesenfeld, of Berlin, has recently described (*Chemiker Zeitung*, October 7) the preparation and properties of pure ozone. Ozonised oxygen containing 10-15 per cent. of ozone was liquefied in exhausted glass bulbs by cooling in liquid air. The deep blue liquid, on exposure to reduced pressure, gave off mainly oxygen, and at a certain composition separated into two layers: the upper, dark blue, layer was a solution of ozone in liquid oxygen; the lower, deep violet-black, layer was a solution of oxygen in liquid ozone. The lower layer, formerly considered to be pure ozone, contains about 30 per cent. of oxygen at −183° C. The oxygen was pumped off from it, and pure liquid ozone (B.P. −112·4°C.) obtained. The vapour density of 48 (O_3) was found by Dumas' method. On cooling in liquid hydrogen, solid ozone, in violet-black crystals, M.P. −249·7° C. was formed. The gas, deep blue in colour, is, in the absence of all catalysts, remarkably stable. Pure gaseous ozone can be exploded by an electric spark, but some remains unchanged. This would be expected from the endothermic character of the substance. The critical temperature is −5° C. No evidence whatever of the existence of higher polymers of oxygen was obtained: both in the liquid and gaseous states the formula is O_3. This work is of great interest, and, apart from the determination of the physical properties of ozone, it removes the last doubt as to the simple character of ozone—"oxozon" does not exist.

DIFFERENTIAL GAS ANALYSIS.—Mention has already been made in NATURE of a method devised by Dr. G. A. Shakespear of Birmingham University for measuring differences in composition of similar gas mixtures. The method, which has proved itself valuable for controlling the purity of hydrogen, the safety of atmospheres in balloon sheds, and many other purposes, depends on the differences of thermal conductivity of gases. Two identical spirals of platinum wire are enclosed in separate cells in a metal block, each spiral forming one arm of a Wheatstone Bridge circuit, the other two arms being of manganin. An electric current flowing through the bridge thereby heats the two spirals, which lose heat to the walls of the cells. If the two cells contain gases of different thermal conductivities the spirals will cool at different rates, and one spiral will therefore be maintained at a higher temperature than the other. The difference in temperature of the two wires thus causes a deflection of the galvanometer, the extent of which depends on the difference in conductivity of the two gases. The construction is such that changes in the temperature of the gases affect both sides of the bridge equally. If, therefore, one cell contains a pure gas, and the other cell the same gas mixed with some other constituent, the extent of the deflection will indicate the proportion of the second gas present, and the galvanometer can be calibrated to show directly the percentage composition of the mixture. The difference in conductivity between air and carbon dioxide enables the method to be used to determine the percentage of carbon dioxide in flue-gases. The other constituents of flue-gases either have thermal conductivities differing but little from those of nitrogen, or are negligible in amount, while the effect of the water vapour can be counteracted by keeping the gases in both cells saturated. By attention to certain details the method may be then applied to follow the change in carbon dioxide content of the flue-gases in fuel-consuming installations. The instrument is made by the Cambridge Scientific Instrument Company.

The Origin of Magnetism.

WHEN the proposal was first made to hold in Section A of the British Association at Hull this year a discussion on "The Origin of Magnetism," it was met with the criticism from eminent quarters that the time was not yet ripe for the consideration of this subject. Those who attended the meeting will probably agree that this view was justified, for it can scarcely be said that the position was advanced appreciably, or that any real, or even plausible, answer was given to the main question involved. Perhaps this was in some measure due to the regrettable absence of Prof. Langevin, who had promised to make the opening remarks, and had expressed his intention of using the opportunity for a critical survey of the whole subject. But a recurrence of the ill-health from which he has intermittently suffered for a long time deprived the Section of Prof. Langevin's presence and his eagerly anticipated contribution to the discussion. As it was, the discussion lacked co-ordination; the remarks of the various speakers bore little relation to one another. There was the exposition by Prof. Weiss of his theory of the molecular field and the existence of magnetons; then Sir J. A. Ewing's description of his new molecular magnet models; then the remarks of Dr. A. E. Oxley on the changes of susceptibility imparted to platinum and palladium by the occlusion of hydrogen; and, finally, an account by Mr. L. F. Bates of the measurements of the Richardson effect recently carried out by Dr. Chattock and himself,—all contributions of considerable individual interest, but not closely related to one another nor providing an answer to the essential question of the *origin* of magnetism.

In spite of the comparative failure of the discussion in its wider aspects, one felt that the time had not been wasted, principally because it afforded an opportunity for Prof. Weiss to give a most interesting account of his work in connexion with ferromagnetism and paramagnetism, which is not too well known in this country. Prof. Weiss at very short notice undertook to open the discussion in place of Prof. Langevin, and a fairly complete account of his remarks will eventually appear in the Report of the Association. An outline of this exposition may be profitable here.

Starting from the analogy of the difference between the laws of fluid compressibility for low and high densities, Prof. Weiss showed how Langevin's kinetic theory of paramagnetic substances may be modified so as to include strong magnetism—or ferromagnetism—by the assumption of the existence of a *molecular field* analogous to van der Waal's internal pressure in fluids. A whole array of experimental facts was brought forward in support of this theory of the molecular field. It provides an explanation of the variation of magnetic saturation with temperature; it accounts precisely for the transformation of ferromagnetism to paramagnetism at the temperature of the Curie point, and for the observed law of this paramagnetism. The theory also points to a discontinuity of specific heat at the Curie point, and the magnitude of the discontinuity, calculated from magnetic data, agrees with calorimetric measurements. Still more interesting is the recently discovered magneto-caloric phenomenon, which consists of a reversible temperature variation accompanying magnetisation. This differs from the ordinary hysteresis effect, which is irreversible, and always involves heating. In the reversible effect, magnetisation produces a rise of temperature and demagnetisation a fall. At the Curie point the change is by no means negligible, reaching, as it does, a value of about 1° in fields readily attainable. The extent of temperature variation calculated by means of the molecular field theory agrees with that observed.

When one comes to calculate from various experimental data the numerical value of the molecular field, it proves to be of the order of magnitude 10^7 gauss, which is far in excess of the magnetic field which might in the most favourable circumstances be produced by the magnetic moments of the molecules of a ferromagnetic body, namely, 10^4 gauss. This remarkable result indicates that the so-called molecular field has not itself a magnetic origin. In this connexion Prof. Weiss's own (translated) words are worth quoting:—

"It is therefore impossible for the mutual actions represented by the molecular field to be of a magnetic nature. It is just a notation for forces of a non-magnetic character, with a symbol borrowed from magnetism. I prefer, in place of the primitive definition given earlier, the equivalent definition

$$H_m = -\frac{\delta U}{\delta I},$$

where U is the intrinsic energy per unit volume, and I the intensity of magnetisation. This definition is advantageous in that it does not prejudge the nature of the forces. . . . It does not appear to be impossible that the forces may be electrostatic; that, however, is at present a pure supposition."

In the second part of his address Prof. Weiss directed attention to another important aspect of the combined kinetic theory of Langevin and his own theory of the molecular field. The possession of these theories permits the calculation of the values of the molecular or atomic magnetic moments which have been the underlying assumption in all theories of magnetism. A great number of atomic moments have thus been evaluated from many experimental sources, such as the measurement of the magnetisation of ferromagnetic substances and their alloys both in the neighbourhood of absolute zero and above the Curie point, the investigation of the paramagnetism of solutions of salts, and the like. The general law which emerges is that "all atomic moments are integral multiples of the same elementary moment, to which the name *magneton* has been given." For example, six different and independent observers have found for nickel, over a temperature interval of about 400°, 8·03, 7·99, 8·04, 8·05, 8·03 and 7·98 magnetons respectively, numbers which, it will be seen, are in the immediate neighbourhood of the integer 8. It is, besides, a general property of atoms to possess different integral numbers of magnetons according to various conditions, such as their state of chemical combination, or their temperature, whether in the ion, or in the undissociated molecule. Prof. Weiss affirms that the magneton is a real entity, and he pointed to the fact that the Rutherford-Bohr atom, together with Planck's quantum theory, actually does indicate the existence of a universal elementary magnetic moment, which, however, proves upon calculation to be almost exactly five times as great as the magneton.

Prof. Weiss's general conclusions may be summed up by quoting him again:—

"1. One of the essential conditions for the production of strong magnetism—or ferromagnetism—is the existence, between molecules possessing magnetic moments, of important mutual actions which are numerically expressed by the molecular field, and are certainly of a non-magnetic nature.

"2. The appearance of atomic moments as integral multiples of the same elementary moment—the magneton—is thus one of the important aspects of magnetic phenomena."

Altogether a convincing exposition, in spite of Sir Ernest Rutherford's amusing allusion to the fascination which *whole numbers* have for physicists.

A. O. RANKINE.

Man and the Ice Age.

OF the many discussions which took place during the recent meeting of the British Association at Hull, few are likely, on purely scientific grounds, to prove of more importance than that on the relation of man to the ice age in Britain, in which the sections of geology, geography, and anthropology took part. It cannot be said that any agreement was reached; but the significance of the discussion lies in the fact that protagonists of different schools of thought in geology were brought face to face, while archæologists and geographers were able to formulate and lay before them problems for the solution of which they await the assistance of geologists. In considering the problems of the ice age, geologists and archæologists are dealing with the same material, but each from their special point of view. The result has been a difference in nomenclature and method of classification: the geologist thinks in terms of the deposits; the archæologist in terms of the artefacts found in them. Consequently, as Prof. P. F. Kendall pointed out, any discussion between them is likely to come to a deadlock through disparity of nomenclature. This discussion, however, showed that the difficulty is by no means insuperable.

It was apparent at an early stage in the discussion that there existed a clear-cut difference of opinion as to the method of approach in attacking the problem. Indeed the title of the discussion, in suggesting a restriction of the subject matter to Britain, was a challenge which Prof. W. J. Sollas was not slow to take up, when at the outset he maintained that it was impossible to consider the evidence in Britain apart from conditions on the Continent. Prof. Kendall, on the other hand, held that not merely must consideration be confined to the evidence as it is presented in the British area alone, but that the solution of the problem must be sought in East Anglia in the relation of the northern drift to the chalky boulder clay. On this point, Prof. Kendall's lucid summary of the evidence gave his audience a clear indication of the nature of the problem and of the extent to which the British data may be expected to throw light upon the problem as a whole. It turns to a great extent upon the view which is taken of the relation of the glacial deposits of Yorkshire to those of East Anglia. The chalky boulder clay of East Anglia was carried down by ice from north of the Wash and the fens. In Yorkshire there is a clear glacial sequence of at least three boulder clays, in the lowest of which is a Scandinavian element. In Prof. Kendall's opinion the hope of correlating the Yorkshire evidence with that of East Anglia is to be found in the Wolds, on the west of which is found the purple clay of Yorkshire, and on the east, the chalky boulder clay. Was it possible, he asked, that the latter might be the purple clay transformed by its passage over the Wolds?

The trend of the discussion was to show that the archæological problem is narrowing down to the question of the relation of the gravels containing Chellean and Acheulean implements to the boulder clay, a definite issue for solution by excavation. At Hoxne, such implementiferous gravels were found to overlie a boulder clay, but the evidence is by no means entirely conclusive and appears to conflict with that from elsewhere. Prof. Boswell had hoped to be in a position to place before the sections the results of excavations undertaken to determine this point, but, unfortunately, they had not been completed in time. On the other hand, Mr. Hazzledine Warren showed himself an uncompromising opponent of anything but a post-glacial date for the palæolithic gravels, on the ground that they are conformable to the holocene alluvium, a condition which would be impossible had they been subjected to glacial action. The general disposition appeared to be, however, that further evidence on this clear crucial point must be awaited. On the whole, this would appear to be in agreement with the tendency of the opinions which have been elicited by the British Association Committee appointed at the Cardiff meeting to report on the relation of early types of palæolithic implements and glacial deposits. Of these some have appeared in *Man*; others await publication.

The interest of archæologists and geographers, however, is not bounded by the position of man in relation to glacial deposits in this country. They would wish to know how far conditions in this country can be equated with conditions in the Continental area, extending this term to include North Africa, and how far it is possible by geological evidence to link up the palæolithic cultures of this country with the cultures of these areas. They welcomed, therefore, the opening remarks of the president of the anthropological section, Mr. Peake, in which he referred to the tentative schême for effecting this which he had put forward,[1] and the pronouncement of Prof. Sollas that the British evidence could not be considered apart from the Continental evidence. Prof. Sollas ably summarised Penck's views, and pointed out how the differences between the French and German geologists might be reconciled—differences however, which did not affect the question of the geological age of man. Penck's four great periods of glaciation in the Eastern Alps could be correlated with the river gravels, while in France glaciation could be brought into relation with raised beaches. As a result of such a correlation, it appeared that the Chellean implements belonged to a warm period, the Riss-Würm, the Mousterian straddled the Würm, and the Aurignacian and later phases of palæolithic culture were post-Würm.

The point of view of the archæologist and geographer was well put by Prof. H. J. Fleure. The archæologist in particular has arrived at certain conclusions on purely archæological evidence, for which he looks to the geologist for confirmation or the reverse. Prof. Fleure pointed out that the three centres of glaciation, Scandinavia, Britain, and the Alps, could not be considered apart. Any change in the distribution of ice in one area was bound to affect the climate and distribution of ice in the others. It was therefore incumbent upon the geologists to produce a scheme applicable to all areas.

An interesting question to which Prof. Fleure alluded is raised in the relation of the Bühl period, which was marked by a readvance of the ice, to the conditions in Scandinavia described by de Geer. The study of climatic conditions may also be expected to throw light upon the problem. Prof. Fleure pointed out that a constant anticyclone over the

[1] *Man*, 1922, No. 5.

glaciated region would cause a constant succession of cyclones accompanied by a high rainfall over the Mediterranean and Western Asia. This would support the view that the desert belt of the Sahara was then more to the south, thus accounting for the vast number of palæolithic implements, accompanied by ostrich shells, found in that area. It would also strengthen the probability that man drifted north as the climate improved after the Würm period, and confirm the suggestion of the archæological evidence that after the Aurignacian period there is no break.

A series of recent investigations on the south coast in Hampshire and Sussex, which were described by Dr. L. S. Palmer, bear very directly upon the question of the equation with Continental deposits. Dr. Palmer, who worked in collaboration with a geologist, had endeavoured to relate climate and deposits with implements. As a result, the 100 ft. terraces and beaches show a warm fauna associated with Acheulean and early Mousterian implements; the 50 ft. and 15 ft. terraces a cold fauna associated with Mousterian implements, the cold period being interrupted by a slightly warmer period which justified the division of this phase into two parts. In the superficial brick earths were the Aurignacian, and over the latest Combe rock were the Magdalenian implements. Dr. Palmer found a correspondence between climate, culture, and land oscillations. The investigations were carried out without reference to nomenclature, but on comparison, corresponded with the Continental system of Penck.

At this point the discussion closed. If it had attained no very definite conclusion, the air had been cleared. One definite question has been formulated for further investigation, and it has been shown that a considerable body of opinion is approaching some kind of an agreement as to the manner in which the evidence in Britain may be brought into relation with that of the Continent.

Generation and Utilisation of Cold.

THE general discussion on the generation and utilisation of cold which was held at the Institution of Electrical Engineers on October 16 was organised jointly by the Faraday Society and the British Cold Storage and Ice Association. Although the papers read at the meeting dealt with various aspects of the liquefaction of gases, there were no contributions from the refrigerating industry. Possibly the applications of cold for the preservation of food stuffs have become so standardised that our refrigerating engineers do not interest themselves in new developments. It was intended that the opening paper of the discussion should be read by Prof. H. Kamerlingh Onnes, but owing to the death of his colleague, Prof. Kuenen, he was unable to be present. Consequently Dr. C. A. Crommelin communicated Prof. Onnes's paper as well as his own.

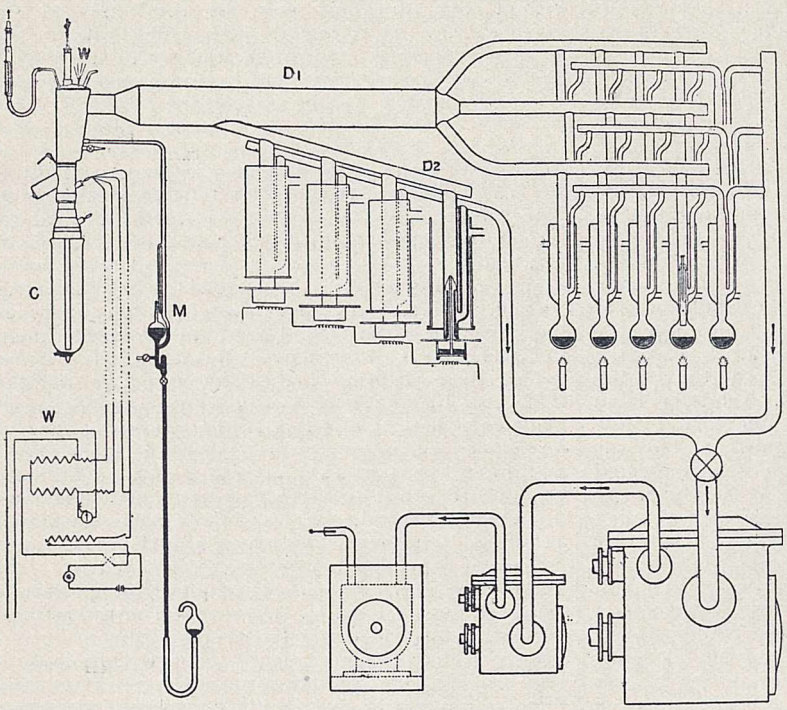

FIG. 1.—Apparatus used in attempt to solidify helium.

C, helium cryostat; M, McLeod gauge; W, resistance manometers; D_1, connexion to glass Langmuir pumps; D_2, connexion to iron Langmuir pumps.

The Leyden cryogenic laboratory has been engaged on low-temperature investigations for the past thirty-five years, and such magnificent work has been done there that any communication emanating from this specialised institution is read with considerable interest.

Dr. Crommelin's paper was of the nature of a general description of the methods of experiment whereby they obtained any desired temperature below zero centigrade and maintained this temperature constant within 0·01° C. The equipment of the cryogenic laboratory is essentially a series of plants working on regenerative Pictet cycles down to liquid nitrogen temperatures. Below this, liquid hydrogen and liquid helium are employed. In the Pictet cycles methyl chloride, nitrous oxide, ethylene, methane, oxygen, and nitrogen are used. Any one of the substances boiling under appropriate pressure will give a range of steady temperatures. By these means a range from −24° C. to −270° C. is obtained which is complete but for short gaps.

Cryostats containing the different liquids are thermally insulated by vacuum walled vessels and the losses reduced to a minimum by the immersion of the apparatus in baths of the commoner elements such as liquid oxygen.

For the range −259° to −269° C., which cannot be obtained by the use of a boiling liquid, a hydrogen vapour cryostat is employed, the vapour being heated electrically to the desired temperature and circulated around the experimental bulb.

The paper also contains some interesting data as to the capacity of the plant, and it is stated that liquid hydrogen can be produced at the rate of more than 13 litres per hour. A high degree of purity is required in the gases employed, and it appears that

the ordinary liquid air process of producing oxygen does not give gas of sufficient purity.

Prof. Onnes's paper contains an account of his attempts at producing solid helium and, of course, the attainment of the lowest temperature. His original experiments with helium date back to fifteen years ago, when he found that liquid helium boiling under the lowest pressure he could produce (about 2·2 mm.) did not solidify. The temperature was estimated as 1·15° absolute. In 1920, Onnes determined to make a fresh attempt, using the best pumps available for reducing the pressure. Batteries of Langmuir condensation pumps were constructed, twelve of glass and six of iron, all working in parallel and delivering into two Burckhardt vacuum pumps connected in series with a Siemens oil pump. The largest Burckhardt pump was capable of dealing with 360 cubic metres of gas per hour. A diagram of the experimental arrangements is shown in Fig. 1.

The complete battery of pumps was capable of removing one litre (N.T.P.) of gas per hour under a suction pressure of 0·005 mm., but owing to the gas friction in the apparatus, the actual pressure produced at the surface of the helium was only 0·012 to 0·014 mm. Under these conditions the lowest temperature attained was 0·82° absolute. Even then helium did not solidify.

Not the least difficult part of these investigations is the measurement of temperature. The actual temperature of the liquid is obtained by calculations based upon the general equation of Van der Waal and extrapolating the temperature vapour pressure relationship for helium. The form of the extrapolated curve was compared with those obtained for various other elements as the line shows a decided curvature at normal temperatures. At the meeting Prof. Porter discussed the theoretical basis of this method of extrapolation and the possible error.

The two papers from the Leyden laboratory should prove of material assistance to the student interested in the technique of low-temperature investigations.

The industrial application of the liquefaction processes was dealt with by three speakers. Mr. K. S. Murray gave a general account of the processes employed by the British Oxygen Co. It was interesting to hear that the efficiency of the liquefaction process is not appreciably greater than that of the old barium oxide process using the reversible pressure reaction. The advantage of the liquefaction process is that it produces a purer gas. Figures for the cost of producing oxygen were given, as well as technical descriptions of the various types of rectification apparatus.

The second paper was sent by M. Claude, and in it was described a plant for the separation of hydrogen from water gas by a liquefaction process. The method can be utilised when the gas, such as that from coke ovens, is too impure to permit of the use of the catalytic reaction depending upon the conversion of carbon monoxide to carbon dioxide. The plant described is used for supplying hydrogen to a synthetic ammonia apparatus producing 5 tons of ammonia per day. An interesting feature of the apparatus is the introduction of small amounts of nitrogen into the system to serve as liquid nitrogen lubricant in the expansion engine.

In the third paper, Mr. E. A. Griffiths gave an account of the use of oxygen in breathing apparatus for airmen, and also of the plants for manufacturing liquid oxygen for this purpose. The chief difficulty in the use of cold liquefied oxygen is that of storage and transport. The mechanism of the metal vacuum vessel, which is the only practicable solution of the problem, was briefly dealt with. The manufacture of these vessels is a simple matter, and the thermal losses in properly constructed vessels is 12 per cent. of the liquid oxygen content per day for a flask of two litres capacity, while for a twenty-five-litre flask it is only 4½ per cent.

The vaporisers for converting the liquid oxygen into gas at a rate which can be kept under control were described. In view of the simplicity of these devices, it is surprising that greater use is not made of liquid oxygen in medical and experimental work.

The portable plants employed for producing oxygen utilise both the Claude and the Linde principles. Although the theoretical efficiency of expansion with external work is about three times that possible with the Joule-Thomson free expansion, the actual results obtained on test are not appreciably different. This appears to be due to the practical limitations of the expansion engine. A similar conclusion was arrived at independently by Mr. Murray in the case of large plants.

The expenditure of power for the production of oxygen is of the order of 2½ to 3 H.P. per litre/hour: the figure for the Pictet cycle, according to Crommelin, is decidedly lower, being only 1·64 H.P. per litre/hour. The over-all efficiency of liquefaction processes is therefore extremely low and generally less than 3 per cent.

The remaining papers were contributed by investigators working under the direction of the Engineering Committee of the Food Investigation Board (Department of Scientific and Industrial Research).

Dr. Ezer Griffiths dealt with the determination of thermometric lag in various types of thermometers and with some new materials for thermal insulation at low temperatures.

Prof. C. F. Jenkins gave a summary of his work on the thermal properties of ethyl chloride. His research on this substance is an extension of his previous work on carbon dioxide. The data which he has now obtained should be of considerable value to the refrigerating engineer, for ethyl chloride has many advantages over ammonia and carbon dioxide for use in small refrigerating plants.

E. A. GRIFFITHS.

Propagation of the Sound of Explosions.

IT has frequently been noted that on the occasion of great explosions there are curious anomalies in the propagation of the sound. Usually there is a normal zone of audibility in the immediate neighbourhood of the explosion, beyond this a zone of silence, where the sound is not heard, and again outside the zone of silence a second zone of audibility. It is remarkable that while an observer at say 50 miles away may not hear an explosion, an observer at 80 miles may hear it distinctly.

These abnormalities are closely connected with the meteorological conditions, though the detailed relationship between them is not known. One theory is that the wind lifts the sound over an area and brings it down again many miles away. Another theory ascribes the zone of silence to the effect of the distribution of wind and temperature at high altitudes. The theoretical development of the problem is extremely complex, and so it was decided to make an experimental study of the meteorological conditions along with detailed observations of the extent of the zone of silence in the hope of elucidating the relationship between them.

The International Commission for the Investigation

of the Upper Air appointed a sub-commission to consider the problem set out above, and the sub-commission applied to various Ministries of War with the view of obtaining their collaboration in the case of obligatory destruction of explosives. The first favourable reply came from the Dutch Ministry of War, and it was finally arranged that at 17h. G.M.T. on October 28, five tons of ammonium perchlorate should be exploded on the Oldebroek Artillery Drill Ground (longitude 5° 59′ 40″; latitude 52° 29′ 56″).

In this country arrangements were made by the Meteorological Office for the observers at all the observatories and reporting stations to listen for the sound, and to make notes regarding the meteorological conditions at the time. Where possible, observations of wind and temperature in the upper air were also made. In addition, through the medium of the Press, the public were also invited to forward to the Meteorological Office notes of any observations made.

Up to the time of going to press a total of more than one hundred reports have been received and it has not yet been possible to examine them in detail. The most distant points at which the explosion is alleged to have been heard are North Wales and Northumberland. Two valuable records have been obtained on the hot wire microphones of the Signals Experimental Establishment, at Woolwich, and at Biggin Hill (Kent) respectively.

As soon as the British observations have been examined and summarised, the results will be forwarded to the Dutch Meteorological Service for collation with continental reports.

The Whitworth Scholarships.

SEVERAL important changes are indicated in the new regulations for Whitworth Scholarships which have been issued by the Board of Education. In 1923 six Whitworth Scholarships, each of an annual value of 125*l.* and tenable for three years, will be offered for competition, as well as two Whitworth Senior Scholarships of an annual value of 250*l.*, tenable for two years. There are also Whitworth prizes which will be awarded to unsuccessful competitors for the scholarships, not exceeding 25 in number and of value 10*l.* each. The Whitworth Exhibitions (50*l.* tenable for one year) have been abandoned. The scholarships will be open to candidates whose age does not exceed 21 years, and the number of subjects in which candidates will be examined is limited to four. Candidates for the senior scholarships must be less than 26 years of age and will be examined in seven subjects.

The Board has also issued a circular directing attention to the changes, some of which were made last year, in order to render the requirements regarding candidates' practical experience in handicraft more consistent with the present arrangements for apprenticeship and training in mechanical engineering. The Board's experience shows that candidates may be divided into two groups, a large one consisting of candidates whose education since leaving school has been part-time, and for whom a full-time course of study is likely to be suitable, and a smaller one consisting of those who have already completed a full-time course and can take a further course of work of post-graduate standard. Hence the institution of scholarships and senior scholarships.

There still remain difficulties which the new regulations will not remove. In the four years between 17 and 21 years of age a hard-working evening student can reach the ordinary university degree standard in the subjects laid down for the scholarship examinations, but has only touched lightly certain subjects which form part of any organised full-time course. If a scholarship is awarded to him, and he proceeds to a full-time course, he will find that he cannot be exempted from repeating a great deal with which he is perfectly familiar. This difficulty is a very real one, as is well known to every teacher who has been consulted by a successful Whitworth candidate regarding his choice of a suitable college. There is also the difficulty of finding a suitable opening in the works after having been away for three years between the ages of 21 and 24, a difficulty which has led to many promising young men abandoning practical life in favour of teaching.

The circulars issued by the Board convey the impression that they do not favour the plan followed by many of the former scholars, who spent their scholarship term in works offering special facilities for widening their practical experience, and at the same time continued their studies in part-time courses. There is a great deal to be said in favour of this plan, and a glance at the names of former scholars who followed it and have risen to eminence in engineering would appear to justify its reconsideration.

University and Educational Intelligence.

BRISTOL.—The Bristol Medico-Chirurgical Society has offered the society's library as a gift to the University. The library comprises about 15,000 volumes (some rare and of great interest) and has been valued at more than 12,000*l.* It contains some rare books and receives more than 100 current periodicals in exchange for the society's journal. The council of the University has very gratefully accepted this magnificent offer, which will raise the medical library of the University to one of the most valuable medical libraries in the country. The advantage to the research worker of having access to such a library cannot be over-estimated.

CAMBRIDGE.—Mr. R. E. Priestley, Christ's College, has been elected to a fellowship at Clare College; Mr. M. C. Johnson, St. John's College, has been elected to the Arnold Gerstenberg studentship; Mr. N. J. T. M. Needham, Gonville and Caius College, has been elected to the Benn W. Levy research studentship in biochemistry.

The Syndicate appointed to draft Ordinances to carry out the provisions of the new statute admitting women students to the titles of degrees has been published. It is proposed to recognise Girton and Newnham Colleges as institutions for the higher education of women for the purposes of the statute. The total number of students at the two colleges (or at all institutions for the higher education of women, should any fresh college be recognised) who are receiving instruction in the University or working in the University laboratories or museums is not to exceed five hundred. The Council of the Senate may at any time inquire into the condition and management of a recognised institution for the higher education of women, and may, if it think fit, recommend the termination of its recognition. Women must reside nine terms, and in other such matters come under the same regulations as the undergraduates before admission to the titles of their degrees. Once the title has been conferred upon them, they become entitled to wear the same academical dress as that worn by a member of the University who has been admitted to the same degree. Women are to be admitted to courses of research and to examinations for diplomas sub-

stantially on the same terms as men. Residence already kept and examinations already passed will qualify past students for the same privileges as if the new regulations had been in force in earlier days.

The *Times* announces a bequest by the late Mr. A. M. Shield of some 90,000*l.* to the Cambridge Medical School. The only definite item mentioned is the foundation of a Marmaduke Shield scholarship of 100*l.* a year in human anatomy.

LEEDS.—The following appointments to the staff have been made by the Council of the University: Mr. R. B. Tasker, honorary demonstrator in anatomy for dental students; Mr. C. Holland Child, Mr. G. H. H. Russell, and Mr. R. B. Tasker, honorary clinical tutors in dental surgery; Dr. A. C. Monkhouse, research assistant in the fuel industries department, to work under the joint committee of the Institution of Gas Engineers and the University on gas heating, lighting and ventilation research; Dr. E. C. Porter, demonstrator in the department of leather industries; Mr. J. C. Mann, assistant lecturer in agricultural chemistry; Mr. S. J. Saint, assistant lecturer in agriculture; Mr. R. E. Edwards, demonstrator in agricultural botany; Mr. J. C. Leslie, district lecturer in agriculture; Mr. G. F. Pilling, assistant lecturer and demonstrator in agriculture; Mr. H. W. Swift, demonstrator in engineering; Mr. W. A. Wightman, demonstrator in organic chemistry; Mr. Thomas Henderson, demonstrator in inorganic chemistry; and Miss E. M. Hickman, demonstrator in the department of pathology and bacteriology.

MANCHESTER.—Applications are invited for the position of Keeper of the Museum in place of Dr. W. M. Tattersall, now of the University College of South Wales, Cardiff. The latest date for the receipt of applications, which should be sent to the Secretary of the Manchester Museum, is Friday, December 1.

Provision has been made in the Faculty of Technology, which formerly awarded an ordinary degree of B.Sc.Tech., to give a higher B.Sc.Tech. degree in various sections of technological science, one of which will be the chemistry of colouring matters.

In view of the retirement of Prof. H. B. Dixon from the chair of chemistry, a committee of past and present students are raising a fund to recognise his thirty-five years of distinguished service. The fund is to be devoted mainly to the provision of grants to enable students of chemistry to complete their courses, and it is also intended to set up in the chemical theatre a plaque or bust of Prof. Dixon. These objects necessitate a generous response on the part of old students and colleagues of Prof. Dixon, and those who have not yet subscribed are invited to send their subscriptions to Dr. Norman Smith at the University. A complimentary dinner will be held on December 8, further particulars of which can be obtained from Dr. J. E. Myers.

THE Association of Science Teachers and Association of University Women Teachers have organised a conference on the teaching of science in schools and colleges to be held on Saturday, November 25, at University College, London. The opening speakers will be Sir William Tilden and Mr. A. G. Tansley.

THE Parliamentary candidates of University constituencies, for the general election on November 15, are as follows (the names of new candidates are in italics):—Oxford (2).—Lord Hugh Cecil (U.); Sir Charles Oman (U.). Cambridge (2).—J. F. P. Rawlinson (U.); *Prof. W. R. Sorley* (U.); *J. R. M. Butler* (Ind.). London.—*Sir Sydney Russell-Wells* (U.); *Prof. A. F. Pollard* (L.); *H. G. Wells* (Lab.). Combined English (Manchester, Liverpool, Durham, Leeds, Sheffield, Birmingham, and Bristol) (2).—H. A. L. Fisher (N.L.); Sir Martin Conway (U.); *B. Faraday* and *Dr. S. Lawrence* (U.), and *L. Woolf* (Lab.). Wales.—*Sir E. J. Ellis Griffith* (L.); *T. A. Lewis* (N.L.). Scotland (St. Andrews, Glasgow, Aberdeen, and Edinburgh) (3).—Sir Henry Craik (U.); *Sir George Berry* (U.); D. M'Coig Cowan (N.L.). Queen's, Belfast.—Sir William Whitla (U.).

THE list of successful candidates in the open competition for Royal Scholarships and Free Studentships, 1922, just issued by the Board of Education, shows that in Group A (Mechanics) there were fifty-four competitors, and of the nine scholarships and studentships awarded, six are to apprentices in H.M. Dockyard. This is a remarkable testimony to the efficient educational work carried on in the dockyard schools, which all dockyard apprentices must attend for certain specified periods every week. The number of competitors in the other groups of subjects in which scholarships and studentships are awarded were: physics, 17; chemistry, 16; biology, 1; geology, no qualified candidates.

NUMEROUS announcements of courses of technical education for 1922–23 have been received recently. Courses of advanced study and training in research are offered by the Manchester College of Technology in many branches of applied science, including special problems connected with textiles, brewing and allied industries, paper-manufacture, photography, coal-tar, dyestuffs, and india-rubber. The college awards annually a varying number of research scholarships (last year twelve) of 100*l.* each, open to graduates of any university in the British Empire and to other persons suitably qualified. A department of industrial administration has recently been opened. The Sir John Cass Technical Institute of Aldgate, London, invites special attention to its advanced courses (evening) in brewing, micro-biology, petroleum technology, colloids, alternating currents and electrical oscillations, metallography and pyrometry, heat treatment and mechanical testing of metals and alloys, and foundry practice. The Northampton Polytechnic of Clerkenwell, London, has, in addition to its evening courses, day courses in civil, mechanical, including automobile and aeronautical, and electrical engineering, in optical engineering and applied optics, and in horology.

THE Scottish Colleges of Agriculture maintain a close connexion with the regions which they serve by means of their systems of extra-mural work, including lectures and individual instruction, demonstrations and experiments, and advisory work. The Calendar for 1922–23 of the Edinburgh and East of Scotland College mentions a notable development of work in connexion with school gardens which have been laid down under the guidance of the college staff at 196 schools. Seven supplementary school centres are visited by the staff once a week for practical instruction in the school garden combined with theoretical instruction in the laboratory. The Calendar of the North of Scotland College contains an account of the recently opened Rowett Institute for research in animal nutrition, and of an important research which is being conducted by Dr. Rennie in regard to certain diseases of adult bees. In the area served by this college, attendances at county extension classes increased during the past two years from three to eighteen thousand, while attendances at short courses of lectures and single lectures increased from fifteen to thirty-eight thousand. Special schemes are arranged to meet the requirements of the crofting districts in the western seaboard and islands and in Shetland.

Calendar of Industrial Pioneers.

November 5, 1800. Jesse Ramsden died.—Called by Delambre "le plus grand de tous les artistes," Ramsden, by the combination of great scientific ability and practical skill, rose to be the leading instrument maker of his day. Especially valuable was his invention of a dividing machine completed in 1773 after ten years' work. He was born in Halifax, Yorkshire, in 1735, worked first as a cloth worker, and then learned the art of engraving from a London optician.

November 6, 1913. Sir William Henry Preece died.—Born in Carnarvon in 1834, Preece, after passing through King's College, London, joined the Electric and International Telegraph Company and eventually became one of the principal telegraph engineers in the country. From 1892 to 1899 he was Engineer-in-Chief and electrician to the Post Office, in which situation he made some of the earliest experiments in wireless signalling and gave valuable support to Marconi. He was twice president of the Institution of Electrical Engineers and was also president of the Institution of Civil Engineers.

November 8, 1807. Pierre Alexander Laurent Forfait died.—A distinguished naval constructor whose skill proved of the highest value to the French nation, Forfait first gained a reputation by the building of sailing-vessels for maintaining regular communication between France and America. He was the author of a treatise on the masting of ships and wrote many papers for the Paris Academy of Sciences and the "Encyclopédie Méthodique." He carried out important work at Antwerp and on the Seine, and under Napoleon served in the Ministry of Marine.

November 8, 1911. William Edward Ayrton died.—The author of some 150 scientific papers, a prolific inventor, and one of the pioneers of technical education in London, Ayrton served in the Indian Telegraph Service from 1868 to 1872, was professor of physics and telegraphy at the Imperial Engineering College, Tokio, and from 1884 held the chair of physics and electrical engineering at the Central Technical Institution, London. His researches extended to all sides of modern electrical engineering, while among the positions he filled were the presidencies of the Physical Society and the Institution of Electrical Engineers.

November 11, 1906. John Devonshire Ellis died.—Trained as an engineer at Birmingham by his father, Ellis in 1854 joined John Brown at the famous Atlas Works at Sheffield, with which he remained connected till his death. He was largely responsible for the manufacture of the armour for our first ironclads, the *Black Prince* and *Warrior*, and was an ardent advocate of the Bessemer process of making steel. He also introduced a method of welding a hard steel face to a wrought-iron backing for the armour of ships. He succeeded Brown as head of the firm in 1870, and in 1889 received the Bessemer medal of the Iron and Steel Institute.

November 11, 1893. Anthony Reckenzaun died.—A pioneer of electric traction, Reckenzaun was born at Gratz, Styria, in 1850, and, after being trained as an engineer, worked in England and was engineer to the Electric Power Company. In 1881 he made a trial of an electric car, in 1882 built the launch *Electricity*, and in September 13, 1886, with the *Volta* crossed the Channel, the motive power being obtained from electric cells. He also visited America and applied his system of driving by electric batteries to some cars at Philadelphia. E. C. S.

Societies and Academies.

LONDON.

Association of Economic Biologists, October 13.—Prof. E. B. Poulton, president, in the chair.—E. J. **Butler**: Virus diseases in plants. The first demonstration that disease can be caused by a filtrable virus was by Iwanowski, in 1892, in mosaic disease of tobacco. Mosaic is now known in nearly 100 species of plants. Diseases like peach-yellows and others characterised by phloem-necrosis are probably caused by similar agents though the filtered juice is not infective. All hitherto tested can be transmitted by grafting, most of them by insects (the chief method in Nature), and many by inoculating with sap. Contact will not cause infection. Infection may be hereditary in the insect transmitter and in the plant. "Carriers" are known. The causal agents are believed to be living organisms. Several investigators have recently found large amoebiform corpuscles or smaller granules in infected cells. The former have been compared with cytoryctes or neuroryctes and the latter with Chlamydozoa but a resemblance to Rickettsia is suggested. The causal organisms appear to be obligate parasites.—J. A. **Arkwright**: Virus diseases in animals and man. The chief points of interest common to plant and animal "virus diseases" are (1) the nature and properties of the virus; (2) the means of transmission, *e.g.* "carriers" and insect vectors; (3) measures for prevention, *e.g.* breeding or selection, and isolation or destruction; (4) perhaps the concentration of the virus in certain special tissue cells. About fifty animal virus diseases have been described which may be roughly classified as follows: (1) visible, not filtrable, not cultivated, *e.g.* Rickettsia; (2) probably visible, filtrable, cultivated, *e.g.* pleuro-pneumonia of cattle, poliomyelitis; (3) filtrable, not cultivated, some (?) visible in the tissues, *e.g.* foot and mouth disease, vaccinia; (4) filtrable, very resistant, *e.g.* infectious anæmia of horses, fowl-pox. In general properties most do not differ much from bacteria, though some are very resistant to drying, glycerine, and heat. The smallest clearly visible and the largest filtrable particles are of the same order of size, *i.e.* about 0·2 micron. Living organisms may conceivably be much smaller than this. The differentiation of colloidal particles of about 0·2 micron in size by means of the microscope requires attention especially to their arrangement and their range of size and shape, rather than to the appearance of individual particles. Theoretically it is possible that an enzyme may be the cause of an infectious disease on the analogy of Twort's lytic substance and the bacteriophage of d'Herelle.

PARIS.

Academy of Sciences, October 2.—M. Albin Haller in the chair.—H. **Deslandres**: The emission of X-rays, ultra X-rays, and corpuscular rays by the celestial bodies. A summary of previous results on radiations of high frequency and great penetration given by the sun and stars. These radiations form an extremely minute proportion of the total radiation, but their remarkable electrical properties give them an important rôle in the electrical phenomena of atmospheres. Kohlhörster's experiment on the ionisation of gas in a closed vessel at high altitudes (9000 metres) should be repeated at several points on the earth, and extended to the highest possible altitudes attainable by captive balloons. The cost will be considerable, and international co-operation is suggested as desirable.—A. **Brachet**: The properties of the germinal

localisations of the egg. The eggs of *Rana fusca*, after growth to the advanced blastula stage, were pricked with a needle at various points. From the resulting modifications in the growth it can be concluded that the formative materials of the whole of the central nervous system and the dorsal chord are, in the blastula and consequently in the fertilised egg, localised in the zone occupied by the grey crescent.—Paul **Montel**: Quasi-normal families of meromorphic functions.—Eligio **Perucca**: The surface properties of mercury: voltaic character, surface tension, photo-electric effect. Measurements of the Volta effect and surface tension of mercury in a vacuum and in different gases at varying pressures show changes in both magnitudes which are in qualitative agreement with the anti-contact theory of Frenkel.—Jean **Durand**: Contribution to the study of the thermal modifications of some cast irons. A diagram is given showing the volume expansions and contractions produced in a fragment of cast iron by five successive heatings between 600° C. and 900° C. The swelling of cast iron becomes significant only if the proportion of silicon is sufficiently high and the heating is slow.—L. J. **Simon** and A. J. A. **Guillaumin**: The quantitative determination of carbon and of hydrogen by the use of chromic and sulphuric acids. The carbon is determined directly as usual and the hydrogen indirectly by measuring the amount of oxygen (derived from a weighed amount of potassium bichromate) used in the combustion. Analytical figures are given for ten organic compounds of different types.—A. **Brives** and M. **Dalloni**: The earthquake of August 25, 1922, and the geological structure of the region of Ténès-Cavaignac (Algeria).—René **Souèges**: Embryogenic researches on *Hippuris vulgaris*.—Marc **Bridel** and Mlle. Marie **Braecke**: The presence of aucubine and of saccharose in the seeds of *Rhinanthus Crista-Galli*. The biochemical method of Bourquelot applied to Rhinanthus seeds indicated the presence of saccharose and aucubine, and both these substances were then isolated from the seeds in a pure state.—A. **Policard**: The mechanism of working of the adipose cells. The elaboration by the mitochondria represents only one of the possible modes of fixing fat; the adult cell takes up the fat by direct fixation without preliminary chemical change.—A. **Desgrez**, H. **Bierry**, and F. **Rathery**: Diabetes, β-oxybutyric acid, and levulose. A study of the conditions under which a certain quantity of levulose may be added with advantage to the diet of diabetic patients.—A. **Goris** and P. **Costy**: Urease and urea in fungi. Urease is present in nearly all the higher fungi. In cases where urease is absent, or present in very small proportion, urea has been found to be present.—Emile F. **Terroine**, R. **Wurmser** and J. **Montané**: The influence of the constitution of the nutritive media on the composition of *Aspergillus niger*.—Georges **Truffaut** and N. **Bezssonoff**: A new bacillus capable of fixing nitrogen. This organism was isolated from some cultures of Versailles garden soil, and morphologically is connected with the Proteus group. This bacillus is aerobic and fixes atmospheric nitrogen. It appears to differ from the bacilli assimilating nitrogen hitherto known, and it is proposed to name it *Bacillus Truffauti*.—J. **Cluzet**, A. **Rochaix**, and Th. **Kofman**: The action of the secondary radiation of X-rays upon micro-organisms.

October 9.—M. Albin Haller in the chair.—H. **Douvillé**: The Lepidocyclines and their evolution: a new genus "Amphilepidina."—E. L. **Bouvier**: New researches on the appearance of reproductive individuals in the ants, *Formica rufa*, and *F. pratensis*.—Paul **Vuillemin**: The petalostem.—G. **Bratu**: Progressions of higher order.—Halvor **Hansson**: A new method of multiplication of functional scales.—M. **d'Ocagne**: Remarks on the preceding communication.—Rodolphe **Soreau**: The laws of variation of the characteristics of standard air with altitude.—M. **Seigle**: The possibilities of the commercial use of mild steel bars hardened by extension. Details of the mechanical effects produced in mild steel bars by extension up to the breaking point have been given in an earlier communication. The advantages of this method of hardening are summarised and various possible industrial applications mentioned.—Charles **Nordmann** and M. **Le Morvan**: The effective temperatures of the stars θ and ι in the Great Bear. Reply to a criticism of Ejnar Hertzsprung on a previous communication.—Charles L. R. E. **Menges**: The coefficient of Fresnel.—G. **Holst** and F. **Oosterhuis**: The explosive potential of a gas. In Townsend's theory of ionisation by shocks the explosive potential depends only on the properties of the gas, and the material of the electrodes is without effect. The authors have proved experimentally that the nature of the cathode has an important influence. They support the hypothesis that the positive ions do not produce ionisation by contact with the gas molecules, but that by their electrostatic attraction they can liberate them from the cathode. A new theory of explosive potential is outlined, based on this hypothesis.—Jean **Rey**: The probability of illuminating an aeroplane by means of an electric projector.—André **Brochet**: Remarks on the preparation of cyclohexanol. Phenol containing 5 per cent. of its weight of reduced nickel as catalyst is readily reduced to cyclohexanol by hydrogen under pressure in an autoclave. The temperature should be maintained between 100° C. and 150° C. and the pressure kept at 10 to 15 atmospheres. The conversion is quantitative, and no indication was obtained of the formation of any intermediate compound.—A. **Damiens**: The absorption of ethylene by sulphuric acid. The production of ethyl alcohol, diethyl sulphate, and of liquid hydrocarbons. Cuprous oxide dissolved in the strong sulphuric acid proved the best catalyst. On hydrolysis, the acid solution gave different products with varying conditions. Absorption at ordinary temperature, with acid not under 97 per cent., gives ethyl alcohol only, but when a certain concentration of ethylsulphuric acid is reached, ethyl sulphate is also formed. At higher temperatures the velocity of absorption increases, and a considerable quantity of saturated hydrocarbon of the nature of petrol appears among the products of hydrolysis.—C. **Mariller** and Van **Ruymbeke**: A method for the preparation of commercial absolute alcohol and its application to the preparation of a national motor fuel. The vapours from 95 per cent. alcohol pass up a rectification column down which a stream of glycerol is descending. The latter removes water and the distillate contains 98·5-99 per cent. alcohol. The alcohol removed by the glycerol can be readily recovered.—Raoul **Combes** and Mlle. Denise **Kohler**: The disappearance of hydrocarbons in dying leaves. When the leaves die in the autumn, about 45 per cent. of the carbohydrates remain in the fallen leaf and are lost to the tree; 35 per cent. disappear by respiration and only 20 per cent. return to the living parts of the tree and are retained in a form ultimately utilisable.—St. **Jonesco**: The transformation of a chromogen of the yellow flowers of *Medicago falcata* under the action of an oxydase.—Marcel **Mirande**: The relation between anthocyanine and the oxidases.—Léon **Azoulay**: Provoked and spontaneous movements of the leaves of *Russula Queletii* and its varieties.—P. **Mathias**: The evolutive cycle of a holostomid

trematode (*Strigea tarda*).—M. **Blanchard** and G. **Lefrou**: A spirochæte found in the blood in a case of hæmoglobinuric bilious fever and its pathogenic action.

Diary of Societies.

MONDAY, NOVEMBER 6.

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

SOCIETY OF ENGINEERS, INC. (at Geological Society), at 5.30.—E. E. Turner: The Atlantic Cruise of H.M. Airship R34.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—F. Gill and others: Discussion on The Importance of Commercial Knowledge to the Engineer.

ARISTOTELIAN SOCIETY (at University of London Club, 21 Gower Street), at 8.—Prof. A. N. Whitehead: Uniformity and Contingency (Presidential Address).

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Engineers' Club, 39 Coventry Street, W.1), at 8.—Dr. E. F. Armstrong: Some Problems in Chemical Industry.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—President: Opening Address.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.30.

TUESDAY, NOVEMBER 7.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. R. O. Moon: Philosophy and the Post-Hippocratic School of Medicine. (Fitz-Patrick Lecture).

ROYAL SOCIETY OF MEDICINE (Orthopædics Section), at 5.30.

MINERALOGICAL SOCIETY, at 5.30.—Anniversary Meeting.—W. A. Richardson: The Frequency-distribution of Igneous Rocks in Relation to Petrogenic Theories.—Miss Naggs: Crystallography of Organic Compounds.—Dr. G. T. Prior: The Meteoric Iron of Karee Kloof, Cape Province, and the Meteoric Stone of Leeuwfontein, Pretoria, S. Africa.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.

INSTITUTION OF CIVIL ENGINEERS, at 6.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 6.—E. J. G. Bradford: The Synthesis of Geographical Information.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Institution of Mechanical Engineers), at 8.—J. D. Morgan: High-Tension Ignition.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 8.—W. L. F. Wastell: Presidential Address.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Sir Arthur Keith: An Account of Mr. G. Despott's Excavation of the Cave of Ghar Dalam, Malta, and an Exhibit of Two Teeth of Neanderthal Man found there.

THE RÖNGTEN SOCIETY (at Institution of Electrical Engineers), at 8.15.—Sir Humphry D. Rolleston: Acute Constitutional Symptoms due to Radiations. (Presidential Address.)

ROYAL SOCIETY OF MEDICINE (Pathology Section) (in Laboratory of Imperial Cancer Research Fund), at 8.30.—Dr. A. N. Begg: Carcinomatous Infiltration of Nerves.—Dr. A. H. Drew: The Conditions for Growth *in vitro*.—Dr. W. Cramer: Blood Platelets.—Dr. B. R. G. Russell: Intra-cerebral Tumour Heteroplasty.—Dr. J. A. Murray: Multiple Primary Cancer.

WEDNESDAY, NOVEMBER 8.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—R. D. Oldham: The Earthquake of August 7, 1895, in Northern Italy.—R. D. Oldham: The Pamir Earthquake of February 18, 1911.—Dr. F. Dixey: The Geology of Sierra Leone.

ROYAL SOCIETY OF MEDICINE (Surgery: Sub-section of Proctology), at 5.30.—Sir Charles Symonds and others: Discussion on Gonorrhœal Stricture of the Rectum and its Treatment.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—R. L. Smith-Rose and R. H. Barfield: The Effect of Local Conditions on Radio Direction-finding Installations.

ROYAL SOCIETY OF ARTS, at 8.—Lord Askwith: The Value of Strikes and Lock-outs.

INSTITUTION OF AUTOMOBILE ENGINEERS, at 8.—Major F. Strickland and H. R. Ricardo: The Low Compression, Moderate Speed Engine *v.* The High Compression, High-speed Engine.

THURSDAY, NOVEMBER 9.

ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Prof. H. E. Armstrong: Studies on Enzyme Action. XXIII. Homo- and Hetero-lytic Enzymes.—Prof. A. V. Hill and W. E. L. Brown: The Oxygen-dissociation Curve of Blood and its Thermodynamical Basis.—Dr. H. Hartridge and F. J. W. Roughton: The Velocity with which CO replaces Oxygen from its Combination with Hæmoglobin. Parts I. and II.—L. T. Hogben: Studies on Internal Secretion. I. The Effect of Pituitary (Anterior Lobe) Injection upon Normal and Thyroidectomised Axolotls.—L. T. Hogben and F. R. Winton: The Pigmentary Effector System. II.—A. Fleming and V. D. Allison: Further Observations on a Bacteriolytic Element found in Tissues and Secretions.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society) (Annual General Meeting), at 5.—Presidential Address.—H. W. Richmond: The Mathematical Problems of Shell-Flight.—W. R. Burwell: Asymptotic Expansions and generalised Hypergeometric Functions.—W. L. Ferrar: Determinants whose Elements are Determinants.—A. Kerekjártó: Transformation of Variables in a Multiple Integral.—C. Krishnamachari and M. Bheemasenaran: (1) The Properties of Certain Numbers. (2) Contribution to the Evaluation of Persymmetric Determinants.—L. J. Mordell: Trigonometric Series involving Algebraic Numbers.—H. W. Richmond: Analogues of Waring's Problem for Rational Numbers.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. R. O. Moon: Philosophy and the Post-Hippocratic School of Medicine. (Fitz-Patrick Lecture.)

THE WOMEN'S ENGINEERING SOCIETY (at 26 George Street, Hanover Square), at 6.15.—A. P. M. Fleming: Research.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. R. S. Clay: The History of the Photographic Lens.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.—Clinical Meeting.

INSTITUTE OF METALS (London Section) (at Royal School of Mines), at 8.—Prof. H. C. H. Carpenter: The Production of Large Crystals of Aluminium and some of their Properties.

FRIDAY, NOVEMBER 10.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Imperial College of Science and Technology), at 2.30.—Dr. E. S. Russell: The Work of the Fisheries Laboratory at Lowestoft.—Sir Sidney F. Harmer: The Present Position of the Whaling Industry.

ROYAL ASTRONOMICAL SOCIETY, at 5.

ROYAL SOCIETY OF MEDICINE (Clinical Section) at London Hospital), at 5.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—G. Temple: The Homographic Treatment of the Symmetrical Optical Instrument.—Prof. A. O. Rankine and C. J. Smith: The Structure of the Sulphur Dioxide Molecule.—A. S. Houghton: The Thermal Effect of Vapours on Rubber.—J. T. Robin: Demonstration of an Apparatus for Testing the Tensile Strength of Gas Mantles.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. Macaulay: The Development of Ball and Roller Bearings.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.

SATURDAY, NOVEMBER 11.

BRITISH PSYCHOLOGICAL SOCIETY (at King's College), at 3.—Miss L. G. Fildes: A Case of Word Deafness.—C. Fox: The Influence of Subjective Preference on Memory.

PUBLIC LECTURES.

SATURDAY, NOVEMBER 4.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—E. Lovett: The Folk-lore of the Cat.

MONDAY, NOVEMBER 6.

MIDDLESEX HOSPITAL MEDICAL SCHOOL (in Physiology Lecture Theatre), at 5.—Prof. Swale Vincent: Secretion and Internal Secretion. Succeeding Lectures on November 9, 13, 16, 20, 23, 27, and 30.

GRESHAM COLLEGE, at 6.—Sir Frederick Bridge: Music. Succeeding Lectures on November 7, 8, and 10.

CITY OF LONDON Y.M.C.A. (186 Aldersgate Street), at 6.—Sir Leonard Rogers: Insects and Disease: Some Triumphs of Medical Science.

WEDNESDAY, NOVEMBER 8.

CHARING CROSS HOSPITAL MEDICAL SCHOOL, at 3.—Sir Arthur Keith Evolutionary Tendencies in Man's Body (Huxley Lecture).

LONDON HOSPITAL MEDICAL SCHOOL, at 4.—Dr. P. Kidd: Forty Years in the History of Tuberculosis (Schorstein Memorial Lecture).

UNIVERSITY COLLEGE, at 5.30.—I. C. Gröndahl: Norway. Succeeding Lectures on November 15, 22, 29, and December 6.—At 6.15.—A. W. Flux: The Foreign Exchanges (Newmarch Lectures). Succeeding Lectures on November 15, 22, 29, December 6 and 13.

THURSDAY, NOVEMBER 9.

UNIVERSITY COLLEGE, at 5.15.—Prof. J. E. G. de Montmorency: Customary Law in London and other English City Areas. Succeeding Lectures on November 16, 23, 30, December 7 and 14.—At 5.30.—E. R. Vincent: The Palio of Siena, an Historic Italian Festival.

KING'S COLLEGE, at 5.30.—Miss Hilda D. Oakeley: The Stoic Philosophy. Succeeding Lectures on November 16, 23, 30, and December 7.

FRIDAY, NOVEMBER 10.

UNIVERSITY COLLEGE, at 5.15.—Dr. T. E. Gregory: International Exchanges.—C. Tate Regan: Problems of Evolution, with Special Reference to Fishes. Succeeding Lectures on November 17 and 24.

BEDFORD COLLEGE FOR WOMEN, at 5.30.—Dr. M. Cary: Ancient Geographical Exploration.

SATURDAY, NOVEMBER 11.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. W. A. Cunnington: The Natural History of Crabs.