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Applied Anthropology.

IN the course of the recent meeting of the British Association in Edinburgh one of the sessions of the Anthropological Section was devoted to the discussion of the ways and means by which the science of anthropology might be made of greater practical utility in the administration of the Empire, particularly in relation to the government of our subject and backward races. The question was raised by a communication from Sir Richard Temple, who, unfortunately, was not able to be present in person. He recalled the fact that in the course of his address as president of the section at the Birmingham meeting in 1913, and in a discussion which had been held later in the same meeting, he had brought this question before the Association and recapitulated the steps which had been taken afterwards by the Association and other bodies to bring this matter to the notice of the Government of that time and the public. This movement, which gained considerable support, was brought to an end by the outbreak of war. Once more Sir Richard Temple, in the present appeal, urged the necessity for the official recognition of anthropology as an essential part in the training of those members of the public services whose duties in remote parts of the Empire will bring them into contact with an alien or primitive culture. To this end he advocated the institution of an Imperial School of Anthropology of which the function should be both the training of the official and the collection and classification of the data gathered in the field by such trained officials and others, to form at once the subject-matter of the instruction given by the school and the basis of further research.

It is apparent that this proposal involves two ideas which in practice it will probably be found expedient to keep quite distinct. The question of training should stand apart from that of the organisation of anthropological study and research. Sir Richard Temple's suggestion in its original form as put forward at Birmingham was that the Imperial School might be constituted in connection with one of the universities. Yet it would be difficult to decide upon the claims of any one university, apart from financial considerations dependent to a large extent upon possible benefactions. Several of the universities now have facilities for instruction in some, if not all, branches of anthropology, and the number is increasing. Further, an officially recognised school in receipt of financial support from public sources would necessarily be subject in a greater or less degree to official control, a prospect which anthropologists cannot regard with equanimity. In the present state of the science freedom in method and in outlook is essential to the advancement of the study. Each centre must be free to work out its own salvation. Just as each university has its distinguishing characteristics, so each centre of anthropological teaching should develop along the lines which circumstances such as the character of the museums available for practical work or other local circumstances may dictate. With this development a stereotyped curriculum, whether in a central school or imposed upon all centres of teaching, would be incompatible. Nor is it without significance that centres of anthropological study and research are rapidly increasing in numbers outside this country. In India, in South Africa, and elsewhere, schools of anthropology are springing up. Sooner or later it may be hoped they will be in a position to make good their claim to inclusion in any organised scheme of instruction.

If, however, on these grounds it does not seem desirable to urge the institution of a central school, which, as Sir Richard Temple himself would probably agree, is little more than a matter of machinery, the training of the official is a question of vital importance upon which it seems scarcely possible that there could be two opinions. It is significant that many of those who have insisted upon the importance of such training and given the proposal their strongest support have themselves been successful administrators. They point out that not only are sympathy and understanding essential in dealing with a primitive or alien population, but also that in acquiring such sympathy and knowledge by a long and sometimes painful experience an official must be guilty of many mistakes which a little training in anthropological method and outlook might have averted. It must be remembered that the training advocated is intended, not to turn out specialists in anthropological research, but to give the future official such a knowledge of primitive beliefs, institutions, and modes of thought as will enable him to acquire in a reasonably short space of time a sympathetic knowledge of the people with whom he has to deal, as well as make it possible for him to appreciate the bearing of the psychological and sociological factors which go to make up their culture as a whole.

Dr. Rivers, in the course of the discussion at Edinburgh, directed attention to a fact of extreme importance which is often overlooked. He pointed out that on the introduction of a civilised administration certain native customs are bound to be eliminated, but that it is necessary that such customs should be understood in all their bearings. Otherwise, owing to the interrelation of the constituent elements of a culture, the whole life of a people may be changed. It was to this that he attributed largely the dying out of certain backward peoples. The cause was psychological rather than material—they lost all interest in life. Anthropologists are familiar with more than one instance in which an ill-considered suppression of a native custom has had a grave effect on social structure, as, for instance, in South Africa, where interference with the "bride-price" affected the legitimacy of all native marriages. On the other hand, the attempt which is now being made in that Dominion to assist the social development of the native is based entirely upon a gradual and sympathetic adaptation of native institutions to conditions imposed by contact with a civilised community.

Happily the recognition of the bearing of these facts upon the preliminary training of the official is increasing. The training for the Sudan service instituted at Oxford and Cambridge at the request of Sir Reginald Wingate, when Sirdar, has, unfortunately, come to an end, but in other cases a short course of training is required. For instance, officers intended for the West African service are now being trained at London University. This requirement should be extended, and the institution of additional training centres should receive every encouragement. Nor should the needs of others than officials be overlooked. Facilities for anthropological study should be available for missionaries and traders in particular. Many missionaries, it is true, have availed themselves of the opportunities offered at Cambridge. Such a course of training should be regarded as an essential part of the missionary's equipment.

The value of a knowledge of anthropology as a commercial asset has not received adequate attention, though it is no less important for the trader than for the official. In view of the well-known conservative turn of mind of a primitive people, as well as the strength of their religious beliefs, in affecting their use of any given article, it is indeed surprising that so little attention is given to a study of cultural conditions as an antecedent to trading enterprise. A case often quoted is that of India, where the Germans before the war, by supplying canvas hold-alls in deference to native religious feeling, drove the leather article supplied by our manufacturers out of the market.

While the tendency of the discussion at Edinburgh showed that there was a general agreement as to the necessity for administrative officials to be trained in anthropology, it also emphasised the need for a central body to deal with the co-ordination and preparation of the material for such studies. The institution of such a central bureau is a question which was raised at a British Association meeting so long ago as 1895, and has been discussed on several later occasions. In 1908 the Royal Anthropological Institute, when Sir William Ridgeway was president, urged upon the Government the necessity for a central bureau and asked for a subsidy to enable it to carry out the work. Up to the present these efforts have not been successful.

It is scarcely necessary to dwell at length upon the functions which such a central bureau for anthropology should perform. The various teaching centres being concerned mainly with instruction and only incidentally with organisation, the collection and collation of data and their publication would best be undertaken by such a central body. The question of publication in particular is one which at the moment is becoming acute. Many of the younger workers in these days of high printing charges find a difficulty in securing facilities for publishing their work, and the same applies to officials who have made a study of the people under their charge. Publishers are unwilling to undertake the risk of publishing this material without a substantial subsidy which the authors are not, as a rule, able to afford. It is well known that at the present moment there is material dealing with the native peoples of our dependencies waiting to appear, which would, when published, be of the greatest value to administrators. Further, in the official publications of the various administrations there is much valuable material waiting to be made more readily accessible to students. The preparation of abstracts or even bibliographies of such material would be an essential function of the bureau. Owing to its position as a centre for the collection and collation of facts, and owing to the fact that it would be in close touch with those who could speak with authority on any and every part of the Empire, however remote, its value as an intelligence bureau would be incalculable, while Government departments, officers in the service of the Crown, missionaries, traders, and others, would naturally turn to it for information and guidance.

A duty of equal or even greater importance, though not so immediately apparent, would fall to this body in the diffusion of anthropological knowledge and the inculcation of an anthropological point of view among the general public. The need for such knowledge is becoming more urgent day by day for the proper understanding of imperial problems which we in this country or those in the Dominions are called upon to face. Further, it is often forgotten that anthropology does not deal exclusively with backward races or with the physical characters of the civilised. The culture and the underlying psychological basis of that culture among civilised races are equally within its scope. Even our own population is as yet a field which, anthropologically speaking, is largely unexplored. As was pointed out by Prof. Patrick Geddes and others at Edinburgh, it is the lack of the anthropological point of view in dealing with our own and other peoples which lies at the base of much of our present troubles.

Chemical Warfare.

The Riddle of the Rhine: Chemical Strategy in Peace and War. By Victor Lefebure. Pp. 279. (London: W. Collins, Sons, and Co., Ltd., 1921.) 10*s.* 6*d.* net.

EVERY great war within the last hundred years has been characterised by some new development in the means of offence, based upon the applications of science. Each successive war, in fact, is, in greater or less degree, a reflex of contemporary scientific knowledge concerning the most effective practicable measures by which belligerents may destroy human life; but it was reserved for the last great war—the greatest of all wars—to witness the introduction of a method of warfare which, in its savage ferocity and in its callous disregard of human suffering, is unparalleled in history. April 22, 1915, when the Germans sent great volumes of the deadly chlorine gas against the Allied lines, is a black-letter day in the annals of warfare. It was thought at first to have been a last desperate effort to dislodge the French from a position which all recognised methods of fighting had failed to take. The truth, however, is now beginning to appear. It was the first trial of a new war method, deliberately conceived and worked out by the Germans, even before the outbreak of war, and in flagrant disregard of their undertaking at the Hague Convention to abstain from the use of asphyxiating or deleterious gases. According to the author of the book before us,

"there is evidence that the Kaiser Wilhelm Institute, and the Physico-chemical Institute near by, were employed for this purpose as early as August, 1914. Reliable authority exists for the statement that soon after this date they were working with cacodyl oxide and phosgene, both well known before the war for their very poisonous nature, for use, it was believed, in hand grenades. Our quotations are from a neutral then working at the Institute. 'We could hear the tests that Professor Haber was carrying out at the back of the Institute, with the military authorities, who in their steel-grey cars came to Haber's Institute every morning.' 'The work was pushed day and night, and many times I saw activity in the building at eleven o'clock in the evening. It was common knowledge that Haber was pushing these men as hard as he could.' Sachur was Professor Haber's assistant. 'One morning there was a violent explosion in the room in which most of this war work was carried out. The room was instantly filled with dense clouds of arsenic oxide.' 'The janitors began to clean the room by a hose and discovered Professor Sachur.' He was very badly hurt and died soon after. 'After that accident I believe the work on cacodyl oxide and phosgene was suspended, and I believe that work was carried out on chlorine or chlorine compounds.' 'There were seven or eight men working in the Institute on these problems, but we heard nothing more until Haber went to the Battle of Ypres.'"

Ludendorff, in his "War Memories," refers to the valuable services of Geheimrat Haber in connection with the use of gas.

That what has come to be known as "chemical warfare" was intended by the Germans to be the novel and distinguishing feature of the war they had so sedulously planned was abundantly proved by its subsequent course. The *liaison* between the German G.H.Q. and the Interessen Gemeinschaft, the organisation which controlled the great chemical manufacturing establishments of Germany, was complete. It was mainly through the agency of the I.G. that in the first place Geheimrat Haber and his colleagues were furnished with the poisonous products they needed for their trials, and it was the I.G. that directed the Badische Anilin- und Sodafabrik at Ludwigshafen, the chemical factory at Berlin, of which the late Dr. Martius was the head, Höchst, Leverkusen, and the rest of the great Rhine dyestuff-producing works, all working in concert, to supply the various lethal substances, eighteen at least, which it was eventually decided to employ. The I.G. organisation was comparatively simple. It lay ready to hand, and could be promptly set in motion with no bureaucratic friction and no official delays. Much of the plant needed to produce synthetic dyes could equally well produce synthetic poisons, and the apparatus was of a type that could be rapidly augmented if necessary.

It was these conditions which, no doubt, in the first instance, led the Germans to plan their new war method. The unique position of their great manufacturing establishments, with their special machinery and experience, their perfect organisation and scientific direction, their intimate co-operation, their hundreds of trained chemists, and their thousands of skilled workmen, gave them an overwhelming advantage over their enemies. The marvel is that they should have ultimately failed. They had the initial advantage of surprise, and at one period it is certain that the way to the coast, which it was their objective to reach, was open to them; but by the mercy of Providence they were made blind to their opportunity, and we all know the sequel. It was that the Allies eventually beat the Germans at their own game.

What we are now concerned to know is whether the game is to continue. Has chemical warfare come to stay? Military experts apparently halt between two opinions. The issue would seem to rest with Germany. This issue will give her pause to think. Those who seek to guide her policy must take stock of her position as the war has left it. Is she in the same strong position now in regard to her organic chemical industry that she occupied prior to 1914? If, with the condition of that industry as it was in all the Allied countries at that period, she yet failed, what chance would she have now? The development of applied organic chemistry in this country, in France, or in America, is not at present all that we might wish to see it, or as assuredly it will be in the not remote future, but it is still very considerable. Each country is immeasurably better able to withstand the German menace of poison gas, and, if necessary, to retaliate with it, than it was half a dozen years ago.

We have learned by experience. The initial advantage of organisation and surprise in the production and military use of poison gas no longer rests with Germany—at least, to nothing like their former extent. She has already paid dearly, both morally and materially, for her breach of the Hague Convention to which she had subscribed, and it is not difficult to suggest means whereby she can be still further penalised should she fail to give adequate assurance, when required, that she means to abandon the new war method she has initiated. Should she be required to abandon it? This is a matter which surely falls within the purview of the Washington Conference on disarmament. The Covenant of the League of Nations has already incidentally dealt with it. Article 8, however, requires to be more explicitly directed to it. Moreover, the power of the League needs to be strengthened to enable it to deal more effectively with breaches of its regulations.

If the German menace were removed there would probably be little difficulty in securing international agreement among members of the League to ratify once more the article of the Hague Convention to "abstain from the use of projectiles the object of which is the diffusion of asphyxiating or deleterious gases." Germany cannot continue to remain outside the League. Sooner or later she will put herself in order and apply to come in. Her national position and her future as a world-Power will require it. Once a member she must subscribe to, and must obey, its conditions. It must rest with the League to enforce, if necessary, Germany's obligations. The loss of the markets of the world for the products the Interessen Gemeinschaft controls might be the least of the penalties she might be made to incur for a breach of them.

The whole story of the inception and development of gas warfare by Germany has still to be told. Schwartes's book, "Die Technik im Weltkriege," throws some light on the subject from the German side, and we have references to it in such works as Ludendorff's "War Memories." The report of the Hartley mission to the German chemical factories in the occupied zone, and Gen. Hartley's report to the British Association, taught us much and revealed the intimate association of the all-powerful I.G. with the German War Department. Major Lefebure, in the work under review, has undoubtedly made the most considerable contribution to the history of chemical warfare which has yet appeared. He has described its rise, the nature of the various lethal substances employed, the modes of protection, the efforts of the Allies to retaliate, the successive attempts to secure the initiative, and chemical warfare organisation in Germany, in this country, and in America. He has said comparatively little respecting France, but its story has been admirably told by Prof. Moureu in his "La Chimie et la Guerre," already noticed in these columns.

The weakest point of Major Lefebure's book is its constructive policy. He proposes to counter the German menace by breaking down the German monopoly in the manufacture of synthetic dyestuffs. This, he says, can be done only by what he calls "a redistribution of organic chemical forces. This, indeed, is the one solid chemical disarmament measure which can and must be brought about." But how? By interfering with "the play of ordinary economic laws." Who is to interfere? The League of Nations. Surely this is not even a counsel of perfection. Nobody, however powerful, can long resist the play of ordinary economic laws. As somebody has observed, the result would be that the economic laws would come back at you like a punch-ball.

T. E. THORPE.

Alfred Newton, Ornithologist.

Life of Alfred Newton, Professor of Comparative Anatomy, Cambridge University, 1866–1907. By A. F. R. Wollaston. With a preface by Sir Archibald Geikie. Pp. xv+332. (London: John Murray, 1921.) 18*s*. net.

DURING the fourteen years that have elapsed since the death of Prof. Newton many of the older members of his circle who had eagerly anticipated the perusal of this volume have passed away, but every British ornithologist will welcome an account of one who for half a century was the leading exponent of the science in this country—one, too, whose remarkable influence in all matters relating to the study of bird-life can be fully realised and appreciated only by those who had the good fortune to participate in his friendship. As Prof. Newton kept voluminous journals and seldom destroyed a letter, the work, as Sir Archibald Geikie points out in his preface, has been given largely the character of an autobiography. With this wealth of material at his disposal, it is greatly to be regretted that the author has found it necessary, owing to the increased costs of publication, to reduce the volume by nearly half its bulk, and we feel certain that a bolder policy in this respect would have entailed no loss. Mr. Wollaston, however, has made a careful selection of his material, and has succeeded in producing a vivid picture of the varied activities and interests of a life of such fullness as is vouchsafed to but few, drawn from the professor's own letters and journals, and from the correspondence and recollections of those who were intimately associated with him.

Students of the history of zoology in this country will find much new information in the chapters dealing with the foundation, in Newton's rooms at Cambridge in 1858, of the British Ornithologists' Union and its journal, *The Ibis*, and with the part played by Newton in the early promulgation of the doctrines of Darwin and Wallace.

Much may be learned from the glimpses that are given us of Newton's methods of work and of the extraordinary pains he took to ensure that perfect accuracy, even in the smallest details, which characterises everything that he published, and renders it as perfect as human effort could make it at the time. His greatest work, the "Dictionary of Birds," displays research and scholarship unparalleled in ornithological literature, and must ever remain one of the classics of the science. Newton's desire for completeness prevented the publication of works on the great auk or garefowl, and the history of the great bustard in Britain, for which he had been collecting material for many years. It is to be hoped that the attention now directed to this vast store of material may lead to its speedy editing and publication.

Space will only permit of a reference to the character-sketch contributed by Dr. F. H. H. Guillemard. Here we see the professor in his study in the Old Lodge at Magdalene—"the nest in which *The Ibis* was fledged"—where every Sunday evening he was at home to any member of the university who was interested in zoology. It was here, rather than in the lecture room, that his influence on zoological thought at Cambridge was exerted. To quote the apt remark of Sir A. Shipley, "Newton's Sunday evenings saved zoology as the science of living animals in Cambridge."

W. E. C.

Fruits of the Tropics and Subtropics.

Manual of Tropical and Subtropical Fruits: Excluding the Banana, Coconut, Pineapple, Citrus Fruits, Olive and Fig. By W. Popenoe. (The Rural Manuals.) Pp. xv + 474 + 24 plates. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1920.) 30*s.* net.

A CONSIDERABLE literature on the more important fruits of tropical and subtropical countries exists, much of it in the form of bulletins or articles in journals which are not easily accessible to all who require them. A volume in which all the more valuable information so widely distributed had been collected would have proved a boon to many. Such a purpose Mr. Popenoe's manual has, in a large measure, fulfilled. But the work is far from being a mere compilation. The author has drawn freely on the writings of others, as he admits, but his wide knowledge of the subject has enabled him to select critically from the material at his disposal, and having travelled extensively in tropical and subtropical regions as agricultural explorer for the United States Department of Agriculture, as well as having had practical experience in fruit-culture in California and Florida, he has produced a volume based largely on his own observations and experiments. Certain well-known fruits, as pointed out on the title-page, have been excluded for the reason that they have been already dealt with in other volumes, while the term "fruits," as understood in the volume under notice, does not include nuts.

The work is divided into sixteen chapters, the first being an excellent article on the outlook for tropical fruit. Then follow chapters on the following and related fruits: The avocado, the mango, the annonaceous fruits, the date, the papaya, the loquat, fruits of the myrtle family, the litchi, the sapotaceous fruits, the kaki, the pomegranate and the jujube, the mangosteen, the breadfruit, and miscellaneous fruits, among which are included the durian, carambola, tamarind, and tree-tomato. Before the index there is a brief bibliography, and in addition to the twenty-four half-tone plates there are sixty-two line-drawings in the text. The book is well printed and in every way a worthy companion to the many excellent works comprising "The Rural Manuals," edited by Dr. L. H. Bailey. We have no doubt that it will be regarded, as it deserves to be, as one of the standard books on tropical and subtropical fruits.

There are probably few fruits of much importance, in addition to the six named on the title-page, that are not included in the work, though in some cases the information given about them is necessarily very meagre. We observe that none of the Cucurbitaceæ is mentioned. Most of the fruits of this family are apparently outside the scope of the volume, though *Acanthosicyos horrida,* the narras or 'nara, a native of south-west tropical Africa, is one that might have been included, for it appears to have qualities that would render it an invaluable plant for hot, dry, sandy regions, where very little vegetation of any kind is found. The late Prof. H. H. W. Pearson said of it in the *Kew Bulletin,* 1907, p. 344: "For about four months in the year the fruits and seeds render the Hottentots independent of other sources of food, and to some extent of water also."

Our Bookshelf.

How to Teach Agriculture: A Book of Methods in this Subject. By Prof. Ashley V. Storm and Dr. Kary C. Davis. Pp. vii + 434. (London: J. B. Lippincott Company, 1921.) 12*s.* 6*d.* net.

DRS. STORM AND DAVIS have produced a book entirely for the teacher; they develop some interesting ideas and make a number of suggestions which cannot fail to be helpful. The book contains an interesting chapter on teaching through charts, slides, and films, which could be read with advantage by many agricultural teachers in this country. The authors state that the use of films as a means of teaching is rapidly gaining ground in America. The expense of the projecting machine is being reduced by the manufacture of smaller and less costly models, while the expense of the films is being lessened by more economical methods of manufacture. Teachers and producers are co-operating in making films that are actually, and not merely ostensibly, educational, while the inefficiency of the film service is being overcome by the development of co-operation between schools, colleges, and commercial and teachers' organisations.

The Electrical Transmission of Photographs. By M. J. Martin. Pp. xi + 136. (London: Sir Isaac Pitman and Sons, Ltd., 1921.) 6*s.* net.

ALTHOUGH the transmission of photographs over telegraph circuits may still be said to be in the experimental stage, a number of processes have been developed to a considerable extent, and already pictures are sent over the London-Paris and other lines to a limited extent in illustrated journalism. The author summarises the work of various inventors in this field, and the processes described include those depending on the action of light on selenium, and those in which a stylus travels over a metallic image. Full instructions are given for the construction of an experimental equipment, and a chapter is included referring briefly to the wireless actuation of such apparatus.

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.]*

The Age of the Earth.

AT the discussion on the age of the earth at Edinburgh we were unfortunately prevented from hearing Dr. Jeffreys's contribution owing to lack of time. I have, however, read it with interest in NATURE of October 27. My only object in writing now is to demur to an allusion in it: "Lord Rayleigh's suggestion that the earth must be becoming hotter." The words I used were carefully qualified, and I do not think that I can do better than quote them: "If [the radio-active materials present in the earth] are generating more [heat than is now leaking out from the earth] (and there is evidence to suggest that they are), the temperature must, according to all received views, be rising."

I appreciate the difficulty of such a supposition as clearly as Dr. Jeffreys. RAYLEIGH.

Terling Place, Witham, Essex, October 31.

Inheritance, Mendelism, and Mutation.

IN NATURE (August 18, pp. 780–84) appears an article by Prof. Goldschmidt on "The Determination of Sex." The author supposes he is dealing with inheritance. At any rate, Mendelians suppose they deal with inheritance, and he declares "we may safely say that to-day, in the light of Mendelism and the work accomplished in the realms of cytology, the problem is solved as completely as the methods of biology permit." Very probably the odd chromosome of which he writes has influence; but very massive evidence indicates that sex is determined mainly, not by the nature, but by the nurture of the individual—by such things as hormones from the sex-glands, food, temperature, and the like. In other words, it is certain that both sets of sexual characters are *inherited* by the individual, but, except in true hermaphrodites and in "intersexuality" (abnormal blending), only one set is *reproduced*. Male is undeveloped female, and *vice versa*. There is alternative patency and latency, alternate *reproduction*, not alternate *inheritance*. But the alternation is often irregular. For example, in aphides, during a long and indeterminate series of generations, the male characters are latent.

So far as it is possible to judge from ordinary experience of life, offspring appear to blend most parental characters, as is best seen when, within limits, the parents are much unlike. For example, when blue-eyed Scandinavian crosses with black-eyed negro, the result is a mulatto, who, though he may incline more to one parent than to the other, is conspicuously a blend. Mulattos, mated together, continue to breed true, but if succeeding matings be with pure white the touch of the tar-brush grows fainter generation after generation. In sexual characters and eye-colour there is, however, no apparent blending. The child is male *or* female, with, almost invariably, black eyes—black dominating over blue. But do sexual characters and eye-colour furnish evidence that there is here no blending? Is it reasonable to expect the male characters to blend with female characters? Is this what happens in the case of truly hermaphrodite animals and plants when both sets of sexual organs are patent? For example, do stamens blend with pistils? Plainly, except in cases of "intersexuality," when the male and female characters do blend more or less, if there is any blending, it is between the patent male characters of the one parent and the latent male characters of the other. So, also, with the female characters.

Similarly with eye-colour. With at least rare exceptions, mulattos, no matter for how many generations interbred, have black eyes. The black continues dominant. But if each succeeding generation mates with white, then at length blue eyes *suddenly* appear. How could this happen if the inheritance, not merely the reproduction, were alternate? The black would then remain as dominant in the octoroon as in the mulatto. But with the inheritance of both characters and the reproduction of only one the thing is comprehensible. Each reinforcement of blue then weakens the dominance of the black until at last blue becomes dominant. Much the same appears to happen in the case of human monstrosities—idiocy, hare-lip, club-foot, and the like. Here normality is dominant until the conditions of nurture are in some way altered—*e.g.* by the reinforcement of the monstrous strain. Apparently, then, the long latency of the blue eye-colour is comparable with the similar latency of the male characters in aphides.

What is a mutation? As well as I am able to judge from literature, it is a character the reproduction of which is Mendelian, and which, very commonly, is of "wide amplitude," a "sport." It has been said that, "unlike fluctuations which are responses to nurture, mutations have representatives in the germ-plasm." But this is merely a misuse of language, for since all characters are products of germinal potentiality and fitting nurture, all must be equally germinal and somatic. As already indicated in a former communication (NATURE, August 25, pp. 808–10), whenever we are able to observe natural selection actually at work, its choice is obviously among fluctuations, not mutations. Thus every shade of susceptibility to tuberculosis may be observed; for in the same surroundings some individuals resist disease altogether, others recover more or less quickly from illness, while others die after long or short illnesses; in different localities the stringency of selection is different; races have been afflicted by the bacillus during diverse durations of time, and every race is resistant in proportion to the length and severity of its past experience. Moreover, the inheritance is blended; thus half-breeds (*e.g.* Europeans crossed with Asiatic, negro, and American Indian) are susceptible in proportion to the blended susceptibilities of their ancestors. For example, Eurasians commonly survive in the cities of the temperate zones, where American half-breeds almost invariably perish. It is probable that few of the American Indians and Maoris and their half-breeds that came to and survived the Great War have returned home to live.

On the other hand, as Darwin noted, man "often begins his selection by some half-monstrous form, or at least by some modification prominent enough to catch the eye, or be plainly useful to him." Man is in haste to get results, and usually cannot observe small differences in races other than his own. Thus even the natives of China seem to an Englishman newly arrived as like as peas in a pod—as doubtless they are. In some cases, however, man is obliged to rely on fluctuations—as in breeding for speed in horses, when a thousand co-ordinated structures are involved. A thousand co-ordinated mutations occurring in one individual are almost inconceivable. It seems, then, that natural selection, which works for the benefit of the individual and his race, chooses fluctuations, while artificial selection, which works for the benefit of man, relies largely on mutations.

It is agreed that fluctuations blend. The following then are the rival suppositions:—(*a*) That the inheritance of Mendelian characters is alternate, and (*b*) that only the reproduction of them is alternate; (*a*) that Mendelian characters do not blend, and (*b*) that they do blend (not with the alternate character, but with the similar character, latent or patent in the mate); (*a*) that Mendelian characters are stable and can be eliminated only by selective breeding or by retrogressive mutations, and (*b*) that they fluctuate, and therefore are liable, when useless, to undergo retrogression like other useless characters; (*a*) that the function of sex is to mix characters as marbles of two colours are mixed in a bag, and (*b*) that the function of sex is to blend characters as two paints are blended on a palette (apparently the result of this blending is retrogressive through a preponderance of retrogressive variations; hence the decrease and ultimate disappearance of useless characters, including mutations, whereby the race is stripped of redundancies as an athlete is stripped for a race; in this way, presumably, the life-history of the race has been shortened until recapitulation in development is possible); (*a*) that species and varieties have all originated through mutations, and (*b*) that all natural species and varieties have originated and evolved through the selection of fluctuations, while the selection of mutations has played a great part in the creation of artificial varieties; and finally (*a*) that like does not necessarily beget like when parent and offspring develop under like conditions (for if the doctrine of the Mendelian *inheritance* be true, the pure extracted recessive is by nature unlike the impure dominant parent whence it is derived), and (*b*) that apart from variations, like does exactly and necessarily beget like under like conditions of nurture—for example, a daughter would have developed male traits like her father had her nurture been similar.

Now let us seek crucial examples. Their discovery should not be difficult among the vast collections of facts which have been recorded about living beings. If the *inheritance* (not merely the reproduction) of Mendelian traits is alternate, how is it possible to account for the oft-observed reappearance in *purely bred* domesticated varieties of long-lost ancestral characters? According to Mendelian theory such traits should have been totally eliminated perhaps hundreds, or even thousands, of generations before from the "pure" dominants and recessives that are supposed to have carried on the heritage. As Darwin noted: "We see that in purely bred races [of pigeons] of every kind known in Europe, blue birds occasionally appear having all the marks which characterise *C. livia*." "Purely bred Game, Malay, Cochin, Dorking, Bantam . . . and silk fowls may frequently be met which are almost identical in plumage with the wild *G. bankiva*." "Pure" extracted recessives have given dominant offspring, and *vice versa*. Many similar cases might be cited. If "the central phenomenon of Mendelian heredity is segregation," not even the reunion of disunited factors and determiners can account for these reversions; for if the breeding has been *pure*, then reunion, *ex hypothesi*, is inconceivable. In parenthesis, it may be noted that an individual may resemble a remote ancestor in two ways:—(1) He may reproduce a dormant ancestral trait, thereby rendering latent the alternate character which had been patent in his immediate predecessors; or (2) he may, through a failure in nature or nurture, fail to recapitulate the life-history of his race beyond the point reached by an ancestor and by himself as a fœtus—for example, "Occasionally a foal is born with two hoofs on one or more of its limbs; at long intervals a foal appears with three hoofs on one or more of its limbs."

"The fact that the gametes of the cross transmit [or reproduce] each member of the pair pure is as strong an indication as can be desired of the discontinuity between them." If that be so, the converse must be true also—the fact that the gametes of the cross transmit each member of the cross blended is as strong an indication as can be desired of the continuity between them. In other words, if offspring reproduce divergent parents unblended, then there is a presumption that one or other, or both, of each pair of differences arose through mutation; but if there is blending the presumption is that the unlikenesses arose through fluctuation, it may be through the accumulation of many successive fluctuations. For example, since in the crossing of white and black human races eye-colour does not blend, it is probable that this particular unlikeness arose through mutation (and, since British eyes are of many colours, that we are a very hybrid race). On the other hand, since skin-colour blends, it is probable that this colour difference arose through the accumulation of fluctuations. Similarly, if the progeny of racehorses crossed with ordinary horses do not blend hair-colour, but are intermediate as regards speed, the presumption is that the divergency in hair-colour arose through mutation, but that in speed evolved through fluctuations. Now comes the point I am driving at. *When we cross artificial varieties we frequently discover instances of alternate reproduction, especially in traits which are not vital for existence. But when we cross natural varieties (which carry few superfluities) we almost invariably get blending in nearly everything except sex and characters associated with sex (for example, human eye-colour, which is an attraction).* A few years ago there was a beautiful example of blending in the London Zoo in a cross between brown and polar bear, recrossed with the latter. Essentially it was a case of mulatto and quadroon.

But the crossings of natural and artificial varieties reveal another significant difference. Darwin wrote: "Besides visible changes which it [the germ] undergoes, we must believe it crowded with invisible characters proper to both sexes, to both the right and left sides of the body, and to a long line of male and female ancestors separated by hundreds, and even thousands, of generations from the present time; and these characters, like those written on paper in invisible ink, lie ready to be evolved whenever the organism is disturbed by certain unknown conditions. . . . We conclude that a tendency to this peculiar form of transmission is an integral part of the general law of inheritance." But if we study the evidence which Darwin cites and which led him to this conclusion, it becomes plain that he relied altogether on facts derived from artificial varieties. So far as I know (with one doubtful exception, *Kalenchoe flammea* crossed at Kew with *K. Bentii*), there has not been recorded a single instance of the reappearance of a *latent* ancestral trait when natural varieties have been crossed; but the crossing of artificial varieties has revealed multitudes of them. Often they have appeared even when there is no crossing, as in pigeons, fowls, and many plants—hence De Vries's "ever-sporting" varieties.

Of all the foregoing the human race affords excellent illustrations. Man is a natural species, divided into a multitude of natural varieties. Where there has been perpetual war, accompanied by the killing of the vanquished, as in Papua, almost every valley and island has its biologically distinct race. Obviously, lack of intercourse (interbreeding) swiftly produces racial divergence, which steadily increases generation after generation—as witness the great unlikenesses between races separated by great distances, and therefore long durations of time. Human written history has a duration of four thousand years; men are fond of recording wonders; yet never has a useful and persistent human mutation been recorded.

Judging, then, from crucial examples, (1) natural varieties have evolved by way of fluctuations, but artificial varieties in great measure by mutations; (2) there is no Mendelian segregation, but only Mendelian reproduction; (3) blending is universal; and (4) apart from variations (including the results of blending), like, always and necessarily, begets like when parent and child develop under like conditions of nurture.

Surely it is evident that if we use precise language (as Darwin tried to do), and bring all the available evidence into court by means of crucial examples (as Darwin did), the dust which Neo-Lamarckians, Neo-Darwinians, and the rest of the sects have flung into our eyes will be washed away, and our very great man will come into his kingdom again.

G. ARCHDALL REID.

Methods of Improving Visibility.

THE observations of Prof. C. V. Raman (NATURE, October 20, p. 242) on a method of improving the visibility of distant objects by the elimination of reflected light by means of a Nicol's prism placed in the eye-piece of a telescope are certainly interesting, but at the same time they are thoroughly well known, and the idea of increasing the visibility by the elimination of polarised light has received a great deal of attention lately. During the war a considerable amount of experimental work was carried out by the Admiralty in connection with fog-penetration and the beamless searchlight, both of which dealt with polarisation phenomena. It was, however, found advisable to substitute for the Nicol's prism as used by Prof. C. V. Raman a few plates of plain glass placed obliquely at a suitable angle across the axis of the particular instrument, since it is extremely difficult to make really large Nicol's prisms, in addition to which the actual absorption by Nicol's prisms is rather excessive. The matter was also taken up by the late Sir William Crookes, and formed the basis for lenses cut from quartz crystals at right angles to the principal axis, thus utilising the rotary polarising effect of this material. I have lately been using tourmaline for obtaining a similar effect, and I have found that a very thin plate of tourmaline cemented as a semi-lens on to an ordinary pair of spectacles is best for this purpose.

Tourmaline is a mineral that has found a great deal of application lately, and particularly during the war in connection with the piezo effect, in the apparatus used for the detection of submarines and submarine-sounding, and is, in consequence, fairly abundant. For this purpose the plates of tourmaline are cut perpendicular to the vertical axis, but the maximum polarising effect is obtained from plates cut parallel to this axis. Thin plates of this material, when so cut and fixed into the spectacles as mentioned, give an effect the benefits of which can only be realised when put to the actual test. Thus, for example, when fishing, the injurious glare from the water is entirely eliminated. At the same time the eye is able to penetrate the water to considerable depths. This fact will, of course, be appreciated by those engaged in the study of pond-life.

A further application is the manufacture of spectacles for invalids and others residing at the seaside, whereby, again, the glare of the water is almost entirely eliminated and the delightful tone of the tourmaline is very restful to the eye. In photography a further application consists in using a sheet of tourmaline as a light-filter, whereby reflection, and in particular that from shining objects, is largely eliminated; and while it is not possible to take photographs of water directly facing the sun, many pictures which are otherwise impossible can be taken by means of this screen.

A final application, and one with which my experiments originated, was the examination of photomicrographs, which, owing to their delicate nature, were of necessity mounted below a sheet of glass. The continued observation of these objects was found to be a very tedious process owing to the brilliant light required and the consequent reflection from the glass. This reflection was again eliminated by the tourmaline. The plates of tourmaline must, of course, be so mounted that the vertical axis is placed vertically in the spectacles.

These applications have already been provisionally protected at the Patent Office, but up to the present I have found no firm that will take up the manufacture of such glasses. I am confident, however, that a very useful industry awaits the firm with the necessary enterprise.

A. G. LOWNDES.

Marlborough College, Wilts, October 28.

PROF. C. V. RAMAN'S suggestion (NATURE, October 20, p. 242) for improving visibility at sea was put forward by me some years ago in "Elementary Seamanship" (Griffin and Co.), and is useful not only for objects above the surface, but for those—like coral-reefs—some little distance below the surface. In the last instance, when there is a slight ripple on the surface of the water it is often difficult to detect them even when navigating with the sun astern. The use of the Nicol prism clears up in a great measure this difficulty.

DAVID WILSON-BARKER.

Flimwell, October 28.

Penial and Genital Setæ of Lumbricus terrestris, L., Müll.

ON p. 172 of Prof. O'Donoghue's "An Introduction to Zoology for Medical Students," reviewed in NATURE of August 11, it is stated that in *Lumbricus herculeus* (the name is a synonym of *L. terrestris*) "in the fifteenth segment the two pairs of ventral setæ lying close to the male external aperture are modified to form the penial setæ." In Bourne's "An Introduction to the Study of the Comparative Anatomy of Animals," vol. 2, pp. 19–20 of the fifth edition, 1912, it is said that in the same worm "the chætæ of the clitellar region differ from those of the rest of the body, being finer and nearly straight, with hooked inner ends. There is also a pair of modified chætæ in somite 15." Borradaile, in "A Manual of Elementary Zoology," p. 217 of the third edition, 1920, says, "The ventral setæ of the clitellum, of the 26th and of the 10th to the 15th segments are straighter and more slender than those of other segments, which are stout and somewhat hooked. The modification is in connection with the use of the setæ of the 26th segment during coition, and of the other straight setæ during the formation of the cocoon in which the eggs are laid." Parker and Haswell, in "A Textbook of Zoology," p. 455 of the second edition, 1910, state that "the setæ in the clitellum, and those in the neighbourhood of the genital apertures, are much slenderer than the rest."

Systematic writers, however (to whom modifications in the form of the setæ are of importance as furnishing specific characters), do not appear to have recognised the presence of penial setæ in segment 15 of *Lumbricus terrestris*. Thus Beddard, in "A Monograph of the Order of Oligochæta," 1895, p. 122:—"Genital setæ associated with the male-pores only occur in the Megascolicidæ, the Eudrilidæ, and (rarely) in the Geoscolicidæ, Lumbriculides; in fact, they only occur in those families of terrestrial Oligochæta in which the male-pores are provided with spermiducal glands"; he notes (p. 688) that the clitellar setæ of the Lumbricidæ are commonly modified in shape, being very much longer and thinner than those on the non-clitellar segments. Michaelsen, in the Tierreich volume on Oligochæta, 1900, p. 470, gives as a family character of the Lumbricidæ that commonly the setæ on certain segments of the anterior part of the body are situated on papillæ, and modified as genital setæ in the form of "Furchenborsten," with longitudinal ridges and one or more intervening grooves at the distal end. In *Lumbricus terrestris* (p. 512), "Usually the ventral setæ of segm. 26 or (less often) 25 and 26 are situated on broad papillæ and modified as grooved genital setæ, slender, curved only at the proximal end, 1·6 mm. long and 45μ thick."

The above statements are not in all respects concordant. The fullest of them, that of Borradaile, can apparently be traced back, through Vejdovsky's "System und Morphologie der Oligochæten," 1884, p. 156, to Hering's paper in the *Zeitschrift für wissenschaftliche Zoologie*, vol. 8, 1857, p. 418, who states that peculiar setæ are found in *Lumbricus agricola* (another synonym of *L. terrestris*) in the ventral series in the tenth segment, in the fifteenth or one of the adjacent segments, in the region of segment 26, and, lastly, in the clitellar segments (31–38); these peculiar setæ are thinner and about double the usual length.

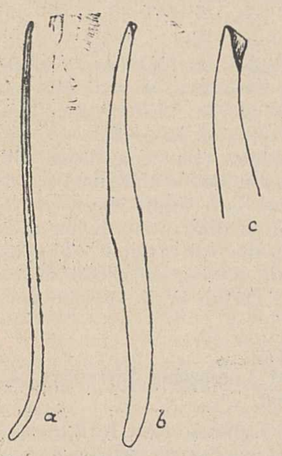

FIG. 1.—(*a*) Clitellar seta of *Lumbricus terrestris* (×30). (*b*) Ventral seta of segment 15 (×64). (*c*) Tip of ventral seta of segment 15 (×188).

Some of the authors quoted above do not mention any modification of the setæ near the male apertures; of those who do mention it some do not say in what the modification consists, and those who describe it state that it is the same as the modification in certain other segments, *e.g.* those of the clitellum.

I have examined three specimens of *Lumbricus terrestris*, all with the clitellum and "ridges of puberty" (on segments 33–36) fully developed; as shown by the condition of the spermathecæ, two had copulated, one apparently not. For comparison, an unmodified seta (a ventral seta of segment 17) was taken; this was of the well-known type, in length 0·74 mm., with the nodulus distal to the middle of the shaft (portion distal to nodulus is to portion proximal to nodulus as 2 is to 3).

In segments 8–10 the ventral setæ were much more massive than usual, and about 1·24 mm. long, but of the ordinary type (the larger size of the ventral setæ in the anterior segments can be appreciated on examining the surface of the worm with a lens). In segments 12–14 some setæ were massive, like those just described, while some were of about normal size (0·82 mm. long) or slightly larger (0·91 mm. long).

The ventral setæ of segment 15 were not discovered in one of the worms, perhaps because they had fallen out; in both worms which possessed them they were 0·87–0·91 mm. long, with nodulus about the middle, the shaft gradually tapering from nodulus to tip, and only slightly curved (Fig. 1, *b*); the tip was excavated, somewhat like a sugar-scoop (Fig. 1, *c*). The lateral setæ of this segment are of the usual size and type.

The ventral setæ of segments 25 and 26 were not at all modified in type, though they were rather larger than the one taken for comparison (0·96, 1·07, 1·17, and 1·2 mm. long).

The setæ of the clitellar segments correspond to the descriptions of the authors quoted. They were 1·85 mm. long, slender, with no distinct nodulus, though the shaft was thickest a little above the proximal end; there was a marked proximal curve, and the shaft was almost straight in the rest of its extent; it tapered very gradually and ended in a blunt point, and was grooved or ridged along its sides in the distal half (Fig. 1, *a*).

In the specimens examined, therefore, the only modified setæ (apart from variations in size) were those of segment 15 and of the clitellum. The modification of the clitellar setæ was that described by certain of the authors above quoted; but that of the ventral setæ of segment 15 was of an altogether different type, which apparently has not hitherto been recognised.

J. STEPHENSON.
Zoological Department, Edinburgh University, September 29.

Speaking Films.

IN the article on speaking films which appeared in NATURE of October 27 Prof. Rankine says: "Combinations of picture films and ordinary gramophones have been frequently tried without success sufficient to ensure their survival in practice. The difficulty, of course, mainly arises from the impossibility of *preserving* synchronism between a gramophone record and film."

This mechanical difficulty could be overcome, at least in the early stages of the life of a film, but even then a more serious difficulty, which may best be described as psychological, would remain. It must be remembered that both by the film pictures, the film sounds, or the gramophone sounds deceptions are practised on the human senses. The eye is deceived into believing that it sees real people in movement when it is doing no more than witnessing the antics of graduated shadows. If the film fails to deceive the sense of seeing, it fails also in its psychological effect. The intimacy with which devotees of the "pictures" speak of the "film stars" who are "featured" shows that they do indeed believe that they see them, that it is actually Charlie Chaplin or Mary Pickford who is present before them. It is only when the senses surrender themselves completely to this deception that the emotions are fully affected.

In the same way the gramophone deceives the sense of hearing. Unless we can actually believe that we hear Caruso or Sir Harry Lauder the enjoyment and the effect will remain partial.

Now, my own experience is that you may deceive one sense at a time, but not two. You may deceive the eye with the film or the ear with the gramophone, but if you attempt to deceive both together failure results and both deceptions are destroyed. Some years ago I witnessed a film which showed a nigger dancing to a banjo. As long as he only danced I forgot that he was a black-and-white picture on a white sheet, but when a gramophone attempted to render the words of his song and the banjo accompaniment the illusion disappeared. There was no appearance whatever of a nigger singing. What I saw was a shadow moving on a screen; what I heard was a gramophone making noises with all the familiar defects.

It is quite possible that in this case the synchronisation of film and record was not perfect, and that its inaccuracy helped to destroy the illusion, but it must be remembered that both one and the other—as Prof. Rankine indicates in the case of speech records—depend in great measure upon suggestion. The dominant part of a word gives us the key to the whole. Both words and pictures are scientifically "imperfect," and when we attempt to amalgamate them the resultant imperfection is so great that the effect is wholly lost. LOUGH PENDRED.

33 Norfolk Street, Strand, London, W.C.2,
October 28.

FROM practical experience I am able neither to confirm nor to contradict Mr. Pendred's interesting observations on the difficulty of practising simultaneous deceptions on the senses of seeing and hearing. It is quite possible, of course—perhaps likely—that it is easier to produce one such effect than both at once; but I can see no reason, *a priori*, for expecting the double deception to be impossible. It must be remembered that both moving pictures and ordinary gramophones have been improved greatly during the years since Mr. Pendred's experiences, and that, could perfect synchronisation be guaranteed, the results he describes might now be modified considerably. Mr. Pendred would, I think, admit that if both pictures and sounds could be sufficiently improved, the remaining imperfections, even though, possibly, additive, might yet be so small that the deceptions aimed at would both be effective.

There is no doubt that the photographic and photoelectric method of recording and reproducing sounds is much superior to the comparatively coarse methods used in ordinary gramophones; and this may quite well be a reason, in addition to the attainment of synchronisation, for the success of the talking pictures produced by Mr. Bergland, and spoken of so highly by the *Times* correspondent and by Prof. Arrhenius. A. O. RANKINE.

Royal College of Science, South Kensington,
London, S.W.7, November 2.

The Differentiation of Boiled and Unboiled Water.

IT is often desirable to be able to ascertain whether water alleged to have been boiled for drinking purposes has in reality undergone the treatment. This may be readily determined by means of indicators appropriate to the type of water, for the effect of boiling is always to lower the hydrogen-ion concentration by removing carbon dioxide from solution and decomposing bicarbonates.

For example, Plymouth tap-water, a soft water from Dartmoor, is now at *p*H6·8, and gives a yellowish colour with phenol-red. On boiling in a hard glass test-tube it develops the full red with this reagent, a light pink with phenolphthalein, and a yellowish colour with thymol-blue. It is then at *p*H8·5.

Youghal tap-supply is at *p*H7·0, but contains far more bicarbonate than Dartmoor water, since on boiling it not only gives the full red with phenol-red, but also gives a more intense colour with phenolphthalein and a slaty-blue with thymol-blue, denoting *p*H9·0, the limit for water saturated with calcium carbonate in absence of carbonic acid.

Water from Blagdon Reservoir (Bristol supply) was found to be at *p*H7·8, and at Pusa, in Bihar, the laboratory tap-water is at *p*H8·1, that of the River Gandak from which it is derived being somewhat more alkaline. Running streams may be up to *p*H8·3 even when derived from wells at *p*H6·4. Saunders (Proc. Cambr. Phil. Soc., 1921, vol. 20, p. 350) has shown that supplies in chalk and gault districts are at *p*H7·1–7·2 very constantly, streams rising to *p*H8·25–8·5. Sea-water is close to *p*H8·2.

For these more alkaline waters phenol-red would be an unsuitable reagent to detect the unboiled state, as even in it the full red is developed, but phenolphthalein would serve, showing either a colour or an increase in intensity with the boiled water.

Higher limiting values may be obtained with waters containing magnesium salts, since that for magnesium carbonate, on boiling, is close to *p*H10·0. Sea-water, therefore, may approximate to this, and fresh-water from a small reservoir on Staddon Heights, Plymouth Sound, was by insolation with its naturally occurring algæ brought up to *p*H9·7.

On cooling, carbon dioxide is re-absorbed by boiled water. This proceeds until the equilibrium with the bicarbonate stage is reached, which is at *p*H8·37 for saturated calcium bicarbonate. It is slightly lower for water which has been boiled, since it can no longer be saturated with respect to bicarbonate. This stage still gives a good colour with phenol-red, being more than *p*H8. With water which is naturally at this reaction when unboiled it is advisable to make a direct test to ascertain the time that elapses before the original reaction is regained, but a positive result may always be accepted as proof of boiling.

Since one omission to boil the water may, especially in the tropics, lead to a fatal illness, it is hoped that the use of phenolphthalein, phenol-red, or other suitable indicator may be of use. W. R. G. ATKINS.

Marine Biological Laboratory, Plymouth,
October 31.

Ophion luteus.

THIS fly, one of the larger Ichneumonidæ, appears in my house every year in late summer. Several members of my family have complained of being stung by it, always at night, usually after they had gone to bed in the top story, third above the basement. All doubt about the aggressor was dispelled by a young lady who, when reading in bed, felt a stab on the arm and saw the insect *flagrante delicto*. I am informed on high authority that, while Ophion is one of the few Ichneumonidæ which are known to sting, and while a small, narrow poison sac has been detected in a few species of that immense family, none has been recorded in *Ophion luteus*. But whereas the sting is followed in every instance by considerable inflammation and pain, such as would not be the effect of the mere stab of a needle, it seems almost certain that some irritant is injected into the wound, possibly for the purpose of paralysing the fly's legitimate victim, as in the case of the hunting-wasps.

It puzzles one to divine the purpose of Ophion in attacking sleeping human beings. The weapon employed is the sharp point of the ovipositor. It seems scarcely possible that the intention is that the progeny should be lodged and fed in the body of man, woman, or child. What is normally the creature which Ophion seeks as a harbour for its eggs and larvæ? Is this known? Only once have I seen Ophion in my own bedroom on the first floor. I was reading in bed one night in August last when the fly alighted on the sheet. I regret that instinct prevailed over reason, and I destroyed the creature before the purpose of its visit was revealed.

HERBERT MAXWELL.

Monreith, Whauphill, Wigtownshire, N.B.

Indian Land Mollusca.

I AM sorry that my offer of the Indian operculate land-snails in the collection of the Indian Museum did not reach Sir Arthur Shipley. The offer had the support of the Government of India, which wrote strongly to the India Office as to the unfortunate effect of publishing Mr. Gude's volume without reference to the Indian Museum collection.

I fail, however, to see what the war has to do with the case, and prefer to ignore Sir Arthur Shipley's motive in his attempt to introduce it in his letter in NATURE of October 27 (p. 271). The volume in question was published in 1921, and was, I understand, completed shortly before it was published. I received official information that it was in active progress from the Education Department of the Government of India only in the latter part of last year. My offer was made in reference to this communication through the channel through which I had received it.

N. ANNANDALE.

Royal Societies Club, St. James's Street, S.W.

Curiosities of Nomenclature.

AT Section D of the British Association in two successive years I asked for an explanation of the generic name Calymene, without obtaining it from a roomful of zoologists. On the second occasion I suggested, among other guesses, the remote possibility of a derivation from the Greek word κεκαλυμμένη. Since then, while consulting Buckland's Bridgwater Treatise of 1836 for quite another purpose, I have found (vol. 1, p. 371) a footnote on genera of Trilobites giving "Calymene, from κεκαλυμμένη, concealed," with Buckland's comment that such names were "devised expressly to denote the obscure nature of the bodies to which they are attached."

Nearly half a century after the date of Brongniart's genus the American carcinologist Packard named a genus Cæcidotæa (if I may trust Scudder's "Nomenclator Zoologicus," vol. 1, p. 52, and vol. 2, p. 47), thus implicitly assigning his blind isopod to the family Idoteidæ in the Valvifera away from its proper place among the Asellidæ. Harger in 1878 spells the name Cœcidotea (U.S. Fish. Comm., part 6, p. 314). Now Dr. Tattersall, with the spelling Cæcidothea (Mem. Asiat. Soc. Bengal, vol. 6, p. 417, 1921), records a new species of the genus from a shallow domestic well in Japan, and observes that "this species is distinguished at once from all the other species of the genus by the presence of distinct, though very small, eyes." Thus we have in Packard's professedly blind Idoteid genus a species which is not an Idoteid and which is not blind. Apart, however, from obvious misnomers, the endeavour to pack a budget of information into a single descriptive name must often fail, because it cannot be foreseen that any character noted in the generic name will prove of more than specific value.

T. R. R. STEBBING.

Ephraim Lodge, The Common, Tunbridge Wells.

The Flight of Thistledown.

PROF. MILES WALKER'S letter in NATURE of October 20 recalls an incident observed during a holiday in the Cheviots in June last which may possibly be of interest in connection with his inquiry.

It was June 24, the hottest day of the year up to that date, and with brilliant sunshine. The air was comparatively still but for the quivering due to the heat, and there was no distinct current. Our attention was arrested by what to all appearance was a dragon-fly hovering 5 or 6 ft. from the ground, and frequently darting a foot or two away. This went on for probably a minute or two, until, in fact, we caught the object for the purpose of finding out what it was. It proved to be a thread of thistledown or something akin to it, and probably an inch and a quarter or more in length.

It was, perhaps, an insignificant occurrence, but the effect was certainly curious and striking. The tiny film very effectually simulated the flight of a dragon-fly, and would, I think, have deceived all but a practised observer. Whatever current there might be was negligible, and the movement—or the stationary quivering attitude—seemed quite independent of it.

W. E. LISHMAN.

73 Osborne Road, Newcastle-upon-Tyne, October 28.

THE rising of plant-down on calm, sunny days as described by Prof. Miles Walker in NATURE of October 20, p. 242, has also been noticed by me occasionally. But could not the upward motion be explained by an upward current of air? We know that the air is usually full of eddies on a hot afternoon. In order to prove that the thistledown moved through, instead of with, the air, it would be necessary to make simultaneous and contiguous measurements of air-motion by means of smoke or of some very special anemometer. It would be interesting to learn if anyone has tried such an experiment.

LEWIS F. RICHARDSON.

Westminster Training College, S.W.1.

Ceratium and Pedalion.

IN recently announcing (NATURE, September 8, p. 42) the finding of Ceratium in this district, I assumed, on the authority of Kent's "Manual of the Infusoria," that the species was *C. furca*. By the kindness of Herr Lektor E. Jörgensen, author of a monograph on the genus Ceratium, who has examined some specimens, I am now enabled to correct the impression unwittingly given by my letter, and to state that the forms found by me are varieties of *Ceratium hirundinella*. My error is, perhaps, a pardonable one in view of the marked differences between the actual organism and Kent's illustration of *C. hirundinella*, and the general correspondence of the specimens found with his description, etc., of *C. furca*.

With regard to *Pedalion mirum*, no information has yet reached me that this rotifer has, during the past thirty-two years, been found at places in Great Britain other than the three mentioned in Hudson and Gosse's work on "The Rotifera."

A. E. HARRIS.

44 Partridge Road, Cardiff, October 20.

Muscular Piezo-electricity?

THE well-known "action current" of muscle can have nothing to do with piezo-electricity, since it may reach its maximum before any mechanical change begins. Nor do I see anything to suggest the occurrence of such electricity in other animal tissues or organs. Mr. Wriothesley Russell (NATURE, October 27, p. 275) might, however, find plants worth investigating for evidence of it. I directed attention sixteen years ago to the association of crystals with electrical changes in *Desmodium gyrans* (Proc. Physiol. Soc., July, 1905), and (according to a short notice in NATURE for August 11, 1921) Steckbeck has shown their association with propagation of stimuli in *Mimosa pudica, Biophytum sensitivum*, and other sensitive plants.

F. BUCHANAN.

University Museum, Oxford, October 31.

Faraday and the Quantum.

By DR. H. STANLEY ALLEN.

IN the third volume of his "Experimental Researches in Electricity" Faraday returns again and yet again to the discussion of lines of magnetic force and of their physical existence. The first paper in the volume bears the suggestive title, "On the Magnetisation of Light and the Illumination of Magnetic Lines of Force." He defines the latter by saying: "By *line of magnetic force*, or *magnetic line of force*, or *magnetic curve*, I mean that exercise of magnetic force which is exerted in the lines usually called magnetic curves, and which equally exist as passing from or to magnetic poles, or forming concentric circles round an electric current." He then goes on to describe his discovery of the magnetic rotation of the plane of polarisation, a phenomenon which Lord Kelvin regarded as a demonstration of the reality of Ampère's explanation of the ultimate nature of magnetism. In the celebrated letter to Richard Phillips, published in the *Philosophical Magazine* for May, 1846, under the title, "Thoughts on Ray-vibrations," Faraday writes:—

> The view which I am so bold as to put forward considers, therefore, radiation as a high species of vibration in the lines of force which are known to connect particles, and also masses, of matter together. It endeavours to dismiss the æther, but not the vibration.

Again in 1852 he says:—

> Having applied the term *line of magnetic force* to an abstract idea, which I believe represents accurately the nature, condition, direction, and comparative amount of the magnetic forces, without reference to any physical condition of the force, I have now applied the term *physical line of force* to include the further idea of their physical nature. The first set of lines I *affirm* upon the evidence of strict experiment. The second set of lines I advocate, chiefly with a view of stating the question of their existence.

This question he regards as "both important and likely to be answered ultimately in the affirmative."

The quantum theory seems to supply the affirmative answer anticipated by Faraday. It has long been recognised that this theory requires a certain atomicity in nature which may be represented either by Planck's constant h, or by some combination of h with other fundamental constants. Planck's constant, which has the value 6.558×10^{-27} erg sec., may be looked upon as a quantum of action, but it is perhaps simpler to regard it, in accordance with the suggestion of J. W. Nicholson, as an angular momentum. The first indication that the quantum may be essentially magnetic appears in the work of S. B. McLaren, who, in a letter to NATURE (vol. 92, p. 165, 1913), identified the natural unit of angular momentum, $h/2\pi$, used by Bohr, with the angular momentum of the magneton. "Rejecting entirely the idea of magnetic or electric substance, the magneton may be regarded as an inner limiting surface of the æther, formed like an anchor-ring. The tubes of electric induction which terminate on its surface give it an electric charge; the magnetic tubes linked through its aperture make it a permanent magnet." It may be shown from ordinary electrodynamic considerations that the angular momentum of such a system is equal to $Ne/2\pi$, where N is the number of magnetic tubes threading the magneton, and e is the electrostatic charge. According to the quantum theory, the angular momentum must be $nh/2\pi$, where n is an integer, and we may have a one-quantum magneton, a two-quantum magneton, and so on. Identifying these two expressions for the angular momentum, we find

$$Ne = nh,$$

or

$$N = n(h/e).$$

Thus it is seen that the number of tubes of magnetic induction passing through the aperture of the magneton is equal to an integer, n, multiplied by the constant factor h/e. If we suppose that the charge of the magneton is equal to the electron charge 4.774×10^{-10} E.S.U., we find for h/e, which defines what must be the *fundamental* unit magnetic tube, the value 1.374×10^{-17} E.S.U. or 4.120×10^{-7} E.M.U. Consequently one C.G.S. magnetic tube contains nearly two and a half million (2.43×10^6) *quantum tubes*. The electrokinetic energy of the unit tube is $\frac{1}{2}h\nu$, where ν is the frequency of revolution.

A magneton theory of the structure of the atom has been developed with great ingenuity by A. L. Parson, but his theory has not met with acceptance, partly because it employs the notion of a sphere of positive electricity in place of a positive nucleus, but mainly because it is not based on the atomic numbers of Moseley which are now generally accepted as representing accurately the number of electrons in the neutral atom outside the nucleus. Ultimately it may prove necessary to adopt some form of the magneton hypothesis, which seems well adapted to explain magnetic properties, and, by admitting the possibility of stationary electrons, as in the Lewis-Langmuir theory, chemical properties also. But at the present time the results obtained from the Bohr-Sommerfeld theory of spectral frequencies seem to demand electrons which are moving in certain orbits. As pointed out in these columns by Dr. Norman Campbell (NATURE, vol. 106, p. 408, 1920), the difference between the two views may be purely formal.

It is, however, desirable to consider whether the theory of Bohr, like the magneton theory, points to the existence of discrete magnetic tubes. In 1916 A. L. Bernoulli came to the conclusion that when an electron is in movement in a uniform molecular magnetic field the number of lines of force cut by the radius vector at each revolution is one and the same universal constant. In a paper read before the Royal Society of Edinburgh in November, 1920, the present writer attempted to show that, without any restriction as to the uniformity of the magnetic field, when any number of point charges are revolving round an axis with a common angular velocity, the number of magnetic tubes passing through the stationary circular orbits is equal to an integral number of times the constant h/e. Recently an attempt has been made to extend the result to the more general case of an electron revolving round the positive nucleus in an elliptic orbit. It has been shown independently by Sommerfeld and by W. Wilson that the size and shape of the ellipse depend upon *two* integers n and n', the first introduced by the application of the quantum theory to the angular motion, the second by the application of the theory to the radial motion. The sum of these two integers determines the value of Bohr's W, the total energy of the system with the negative sign prefixed. Making certain plausible assumptions, it appears that the total number of quantum magnetic tubes passing through the elliptic orbit is simply this sum, $n+n'$. This result is obtained by employing the generalised form of the quantum theory first put forward by W. Wilson and used with such success by Sommerfeld and others.

On this theory the mean value of the kinetic energy corresponding to a particular degree of freedom is equal to $\frac{1}{2}nh\nu$, where the mean value is taken over the period, $1/\nu$, corresponding to the co-ordinate under consideration. It is now assumed that this mean energy may be identified with electrokinetic energy. The periodic motion of an electric charge e in an orbit with high frequency ν is regarded as equivalent to a current $e\nu$, and the electrokinetic energy may then be written $\frac{1}{2}Ne\nu$, where N is the number of magnetic tubes passing through the actual orbit, but corresponding to the particular co-ordinate in question. Equating the two expressions for the energy, we find at once

$$N=n(h/e).$$

It must, of course, be admitted that we do not get out of the equations more than we put into them, so that the assumptions made above virtually imply the existence of discrete tubes of magnetic induction. It is to be noted that we are concerned twice over with the process of taking a time average of a certain quantity, first in evaluating the mean kinetic energy, and secondly in evaluating the electrokinetic energy and assuming the moving charge as equivalent to a current $e\nu$. In the words of Dr. Norman Campbell, "Classical dynamics, it is clear, is only 'statistical'; what are the principles of the elements of the statistical group is the main problem of the physics of the future." The suggestion now made is that the quantum tube is the element referred to.

The physical existence of Faraday's magnetic tubes conforms in many respects to the mode of representation suggested by Sir Joseph Larmor: "One or more electrons constrained to move round a channel would be like an amperean current. It is not unlikely that constraint of this kind will have to be introduced into molecular models to give an account of paramagnetism and ferromagnetism—namely, structure in space or atom involving channels more or less definite for the electrons to circulate in." On the present view such channels or partitions would be provided in consequence of the discrete nature of the tubes of magnetic induction, which would determine the radius of the permissible orbit which an electron describes about the nucleus and account for the property of rigidity.

Sir Oliver Lodge, in a recent paper (*Phil. Mag.*, vol. 41, p. 942, 1921), writes as follows:—"Magnetic lines are always closed curves; there is no known way of generating them; they always pre-exist, though they may be of atomic or molecular magnitude, and in a magnetic field are opened out so as to enclose a perceptible area. This is generally admitted to be the process of magnetisation, and when the magnetism ceases the lines shrink up into infinitesimal, or practically infinitesimal, orbits again. That the *quantum* is associated with these ultimate magnetic units is exceedingly likely."

If we accept the existence of quantum magnetic tubes, many questions of great interest suggest themselves. What happens in the emission or absorption of radiation? Does radiation imply the separation or ejection of a quantum tube from an atomic system, and absorption the incorporation of an external tube? Then, again, how are electrostatic forces to be regarded? Sir Joseph Thomson has pictured a magnetic field as due to the motion of electrostatic tubes. It would, of course, be possible to reverse the process and regard an electrostatic field as set up by moving magnetic tubes. In a suggestive communication to the British Association at Edinburgh Prof. Whittaker discussed the properties of tubes of force in four dimensions, and pointed out that such a tube, which would satisfy all the requirements of the relativity theory, would involve *both* the electric and the magnetic vector. Further, in the four-dimensional world it is action, not energy, which is conserved, so that the field appears open for a direct application of the quantum principle. The experimental physicist may feel somewhat appalled at the prospect of such a solution of his difficulties, but it may yet be necessary to invoke a four-dimensional tube of force as the unit brick from which a universe may be constructed.

The Mineral Industry of India.[1]

By PROF. HENRY LOUIS.

SINCE the year 1903 the Geological Survey of India has published quinquennial records of mineral production upon the lines laid down by the then director, Sir Thomas Holland, and these have supplied an invaluable summary of the development of the mineral resources of India, and, above all, of the industrial progress of the Peninsula. The volume before us, on exactly the same lines as its predecessors, is of especial interest, because it covers a period which may fairly be looked upon as that of the modern industrial awakening of India. Before the war the development of the Indian coalfields had commenced; there was a small but scarcely flourishing iron industry, and a few industries other than native industries were coming into existence. The war, with its attendant disturbance upon the world's shipping, profoundly affected the economic situation in India, and compelled India to produce for herself materials which it had hitherto been found more convenient to import. The majority of the industries thus founded have become stabilised, and among others the foundations for a great iron and steel industry have been laid. It would not be wholly surprising if, within a relatively short period, India were in a position to export steel billets to this country instead of receiving iron and steel from us.

So far as natural resources are concerned, an iron industry depends essentially upon the production of coal and iron ore. During the period under review the production of coal rose from about 16½ million tons in 1914 to 20¾ million tons in 1918, thus increasing by nearly 25 per cent. The values at the pit's mouth given in these records depend to a great extent upon the position of the collieries and the demand for coal in their immediate vicinity; furthermore, during 1917 and 1918 the prices were fixed by the Coal Controller on behalf of the Government, and, therefore, have no statistical value. The prices for 1916 are, therefore, the most recent prices that can be considered here. The two provinces of Bengal and of Bihar and Orissa are the most important coal producers, having during the period under discussion produced more than 90 per cent. of the total output, and the average value per ton of coal in these two provinces in 1916 was 4*s.* 2*d.* at the pit's mouth (taking the rupee at 1*s.* 4*d.*). There appear to be enormous quantities of high-class iron ores in the two provinces above-named, averaging above 60 per cent. of iron, and containing for the most part moderate proportions of phosphorus with relatively little silica; the value of the ore, even of this high quality, was in 1918 1*s.* 8*d.* per ton. When these prices are compared with prices at home it will be seen that they are only about one-eighth of corresponding prices in this country, and when it is further borne in mind that Indian labour is plentiful, is still cheap in spite of its increases in recent years, and is intelligent, docile and reasonably efficient, it must be fairly obvious that we in the old country can scarcely hope to compete with India as an iron-producer.

An examination of the figures respecting coal production brings out the importance of the Indian coal output; it is greater than that of any other British Dependency, and its rate of development appears to be exceeded only by that of Japan; it is interesting to note that in 1885 India and Japan each produced 1,294,000 tons, whilst in 1918 India produced 20,722,000 and Japan 27,579,000 tons. The efficiency of the Indian coal-miner appears to be relatively low, mainly because, on account of the cheapness of the labour, much work is done by hand in India which is done by mechanical means elsewhere; in the Indian coalfields the system of transporting coal in baskets carried on the head is not yet wholly extinct. Nevertheless, the output per person employed during the period under review was about 108 tons per person, or just about half of what it is in this country. The most important feature, however, is that the output per worker employed below ground has increased, and is steadily increasing, this being the opposite to what we unfortunately find to be the case in this country. Concurrently with this improvement we find that the accident death-rate is decreasing; during the quinquennial period here discussed the death-rate per thousand persons employed was 1·14, whilst during the corresponding period in the United Kingdom it was 1·3.

The report also directs attention to the fact that coal-cutting machinery is on the increase in India; that the Indian collieries are admirably adapted for the employment of electricity underground; that several important schemes for electric supply to the coalfields are in contemplation; and that the Indian workman is naturally highly adaptable to the handling of electrical machinery; and it is predicted that the result of the more extended use of electricity will be to cheapen costs still further. Competition with Indian coal will thus be rendered still more difficult so far as we are concerned, and the prediction that Indian coal will before long supply Egypt, and may even compete with us in the Mediterranean, appears by no means impossible of accomplishment.

In other respects the mineral industry of India appears to be in a thoroughly successful condition, and shows signs of a steady advance, the value of the output having more than doubled itself in the last ten years. Attention may be directed to the fact that India is now manufacturing its own ferro-manganese, and that it is hoped before long to produce sulphuric acid from indigenous materials—namely, from the zinc concentrates produced by the Burma Corporation at Bawdwin.

[1] Records of the Geological Survey of India. Vol. 52., April, 1921 "Quinquennial Review of the Mineral Production of India for the Years 1914–18." By the Director and Senior Officers of the Geological Survey of India.

Liquid Air Explosives.

AN Order in Council (1921, No. 1194) has been issued exempting explosives made by impregnating absorbent carbonaceous material with liquid air or oxygen from that provision of the Explosives Act which requires the manufacture of explosives to be carried out in licensed premises. This Order will, therefore, enable free competition between explosives of the usual type and mixtures of liquid oxygen with a fuel that can be made on the spot shortly before firing.

Liquid oxygen explosives originated in Germany, but before the war had no great vogue. During the war they were used on a fairly large scale by the Germans in non-gaseous coal mines, in iron mines, and for the destruction of machinery in French steel plants. This development was occasioned by the need for conserving Germany's supply of nitrates for the manufacture of military explosives.

The increasing cost of explosives and the improved methods of obtaining liquid oxygen make the problem of producing explosives by the simple method of saturating materials like wood-meal with liquid oxygen an attractive one. The explosives so produced also present certain advantages, especially as regards freedom from danger in transport, storage, and handling, but they have certain inherent disadvantages: thus, the rapid evaporation of the liquid oxygen necessitates rapid firing and so limits the number of shots that can be fired in one blast; it is necessary to have a liquefying plant close at hand; and the explosive cannot be used in fiery mines.

The plant required for liquefaction must be capable of turning out a product containing at least 85 per cent. of liquid oxygen. This is conveyed in Dewar vessels to the proximity of the rock face, where it is poured over a paper cartridge containing carbonaceous matter of different kinds, such as carbonised cork, or wood-meal, with or without the addition of petroleum. The impregnation of this cartridge with the liquid oxygen is carried out in a cylindrical vacuum-jacketed vessel, care being taken that the impregnated cartridge contains sufficient oxygen to ensure the total combustion of the carbonaceous filling and of its paper envelope. The impregnated cartridges are then pushed into the bore hole, where they are detonated by means of the usual detonator, or in some cases simply by a gunpowder fuze. According to another method the cartridges are impregnated in the bore-hole itself. The violence of this explosive is comparable with that of the more intense blasting agents, but much depends upon the manipulative skill of the workers.

For industrial purposes, since the war, there has been a general reversion to explosives based on nitrates, but it is understood that liquid air explosives are still used in Germany to a limited extent, and that experiments are being made with them in certain French Departments. Their investigation is also being carried on by the United States Bureau of Mines, which has issued a preliminary bulletin on the subject.

Obituary.

PROF. F. A. BAINBRIDGE, F.R.S.

PROF. FRANCIS ARTHUR BAINBRIDGE passed away on October 27. His friends knew he was not well enough to carry on his usual busy life of teaching and research, but none foresaw that his life would be suddenly cut short by heart failure. He was only forty-seven years old and in the prime of his career. Our deep sympathy goes out to his widow and little daughter.

Prof. Bainbridge had for years been a man of poor physique, and it was a wonder to his friends how, in spite of frequent attacks of illness, he contrived to do so much useful work. He was modest and retiring, but his catholic interest in scientific work and in things in general made him a delightful and lovable companion. He was a skilful experimenter, a clear writer, and an excellent teacher. Such men we can ill spare. The book ("Essentials of Physiology") he wrote with the late Prof. Menzies is highly esteemed, and illustrates to the full the power he had of interesting his readers and of making crooked paths straight.

Prof. Bainbridge was born at Stockton-on-Tees, educated at the Leys School, and then at Trinity College, Cambridge. His medical studies were carried out at St. Bartholomew's, and after a brilliant academic career he filled several minor posts in that hospital. His early researches were carried out at University College. Among the positions he held were British Medical Research Scholar, demonstrator in pharmacology at St. Bartholomew's, Gordon lecturer on pathology at Guy's, Jenner Memorial student and assistant bacteriologist at the Lister Institute, later the professorship of physiology at Newcastle (1911), and finally, 1915, he returned to his old school, St. Bartholomew's, as university professor of physiology. At the outbreak of war he at once offered his services, received a temporary commission in the R.A.M.C., and had charge of a military hospital at Newcastle; he worked also on the action of poison gases at Millbank, and gave lectures on that subject in cadet training schools throughout the country; but the stress of work was too great, and his health broke down, so that he had to resign his commission. His devotion to duty of all kinds made him an example to us all. His honours included the F.R.C.P. and F.R.S.

Instead of attempting to give a list of Prof. Bainbridge's published researches, I will quote from a document drawn up by Prof. Starling which admirably gives the main features of his work; he has allowed me to use it:—

"A very large proportion of Prof. Bainbridge's work represents important additions to knowledge which have found a permanent place in the record of scientific discovery. In pathology his most important work was in the differentiation of the different types of para-typhoid bacilli, a study which has been carried very far in later years. It was, however, on the physiological side that his work was of most importance. In his researches on lymph formation he took up the question of the tissue lymph and defined for the first time the part played in lymph formation by the metabolism of cells. Working on the sub-maxillary gland and the liver, he pointed out the defects in the secretory theory and showed that all the results obtained might be explained as due to the production of metabolites in the cells and the consequent rise of osmotic tension in the tissue fluid which had the effect of attracting fluid from the blood vessels and adding to the lymph flow from the part. The question of the mechanism of urinary secretion was one which occupied him frequently through his scientific career. His earliest work, carried out with Beddard, consisted in a repetition of Nussbaum's experiments, avoiding many of the sources of fallacy which these contained. At first he was inclined to ascribe a secretory function both to glomeruli and to tubules, but later, in experiments carried out at Newcastle, he was led to adopt Cushny's view, in the support of which he brought forward many new and ingenious experiments. His work with Evans on the functions of the mammalian kidney fed with blood from a heart–lung preparation was, unfortunately, only in the nature of a preliminary communication, but the method promises to be of considerable value for the elucidation of many problems connected with urinary secretion. His work on the gall-bladder with Dale was a useful contribution to a department of physiology in which knowledge is very deficient.

"Most interest, however, attaches to his latest work on the circulation, and especially to the discovery of the relationship which holds between pressure on the venous side of the heart and the rate of the heart beat. Many attempts had been made to explain the acceleration of the pulse which occurs in exercise. The pace-maker itself is unaffected by the pressure in the auricular cavity, though a quickening of the pulse is one of the methods adopted by the organism for enabling the heart to deal with the greater inflow of blood into this organ which accompanies muscular exercise. Bainbridge showed that any rise of pressure on the venous side of the heart caused a quickening of the beat, partly by inhibition of the vagal tone, partly by reflex excitation of the accelerator mechanism. This condition is the converse of that which is expressed as Marey's law, a rise of pressure on the ventricular side tending to cause reflex slowing of the heart, and it is therefore described as 'Bainbridge's law.' The review of the whole subject of the physiology of exercise, which he undertook in writing a comprehensive monograph on the subject, suggested many new problems for work on the circulation, and he was making plans to attack these problems, partly alone, partly in conjunction with other physiologists, when his work was brought to a sudden and premature close; but he was happy in his work and in the planning of new researches, and he would be content that others should build on the foundations which he has laid down."

Prof. Bainbridge married in 1905 Hilda Winifred, daughter of the Rev. E. Thornton Smith. In his wife he found a companion keenly interested in his work, who, by her constant co-operation and care, enabled him to utilise his talents to the full, in spite of the disability of ill-health from which he suffered.

W. D. H.

DR. W. S. BRUCE.

THE untimely death on October 29, at the age of fifty-four, of William Speirs Bruce removes a leading oceanographer and the foremost British authority of his time on Polar regions. From the age of twenty-five Bruce had devoted practically his whole life to the exploration of Polar lands and seas, and had to his credit no less than twelve Arctic and two Antarctic expeditions. On the eve of completing his medical course at Edinburgh he sailed for the Antarctic in the Dundee whaler *Balaena* in 1892. The visit of this and other whalers was of course a commercial venture, and though Bruce was mainly occupied in assisting the crew in sealing, he found time to make many valuable observations in the north-western part of the Weddell Sea, the first scientific observations made in those regions for half a century. Returning home the following year, he became an assistant in the *Challenger* office, and later was in charge of the observatory on the summit of Ben Nevis until 1896, when at a few hours' notice he sailed in the *Windward* to Franz Josef Land with the Jackson-Harmsworth Polar expedition. For a year he assisted in the survey of the archipelago and made valuable collections, and he was present at the historic meeting with Dr. F. Nansen on his return from the Polar ocean. In 1898 Bruce sailed with Major A. Coats to Novaya Zemlya, Kolguev, and Hope Island, and later in the same summer with the Prince of Monaco to Spitsbergen. This was the first of many cruises with the Prince of Monaco, and laid the foundation of Bruce's wide and authoritative knowledge of Spitsbergen and its natural history.

Since his return from the Antarctic Bruce had never ceased urging the renewal of Antarctic exploration. The difficulties in awakening interest and raising the funds were great, especially for a man of Bruce's sensitive and retiring nature; but he was dauntless, as ever, in the pursuit of his aim. Largely through the liberality of the late Mr. James Coats, of Paisley, and Major Andrew Coats, but also by public subscription in Scotland, sufficient funds were raised, and in 1902 the Scottish National Antarctic Expedition sailed in the *Scotia* for the Weddell Sea, returning in 1904. The expedition, like all with which Bruce was associated, had no record-breaking aims except in the amount of scientific work to be accomplished. It devoted chief attention to oceanography, zoology, and meteorology. From all points of view it was a great success. By the unexpected discovery of Coats Land in lat. 74° S., some half-million square miles were added to the area of Antarctica. More than 10,000 miles of ocean were sounded and investigated, and collections were made in depths down to 3,000 fathoms. With the single exception of the *Challenger*, the *Scotia* collections have never been equalled in size and importance.

The expedition founded a meteorological station at the South Orkneys, which has since been maintained by the Argentine Government. Later attempts to organise a new Antarctic expedition failed for want of funds; but Bruce devoted himself to publishing the scientific results of the *Scotia* expedition and the foundation of the Scottish Oceanographical Laboratory in which he hoped to see the nucleus of a great oceanographical institute in Edinburgh. He also paid repeated visits to Spitsbergen, exploring and mapping in detail Prince Charles Foreland and taking a leading part in the economic development of the archipelago.

Bruce received the gold medal of the Royal Scottish Geographical Society (1904), the patron's medal of the Royal Geographical Society (1910), the Neill prize and gold medal of the Royal Society of Edinburgh (1911–13), and the David Livingstone centenary gold medal awarded by the American Geographical Society (1920). He was an honorary LL.D. of Aberdeen (1907), and was nominated by the Prince of Monaco a member of the committee of the Oceanographical Institute of Paris. His publications include "Polar Exploration" (1911), "The Weddell Sea: An Historical Retrospect" (1917), and many zoological and oceanographical papers in transactions of various societies and in the *Scotia* results.

No man could give himself more wholly to his work than Bruce did, or ask for less reward: publicity in any form was distasteful to him. He shrank from a life lived in public, but he was tireless in advancing Polar exploration even when he himself could not share in the expedition concerned. As a leader his indomitable spirit, invariable thoughtfulness for others, and cheery comradeship endeared him to all who served with him. His last instructions contain an appeal for further Antarctic work in their directions that after cremation his ashes are, if possible, to be scattered in the South Atlantic ocean about long. 10–15° E. in a high southern latitude, a region where exploration is much needed.

R. N. R. B.

PROF. F. E. ARMSTRONG.

THE death of Prof. F. E. Armstrong, which occurred after a very brief illness on October 28, deprives the University of Sheffield and the mining industry of a man who had already rendered great services to both and would have rendered many more had he lived. Born in 1879, the son of the Rev. R. A. Armstrong, a Liverpool Unitarian minister, Francis Edwin Armstrong was educated at Giggleswick School and University College, Liverpool. After spending some time in an electrical engineering firm, he became an articled pupil at the Tinsley Park Colliery, Sheffield, and afterwards assistant to Mr. J. H. W. Laverick, first in Derbyshire, and then in Warwickshire. In 1906 he went to Mexico to manage the collieries of the late Sir Ernest Cassel, and also visited and reported on mines in British Columbia. He rejoined Mr. Laverick in Sheffield, and in 1913, when acting as engineer to the Askern Coal and Iron Co., Doncaster, he was appointed to the chair of mining in the University of Sheffield, a position which he was exceptionally well qualified to fill, from his wide practical experience and theoretical knowledge. He was an admirable teacher, and had a great influence among mining men of the district in which he taught. In 1914 he volunteered for service with the Friends' Ambulance Unit, and took his motor-car to France, where he did useful work. In 1917 and 1918 he was head of the Labour Section of the Coal Mines Department of the Board of Trade, and in 1919 was appointed a member of the committee on miners' lamps. His work on this subject was of great value to the committee, and was still proceeding.

Kindly and generous, with an ardent love of justice, Prof. Armstrong was keenly interested in social, political, and religious questions, quietly and unobtrusively taking an active part in many movements of reform. He worked unselfishly, without thought of reward, and might have played an important part in the regeneration of the coal-mining industry. His early and unexpected death came as a shock to his colleagues and students, whose affection and esteem he had won by his kindness and high moral character.

C. H. D.

THE death is announced, on November 4, at thirty-seven years of age, of MR. HERMAN SLOOG, honorary secretary of the Groupe Inter-Universitaire Franco-Britannique, the Société des Ingénieurs Civils de France, and the Office National des Universités et Ecoles Françaises.

Notes.

THE DUKE OF YORK visited Sheffield on November 4 and inspected the works of Messrs. Hadfield, Ltd., and of Messrs. Joseph Rodgers and Sons, in addition to taking part in several functions in the city. In the course of the ceremony of opening a new power station for the electricity department of the Corporation of Sheffield, his Royal Highness referred to the intention of the Corporation to extend the system of electric lighting to the homes of the working people, and went on to say:—"The enormous power station which I am about to open, with all its mechanical and scientific devices, graphically illustrates the last word in economy, and must effectively cheapen production, improve trade, and thereby lessen unemployment. If, in order to meet competition in the markets of the world, manufacturers are forced to economise, it is, in my view, a better policy to seek a solution of the problem in scientific research than merely to fall back upon a curtailment of wages. In the future the prosperity of the manual worker depends so largely upon scientific development in our industries that I would appeal to our younger generation, in whose advancement I have so deep an interest, to let this truth sink well into their minds. If Britain is to maintain her proud position among the nations of the world, they must contribute their quota of science, as in the past generation was done by such men as Kelvin, Watt, Stephenson, and Hopkinson." It is appropriate that such words should be spoken in Sheffield, the principal industry of which, the manufacture of steels of high quality, owes more than most to scientific research. The manufacturers of the city have recognised this fact in their continued support of their University, which has been closely associated with the scientific advancement of industry; and at the present moment, when industry is faced with such a host of economic difficulties, the lesson is more than ever needed, and the wise warning of the Duke of York deserves the attention of all who look for an escape from the present condition of stagnation.

THE forthcoming Royal Society High Altitude Expedition to Peru sails in the third week of this month. The expedition proposes to study the adaptation of man to life at or above the altitude of 14,000 ft. As compared with other localities in which this type of work has been carried out, Peru possesses certain advantages:—(1) Being near the equator, the effects of altitude are less complicated by those of cold than in higher latitudes. (2) The Central Railway of Peru, the highest standard-gauge railway in the world, ascends the Andes to an altitude of 15,885 ft. (3) A mining population lives and works in localities situated above 14,000 and 16,000 ft., or even higher. It is alleged, for example, that the porters at the town of Cerro de Pasco, in the Andes, raise the ores 600 ft. from the mines by carrying loads of 160 lb. of mineral many times in the day. There is probably no other population which carries on such heavy work in so rare an atmosphere. Experimental methods for the study of the circulatory and respiratory systems have advanced so much within the last ten or twenty years that the time seems ripe for their application to the extraordinarily interesting problems which life at high altitudes presents. Donations towards the expenses of the expedition have been received from the following:—The Royal Society, the Harvard Medical School, the Carnegie Fund, the Moray Fund, the University of Toronto, the Rockefeller Institute, the Presbyterian Hospital, New York, Sir Peter Mackie, and Sir Robert Hadfield.

ON Wednesday, November 2, the Secretary of State for War (Sir L. Worthington Evans) unveiled in the examination hall of the Pharmaceutical Society, 17 Bloomsbury Square, a bronze relief portrait of the late Lt.-Col. E. F. Harrison, who played such a prominent and important part in combating the poison gas used by the Germans. The hall, lined with a guard of honour furnished by the University of London O.T.C., was filled with a distinguished company of pharmacists, representatives of the War Office, officers in uniform, and graduates of the University in their academical robes. The platform was occupied by the president of the society (Mr. E. I. Neathercoat), the president of the British Pharmaceutical Conference (Prof. H. G. Greenish), and the Secretary of State for War (Sir L. Worthington Evans). The president alluded to Harrison's scientific career, and paid a well-deserved tribute to his energy and ability. In 1915, at the age of forty-seven, he joined the Sportsmen's Battalion as a private, but soon after the first gas attack he was transferred to the Royal Engineers and became a leading spirit in the Anti-Gas Department. His work culminated in the production of the small box respirator, which proved so effective in counteracting the poison gas that no fewer than 22,000,000 were made, Harrison being finally appointed Controller of Chemical Warfare. The Secretary of State for War acknowledged in an admirable speech the debt that the War Office owed to pharmacy for placing at their disposal the benefits of its knowledge and the marvellous results of its investigations, and on behalf of every officer and man in the Army paid a tribute of respect and gratitude to Harrison, by whose devotion and self-sacrifice thousands of lives had been saved. Science had turned the poisoned arrows of the savages into the poison gas of civilisation, and might devise weapons more deadly still, so that the soldier's need for science grew greater every day. Sir L. Worthington Evans then unveiled the memorial, the guard of honour presenting arms, and the buglers of the Coldstream Guards sounding the "Last Post"—an impressive and touching finale to a ceremony marked throughout by reverent dignity and grace.

THE Radio New York Central Station, which is the most powerful transmitting station yet built, was opened on November 5 by President Harding sending a message to all the large radio stations in the world. After pointing out that such an achievement marks an epoch in the scientific development of radio communication, he said that the earnest hope of the American nation is that the peace which blesses their own land may presently become the fortune of all lands and peoples. The station belongs to the Radio Corporation of New York, which already possesses several stations capable of carrying Transatlantic traffic, notably with Great Britain, Norway, Germany, and France. These stations are said to be capable of transmitting automatically at speeds of fifty words per minute. In the new station six separate antennæ mounted on towers 400 ft. high radiate from a common centre. They are each equipped with their own 200-kw. alternator. When completed, the space occupied by the station and its radiating antennæ will be 10 square miles. It is said to be capable of transmitting at 100 words per minute. It can transmit and receive messages in all directions simultaneously. President Harding's radiogram was received by stations in Great Britain, Norway, France, Germany, and Australia, and doubtless by many others. According to the *Times*, the letters WQK are the call-letters of the new station. The frequency of the alternating-current supply is about 19,000. The wave-length used, one of the thirty-nine which have been allotted internationally to the United States, is 16,465 metres.

SECTION 1 (5) of the Safeguarding of Industries Act provided for the appointment of a referee by the Lord Chancellor to decide complaints against the inclusion or exclusion of articles from the Board of Trade's published lists of articles under the key industry part of the Act. The *Times* of October 27 contained an announcement that Mr. Cyril Atkinson, K.C., has been appointed. A day later it was announced that our Customs authorities had given notice that no further consignments of goods coming within the scope of the Act should be sent from abroad until further notice, as their staffs were inadequate to deal with the goods already lying at the docks awaiting examination. The worst prognostications of the opponents of the Key Industries Bill are thus justified. Leaving out of consideration altogether the utility of the measure, it cannot be denied that it was rushed through the Commons, where practically all amendments were brushed aside, and treated as a Money Bill, thus preventing discussion in the Lords. It is already unpopular among many manufacturers and traders, and has roused a strong feeling of resentment among scientific workers. Many complaints have been received by the Board of Trade, so that Mr. Atkinson will probably be kept busy. A deputation representing the British Association of Chemists, which was received at the Board of Trade on October 26 by Mr. P. W. Ashley, took exception to the inclusion under the Act of some hundreds of chemical products that are not made in this country at the present time, and to many other products that are deemed by the association to be outside the scope of the schedule of the Act.

THE Mount Everest Expedition returned to Darjeeling on October 25. Col. Howard Bury's last despatch to the *Times* gives an account of the journey from the base at Kharta, which occupied twenty days. The march from Kharta was up the Arun and Kaichu Valleys to Lumeh. Thence the route chosen was *via* the Quiok (Cuckoo) Pass and the Gadompa rope bridge over the Arun to Tinki Dzong and Khampa Dzong, which was reached on October 11. Messrs. Heron, Wheeler, and Raeburn then went south over the Serpola Pass and the Teesta Valley through Sikkim to Darjeeling, but, owing to the lack of transport on that route, Col. Bury and Mr. Wollaston had to take the main caravan back *via* Linghi and Phari. Heavy weather and much snow were encountered on this part of the route, but Darjeeling was reached without mishap. The season's work has been very satisfactory, and only bad weather prevented the climbers reaching a higher altitude on the possible route to the summit of Mount Everest which was found on the north-east. The coolies were a great success and gave no trouble. Many of them suffered no ill-effects at high altitudes, and have volunteered for next year's expedition. The surveyors under Major Morshead have mapped an area of more than 13,000 square miles, and Major Wheeler made a photographic survey of the whole of the Everest group. Important geological and biological collections have been made by Dr. Heron and Mr. Wollaston. The latter is also bringing back a large collection of seeds from the valleys round Mount Everest.

AT the meeting of the Royal Geographical Society on Monday the president announced that the members of the Mount Everest Expedition are now on their way home, and will be received at a meeting of the society in the Queen's Hall on December 20. Messrs. Mallory and Bullock, who climbed one of the north-eastern buttresses of Mount Everest to within some 6000 ft. of the summit, are satisfied that the actual configuration of the mountain should not prevent the top being reached. Next year's expedition is planned to leave Darjeeling about March 21 in order that May and June may be devoted to the climb, as these appear to be the best months. Col. Howard Bury is unable to resume the leadership next year, but some of the other members of this year's expedition will go out again. The climbing party is to consist of six men. Many of the Himalayan coolies employed this year have volunteered to return. The total cost of the expedition so far, excluding what the Government of India may have expended in survey, is about 5000*l*. The president paid a tribute to the Tibetan authorities for the great assistance they have shown to the expedition.

THE annual Huxley lecture of the Royal Anthropological Institute for the present year will be delivered by Mr. H. Balfour in the lecture-room of the Royal Society on Tuesday, November 29, at 8.30. The title will be "The Archer's Bow in the Homeric Poems."

THE following have been elected officers of the Cambridge Philosophical Society for the session 1921–22:—*President:* Prof. Seward. *Vice-Presidents:* Mr. C. T. R. Wilson, Dr. E. H. Griffiths, and Prof. Newall. *Treasurer:* Mr. F. A. Potts. *Secretaries:* Mr. H. H. Brindley, Prof. Baker, and Mr. F. W. Aston. *New Members of the Council:* Mr. H. H.

Thomas, Mr. R. H. Fowler, Mr. E. Cunningham, and Mr. T. C. Nicholas.

EVEN if the Oppau explosion had been heard in this country, the fact would have been very difficult to prove, and it is therefore not surprising that the Air Ministry should announce a negative result to their inquiries. The explosion took place at 6.32 a.m. (G.M.T.) on September 21, and should have been heard in England between 7 and 7.30 a.m. Only four out of forty-eight correspondents refer definitely to this time, "and there is little to indicate that the noises they mention differed from others which could not have been due to the explosion."

A SUM of 250,000*l.* has been allocated to forestry from the Unemployment Fund. The Forestry Commissioners who will administer this sum wish to direct attention to the grants that are offered, the object being the relief of the unemployed and the promotion of afforestation. As regards local authorities, a free grant of a fixed sum (approximately 60 per cent. of the labour bill) is obtainable for every acre planted. Provision has been made for assistance towards meeting unemployment by means of free grants to woodland owners who provide work for unemployed. In ordinary cases 3*l.* per acre is the sum available, but where the areas are covered with scrub the grant may amount to 5*l.* in all. Inquiries regarding grants, and offers of land for planting, should be addressed, for England and Wales, to the Assistant Commissioner, Forestry Commission, 1 Whitehall, London, S.W.1, and as regards Scotland, to the Assistant Commissioner, Forestry Commission, 25 Drumsheugh Gardens, Edinburgh.

ON November 2 the Natural History Museum Staff Association held a very successful and largely attended scientific reunion—the third and last for the current year—in the board room of the museum by permission of the Trustees. Many interesting specimens recently acquired by the museum were exhibited, the more important of them being a series of marine invertebrates from Japan collected and presented by Mr. Alan V. Insole, which included many rare and remarkable forms; the fœtal African elephant, the third known in point of smallness, presented by Mr. H. A. Hopwood; a series of minerals and rocks from the Simplon Tunnel, including fine crystals of purple anhydrite, presented by Mr. F. N. Ashcroft; and fossils, mostly ammonites, from a single bed of marl in Lower Lias at Charmouth. Lord Rothschild showed examples of melanic aberration in Lepidoptera, and considerable interest was taken in Mr. M. Maxwell's remarkable photographic enlargements of East African big game, especially those showing giraffes in full gallop. Dr. F. A. Bather gave a short lecture on "Tubular Quartzites and Sandstones."

A REPORT of the inaugural meeting of the Institution of Rubber Industry held on October 19 at the Royal Society of Arts appears in the *India-Rubber Journal* for October 22. Sir Henry Wickham, who in 1870 brought the first Hevea seeds from the banks of the Amazon to Kew, was the guest of the evening. After the address of the president, Mr. J. H. C. Brooking, Mr. H. Rogers, manager of Messrs. James Lyne Hancock, Ltd., gave an interesting review of the history of rubber manufacture. The firm mentioned was founded by the great English pioneer of the rubber industry, Thomas Hancock (1786–1865). The Indians of America were the first to use caoutchouc, and from them we get the term "India," while the word "rubber" is due to Priestley's use of the substance in 1770 for erasing pencil-marks. Up to 1840 only unvulcanised rubber was used. The credit of first producing rubber which would withstand changes in temperature without getting soft and sticky belongs to Charles Goodyer, an American, who died in 1861. In 1843 Hancock took out his patent for vulcanising by sulphur alone. This was twenty years after Macintosh had patented his method of rendering fabric impervious to rain and wind. Hancock was assisted in his development of the manufacture of rubber by his four brothers, one of whom, Walter Hancock (1799–1852), was a pioneer of steam road-cars.

IN the issue of *Discovery* for November Mr. F. W. Hall describes the excavations which have disclosed the buried Roman city of Timgad, or Thamugadi, as its founder called it, in Algeria, about a hundred miles from the northern coast and little more than twenty from the nearest French settlement at Batna. It can be compared only with Pompeii, but in some ways Timgad is even more Roman. Pompeii grew out of an old Oscan town, and its architects never had a free hand in laying it out, but Timgad, founded by the Emperor Trajan in A.D. 100, was systematically planned as a fortified frontier town to resist the attacks of the wild tribes of the south. It is built in the form of a Roman camp, a true square with an area of about 30 acres. But it is not quite symmetrical, and the avenue from east to west conforms to the alignment of the great road from Lambacsis to Theveste. Its roads, drainage system, and public baths were constructed with the efficiency which marks all Roman work; a fine system of public markets met the wants of trade, and a public library promoted intellectual culture. Its end came when in 533 Belisarius destroyed Vandal power by his victory near Carthage and, in alarm, the Berber tribes swept down from their mountains and destroyed it. Excavations by the French Government began in 1880, and have continued to the present time, throwing "a flood of light upon Roman life and history by disclosing the authentic features of a daughter city of Imperial Rome."

A LONG account, accompanied by a sketch-map, of the work of the Canadian Arctic Expedition of 1913–18 is given in the *Geographical Journal* for October by Mr. V. Stefansson. Apart from the anthropological and biological observations, which are not yet ready for publication, the main results include the rectification of the coast-line of Banks Island, Prince Albert Land, and Ellef Ringnes Island, and the discovery of two new islands in the Gustav Adolf Sea and one between Isachsen Island and Cape Thomas Hubbard. These islands have not yet received names. By a journey northward over the ice of the Beaufort Sea Mr. S. Storkersen proved the non-existence of the mythical Keenan Land by getting a sounding of more than 3000 metres on its site. It is of interest to note that during his journey Mr. Storkersen and his companions drifted on an ice-floe more than 450 miles during six months, but were unable to discover any definite current in the southern part of the Beaufort Sea; the direction of drift varied with the local winds. This absence of definite current precludes the feasibility of exploring the Beaufort Sea by an ice-bound drifting ship. On the other hand, Mr. Stefansson hopes on his next expedition to explore it by means of small sledge-parties travelling over the sea-ice and depending solely on seals for food.

"COULD the Drought of 1921 have been Forecasted?" is the subject of an article by Mr. C. E. P. Brooks in the *Meteorological Magazine* for September. The author suggests that while the abnormal weather of the past spring and summer in Europe is fresh in everyone's memory, it is an interesting exercise to apply the principles of the *Réseau Mondial*, dealing with the world's meteorology, and by constructing charts of pressure and temperature deviations from normal to attempt a prompt explanation. Charts have been constructed for the months of December, 1920, to June, 1921, comprising North America, the Atlantic, Europe, India, and much of Africa. For the period of the drought extending from February to June anticyclonic conditions prevailed generally over Europe and North America. The pressure attained its maximum near Valencia, where it was 6·2 mb. above the normal, whilst at Spitsbergen the deficiency was 6·5 mb. Temperature was slightly below the normal in the south, but much above the normal in the north. Most of the district covered by the chart suffered from drought. Especial mention is made of Exner's principle, which asserts that low pressure over the Arctic basin in winter is normally associated with high pressure over the Atlantic west and south-west of Ireland and with high temperature over the British Isles in the same season. The author extends Exner's discovery, and is of opinion that some idea of the rainfall of the spring and early summer in the British Isles may probably be obtained from a study of the pressures and temperatures of the Arctic basin during the preceding months. Low Arctic pressure is said to cause low British rainfall, and high Arctic pressure high British rainfall.

PROF. H. H. DIXON, of Trinity College, Dublin, has devised a handy method for the measurement of transparent microscopical specimens situated on the stage of any microscope possessing a reasonably good substage condenser. A small transparent screen, divided by sets of thin black lines into small squares, is held by a suitable adjustable folding stand so as to intercept normally the light falling on the plane mirror of the microscope. By a slight motion of the substage focussing adjustment the image (formed by the substage condenser) of the lines on the screen is brought into focus at the same time as the image of the specimen seen in the microscope. Of course the size of the intervals between the first images of the lines has to be measured once and for all, either accurately by means of a stage micrometer slide of the usual type, or approximately by means of some object of known dimensions. In order to keep the screen in a known position in successive measurements the top of it usually rests against the stage. The makers claim that the regular sub-division of the field by the images of the lines is of assistance in making accurate drawings of microscopic objects. As the result of tests, we can say that the arrangement fulfils all that is claimed for it. It is called the "Ghost Micrometer," and is made by Mr. G. H. Mason, 5 and 6 Dame Street, Dublin.

THE various theories of atomic structure current at the present time agree in ascribing the spectrum emitted by an atom to the electrons. If the electrons emit radiation independently of each other the separation in a magnetic field of the components of a spectral line should be proportional to the field, and deviations from this law may be taken as indication of some kind of coupling between the electrons. At the suggestion of Prof. Nagaoka, of the University of Tokyo, Mr. Y. Takahashi has measured the separations of a number of iron lines produced between nickel steel electrodes by the spark of an induction coil, in the field of an electromagnet capable of going to 37,000 gauss. The separation was observed by a Hilger echelon with a constant deviation spectroscope behind it. For the nine strong violet lines seven were found to give separations proportional to the field, while two gave larger separations in stronger fields. Of the weaker lines some give larger separations than usual, which are not proportional to the field. Both facts point to the existence of some mutual influence of the electrons on each other.

DURING the war a considerable area of Northern France and Belgium was entirely re-mapped, largely from aeroplane photographs taken by a camera rigidly fixed to the underside of the aeroplane. The method of using these photographs for map production is described in *Engineering* for October 21, in an illustrated article by Mr. R. B. Unwin. If the aeroplane were slightly tilted when the photograph was taken the result is a distorted view of the ground instead of a true map. In mapping from aeroplane photographs it is therefore necessary to form a "framework" on which to hang the photographs. The framework consists of a number of points, the exact position of which on the ground must be known, and they must be such as can be identified on the photographs. The original trigonometrical survey points were used as primary points, and as these were not sufficiently close to form a complete framework, intermediate points were fixed. These intermediate points were determined by the use of a plane table behind our lines, or if behind the enemies' lines, were deduced from the aeroplane photographs. At least four points are necessary, which were set out on a compilation diagram, and a tracing made and attached to a board which could be tilted. Lines were drawn on the negative joining the corresponding stations, and an enlarging camera was employed to project an image of the negative on the tracing. The board was then tilted until the image of the lines fitted those on the tracing, thus eliminating the effect of the tilt of the aeroplane. When sensitised paper was substituted for the tracing, the print obtained was free from distortion, and was used for plotting the map.

MESSRS. MACMILLAN AND CO., LTD., are issuing immediately vol. I of "The Palace of Minos," a comparative account of the successive stages of the early Cretan civilisation, as illustrated by the discoveries at Knossos, by Sir Arthur Evans, price six guineas net. The volume deals with the Neolithic and Early and Middle Minoan Ages. It will be found to be an indispensable preliminary to the study of Mycenæan Greece, the culture of which is the outgrowth of the earlier Minoan stages of Crete.

SIR WILLIAM TILDEN and Prof. J. C. Philip are editing for Messrs. G. Routledge and Sons, Ltd., a new series entitled "The Twentieth-Century Chemistry," the aim of which is the production of readable and interesting books which, without being exhaustive monographs, will furnish advanced students of chemistry with a complete survey of the present state of knowledge and opinion in each branch of the science.

MESSRS. G. BELL AND SONS, LTD., are to publish at an early date a translation, by L. Taverner, of "An Introduction to the Study of Metallography and Macrography," by L. Guillet and A. Portevin. The work will contain an introduction by Prof. H. C. H. Carpenter.

Our Astronomical Column.

THE FRENCH WIRELESS TIME-SIGNALS.—These signals are now so widely used by astronomers for time-determination that it is well to direct attention to an alteration which is announced in *Circulaire No. 4, Bureau Internationale de l'Heure*. The signals have hitherto been sent out at definite mean times; but the time is determined by meridian transits of block-stars, which necessitates the use of a sidereal clock, the error of which must be determined, and that of the mean-time clock inferred by comparison. It is now announced that, in order to avoid this transformation, beats 1 and 300 of the rhythmic signals will be sent according to Greenwich sidereal time, and the interval between the beats will be 49/50 of a sidereal second (roughly 44/45 of a mean second, instead of 49/50 as formerly).

A detailed list of the mean times of the signals, both old and new, and of the nature of the emissions used in each, is given in the circular; there are several changes. It is clear that a signal cannot be sent both at a constant mean time and a constant sidereal time: a different sidereal minute will be concerned every day. For some time after the change the signals will be preceded by the words "sidereal time," but it is not clearly explained how the actual sidereal minutes will be made known.

The new system will come into use on November 15, and will be experimented on up to the time of the meeting of the International Astronomical Union, when the question will be further discussed in the light of the experience gained.

PROPER MOTIONS OF LONG-PERIOD VARIABLE STARS.—*Astronomical Journal*, Nos. 784 and 791, contain determinations of the proper motions of thirty-seven long-period variable stars made at Mount Holyoke College by Misses Young, Farnsworth, and Jenkins. Two series of plates were taken, the time-interval ranging from nine to nineteen years. The proper motions are referred to the faint background stars, which were previously tested with a stereo-comparator, to exclude any that showed appreciable motion.

There is thus a certain amount of systematic shift in each field, arising from the solar motion, but it is unlikely to exceed 0·01″ per annum in any case. The deduced annual motion for each star is:—RR Androm., 0·060″; Y Androm., 0·021″; T Camelop., 0·016″; V Orion., 0·028″; Y Monoc., 0·031″; R Gemin., 0·022″; T Gemin., 0·029″; U Cancri, 0·019″; S Hydræ, 0·037″; T Hydræ, 0·021″; T Virg., 0·011″; S Sagittar., 0·013″; χ Cyg., 0·038″; Z Cyg., 0·018″; W Capric., 0·027″; T Delph., 0·023″; RR Aquar., 0·052″; S Ariet., 0·091″; R Ceti, 0·022″; V Gem., 0·040″; RU Herc., 0·006″; S Scorp., 0·037″; W Ophi., 0·030″; RS Herc., 0·042″; SY Cyg., 0·030″; Z Aquil., 0·023″; S Peg., 0·066″; S Aurig., 0·042″; U Puppis, 0·039″; V Leo., 0·023″; U Lib., 0·056″; U Serp., 0·049″; Y Aquar., 0·038″; T Capric., 0·014″; U Aquar., 0·020″; and R Peg., 0·038″.

The mean value is 0·032″, implying distances of the order of 100 parsecs. The sun at this distance would have magnitude 10·5, so that the stars in question have absolute magnitude (at maximum) somewhat brighter than the sun's. They are, therefore, not extreme dwarfs, but neither are they extreme giants of the type of Betelgeux. The only long-period variable with a considerable proper motion is Mira Ceti, for which Boss's value is 0·237″.

THE LAST GLACIAL EPOCH.—The Ice ages have an astronomical aspect, so that reference may be made in this column to a paper by Mr. C. E. P. Brooks (Quarterly Journal R. Met. Soc., July, 1921) which assigns the date 30,000 to 18,000 B.C. for the last great glaciation in North-West Europe (Ireland, Scotland, Scandinavia, and the Baltic). Some remains of glaciation continued until 6000 B.C.; after some intermediate phases the date 1800 B.C. to A.D. 300 is assigned to the Peat-bog Phase, when the climate was cooler and moister than at present. Thes changes are attributed chiefly to alterations of elevation; increased elevation has the double effect of producing glaciation on land and of closing the Straits of Dover and other channels for the warm currents from the Atlantic. Mr. Brooks also assigns considerable weight to the 1800-year cycle in tide-generating force announced by Mr. O. Pettersson. But it is very doubtful whether this cycle will explain any appreciable climatic changes. It does not mean that all the tides are higher at one of these 1800-year maxima, but merely implies that there are a few tides in the year very slightly in excess of those at other epochs, just as there are total solar eclipses of maximum duration at something like the same interval.

Since Mr. Brooks gives evidence of an approach to simultaneity in climatic changes in Europe and America, some cosmical cause is indicated; but the suggestion of a long-period variation in solar output (analogous to the short-period variations announced by Mr. Abbot) seems more hopeful than the tidal cycle.

The Structure of Adularia and Moonstone.

By DR. A. E. H. TUTTON, F.R.S.

A NEW and very promising scientific journal—Science Reports of the Tôhoku Imperial University, Sendai, Japan, vol 1, No. 1—printed in English at Tokio, has recently been issued (June, 1921). It contains the results of an investigation, commenced at Cambridge, by Mr. S. Kozu, who was assisted later in Japan by Y. Endo and M. Suzuki, on the X-ray analysis of adularia felspar from the St. Gotthard and the moonstone of Ceylon and Korea, and on the influence of temperature on their atomic arrangements. Adularia and moonstone are supposed by mineralogists to be solid solutions of varying proportions of orthoclase (monoclinic potash felspar, $KAlSi_3O_8$), albite (triclinic soda felspar, $NaAlSi_3O_8$), and anorthite (triclinic lime felspar, $CaAl_2Si_2O_8$), the moonstone of Ceylon being regarded as a variety of adularia exhibiting the property known as "schillerization," the exhibition of a pearly, sub-metallic, or bronze-like lustre. But determinations made in Cambridge of the refractive indices and optic axial angles of the monoclinic felspars by Mr. Kozu, the results of which were communicated to the Mineralogical Society in 1916, showed that these constants are much higher for moonstone than for adularia. This is due to different molecular structure corresponding to a different chemical composition, the optical constants always increasing with the presence of soda, of which moonstone contains nearly three times as much as adularia.

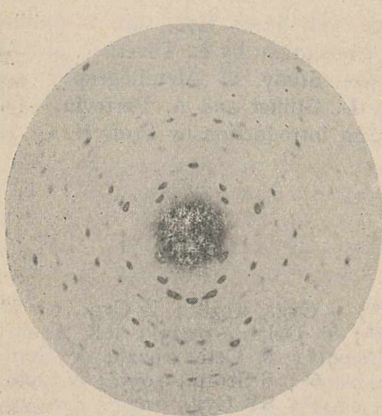

FIG. 1.—Adularia from St. Gotthard, plate parallel (001).

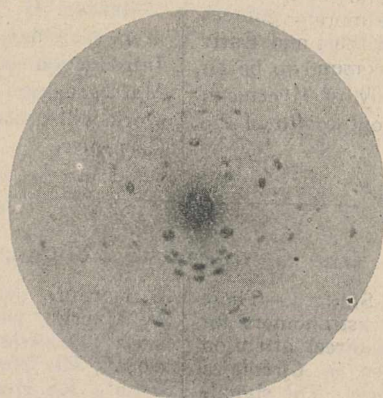

FIG. 2.—Moonstone from Ceylon, plate parallel (001).

When the crystals were submitted to X-ray analysis by the Laue radiographic method, and the radiograms compared, very remarkable differences were observed. In the case of adularia all the spots were arranged on single circles of the stereographic projection of the radiogram, or, in the case of the actual photograph, on ellipses, passing through the centre of the figure, while those of moonstone were in double circles, as will be clear from the two reproductions of the photographs themselves in Figs. 1 and 2, and of their stereographic projections in Figs. 3 and 4.

This indicates that adularia consists of a single kind of space-lattice and forms a homogeneous solid solution, while moonstone consists of two kinds of space-lattice, the atoms being distributed in two different arrangements. The two components of moonstone are not, however, pure potash felspar and pure soda felspar, but two kinds of solid solutions, both having monoclinic symmetry.

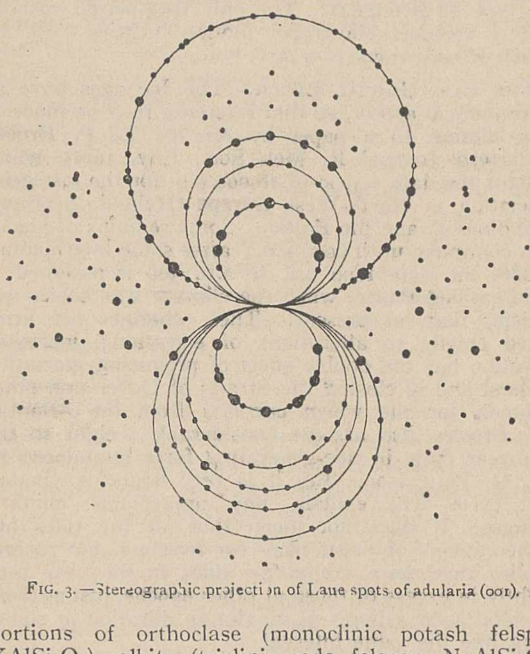

FIG. 3.—Stereographic projection of Laue spots of adularia (001).

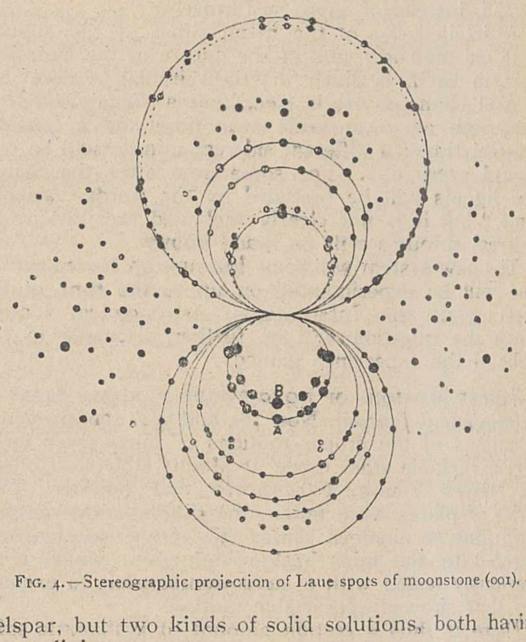

FIG. 4.—Stereographic projection of Laue spots of moonstone (001).

On heating the crystals a most interesting thing happens. Nothing occurs up to 500° C., but then the circles of spots corresponding to the structure richer in soda begin to decrease in intensity and also continuously approach in position those of the arrangement richer in potash, until at about 1060° C. the two series of circles overlie one another exactly and become identical with those of the latter arrangement and similar to those of adularia. At 1190° C. melting begins, and the spots disappear. Moreover, as the temperature approached 1000° C. the schillerization disappeared. Hence the schillerization of moonstone is due to the fact that interference of ordinary light rays is produced by the presence of the two different space-lattices corresponding to the two arrangements.

Similar investigation of the moonstone found ten years ago in Korea led to analogous and confirmatory results. This moonstone proves to be more sodic and calcic than the Cingalese variety, and the two sets of spots which its radiograms exhibit, corresponding to two distinct sets of space-lattice net-planes, are given by plates parallel to the side pinakoid faces, whereas in the case of the moonstone from Ceylon they were afforded by plates parallel to the basal plane. On heating the crystal the schillerization disappears, and the two systems of spots become coincident at a temperature of 790° C., very much below the melting-point of the crystal, which lies between 1100° and 1200° C.

These Japanese investigators would thus appear to have proved that in the cases of moonstone of Ceylon and Korea, the beautiful schillerization appearance is not due to the presence of inclusions and lucunæ, as formerly believed, but to the existence of two distinct, yet closely similar, space-lattices, which are so arranged with respect to each other as to cause the rays of ordinary light to interfere. It is very gratifying that the work commenced by Mr. Kozu in Cambridge has led to such interesting and important results.

Tissue Metabolism.

OXIDATION AND OXIDATIVE MECHANISMS IN LIVING TISSUES.

AT a joint meeting of the Sections of Chemistry and Physiology during the recent meeting of the British Association at Edinburgh a discussion on the above subject was opened by Prof. F. G. Hopkins, who commenced by pointing out that the essential task of biochemistry is dynamic. The task of investigation is difficult because the living structure is easily destroyed. In spite of this obstacle considerable progress has been made by various methods.

In the oxidation of fatty acids it is now recognised that the oxidation takes place in the β-position. Knoop investigated this problem by loading the fatty acid molecule with a non-oxidisable group, namely, a phenyl group. The side chain of fatty acid is oxidised so that all the substances administered reappeared as two substances. All those with an odd number of carbon atoms were oxidised to benzoic acid which was found in the urine combined with glycine as hippuric acid, whilst all those with an even number of carbon atoms were oxidised to phenylacetic acid, which was found combined with glycine as phenylaceturic acid. This result suggested that two carbon atoms were removed at each stage, thus there was no indication that by removal of one carbon atom the series with odd or even carbon atoms could be changed from one to the other.

Embden perfused fatty acids through the surviving liver, and found that all those with an even number of carbon atoms passed through the four-carbon stage whilst those with an odd number of carbon atoms did not pass through that stage. This, again, indicated that a single carbon atom was never removed, so that the odd and even carbon chains were not interconvertible.

The fate of the two carbon atoms that are split off has not yet been determined. It is interesting to remember that large quantities of material are dealt with in this manner, and that more than three thousand tons of fatty acid are oxidised daily in the human body in this country.

It is probable that carbohydrates are not oxidised directly, but that hexoses are converted into lactic acid. In the study of this problem isolated muscles are useful because the functional condition of muscle can be tested by its ability to contract. The change from hexose to lactic acid is probably associated with the presence of hexose phosphate, a fact which links up the metabolism of higher organisms with the fermentation of sugar by yeast, in which hexose phosphate is an important intermediate stage.

Surviving muscle, in anaerobic condition, loses carbohydrate with the formation of lactic acid; when oxygen is readmitted the lactic acid disappears. The removal of lactic acid is not due entirely to oxidation, but about one quarter of the acid is oxidised, and three quarters are reconverted into glycogen. Associated with these changes it can be shown that muscle contraction can be divided into at least two stages, one in which no oxidation occurs, and a later stage in which recovery is associated with the disappearance of oxygen.

The fate of proteins is that they are resolved into their constituent amino-acids, and the oxidation of these individual acids must be investigated. The result of disease, and of the administration of drugs, is to cause the appearance of intermediate products from which one learns that the amine group is removed by oxidation giving rise to keto-acids. The behaviour of acids with special groups in them furnishes further information. In dogs kynurenic acid is the end product of oxidation of tryptophane. If indole lactic acid is administered it is found to be toxic, and it does not give rise to kynurenic acid. The corresponding keto-acid is not toxic, and gives rise to kynurenic acid, showing that in this case the amine group is removed from tryptophane by oxidation giving rise to the keto-acid, and not by hydrolysis giving indole lactic acid as the intermediate substance.

It is the outstanding feature of oxidation in living organisms that they can take in molecular oxygen and combust material at a temperature of not more than 38° C. which are not combusted by molecular oxygen at moderate temperatures outside the body. All cells contain autoxidisable substances with the apparent formation of peroxides. Oxidising enzymes are found in many cells, some of which, however, need the presence of a peroxide whilst others apparently can form their own peroxide. In plants the peroxide-forming substances are probably something of a catechol nature. The oxidases are usually studied by the use of colour-forming indicators.

Hydrolytic oxidation and reduction may also occur. For instance, milk does not act by itself on acetaldehyde or on methylene-blue, but in a mixture of these two milk causes an oxidation of acetaldehyde and reduction of methylene-blue. This is analogous to the Cannizzaro reaction, where two molecules of benzaldehyde react, one being reduced to benzyl alcohol and the other oxidised to benzoic acid. For this type of reaction it is necessary to have an activation of hydrogen with a hydrogen acceptor, so that the oxygen of water is set free to produce oxidation of some other substance.

Prof. Hopkins has lately isolated an autoxidisable substance from a number of tissues. It is a dipeptide containing glutamic acid and cystein. This peptide exists in two forms, one oxidised, in which two molecules of dipeptide unite through their sulphur atoms to form a double molecule. The double molecule is a hydrogen acceptor whilst the single molecule sulphhydrate is a hydrogen donator. This reversible reaction allows the dipeptide to act as an intermediate substance in tissue oxidation, so that the rate of the double reaction may be twenty times as fast as the rate of oxidation in the absence of the dipeptide. The reduction of the disulphide to sulphhydrate requires the presence of a specific tissue enzyme.

The nature of the hydrogen donators in the tissue is not determined, but lactic acid is one of them, with the formation of pyruvic acid.

In his concluding remarks Prof. Hopkins appealed to younger chemists to take an interest in the problems of metabolism as their solution requires chemically trained minds. He pointed out that the reactions which take place in living tissues are not different from those which take place in the laboratory, but that they take place under different conditions. In living tissues catalysts play an important part, and chemical science will not be complete until the nature of catalytic reactions are explained.

A number of speakers took part in the debate, and the participation of chemists in biological work was urged by several speakers.

PHOTOSYNTHESIS.

Following the discussion on oxidative mechanisms, a paper by Prof. E. C. C. Baly, Prof. I. M. Heilbron, and Mr. W. F. Barker was read on the synthesis of formaldehyde and carbohydrates from carbon dioxide and water. This study was the outcome of an investigation into the combination of hydrogen and chlorine under the influence of light. It was found that the rate was not proportional to the intensity of light. It was suggested that the infra-red oscillation frequencies of hydrochloric acid contained some frequencies characteristic of chlorine, thus the first-formed hydrochloric acid could autocatalytically activate more chlorine.

Carbon dioxide absorbs short wave-lengths in the ultra-violet, but it is not affected by visible light. By passing a current of carbon dioxide through water exposed to ultra-violet light it is possible to show the formation of formaldehyde. The previous experiments of Moore and Webster required the presence of an inorganic catalyst, but their failure to show formaldehyde in the absence of the catalyst was probably due to too rapid polymerisation of the formaldehyde. The stirring effect of carbon dioxide passing through the fluid allows some of the formaldehyde to escape polymerisation.

The visible rays require a photocatalyst with an infra-red vibration of the same frequency as the carbon dioxide. Chlorophyll absorbs visible light, and as it forms a compound with carbon dioxide it can pass on the trapped energy to the carbon dioxide. Malachite-green, methyl-orange, and other dyes which can combine with carbon dioxide likewise catalyse carbon dioxide, so that formaldehyde is formed by the action of visible light.

Similarly polymerisation of formaldehyde requires a coloured substance which can unite with formaldehyde.

The photo-equilibrium of

hexose ⟶ carbon dioxide
 \ /
formaldehyde

is difficult to demonstrate because formaldehyde is oxidised to formic acid by hydrogen peroxide, but the reactions of carbon dioxide ⟶ formaldehyde and formaldehyde ⟶ sugar are both catalysed by pigments in visible light.

Formaldehyde is not detectable in plants because of its rapid removal. The chlorophyll absorbs the rays which decompose sugar, hence the above equilibrium becomes

hexose carbon dioxide
 \ /
formaldehyde

Melanesian Land-tenure.

AT a meeting of the Royal Anthropological Institute held on October 11 Dr. W. H. R. Rivers, president, gave an account of the Melanesian system of land-tenure. He described the nature of the ownership of land in two patrilineal societies in Melanesia, Ambrim in the New Hebrides, and Eddystone Island in the Solomons, and showed that its essentially communistic character agreed with the account given by Codrington of the land-tenure of the matrilineal parts of the archipelago. This close agreement, contrasting with the great diversity of other aspects of Melanesian culture, was held to indicate that the communal ownership of land was an early, though not necessarily the earliest, feature of Melanesian society which has been little affected by the many influences to which the general diversity is due.

The fact that chiefs in Melanesia have no special privilege in relation to land, and may even be wholly landless, supports this conclusion, for there is reason to believe that the present chiefs of Melanesia are the descendants of relatively late immigrants.

The ownership of trees, apart from that of the land on which they grow, and the different laws of inheritance to which the two kinds of property are subject were described, as well as the customs by which the produce of certain trees is assigned to individual use by means of religious ceremonial. These customs were explained as concessions made to immigrants by the indigenous owners of the soil, who, while denying to strangers all rights in the land itself, allowed them to own trees and transmit them to their children. It was suggested that in some cases, and especially when individual ownership or usufruct has a religious sanction, the trees concerned may have been introduced by immigrants. The whole situation in relation to the ownership of trees and land was regarded as a characteristic instance of a compromise formation by which was solved a conflict between the communistic sentiments of an indigenous people and the individualism of immigrants.

University and Educational Intelligence.

BRISTOL.—The Imperial Tobacco Co. (Great Britain and Ireland), Ltd., Bristol, has contributed the sum of 10,000*l.*, and Mr. C. H. Baker the sum of 5000*l.*, to the fund now being raised for the development of the University.

CAMBRIDGE.—The University has presented an address to Dr. G. D. Liveing, St. John's College, formerly professor of chemistry, to commemorate the fact that he has kept by residence every term in the University for the last seventy-five years. Dr. Liveing graduated as eleventh wrangler in 1850, and was top of the First Class in the Natural Sciences Tripos in 1851, the first year in which the examination was held. He became fellow of St. John's College in 1853, and professor of chemistry in 1861.

Mr. J. M. Wordie has been elected to a fellowship at St. John's College. Mr. Wordie accompanied Sir Ernest Shackleton to Antarctica as geologist, and recently was a member of a scientific excursion to Jan Mayen Island, where he climbed the Beerenberg.

Prof. A. C. Seward is lecturing on Greenland to the Cambridge Philosophical Society on Monday, November 14.

Statutes have now been approved for the research degrees of M.Sc. and M.Litt. These involve only two years' post-graduate residence as against three years required for the Ph.D.

LEEDS.—On October 25 the University joined in the sexcentenary commemoration of Dante's death by a lecture delivered in the Great Hall by Prof. Grant on "Dante's Conception of History." Prof. Grant laid stress on the interest which Dante took in the historic past of mankind so far as he knew it—a characteristic which marked him off from the other great poets of Europe. His relation to pagan antiquity was examined and the true character of the Italian renaissance was deduced from it. The University sent a letter written in Latin to the citizens of Bologna on the eve of the celebrations expressing homage to the memory of Dante.

On November 3 the new education wing was opened by the Chancellor of the University, the Duke of Devonshire. In the evening a conversazione was held in the main buildings of the University. The proceedings commenced with a reception in the Great Hall by the Chancellor, the Pro-Chancellor (Mr. E. G. Arnold) and Mrs. Arnold, and the Vice-Chancellor (Sir Michael Sadler) and Lady Sadler, after which the visitors, numbering about a thousand, dispersed along three routes to inspect the numerous experiments and exhibits displayed in the various departments of the University. In addition to ordinary departmental displays, there were two special exhibitions, one of which was devoted to "Bacteria and Human Welfare." A large number of microscopic preparations were on view illustrating the bearing of bacteriology on agriculture, horticulture, the leather industries, human pathology, and public health. The other display, described as the Yorkshire Studies Exhibition, was the outcome of a joint contribution of several departments of the University, including geology, agriculture, geography, and history. Both naturalistic and humanistic studies were well illustrated, and contained much matter for guidance for present and future research on the region.

IN connection with the Institute of Chemistry a lecture on "Modern Applications of Chemistry to Crop Production" will be delivered by Dr. E. J. Russell in the Chemical Lecture Theatre of King's College, Strand, at 8 o'clock on Monday, November 14. The lecture is open to all fellows, associates, and registered students of the institute and to all chemical students in recognised colleges.

NOTWITHSTANDING the financial embarrassments of modern universities, to which repeated allusion has been made in these columns, the Lords Commissioners of the Treasury in their review of the estimated expenditure for 1922–23 have decided to reduce the annual grant-in-aid of university education from 1,500,000*l.* to 1,200,000*l.* It appears that the latter sum represents the amount of grant already allocated to the various university institutions in the form of *annual* grant. Accordingly, this sum will not be reduced, but other and additional grants which may have been made, amounting in the aggregate to 300,000*l.*, will be discontinued. This is an unfortunate decision, and one which will be viewed with dismay by those who have to finance the modern university. It will undoubtedly react adversely upon the efficiency of the universities, and, in particular, lead to a further delay in putting the salaries of university teachers upon a sound footing.

THE Royal Technical College, Glasgow, has now completed the one hundred and twenty-fifth year of its existence, and the annual report recently issued by the governors illustrates clearly the impetus which whole-time study has received during the past few years. The total number of students in attendance during the past year was 5646, practically the same as for the previous session, but the proportion between day and evening students has changed considerably. Moreover, the day students, who numbered 1290—an increase of 155—contributed roughly two-thirds of the total student-hours registered in the college, as against a little more than half the total for the previous session. Chemistry, with an enrolment of 1218 day and 478 evening students, heads the list of student enrolments by subjects, but mathematics, natural philosophy, mechanics, and mechanical and electrical engineering have each attracted more than a thousand entries. The financial situation is not so satisfactory, the year's working showing a deficit of nearly 1000*l.* Of the available income of 70,697*l.*, more than a quarter comes from students' fees, about one-sixth from donations and endowments, and a similar fraction from the Treasury, which includes a non-recurrent grant of 4000*l.* The balance was provided by grants from the Scottish Education Department. Noteworthy events of the past session were the establishment of a school of pharmacy in the college, and an anonymous gift founding a research scholarship of the annual value of 200*l.*, mainly for engineers and metallurgists.

RELIEF work among students in Austria was started by the Friends Relief Mission early in 1920, and the acute distress of many Austrian professors and lecturers was the occasion for the formation of a Vienna University Relief Committee, for which funds were subscribed by British universities. In July of the same year the Imperial War Relief Fund agreed to undertake the appeals to universities in the British Isles on behalf of the professors and students of Central Europe, and an inter-university committee was formed. Its appeal met with a generous response—some 22,000*l.* being subscribed in cash and gifts in kind. It is thought, however, that the appeal has not reached many of the senior members and graduates of our universities, and pamphlets descriptive of conditions among professors and lecturers in Austria have been issued in the hope of stimulating further generosity. During the first few months of this year free rations of food were supplied to a number of professors of Vienna University and officials of the State museums and their dependents, several hopelessly inadequate pensions were augmented by monthly grants of 1*l.*, and grants were also made to enable the more needy to purchase clothing. In order to continue this work, a sum of 10,000*l.* is estimated as necessary for the year 1921–22, at the end of which period relief work will probably come to an end. Subscriptions should be marked "Professors" and sent to the Organising Secretary, Universities Committee, Imperial War Relief Fund, Fishmongers' Hall, E.C.4; gifts in kind and worn clothing marked "Universities," should be sent to the Friends Emergency and War Victims Relief Committee, 5 New Street Hill, E.C.4, and notification given to the Organising Secretary; gifts of books should be sent to Mr. B. M. Headicar, Universities Library for Central Europe, London School of Economics, Clare Market, W.C.2.

Calendar of Scientific Pioneers.

November 10, 1832. Johann Gaspar Spurzheim died.—The disciple of and fellow-worker with Gall, the founder of cerebral physiology, Spurzheim studied medicine in Vienna, and with Gall published "Anatomie et Physiologie du Système nerveux en générale et du Cerveau en particulier."

November 10, 1852. Gideon Algernon Mantell died.—Especially successful in the discovery and description of fossils of the South Downs, Mantell was a surgeon by profession and practised at Lewes, Brighton, and Clapham. His collections are preserved in the British Museum and his drawings in Yale University.

November 12, 1793. Jean Sylvain Bailly died.—Originally intended for a painter, an acquaintance with Lacaille led Bailly into astronomical studies, and in 1763 he became a member of the Paris Academy of Sciences, establishing his reputation by a memoir on Jupiter's satellites. Later on he published a history of astronomy. A promoter of the French Revolution, the day of the storming of the Bastille, July 14, 1789, he was chosen mayor of Paris. His action at the Champs de Mars, July 17, 1791, lost him his popularity, and two years later he perished beneath the guillotine.

November 13, 1802. André Michaux died.—Acquiring a taste for botany from his father, Michaux studied under Jussieu, and travelled in Spain, Persia, and North America. He died at Madagascar while on a journey to Australia. The genus Michauxia is named after him.

November 14, 1716. Gottfried Wilhelm Leibniz died.—Born in Leipzig towards the end of the Thirty Years' War, Leibniz was the son of a professor of moral philosophy. During diplomatic missions to France and England he became acquainted with Huygens, Boyle, and Newton, and it was through Huygens he was led to study geometry. In 1676 he became librarian to the Hanoverian family, a post he held until his death. Equally eminent as a philosopher and a mathematician, he is recognised as one of the discoverers of the infinitesimal calculus, and the inventor of the accepted notation. The inauguration of the Berlin Academy of Sciences was due to him, and he became its first president.

November 15, 1630. Johann Kepler died.—Immortalised by his discovery of the laws of planetary motion, Kepler "may be said to have constructed the edifice of the universe." Taught astronomy at Tübingen by Maestlin, in 1593 he succeeded Stadt as professor of that subject at Gratz, and in 1600 joined Tycho Brahe at Prague, after Tycho's death becoming Court mathematician to the Emperor Rudolph II. From 1612 to 1629 he was at Linz, and the following year he died at Ratisbon. Applying the diverse talents of a singularly gifted mind to the study of Tycho's observations, Kepler in 1609 discovered the first two of the laws which bear his name, and in 1618 the third. His "Astronomia Nova" is among the classics of science. At his death his manuscripts were purchased by Hevelius, and are now preserved at Pulkowa observatory.

November 16, 1915. Raphael Meldola died.—For thirty years professor of chemistry at the Technical College, Finsbury, Meldola was especially known for his work on the chemistry of colouring matters. The friend of Darwin, he was also a naturalist, translated Weismann's "Theory of Descent," and was president of the Entomological Society. E. C. S.

Societies and Academies.

LONDON.

Royal Society, November 3.—Prof. C. S. Sherrington, president, in the chair.—T. R. **Merton**: The spectra of lead isotopes. Comparison of the wave-lengths of five lines in the spectra of ordinary lead and lead from Australian carnotite shows differences which are not constant, but vary for the different lines. The difference in wave-length observed for the principal line, $\lambda = 4058$ Å., is about two hundred times as great as that expected on theoretical grounds.—G. I. **Taylor**: Experiments with rotating fluids. Methods are described by which experiments on spheres, cylinders, and vortex rings moving through rotating fluids can be projected in a lantern and instantaneous photographs taken. If any small motion be given to a rotating fluid, the resulting flow will be such that concentrated masses of coloured liquid should be drawn out into thin films, parallel to the axis of rotation. Photographs taken by a camera placed vertically above a rotating basin of water show that the liquid moves in this way.—L. **Bairstow**, Miss B. M. **Cave**, and Miss E. D. **Lang**: The two-dimensional slow motion of viscous fluids. In its restricted form the equation of motion of a viscous fluid is $\nabla^4\psi = 0$, where ψ is Stokes's stream function. If the molecular rotation in the fluid be defined by $\xi \equiv \nabla^2\psi$, the equation of motion may be expressed alternatively as $\nabla^2\xi = 0$. The equation $\nabla^4\psi = 0$ is transformed by means of Green's theorem to a form in which the only unknown is the distribution of the ξ doublets on the boundaries. The strengths of the doublets are found by solving the resulting integral equation. An example shows the motion of fluid past a circular cylinder in an infinite parallel-walled channel. If d be the diameter of the cylinder, ρ the density of the fluid, ν the kinematic coefficient of viscosity, and U the velocity of the fluid in the centre of the channel at infinity, then, when the width of the channel is $5d$, the resistance per unit length of cylinder is $R = 7 \cdot 10 \rho \nu d U$. The value of Ud/ν to which this formula applies is not to exceed 0·2.—H. C. H. **Carpenter** and Constance **Elam**: The production of single crystals of aluminium and their tensile properties. The parallel portion of the test pieces of the sheet was 4 in. × 1 in. × 0·125 in., consisting of about 1,687,000. The conversion of this area into a single crystal involved heat treatment for six hours at 550° C., tensile stress of 2·4 tons per square inch, producing an average elongation of 1·6 per cent. on 3 in., and final heat treatment beginning at 450° and extending up to 600° C. On an average, one test piece in four produces a single crystal over its parallel portion, which frequently grows up into the shoulders of the test piece. The tenacity of single crystals varied from 2·8 to 4·08 tons per sq. in., while the extension on 3 in. varied from 34 to 86 per cent., according to the orientation of crystal relative to stress. Five types of specimens were recognised. Stress tests of test pieces consisting of two and three crystals show the strengthening influence of one crystal upon another. Experiments on round bars resulted in the production of single crystals in the parallel portion of bars 0·564 and 0·798 in. in diameter. The total volumes of the crystals were more than 1 cb.in., and more than 2 cb.in. respectively. The tensile properties were determined, and in every case a wedge-shaped fracture was produced, the bar diminishing principally in one dimension only. Remarkable twinning effects were observed in certain cases.—C. V. **Raman** and B. **Ray**: The transmission colours of sulphur suspensions. When a few drops of sulphuric acid are added to a dilute solution of sodium thiosulphate and a precipitate of sulphur gradually forms in the liquid, the suspension becomes practically opaque to the shorter wave-lengths first and the longer wave-lengths later, and afterwards regains its transparency partially, the shorter wave-lengths re-appearing first and later the longer wave-lengths. A theoretical explanation is offered.—E. F. **Burton** and Miss E. **Bishop**: The law of distribution of particles in colloidal solution.

PARIS.

Academy of Sciences, October 24.—M. Georges Lemoine in the chair.—P. **Painlevé**: Classical mechanics and the theory of relativity. A vigorous criticism of the Einstein theory, and especially of the assumptions contained in the ds^2 equation.—E. **Picard**: Some remarks on the theory of relativity.—A. **Haller** and Mme. P. **Ramart**: The reduction products of dimethylcampholamide. This amide, reduced with sodium and absolute alcohol, instead of furnishing the alcohol with more or less of the corresponding amine, gives only small quantities of the base, together with a substance not identified. The latter, when distilled, gives water and the nitrile of dimethylcampholic acid.—A. **Lebeuf**: Observation of the partial eclipse of the moon of October 16, 1921, made at the Besançon Observatory.—L. **Fabry**: Observation of the eclipse of the moon of October 16, 1921, made at Marseilles.—G. **Julia**: The permutability of rational substitutions.—T. **Varapoulos**: Increasing functions.—P. **Fatou**: A group of algebraic substitutions.—J. **Andrade**: Spiral cylinders and the hypothesis called *des techniciens*. A discussion of the theory of the balance spring of the chronometer.—M. **Riabouchinski**: The equations of motion of a fluid referred to mobile axes.—D. **Eydoux**: The necessity of the existence of a vortex vector in the movements of liquids, when there is a variation of energy along the trajectories of the various particles.—E. **Belot**: Contribution to the study of the formation of double stars, multiple stars, clusters, and planetary nebulæ.—A. **Danjon**: Photometric study of the eclipse of the moon of October 16-17, 1921. Two hundred and twenty-three observations were made at Strasbourg under good conditions, the object being to determine the curve of brightness (e) of the moon at the interior of the umbra, and of the penumbra as a function of the distance to the axis of the core. Sufficient results are given to fix the form of the curve: the theoretical values of log e in the penumbra are in good agreement with the observed values.—J. **Guillaume** and H. **Grouiller**: Observations during the eclipse of the moon of October 16, 1921, made at the Lyons Observatory.—M. **Holweck**: Critical potentials relative to the K and L_1 discontinuities of the absorption of aluminium. New determination of Planck's constant, h. The values obtained are 1560 volts for the critical potential K, 64 volts for L_1, and for h, $6{\cdot}55 \times 10^{-27}$.—P. **Pascal**: Magnetochemical research on constitution in mineral chemistry. The sulphur acids. The method of magnetic analysis has been used with success in the study of the constitution of organic compounds, and has now been employed in the examination of sulphur compounds. From the examination of sulphones, sulphonates, sulphates, hydroxylamine sulphonates, sulphites, and thiosulphates, some conclusions are drawn, the most important of which is that the magnetic properties of the sulphites are inconsistent with the unsymmetrical sulphonic constitution.—M. **Travers**: A new method for the estimation of silica. The silica is converted into potassium fluosilicate, and this titrated with standard alkali. The method has the advantage over the one in common use that neither the presence of alumina nor fluorides interfere.—M. **Grandmougin**: The identity of the dibromoanthraquinone which served for the synthesis of alizarine. Graebe and Liebermann, in their historical synthesis of alizarine, made use of a dibromoanthraquinone, the exact constitution of which has not up to now been fixed. The four homonuclear dibromoanthraquinones, the 1 : 2, 1 : 3, 1 : 4, and 2 : 3 isomers were prepared, and the last (2 : 3) found to be identical with the Graebe and Liebermann material.—Ch. **Maugin**: The possible utilisation of the diffraction diagrams of the X-rays for the complete determination of the structure of quartz.—A. **Nodon**: Experimental researches on the relations between terrestrial electrical phenomena, the state of the atmosphere, and solar foci.—Mlle. Marcelle **Guéraud**: The re-establishment of the genus Chlorocrepis in the tribe of the *Chicoraceae compositae*. *Hieracium staticefolium* was placed by Grisebach in a new species Chlorocrepis. Schultz regarded it as belonging to the genus Tolpis, and Villars placed it in the genus Hieracium, and this has been generally accepted. From the characters of the internal structure the author agrees with Grisebach, and is of the opinion that the genus Chlorocrepis should be reinstated.—R. **Souèges**: The embryogeny of the Boragacæ. The first steps of the development of the embryo in *Myosotis hispida*.—G. **Kühnholtz-Lordat**: The genetic phytogeography of the dunes of the Gulf of Lyons.—M. **Stoquer**: The influence of the temperature on the absorbent properties of soils.—J. L. **Lichtenstein**: The biology of *Habrocytus cionicida*.—F. **Angel**: The development of *Molge Waltlii* and its habitat in French Guinea.—E. **Fauré-Fremiet**: The laws of growth of the tissues constituting the fœtal lung of the sheep.—E. F. **Terroine** and H. **Barthélémy**: The existence of biometrical relations between the red frog, *Rana fusca*, and its eggs at the period of laying.—L. **Léger** and S. **Stankovitch**: The coccidiosis of the young of the carp.—L. **Blum**: A new group of diuretics; interstitial diuretics. Diuresis by the displacement of ions.—T. **Jonnesco**: The treatment of facial neuralgia by the resection of the cervico-thoracic sympathetic nerve.

SYDNEY.

Royal Society of New South Wales, September 7.—Mr. E. C. Andrews, president, in the chair.—G. H. **Halligan**: The ocean currents around Australia. The South Australian current, sweeping the whole of the southern shore of Australia from Cape Leeuwin to Tasmania, the East Australian current, flowing southwards, the Arafura Sea current, and the currents of the north-west and west coasts are described and traced. Immediate and systematic investigation of the ocean currents around Australia is advocated in the interests of both commerce and the safety of the mercantile marine.—J. H. **Maiden**: Records of Australian botanists. Brief sketches were given of the following:—William Anderson, surgeon of Capt. Cook's third voyage from 1776 to 1779; F. M. Bailey, who for forty years (1875-1915) held botanical appointments in Queensland; E. Betche, who was connected with the Sydney Botanic Gardens from 1881 to 1916; H. H. Bradley, famous for his horticultural work; and W. R. Guilfoyle, who successfully remodelled the Melbourne Botanic Gardens.

Books Received.

A First Book in Algebra. By Dr. F. Durell and E. E. Arnold. Pp. v+339+xli. (New York and Chicago: C. E. Merrill Co.)

A Second Book in Algebra. By Dr. F. Durell and E. E. Arnold. Pp. v+330+xliii. (New York and Chicago: C. E. Merrill Co.)

Plane and Solid Geometry. By Dr. F. Durell and E. E. Arnold. Pp. 503. (New York and Chicago: C. E. Merrill Co.)

A Catalogue of British Scientific and Technical Books, covering every Branch of Science and Technology, carefully Classified and Indexed. Prepared by a Committee of the British Science Guild. Pp. xviii+376. (London: British Science Guild, 6 John Street.) 10*s*. net.

The Rainbow Bridge. By R. Farrer. Pp. xi+383. (London: E. Arnold and Co.) 21*s*. net.

A Text-Book of European Archæology. By Prof. R. A. S. Macalister. Vol. 1: The Palæolithic Period. Pp. xv+610. (Cambridge: At the University Press.) 50*s*. net.

A Text-Book of Wood. By H. Stone. Pp. vii+240+41 plates. (London: W. Rider and Son, Ltd.) 21*s*. net.

Eléments d'Analyse Mathématique à l'Usage des Candidats au Certificat de Mathématiques générales des Ingénieurs et des Physiciens. Cours Professé à l'Ecole Centrale des Arts et Manufactures. By Paul Appell. Quatrième édition, entièrement refondue. Pp. x+715. (Paris: Gauthier-Villars et Cie.)

Contributions to the Biology of the Danish Culicidæ. By C. Wesenberg-Lund. (D. Kgl. Danske Vidensk Selsk. Skrifter, Naturv. og Mathematisk, Afd. 8, Raekke vii., 1.) Pp. 210+21 plates. (København: A. F. Høst & Son.) 29 krone.

University of Illinois Bulletin, vol. 13, No. 45: The Genus Phoradendron. By Prof. W. Trelease. Pp. 224+245 plates. (Urbana: University of Illinois; London: Wheldon and Wesley, Ltd.) 2 dollars.

Publications of the United States Naval Observatory. Second series, vol. ix (in four parts). Part 1, Results of Observations with the Nine-inch Transit Circle, 1903–1911. Reduced under the direction of W. S. Eichelberger. Pp. cdlxi+452+6 plates. (Washington: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 116: The Dipterous Genus Dolichopus Latreille in North America. By M. C. Van Duzee, F. R. Cole, and J. M. Aldrich. Pp. iv+304+16 plates. (Washington: Government Printing Office.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium, vol. 22, part 5: Flora of Glacier, National Park, Montana. By P. C. Standley. Pp. viii+235–438+plates 33–52+ix–xix. (Washington: Government Printing Office.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 72: The Owl Sacred Pack of the Fox Indians. By T. Michelson. Pp. 84+4 plates. (Washington: Government Printing Office.)

Papers of the Peabody Museum of American Archæology and Ethnology, Harvard University. Vol. 8, No. 2: Basket-maker Caves of North-eastern Arizona. Report on the Explorations, 1916–17. By S. J. Guernsey and A. V. Lidder. Pp. vii+121+44 plates. (Cambridge, Mass.: Peabody Museum.)

Memoirs of the American Museum of Natural History. New Series. Vol. 3, part 2: On the Structure and Relations of *Notharctus*, an American Eocene Primate. By W. K. Gregory. Pp. 45–244+plates 23–59. Vol. 3, part 3: *Camarasaurus*, *Amphicaelias*, and other Sauropods of Cope. By H. F. Osborn and C. C. Mook. Pp. 245–387+plates 60–85. (New York: American Museum of Natural History.)

Leland Stanford Junior University Publications: University Series. Fossil Fishes of Diatom Beds of Lompoc, California. By D. S. Jordan and J. Z. Gilbert. Pp. 44+29 plates. The Genera of Fishes. By D. S. Jordan. Part 2: From Agassiz to Bleeker, 1833–58. A Contribution to the Stability of Scientific Nomenclature. Pp. ix+163–284+xiii. Part 3: From Guenther to Gill, 1859–80. Pp. ii+285–410+xv. Part 4: From 1881–1920. Pp. 411–576+xviii. Contributions toward a Monograph of the Sucking Lice. By G. F. Ferris. Part 1. Pp. 51. Studies in Ichthyology: A Monographic Review of the Family of Atherinidæ or Silversides. By D. S. Jordan and C. N. Hubbs. Pp. 87+12 plates. The Electrical Charges of Atoms and Ions. By Prof. F. Stanford. Pp. 130. Fossil Fishes of Southern California. By D. S. Jordan and J. Z. Gilbert. Pp. 66+21 plates. Biological Sciences: Vol 1, No. 1. Scale Insects of the Santa Cruz Peninsula. By G. F. Ferris. Pp. 58. Vol. 1, No. 2. Report upon a Collection of Coccidæ from Lower California. By G. F. Ferris. Pp. 59–132. (California: Stanford University.)

Das Problem der Genesis des Actiniums. By M. C. Neuburger. Pp. iii+64. (Stuttgart: F. Enke.) 5 marks.

Raum und Zeit im Lichte der Speziellen Relativitätstheorie. By Dr. C. von Horvath. Pp. v+58. (Berlin: J. Springer.) In Germany, 12 marks; in England, 36 marks.

Capita Zoologica. Verhandelingen op Systematisch-Zoologisch Gebied onder Redactie van Prof. Dr. E. D. van Oort. Deel 1, Aflevering 1: Nouvelles Recherches sur les Nématodes Libres Terricoles de la Hollande. By Dr. J. G. De Man. Pp. 62+14 plates. 10 guilders. Deel 1, Aflevering 2: Studien über Rhizostomeen mit Besonderer Berücksichtigung der Fauna des Malaiischen Archipels nebst einen Revision des Systems. By Dr. Gustav Stiasny. Pp. viii+176+5 plates. 16 guilders. ('s-Gravenhage: Martinus Nijhoff.)

University of London: Galton Laboratory for National Eugenics. Eugenics Laboratory Memoirs, vii.: On the Relationship of the Condition of the Teeth in Children to Factors of Health and Home Environment. By E. C. Rhodes. Pp. viii+80. (London: Cambridge University Press.) 9*s*. net.

Osmania Observatory, Hyderabad: Publications of the Nizamiah Observatory. Astrographic Catalogue 1900·0. Hyderabad Section. Dec. −16° to −21°. From Photographs taken and measured at the Nizamiah Observatory, Hyderabad, under the direction of the late R. J. Pocock. Completed under the supervision of T. P. Bhaskaran. Vol. 4: Measures of Rectangular Co-ordinates and Diameters of 79,590 Star-Images on Plates with Centres in Dec. −20°. (Hyderabad.)

A Manual of Practical Anatomy: A Guide to the Dissection of the Human Body. By Prof. T. Walmsley. (In three parts.) Part 2: The Thorax and Abdomen. Pp. v+233. (London: Longmans, Green and Co.) 10*s*. 6*d*. net.

The Dawn of Modern Medicine: An Account of the Revival of the Science and Art of Medicine which took place in Western Europe during the latter half of the 18th Century and the first part of the 19th. By Dr. A. H. Buck. Pp. xix+288. (New Haven: Yale University Press; London: Oxford University Press.) 25*s*. net.

The Witch-Cult in Western Europe: A Study in Anthropology. By M. A. Murray. Pp. 303. (Oxford: Clarendon Press.) 16*s*. net.

Western Australia: Geological Survey. Bulletin No. 81: The Mineral Resources of the Yalgoo Goldfield. Part 1: The Warriedar Gold-Mining Centre. By F. R. Feldtmann. Pp. 40+3 plates. Bulletin No. 79: The Mining Geology of Comet Vale and Goongarrie, North Coolgardie Goldfield. By J. T.

Jutson. Pp. 76+x+8 plates. Bulletin No. 80: The Mining Centres of Quinn's and Jasper Hill, Murchison Goldfield. By F. R. Feldtmann. Pp. 92+3 plates. (Perth: Geological Survey.)

Geschichte der Organischen Chemie. By Carl Graebe. Erster Band. Pp. x+406. (Berlin: J. Springer.) In Germany, 28 marks; in England, 84 marks.

The Ideas of Einstein's Theory: A Theory of Relativity in Simple Language. By Prof. J. H. Thirring. Translated by R. A. B. Russell. Pp. xv+167. (London: Methuen and Co., Ltd.) 5*s.* net.

Insect Transformation. By Prof. G. H. Carpenter. Pp. xi+282+4 plates. (London: Methuen and Co., Ltd.) 12*s.* 6*d.* net.

Electrodeposition and Electroplating. A General Discussion held at Sheffield, November, 1920. (Reprinted from the "Transactions of the Faraday Society," vol. 16, part 3, 1921.) Pp. iii+83. (London: Faraday Society.)

Memoirs of the Bernice Pauahi Bishop Museum. Vol. 8, No. 1: A Monographic Study of the Genus Pritchardia. By O. Beccari and J. F. Rock. Pp. ii+78+24 plates. Vol. 8, No. 2: Bayard Dominick Expedition. Publication No. 1: A Contribution to Samoan Somatology. Based on the Field Studies of E. W. Clifford and W. C. McKern. By L. R. Sullivan. Pp. 78–98+plates 25–30. (Honolulu.)

Potatoes and Pigs with Milk as the Basis of Britain's Food Supply. A Paper read before the British Association at Edinburgh, September 12, 1921. With some Hints as to the Production of Each. By Lord Bledisloe. Pp. 59. (London: Hugh Rees, Ltd.) 1*s.* net.

Die Pendulations-theorie. By Prof. Dr. H. Simroth. Zweite auflage. Pp. xvi+598. (Berlin: Konrad Grethlein.) 13.50 marks.

East Carelia and Kola Lapmark. Described by Finnish Scientists and Philologists. By Theodor Homén. Pp. xiv+264. (London: Longmans, Green and Co.) 21*s.* net.

Typical Flies: A Photographic Atlas. By E. K. Pearce. Second series. Pp. xiv+38. (Cambridge: At the University Press.) 15*s.* net.

Small Talk at Wreyland. By Cecil Torr. Second series. Pp. vi+120. (Cambridge: At the University Press.) 9*s.* net.

Common Plants. By Dr. M. Skene. (Common Things Series.) Pp. 271+26 plates. (London: A. Melrose, Ltd.) 6*s.* net.

Die Biochemie in Einzeldarstellungen. Herausgegeben von Dr. A. Kanitz. I.: Temperatur und Leblensvorgänge. By Dr. A. Kanitz. Pp. x+175. 54 marks. II.: Uber Künstliche Ernährung und Vitamine. By Prof. Dr. F. Röhmann. Pp. vi+150+2 plates. 42 marks. III.: Uber partielle Eiweisshydrolyse. By Prof. Dr. M. Siegfried. Pp. iv+64. 15 marks. IV.: Die Einwirkung von Mikroorganismen auf die Eiweisskörper. By Dr. P. Hirsch. Pp. x+256. 63 marks. (Berlin: Gebrüder Borntraeger.)

Catalogue of Double Stars from Observations made at the Royal Observatory, Greenwich, with the 28-inch Refractor during the years 1893–1919, under the Direction of Sir F. W. Dyson. Pp. xviii+229. (London: H.M. Stationery Office.) 25*s.* net.

Observations made with the Cookson Floating Zenith Telescope in the years 1911–1918 at the Royal Observatory, Greenwich, for the Determination of the Variation of Latitude and the Constant of Aberration, under the Direction of Sir F. Dyson. Pp. 76. (London: H.M. Stationery Office.) 7*s.* 6*d.* net.

Annals of the Cape Observatory. Vol. 8, part 5: Results of Meridian Observations of the Sun, Mercury, and Venus, made at the Royal Observatory, Cape of Good Hope, in the years 1912 to 1916, under the Direction of S. S. Hough. Pp. 87. (London: H.M. Stationery Office.) 7*s.* 6*d.* net.

Annals of the Cape Observatory. Vol. 10: Spectroscopic Researches. Part 5: The Radial Velocities of 120 Southern Stars, observed at the Cape. By Dr. J. Lunt. Pp. 19. 4*s.* net. Part 6: On the Variable Orbit of the Spectroscopic Binary, 42 Capricorni. By Dr. J. Lunt. Pp. 8. 1*s.* net. (London: H.M. Stationery Office.)

Results of Meridian Observations of Stars made at the Royal Observatory, Cape of Good Hope, in the years 1912–1917, under the Direction of S. S. Hough. Pp. xxii+442. (London: H.M. Stationery Office.) 70*s.* net.

Diary of Societies.

THURSDAY, NOVEMBER 10.

ROYAL SOCIETY, at 4.30.—A. J. Wilmott: Experimental Researches on Vegetable Assimilation and Respiration. XIV., Assimilation by Submerged Water Plants in Dilute Solutions of Bicarbonates and of Acids, and Improved Bubble Counting Technique.—E. G. Young: The Coagulation of Protein by Sunlight.—E. G. Young: The Optical Rotatory Power of Crystalline Ovalbumin and Serum Albumin.—A. R. Ling and D. R. Nanji: The Longevity of Certain Species of Yeast.—F. Kidd, C. West, and G. E. Briggs: A Quantitative Analysis of the Growth of *Helianthus annuus*. Part I., The Respiration of the Plant and of its Parts throughout the Life Cycle.—G. S. Currey: The Colouring Matter of Red Roses.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. R. O. Moon: Hippocrates in Relation to the Philosophy of his Time (Second FitzPatrick Lecture).

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—F. S. Marvin: The Teaching of History.

ROYAL AERONAUTICAL SOCIETY (Students' Section), at 7.—W. L. Le Page: The Soaring Flight Problem.

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Dr. A. Gleichen: The Path of Rays in Periscopes having an Inverting System comprising Two Separated Lenses. —Dr. J. W. French: The Interocular Distance.—T. Chaundy: Note on the Thin Astigmatic Lens.

INSTITUTE OF METALS (London Section) (at Royal School of Mines), at 8.—Prof. C. H. Desch: Plastic Flow in Metals.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Olympia).—T. Thornycroft; N. Macmillan: Marine Motors.

HARVEIAN SOCIETY OF LONDON (at Paddington Town Hall), at 8.30.—Dr. G. A. H. Barton: Ether: Some Simple Methods and Musings.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Sir William Thorburn and Dr. W. Harris: Discussion: The Treatment of Persistent Pain due to Lesions of the Central and Peripheral Nervous System.

FRIDAY, NOVEMBER 11.

OIL AND COLOUR CHEMISTS' ASSOCIATION.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Sir William Bragg: The Structure of Organic Crystals (Presidential Address).

ROYAL ASTRONOMICAL SOCIETY, at 5.—W. H. Pickering: Suggested Explanation of Aberration.—A. R. Forsyth: Note on the Path of a Ray of Light in the Einstein Relativity Theory of Gravitational Effect.—I. van der Bilt: Observations of Minor Planets.—S. D. Tscherny: Observations of Comet 1921 (Reid).—H. S. Jones: Determination of the Photographic Scale of the North Polar Sequence.—E. E. Barnard: Variability of Nova Cygni 1876 (Schmidt).—F. C. Jordan: Note on Secondary Oscillations in the Light-curve of Cepheid Variables.—H. C. Plummer: Mr. Jordan's Note.—H. N. Russell and D. L. Webster: Note on the Masses of the Stars.—Sydney Observatory: Eclipses of Jupiter's Satellites I and II.—F. J. M. Stratton: The Spectrum of Nova Cygni III 1920.

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

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section), at 7.—Sir Philip Dawson: The Future of Railway Electrification.

JUNIOR INSTITUTION OF ENGINEERS, at 8.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Dr. W. S. Inman: The Relationship of Squint, Left-handedness, and Stammering.—Dr. C. F. Harford: The New Psychology and its Relation to Problems of Vision.

MONDAY, NOVEMBER 14.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge, Kensington Gore), at 5.—F. Dixey: The Physiography of Sierra Leone.

SURVEYORS' INSTITUTION, at 8.—J. H. Sabin: Presidential Address.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court).—E. H. Scholl: Remarks on a Recent Trade Visit to Germany.

TUESDAY, NOVEMBER 15.

ROYAL HORTICULTURAL SOCIETY, at 3.—W. F. Bewley: Diseases of Tomatoes.

ROYAL STATISTICAL SOCIETY, at 5.15.

INSTITUTION OF CIVIL ENGINEERS, at 6.—F. G. Royal-Dawson: The Indian Railway Gauge Problem.

ROYAL PHOTOGRAPHIC SOCIETY, at 7.—F. R. D. Onslow: Some Sea Birds.
ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—Reports on Progress during the Vacation, and Developments in Gas Lamps and Electric Lamps and Lighting Appliances.
ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Miss M. Murray: Recent Excavations in Malta.
MEDICO-LEGAL SOCIETY (at 11 Chandos Street, W.1), at 8.30.—Dr. T. Good: Nature *versus* Law.

WEDNESDAY, NOVEMBER 16.

ROYAL HORTICULTURAL SOCIETY, at 10.30—5.30.—International Potato Conference.
ROYAL SOCIETY OF ARTS, at 4.30.—T. H. Lyon: Modern Buildings in Cambridge and their Architecture.
ROYAL METEOROLOGICAL SOCIETY, at 5.—Dr. H. Jeffreys: The Dynamics of Wind.—N. K. Johnson: The Behaviour of Pilot Balloons at Great Heights.—C. J. P. Cave: The Cloud Phenomenon of November 29, 1920.
NEWCOMEN SOCIETY (at Caxton Hall), at 5.—C. F. D. Marshall: The Liverpool and Manchester Railway.
ENTOMOLOGICAL SOCIETY OF LONDON, at 8.
ROYAL MICROSCOPICAL SOCIETY, at 8.—G. Patchin: The Micro-examination of Metals with Special Reference to Silver, Gold, and the Platinum Metals.—R. L. Frink: The Practical Value of the Microscope in Glass Manufacture.—W. C. Crawley and Dr. H. A. Baylis: Mermis Parasitic on Ants of the genus Lasius.

THURSDAY, NOVEMBER 17.

ROYAL HORTICULTURAL SOCIETY, at 10—6.—International Potato Conference.
ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Major P. A. MacMahon and W. P. D. MacMahon: The Design of Repeating Patterns.—Prof. J. W. Nicholson: A Problem in the Theory of Heat Conduction.—Prof. C. H. Lees: The Thermal Stresses in Spherical Shells Concentrically Heated.—R. A. Fisher: The Mathematical Foundations of Theoretical Statistics.—F. P. White: The Diffraction of Plane Electromagnetic Waves by a Perfectly Reflecting Sphere.—Prof. C. V. Raman and G. A. Sutherland: The Whispering Gallery Phenomenon.
LINNEAN SOCIETY OF LONDON, at 5.
LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5 (Annual General Meeting).
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Col. F. Searle: Requirements and Difficulties of Air Transport.
INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—E. S. Byng: Telephone Line Work in the United States.
INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—H. F. Collins: The Igneous Rocks of the Province of Huelva and the Genesis of the Pyritic Orebodies.
CHEMICAL SOCIETY, at 8.—H. Burton and J. Kenner: The Influence of Nitro-groups on the Reactivity of Substituents in the Benzene Nucleus. Part V., Heteronucleal Dinitro-derivatives.—F. Challenger and J. F. Wilkinson: Organo-derivatives of Bismuth. Part V., The Stability of Halogen, Cyano-, and Thiocyano-derivatives of Tertiary Aromatic Bismuthines.—F. Challenger and L. R. Ridgway: Organo-derivatives of Bismuth. Part VI., The Preparation and Properties of Tertiary Aromatic Bismuthines and their Interaction with Organic and Inorganic Halogen Compounds.

FRIDAY, NOVEMBER 18.

ROYAL HORTICULTURAL SOCIETY, at 10.30—1.30.—International Potato Conference.
ASSOCIATION OF ECONOMIC BIOLOGISTS (in Botanical Lecture Theatre, Imperial College of Science and Technology), at 3.—Dr. E. J. Butler and others: Discussion: Meteorological Conditions and Disease.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Dr. E. H. Salmon: The Machinery of Floating Docks.

SATURDAY, NOVEMBER 19.

BRITISH MYCOLOGICAL SOCIETY (in Botany Lecture Theatre, University College).
PHYSIOLOGICAL SOCIETY (at St. Bartholomew's Hospital).

PUBLIC LECTURES.

(A number in brackets indicates the number of a lecture in a series.)

THURSDAY, NOVEMBER 10.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 3.—W. Bateson: Recent Advances in Genetics (2).
UNIVERSITY COLLEGE, at 5.—Prof. J. E. G. De Montmorency: European Feudalism: Its Variation and Decay (2).
KING'S COLLEGE, at 5.30.—H. W. Fitz-Simons: Bridge Construction (3).
GRESHAM COLLEGE, at 6.—Prof. W. H. Wagstaff: Time-Units (3).
BIRKBECK COLLEGE, at 7.30.—Prof. F. Soddy: The Bearing of Physical Science on Economics (1).

FRIDAY, NOVEMBER 11.

UNIVERSITY COLLEGE, at 4.30.—Dr. J. C. Drummond: Nutrition (5). At 8.—Prof. G. Dawes Hicks: Our Knowledge of the Real World (2).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (3).
GRESHAM COLLEGE, at 6.—Prof. W. H. Wagstaff: Time-Units (4).

SATURDAY, NOVEMBER 12.

POLYTECHNIC, REGENT STREET, at 10.30.—Prof. H. E. Armstrong: The Wonders and Problems of Food.

MONDAY, NOVEMBER 14.

UNIVERSITY COLLEGE, at 5.—Prof. E. G. Coker: Recent Researches in Photo-elasticity.
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (4).
KING'S COLLEGE, at 5.30.—H. Moore: Liquid Fuels (3).
KING'S COLLEGE, at 8.—Dr. E. J. Russell: Modern Applications of Chemistry to Crop Production.

TUESDAY, NOVEMBER 15.

KING'S COLLEGE, at 5.30.—Prof. H. Wildon Carr: The Modern Scientific Revolution and its Meaning for Philosophy (6); The Theory of Natural Selection.—Dr. W. Brown: Psychology and Psycho-therapy (5).—L. J. Hunt: Cascade Synchronous Motors and Generators (5).

WEDNESDAY, NOVEMBER 16.

UNIVERSITY COLLEGE, at 3.—Prof. E. G. Gardner: Nature in the *Divina Commedia* (2).
KING'S COLLEGE, at 4.30.—Dr. C. Da Fano: Histology of the Nervous System (6).
ROBERT BARNES HALL, 1 Wimpole Street, W.1, at 5.—Prof. Mellanby: Vitamines and Health.
KING'S COLLEGE, at 5.15.—Prof. G. Elliot Smith: Anthropology.
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (5).

THURSDAY, NOVEMBER 17.

UNIVERSITY COLLEGE, at 5.—Prof. J. E. G. De Montmorency: The Background of Non-European Feudalism (3).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—W. Bateson: Recent Advances in Genetics (3).
BIRKBECK COLLEGE, at 7.30.—Prof. F. Soddy: The Bearing of Physical Science on Economics (2).

FRIDAY, NOVEMBER 18.

UNIVERSITY COLLEGE, at 4.30.—Dr. J. C. Drummond: Nutrition (6).
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, at 5.30.—Dr. J. D. Falconer: The Wonders of Geology (Swiney Lectures) (6).
UNIVERSITY COLLEGE, at 8.—Prof. G. Dawes Hicks: Our Knowledge of the Real World (3).

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