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Agriculture and Fisheries in the Civil Service Estimates.

THE vote to complete the sum of 3,211,605*l.* for the salaries and expenses of the Ministry of Agriculture and Fisheries during the year 1921–22 was agreed to by the House of Commons on April 19. The amount of the vote shows a reduction of 2,156,107*l.* as compared with last year's Estimates; but three-quarters of this is due to the discontinuance of services arising out of the war. We view some of the decreases with mixed feelings; but before mentioning them specifically it is of interest to refer to one or two promising aspects of the Ministry's activities to which Sir A. Griffith-Boscawen directed attention in submitting the Estimates.

Considerable progress has been made with the Land Settlement Scheme for ex-Service men; 48,580 applications have been received, some of which have been rejected for various reasons, and it is estimated that 30,000 men will ultimately be settled. At the present time about 12,000 men are already provided with holdings of 250,000 acres in the aggregate, and about 160,000 acres more are needed to complete the settlement. The scheme inevitably entails losses, foreseen from the beginning, and these may reach as much as 40 per cent. For the first seven years the losses will be made good to the county councils by the State, and after that the capital value will be written down to the then market value, and the holdings handed over on a self-supporting basis to the county councils. In spite of the loss, it is considered that the settlement of 30,000 ex-Service men on the land will prove a valuable asset to the State.

Foot-and-mouth disease still provides a great problem, as it has as yet proved to be impossible to determine how the infection is brought into the country. Although no trace of the disease can be found in Ireland, certain animals imported there have developed the disease within the incubating period, so that a quarantine of fourteen days at the ports is essential for some time to come. During 1920 there were ninety-four outbreaks in this country, involving the slaughter of more than 2000 cattle and 8000 sheep, with other animals, the net compensation paid being 115,000*l.* This policy of slaughter as compared with that of isolation and cure seems to be justified. In France, where the latter method is adopted, 855,161 cattle were affected in 1919–20, and the loss in the value of the animals was 5,000,000*l.* Muzzling against rabies has proved successful in preventing outbreaks for several months, except for a solitary case at Southampton, and loss through rats has been reduced by the campaign against them vigorously carried on since the passing of the Rats and Mice Destruction Act.

The project for manufacturing beet sugar at Kelham is so far advanced that it is hoped that the factory will be in running order this year. Meanwhile a further loan of 125,000*l.* on mortgage is being made to the undertaking to meet the heavy initial costs of working.

The various councils and committees set up by the Agricultural Acts of 1919 and 1920 are in full working order, and are proving very useful. The policy adopted is that of decentralisation, as it is felt that there should be as little control as possible from Whitehall, but that the powers for insisting on good cultivation should be in the hands of the local committees, the members of which possess that local knowledge and interest which cannot possibly be had at headquarters. Both tenant farmers and labourers now enjoy a greater feeling of security on account of the new clauses dealing with compensation. Apparently, too, the guaranteed prices for wheat and oats are effectively checking the tendency to lay down land to grass, as this year the trade in grass seeds has been normal, with no exceptional buying.

All this is satisfactory enough; but the same can scarcely be said of the position of agricultural education and research in the Estimates, which show the following reductions compared with the Estimates for last year:—Agricultural and dairy education (grants in aid), 33,000*l.*; agricultural research (grants in aid), 6100*l.*; agricultural research, 61,190*l.*; experiments and instruction in fruit preservation, 8745*l.* The only increase under the head of agricultural education and research is that of 3650*l.* for the National Institute of Agricultural Botany and Seed Testing Station. By the side of these great reductions we have an increase of 94,000*l.* in the estimate for salaries in the agricultural branch of the Ministry.

The Estimates for the Fisheries Department of the Ministry show similar decreases for research and similar increases on the administrative side. The differences may be summarised as follows:—

	1920–21.	1921–22.
Administration, salaries, wages, allowances, legal and incidental expenses. All this properly called *Administrative Expenditure.*	62,969*l.*	85,434*l.*
The *increased* expenditure for 1921–22 is 22,465*l.*		
Fishery research in general and fishery research grants in aid. *Scientific Research.*	59,700*l.*	35,025*l.*
The *decreased* expenditure for 1921–22 is 24,675*l.*		
Shellfish research and development, development of inshore fisheries, economic destruction of inshore pests, elvers distribution scheme. *Development of Inshore Fisheries based on Scientific Research.*	62,580*l.*	32,405*l.*
The *decreased* expenditure for 1921–22 is 30,175*l.*		

It will be seen that in each branch of the Ministry there has been a considerable increase in the cost of administration—that is, the cost of carrying out duties that are apart from scientific research and development. In the Fisheries Department, for example, the administrative staff employed in 1920–21 (secretaries, principals, clerks, writing assistants, typists, etc.) numbered sixty-two; but it is ninety-one in 1921–22. The inspectorial staff (that is, inspectors, technical assistants, fishery officers, surveyors, collectors of statistics, messengers, charwomen, etc.) was forty-eight in 1920–21; but it is sixty-two in 1921–22. Against that we have a scientific staff of eighteen in 1920–21, and of twenty-one in 1921–22.

We search in vain for a justification of the increased expenditure on administration. The condition of the fishery industry is one of unprecedented depression. Big breaks in wages are contemplated or have been effected, and labour troubles are threatened. The withdrawal of the herring bounties is likely to lead to the laying up of half the East Coast fleets. Exporting has largely diminished. Inshore fishing is decadent. Either administration is impotent when confronted with such economic tendencies, or it thrives upon them. In the face of such industrial depression it is difficult to find a reason for the large increase in the cost of administering the fishery statutes. Frankly, we do not understand why the Ministry largely increases its administrative machinery while economising on development (which is surely the means of counteracting industrial depression) and on research (which provides the *rationale* for successful development). Obviously these Estimates ought to be explained and justified, if possible, for otherwise they suggest an incompetent administration, or a degree of misunderstood economy and control exerted by the Treasury against the better judgment of the Ministry. We might be inclined to take the latter view were it not for the increased cost of purely administrative services, which must have been suggested by the Ministry itself.

It is true that in the debate in the House of Commons Mr. Acland directed attention to the increased expenditure on administration and to the decreased provision for research, but no satisfactory explanation was forthcoming. So far as we are concerned, the opportunity for criticism is afforded only after Parliament has voted the money; and it will be the same next year, unless some body of scientific men obtains early copies of the Estimates and provides suitable representatives in Parliament with material evidence in support of their case for consideration. Criticism of the Estimates is, however, very difficult because of the form in which they are issued. It is impossible to resist the impression that the statement of the expenditure incurred and contemplated is made so as to convey the least possible information as to detail. This impression may be a mistaken one, but if it is the fault lies in the manner in which the Estimates are framed and published.

A Sportsman-Naturalist.

Field Observations on British Birds. By a Sportsman-Naturalist (the late Dr. F. M. Ogilvie). Edited by Henry Balfour. With foreword by Mrs. J. Massie. Pp. xvi+228+vi plates. (London: Selwyn and Blount, 1920.) 25*s*. net.

THE late Dr. F. M. Ogilvie (1861–1918) was an observer of birds from boyhood, and he enjoyed considerable opportunities on the sea-marshes at Sizewell, in Suffolk, and on his property of Barcaldine, in Argyllshire, of following his bent. He was by profession an oculist, and in this, as well as in his hobbies of ornithology and orchid-culture, he showed "the vigour of an able man with the scientific interest, who was steadfast and thorough in all that he took in hand." He published only a few papers, but he delivered eight popular lectures to the Ashmolean Natural History Society of Oxfordshire between the years 1902 and 1916, and these have been edited and put into publishable form by his friend, Mr. Henry Balfour, who has also added judicious footnotes. Naturalists, Mr. Balfour tells us in his preface, will find in these lectures "many shrewd and original remarks, based upon careful observations in the field, by one of the keenest and most cautious of ornithologists."

Of the young golden plover Dr. Ogilvie writes:

"As long as the parents are uttering their alarm note, so long will these little fluffy balls, only hatched perhaps a few hours ago, remain squatted and motionless, with their necks stretched out, their bodies buried in the golden moss, so that all the lighter underparts, including the light eye streak, are hidden from view. . . . I have myself never found a very young nestling Ringed Plover, though I have often looked for them. I have found them when they are a few weeks old, but never directly after they have hatched. I have specimens of them in the latter state, but I obtained them all by hatching eggs out in an incubator. Yet I have constantly been over ground where I knew the birds were breeding freely, and where nestlings must have been quite plentiful."

The invisible young birds are stone-coloured, with black-tipped down.

On the breeding-ground the redshanks are quite fearless, coming to meet the intruder and sweeping by within a few yards, executing all kinds of fanciful aerial flights.

"At this season, too, they possess a curious fondness for perching, a habit I have never observed in winter. . . . It is a point of some interest how a wading bird, with toes formed as a Redshank's are, is able to perch, and to perch securely, on anything so thin and round as a telegraph wire. Their swaying to and fro is not due to the insecurity of their foothold, for you observe birds that have lighted on a gatepost or barway executing precisely the same movements."

The redshanks make false nests in the second half of March,

"little depressions scrabbed out on the ground with a few bits of rushes and grass roughly arranged in them. They look like the work of a 'prentice hand—of a Redshank who was lacking in experience, and was trying to get his 'hand in' before taking to the serious work of nest-building. What the meaning or the objects of these false nests is, I have no idea, nor whether both males and females are engaged in making them, or whether it is only the male. Most of our Norfolk and Suffolk gunners hold the latter view; why, I don't know, and call them cocks' nests."

Now there is little that is new in these observations, but their record reveals directness, sincerity, and caution, and if we knew them before we like to see them again through another man's eyes.

Gannets frequently fly fifty miles or more to their fishing-ground, but in spite of the labour thus involved they collect far more food than they require, a fact unpleasantly conspicuous in the colony.

"Gannets, feeding as they do on surface-swimming fish, are dependent for their supply on the weather. If a gale arises, as often happens in an English summer, the fish swim at a greater depth, and beyond the ken of the Gannets' keen eyes. If the gale continues for three or four days, during the whole of that time the bird will catch nothing, and it is possible that the fear of such a catastrophe occurring is at the root of the habit, and that the bird's instinct teaches him always to keep a day or two's supplies in hand, as long as he is able to do so."

This is not exactly how the theory would be stated by one versed in modern comparative psychology, but the suggestion is a sound one, for though normally a victorious bird, the gannet is, like most other pelagic sea-fowl, in a sad plight when stormy weather lasts for two or three days.

"The Shag's—and, indeed, all the Cormorants'—method of diving is absolutely characteristic. He really springs right out of the water, turns over in the air, and takes a noiseless header; but the body is so close to the water throughout this manœuvre, and the action is so quick, easy and free of effort, that one hardly follows the middle stage where the body of the bird is really out of the water altogether, the moment when his paddles are just leaving the water with his kick off, and the beak is just meeting the water to complete the downward half of the semicircle which he describes."

How different from the submergence method seen in the true divers! One cannot but admire a picture like this. The Manx shearwaters sleep in their burrows by day, and start out on their labours as dusk begins to gather.

"They have a curiously silent flight, gliding past one in the gathering gloom like ghosts indeed. I know no bird, except perhaps some of the owls, whose flight is so absolutely noiseless. The effect is curiously uncanny; they appear suddenly out of the darkness and disappear again like spirits of another world."

Dr. Ogilvie's study of the grey partridge affords an interesting illustration of our relative ignorance of a very common bird. In cold, frosty weather the partridges huddle up closely at night, "shoulder to shoulder, forming a circle with their tails in the centre"; yet J. G. Millais writes to the editor to say that the "jugging" birds he has seen had their heads directed inwards. "During the period of incubation, the scent is suppressed entirely, or so little is left that you may take a first-rate dog within a foot of a sitting bird over and over again, and he will not evince the smallest interest in the locality." But does anyone know precisely how this life-saving suppression of scent is effected? When suddenly threatened with danger the parent partridges utter the warning cry, and the chicks

"squat flat upon the ground, as if they were trying to squeeze themselves into the very earth itself, with nothing to show the presence of life but their little black, beady eyes. As long as the danger remains imminent, the parents keep up an incessant chuck-chucking, and the chicks remain absolutely still and motionless. This instinct in itself is very curious, for it is evidently inborn. A chick that is only two or three hours old will 'squat' at the warning cry, with the same celerity and certainty as a chick of three or four weeks. It can be no question of learning by experience and parental training. It will squat at that cry, and at that cry only, though not from any knowledge of the safety so acquired. Partridges reared under a hen never squat, although danger is threatening, and the foster mother is clucking in a dreadful fluster. . . . The necessary stimulus is absent, and that stimulus is supplied by one particular cry of the parents and nothing else."

Except for the sentence: "This instinct in itself is very curious, for it is evidently inborn," this record of observations is admirable, and the whole account of partridges gives the reader a clear impression of the author's grip and carefulness.

In regard to the snipe's "drumming," there is a fair-minded discussion of the four theories, the author holding firmly that the rapidly beating wings, whether they themselves hum or not, throw a strong current of air on to the outermost feathers of the tail, setting them in vibration which produces sound-waves. As to the position of the orbits,

"a snipe, with its eyes placed as they are, can get the very last fraction out of its bill, as it struggles for a worm half an inch further down in the mud, and yet see all that is going on round it, and be ready for any emergency that the fates have in store."

The cry of the stone curlew is

"a weird discordant clamour, with something uncanny and blood-curdling about it, as though an inferno had suddenly been let loose on earth. We call them 'shriek owls' on this account, and it is not a bad name. Their wild cries ringing out loud and clear, then suddenly ceasing and intensifying the silence of the still summer night, are something suggestive of murder and sudden death."

Regarding the much-discussed serrated claw of the nightjar (also found in the bittern, gannet, heron, and courser), Dr. Ogilvie suggested that it was "a vestigial remnant from some bygone ancestor, which has long since lost its original function, and is now, perhaps, of little service to these latter-day descendants." The editor, whose notes form a valuable addition to his friend's book, remarks that an objection to this theory is to be found in the fact that the pectination is not found in the nestling, but develops later, an unusual feature of vestigial structures.

The rhythmical movements of the cuckoo's stomach during digestion press the hairs of the hairy caterpillars against particular areas of the mucous wall and embed them in the epithelium. Are they shed after a time? Are they ejected as pellets? Do they impede digestion? Are they responsible for a large mortality among the immature cuckoos? These are interesting questions which the author raises, but he need not have asked: "Do the implanted hairs actually take root and grow in their new situation?" Nevertheless, particular attention is paid to the food of certain birds, and there is much information on the subject in his book; thus he maintains that the sparrow-hawk is not so black as it is painted, nor the kestrel so innocent.

Dr. Ogilvie was a sportsman-naturalist, and the sportsman's interests are prominent in these pages, but, on the whole, they are kept in subjection to the interests of ornithology, and the result is what we venture to call a very happy, as well as a very scientific, book.

British Iron Ores.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. xii., *Iron Ores (continued). Bedded Ores of the Lias, Oolites, and Later Formations in England.* By G. W. Lamplugh, C. B. Wedd, and J. Pringle. 1920. 12*s*. 6*d*. Vol. xiii., *Iron Ores (continued). Pre-Carboniferous and Carboniferous Bedded Ores of England and Wales.* By Sir A. Strahan, Dr. W. Gibson, T. C. Cantrill, Dr. R. L. Sherlock, and Henry Dewey. 1920. 7*s*. 6*d*. (His Majesty's Stationery Office.)

THESE two volumes complete the series of six volumes devoted to an account of the iron ores of Great Britain, which will probably form the most enduring monument of Sir Aubrey Strahan's tenure of the Directorship of the Geological Survey. We now need only an account of the iron ores of Ireland, which are far from being negligible, in order to complete our knowledge of the iron-ore resources of the British Isles; the iron industry of this country is deeply indebted to Sir Aubrey Strahan for the invaluable information which he has placed at its disposal in this series of reports. It cannot be suggested that the work has been done before its time; the last official account of British iron ores was issued so far back as 1856 to 1862, when Sir Roderick I. Murchison was Director of the Geological Survey, and this consisted for the most part of a collection of analyses of ores made under the direction of Dr. John Percy.

The best evidence of the care and accuracy with which these analyses were made under the instructions of "the father of British metallurgy" is to be found in the fact that they are still often quoted, and many of them are repeated even in the reports now under consideration. The whole character of the iron industry has, however, been radically transformed within the last sixty years, and ores that were then comparatively neglected are to-day of the highest importance, whilst those that were then being most actively worked are now almost abandoned. This is especially true of the ores to which the present two volumes refer; at that time the bedded ironstones of the Coal Measures formed the mainstay of the iron manufacture of England, whilst the ores of the Lias and of the later formations had scarcely been touched; to-day the great bulk of English iron is made from the latter ores, the Carboniferous iron ores being worked only on a very small scale for quite special purposes in a few districts.

The pre-Carboniferous bedded ironstones are not to-day of any great importance, but they have been fully and carefully described, and rightly so, for it is scarcely possible as yet to foresee what their economic importance may some day be. The authors might have pointed out with advantage the close correspondence between these ores and the ores that have formed the basis of an important industry in Normandy, the latter being also bedded deposits of Oolitic ores consisting essentially of siliceous carbonate of iron, occurring just below the Armorican grit of Ordovician age.

The chief interest in the iron ores of Carboniferous age will probably attach to the estimates of the quantity of such ore that may still remain. Sir Aubrey Strahan's estimate is close upon 7230 million tons; large as this figure is, it is no doubt far below the quantity that actually exists; but it is equally beyond doubt that it is far in excess of the quantity that will ever be wrought. In illustration of the former thesis, the ironstones of Northumberland and Durham may be referred to. The only figure that Sir Aubrey Strahan gives for these is 1,500,000 tons for Redesdale and district; these particular ores occur at various horizons in the Carboniferous Limestone series, and have been worked only at a few points where they happen to outcrop, as at Redesdale, Bellingham, Haltwhistle, etc. The yield of ironstone is stated by two different authorities to have been respectively 8470 and 9680 tons of ironstone per acre, so that the estimate of quantity here given corresponds to less than 200 acres. Yet these ores are known in places some miles apart; they accompany beds of coal that are notable for their persistence, and there is no reason whatever for assuming that the ironstones are an outcrop formation and do not continue in depth.

It is, therefore, quite possible that these ironstones may extend over many hundreds of square miles, and, if so, the estimate of the quantity of ore given in the report is but a minute fraction of the amount that actually exists in this area. Furthermore, the ironstones of the Coal Measures are altogether omitted from the calculation; yet these ironstones were actually worked, and a century ago gave rise to a quite important iron industry in the northern part of Durham and the adjoining parts of Northumberland, in many places, such as Waldridge Fell, Urpeth, Birtley, Wylam, Hedley, Tow Law, Bedlington, etc., covering an area of probably quite 200 square miles. Mr. William Cargill estimated the yield at Shotley Bridge to be 5324 tons per acre; this appears to have been one of the richest sections, and if, for the sake of illustration, it is assumed that the average contents were only 2500 tons per acre, the total quantity of this ore could be estimated at 320 million tons. Furthermore, there are no grounds for assuming that these ores are limited to the area above-mentioned; they may quite well underlie the entire coal-field. For these counties, therefore, it may be asserted without hesitation that the estimate in the report falls very far short of the truth. At the same time it may be said with equal certainty that very little, if any, of this ironstone is ever likely to be wrought, so that, however greatly Sir Aubrey Strahan may have under-estimated the quantity of ironstone that exists in this part of England, the error is of no practical importance whatever.

The chief practical interest attaches to the report on the ores of the Lias, Oolites, and later formations, for it is to these that the British ironmaster must look for his ore supplies in the future. The work has been done in a most thorough and painstaking fashion, and will no doubt remain the standard work of reference on this subject for many years to come. Most of the figures have already been given in the Summary of Progress of the Geological Survey for 1917, but it is greatly to be regretted that the present volume nowhere tabulates the results now arrived at, as has been done for the Carboniferous ores. The Summary above quoted gives as the total amount of reserves of these ores in England more or less developed 1765 million tons, and as the probable additional reserves 2093 millions, or a total of 3858 million tons. The present report gives figures that do not differ very greatly from these, except as regards the Northampton ore. Apparently the total quantity of this ore is now given as 2308 million tons to be gotten from the counties of Northampton, Lincoln and Rutland, exclusive, apparently, of possible reserves, whilst the Summary of Progress gave as the known reserves 1252 millions, and as the probable reserves 976 millions, or a total of 2228 million tons. The grand total now arrived at apparently amounts to 4154 million tons, so that without insisting on minute exactitude, which is obviously out of the question in such matters, the British ironmaster may take comfort in the thought that he has probably something like 4000 million tons of ore at his disposal, and it is interesting to note that about one-half of this is represented by the Northampton ironstone.

These figures are eminently satisfactory, and Sir Aubrey Strahan deserves sincere thanks for this contribution to our knowledge, as well as hearty congratulations on the conclusion of this excellent piece of work.

H. LOUIS.

Physical and Inorganic Chemistry.

Recent Advances in Physical and Inorganic Chemistry. By Prof. A. W. Stewart. With an Introduction by Sir William Ramsay. Fourth edition. Pp. xvi+286+v plates. (London: Longmans, Green, and Co., 1920.) 18*s*. net.

THE popularity of Prof. Stewart's book shows that it meets the requirements of certain kinds of readers. It can scarcely appeal to the serious student of physical and inorganic chemistry. A good deal of the material dealt with would not commonly be said to belong to either of the branches of chemistry indicated in the title. Much of it is pure physics, such as the long descriptions of X-rays and positive rays, and it is noteworthy that in just these cases good recent monographs by experts, not too large or beyond the capacity of students, are available. Would it not have been wiser to utilise this space for the description of some less accessible recent advances in inorganic or physical chemistry?

In other cases, notably in the account of the fixation of nitrogen, the author does not appear to have been very critical in his choice of material. A whole chapter is devoted to the permutites, which cannot be said to have any general interest, and have a restricted industrial application. With such matters as the production and utilisation of ozone not dealt with, one could well have spared such unimportant details as these.

The chapter on absorption spectra seems out of place, since it deals mainly with organic chemistry, and the general conclusions drawn from the mass of work described are lamentably vague. It may be that "one atom has the effect of stimulating another into a certain state of vibration, while other atoms have not this power," but the statement does not take us much further, and reminds one of the conclusion reached by many workers in this and allied fields a few years ago, that the effects were somehow due to "motions of the electrons." These vague generalisations are not of much service.

It is doubtful whether a whole chapter on artificial transmutation is wise in a book which can be intended only for students. So little which is certain can yet be said in this field that it would perhaps have been wiser to use the space for some more definite advance. After devoting a whole page to the "transmutation" experiments of Ramsay and Cameron, the author can only add that a careful repetition of the work led to negative results. The reviewer is also under the impression that Sir E. Rutherford has modified his views on "H-particles," and in any case this work is really too new and controversial to present to comparative beginners, for whom the book appears to be intended.

Prof. Stewart seems to have a quarrel with facts; he thinks that hypotheses are unduly neglected by a certain school of chemists, and he reproaches physical chemists with not knowing enough about organic chemistry. It must be admitted, however, that hypotheses may run wild unless brought into some relation with experiment, and that comparatively few chemists find it possible to become really conversant with two such extensive branches of the science as organic and physical chemistry. To quarrel with mathematics as an aid to chemistry is also a little unfair. Even if it serves no other purpose, a smattering of the principles of mathematics might lead one to pause before committing oneself to a statement such as the following: "The possibility of negative mass suggests itself, and the atomic weight might be regarded as the algebraic sum of the positive and negative masses within the atom." Many strange old hypotheses have been galvanised into life again during the last few years, but this is surely the first reappearance of the theory of phlogiston.

The Bohr atom, we learn, has "not even satisfied the purely physical requirements of an atomic hypothesis." In addition, the "plain chemist," for whom Prof. Stewart says he has written, might not understand the "few elementary exercises in the calculus" which would be required for its elucidation. The reviewer must, however, entirely disagree with the suggestion that such matters were omitted to make room for "material of more practical interest."

The last chapter is full of assertions with which no thoughtful student of physical chemistry could for a moment agree. A personal attack on Ostwald is scarcely the sort of thing to include, as a whole chapter, in a "students'" book, even if the criticism were better informed than is the case in the present essay. It is to be hoped that this wholly unnecessary and entirely one-sided attack will disappear from future editions.

J. R. PARTINGTON.

Our Bookshelf.

A Diplomat in Japan. By the Right Hon. Sir Ernest Satow. Pp. 427. (London: Seeley, Service, and Co., Ltd., 1921.) 32*s.* net.

THE author of this important work ranks as one of the greatest living authorities in this country on the tangled and critical politics of the Far East. His diplomatic career included an almost continuous residence in Japan from 1862 to 1882, and culminated in his tenure of the post of British Minister in Peking during the eventful years succeeding the Boxer rising of 1900. He has thus had almost unrivalled opportunities of watching the wonderful evolution of Japan from the position of a relatively weak feudal State, distracted by the struggles between rival *daimyôs,* to its present status as a great World Power with a highly centralised administration. In these circumstances it is to be hoped that the present book, interesting and useful as it is, may be only the first instalment of a more ambitious work which shall give us a critical interpretation of the deeper issues underlying the transition from the old to the new Japan, and a reasoned comparison of the social forces at work in the Empire of the Mikado with those affecting the development of her great neighbour on the mainland. Such a contribution to Western knowledge of the Far East is greatly needed.

In the volume under notice Sir Ernest Satow has contented himself with acting as showman of a marvellous pageant the culmination of which in the Japanese revolution of 1868 involved the downfall of the Shogunate and of feudalism, the restoration of the undivided authority of the Mikado, and the inauguration of the present Meiji era (Age of Enlightenment). The book consists mainly of an extremely graphic record of six years (1862–68), based upon the author's diaries written by him in his early days as a student-interpreter in Japan, when his youthful imagination was captured by the fascination of a wholly unfamiliar society, and when he was consumed by an insatiable curiosity to read and understand what had long been for Europeans a sealed and mysterious land. The book abounds in vivid descriptions of scenery, customs, men, and events. The account of one of the first overland journeys made by Europeans (from Ozaka to Yedo) is among the best of its kind. The personal narrative is sufficiently interspersed with historical explanations—*e.g.* chap. iii., "Political Conditions in Japan"—to enable the reader to appreciate the significance of the events described.

P. M. ROXBY.

Hydro-Electric Survey of India. Vol. ii.: *Second Report on the Water-Power Resources of India, ascertained during the Season* 1919–20 *by F. E. Bull and J. W. Meares.* Pp. 123. (Calcutta: Government Printing Press, 1920.) R.1 6 annas.

THE investigation of the water resources of India has been in hand for some time. The preliminary report, issued in the autumn of 1919, gave an account of the initiation of the Survey and the preparations made by Mr. Barlow in conjunction with Mr. Meares up to the time of the death of the former. The second volume, now issued, contains a *résumé* of the work which has been done since Mr. F. E. Bull took over the chief engineership, with Mr. Meares as electrical adviser. The itinerary consists of a series of visits to officers specially engaged in the Survey, checking their reconnaissances, and making further researches in British India and the Native States.

Part i. of the report consists of a note by Mr. Meares on the general principles of development and storage of water for electrical purposes, compiled for the guidance of those making local investigations, and exhibits the standard form in which it is recommended that the data collected should be recorded. Part ii. deals with administrative matters connected with the Survey. Part iii. contains the results of the reconnaissances made by the chief engineer and the electrical adviser, together with observations on the provincial surveys. Decisions were made as to the suitability or otherwise of various localities for further investigation. Difficulties, however, were encountered which prevented in several cases any very effective progress, and it is stated that until additional staff can be recruited and an adequate supply of survey instruments assured it will not be possible for the work to proceed on more satisfactory lines. BRYSSON CUNNINGHAM.

The Principles of Politics: An Introduction to the Study of the Evolution of Political Ideas. By Prof. A. R. Lord. Pp. 308. (Oxford: At the Clarendon Press, 1921.) 8*s.* 6*d.* net.

PROF. LORD modestly describes his book as a bridge for students from Sir Frederick Pollock's "History of the Science of Politics" to Dr. Bosanquet's "Philosophical Theory of the State." In this task he has succeeded well. His style is eminently readable, his arguments are clear, and his information is accurate. His analyses of political theories are supported by apt quotations, in the selection of which—*e.g.* from Spinoza's political writings and from the *Federalist*—he has departed, with excellent effect, from the traditional text-book grooves. The introductory chapter gives a good account of the influence of the Renaissance and the Reformation on political theory. There follows a chapter on the social contract, three chapters on different theories of sovereignty, one on democracy and representation, one on the notion of law, three on the theory of rights, and lastly a conclusion in which Prof. Lord sums up his own positive point of view, which is that of the classical idealist theory of the State, as developed, under the influence of Kant and Hegel, by T. H. Green and Bosanquet. It is a little to be regretted that Prof. Lord's scheme did not permit him to touch on the recent criticisms of this theory by writers like Graham Wallas, G. D. H. Cole, H. J. Laski, R. H. Tawney, and many others. He keeps strictly to historical materials. Hobbes, Locke, Rousseau, and Spinoza are the prominent figures, with Machiavelli, Bentham, and Burke in the second rank. No nineteenth-century theorists find mention except Mill and Spencer, and these only in the discussion of individualism. However, within these self-imposed limits Prof. Lord has written a book which teachers and students of political theory alike will find useful.

R. F. A. H.

Abnormal Psychology and its Educational Applications. By F. Watts. Pp. 191. (London: George Allen and Unwin, Ltd., 1921.) 7*s.* 6*d.* net.

THE first edition of this book, published under the title of "Echo Personalities," received notice in NATURE for July 17, 1919, under the title "Abnormal Psychology and Education." When a second edition was asked for, the author accepted the obvious suggestion and adopted a title which is more likely to indicate the scope of the book. Few changes have been made in the new edition; the chapters have been usefully subdivided, while those on psychopathology and the development of personality, and on the psychology of the defective mind and its influence on teaching methods, have received considerable additions. The chapter on the psychology of the supernormal mind finds no place in the new edition.

Tables of Physical and Chemical Constants, and some Mathematical Functions. By Dr. G. W. C. Kaye and Prof. T. H. Laby. Fourth edition. Pp. vii+161. (London: Longmans, Green, and Co., 1921.) 14*s.* net.

THE changes which have been made in the new edition of this valuable manual of constants are mostly matters of detail. All the chemical data have been recalculated on the basis of the international atomic weights, and, with the co-operation of Dr. E. Griffiths, of the National Physical Laboratory, a revision of the heat tables has been attempted. Tables of atomic numbers, spark-gap voltages, X-ray wave-lengths, and terrestrial magnetic constants also find a place in the new edition, and more extended tables of the relative value of the acceleration of gravity have been added. The first edition received detailed notice in NATURE of February 8, 1912.

The Theory of Relativity. By Prof. R. D. Carmichael. Second edition. (Mathematical Monographs, No. 12.) Pp. 112. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) 8*s.* 6*d.* net.

THE earlier portion of Dr. Carmichael's book is a reprint of the first edition, which received notice in NATURE for March 12, 1914. The later pages, which are grouped together under one large chapter with twelve subheadings, deal with the generalised theory of relativity. The new chapter opens with a brief summary of results obtained from the restricted theory, and an account of the general theory follows. Sufficient detail is given to provide some explanation of the general theory of gravitation, the nature of the three phenomena by which experimental proof of the theory may be expected, and the connection between the generalised theory and Maxwell's electromagnetic equations. Applications of the theory other than those which are immediately associated with the fundamental ideas or with phenomena for testing the validity of the theory have been omitted in order that attention may be directed more readily to the more novel aspects of the theory.

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 Internal Physics of Metals.

I NOTICE in an article in NATURE of April 14 on "The Internal Physics of Metals" considerable importance is given to the idea of the existence of an amorphous or vitreous layer between the crystals composing metals and alloys, and certain seasonal changes in them are attributed to the presence of this layer. The remark is made that until 1919 the phenomenon of "season cracking" was considered to be an isolated one, and recognised only in brass.

"Season cracking" is, however, only an extreme case of the secular relief of strain which occurs in all metals which have been subjected to cold working.

It may be of interest to some of your readers to learn that this state of strain in cold-worked metals and its cause had been dealt with in a paper read before the Faraday Society in 1904, while in the May lecture to the Institute of Metals in 1911 an illustration was exhibited of the partial relief of strain by cracking which had occurred within twenty-four hours. In these papers, and in others communicated to the Royal Society, the change from the crystalline to the vitreous state brought about by mechanical disturbance and "flow" was shown to occur in metals and other crystalline substances. The effects of this change of state on the chemical, electrical, acoustical, optical, and mechanical properties of the substances were dealt with, and were all shown to be associated with a condition of strain which could be completely relieved by the restoration of the fully crystallised condition by raising the mass to a temperature far short of its melting point.

It was suggested that the changes of structure which are produced by the cold working of metals could be accounted for by the occurrence of liquid-like flow at all internal rubbing surfaces, followed by almost instantaneous resolidification of the liquid phase, thus producing a hard cement, binding together the broken and distorted remains of the original crystal grains. In wire-drawing, for example, an entirely new "texture" is developed even in pure metals. The crystal grains are drawn out into fibres, which are embedded in and cemented together by the portion of the metal which had passed through the liquid phase as the wire flowed through the hole in the draw-plate. Owing to the greater solubility of the metal which has flowed into the vitreous state, the first effect of a solvent on the wire is to dissolve away the cementing material and to expose the fibrous structure.

"Season cracking" seems, therefore, to depend (1) on the free flow of the metal during drawing, for the greater the production of the liquid phase the greater will be the shrinkage at the moment of resolidification, and the greater will be the resulting state of strain in the hardened metal; and (2) on the subsequent action of a solvent which, by removing or breaking up the vitreous skin and cementing material, will enable the elastically strained fibres or layers to spring apart. The solvent may be mercury, or an acid or saline liquid, or acid vapours or even water vapour in the atmosphere. A piece of hard rolled metal foil is thoroughly springy and resilient, but this resilience is completely removed and the foil becomes soft if the vitreous layer on the surfaces of the foil is removed by a solvent.

GEORGE BEILBY.

April 21.

SIR GEORGE BEILBY's work on the generation of amorphous metal as the result of "flow" during plastic straining or surface polishing of metals is so well known and appreciated that a contribution from him to the discussion of "season cracking" is very welcome. At the general discussion on this subject the fullest reference to his work in first indicating the existence of metal in an amorphous condition was made. Sir George Beilby's letter, however, appears to be based mainly upon the brief article in NATURE of April 14 rather than on the full discussion of the subject, of which that article could not give more than a very brief account from one particular point of view. No doubt for that reason Sir George Beilby has apparently missed some of the main points of the discussion, and has made a suggestion with regard to "season cracking" which is not easily reconciled with the known facts.

Thus, one reason why special importance is attached to an amorphous inter-crystalline layer or "cement" which exists in entirely unstrained metals is that fracture in "season cracking" follows the boundaries of the original crystals, and does not follow the lines of flow or slip within the crystals upon which Sir George Beilby's amorphous metal is formed. Further, it has now been clearly shown that fracture essentially of the nature of "season cracking" can and does occur under the prolonged application of external stress in fully annealed, or even cast, metal in which there has been no formation of Sir George Beilby's amorphous metal as the result of plastic strain. It follows, therefore, that the amorphous metal generated by plastic strain must be regarded as playing only an indirect part in the phenomena of "season cracking," that part being so to stiffen and harden the metal that it can carry an internal stress high enough to bring about the gradual separation of the crystals along their original boundaries.

With regard to the statement that prior to 1919 "season cracking" had been regarded as an isolated phenomenon confined to brass, this is true in the sense that until the publication of Rosenhain and Archbutt's paper it had not been recognised that this type of inter-crystalline fracture under prolonged stress could occur in other metals than brass, and possibly nickel-silver, whereas it was then shown that it also occurs in lead, in aluminium alloys, and even in steel.

THE WRITER OF THE ARTICLE.

Biological Terminology.

MR. CUNNINGHAM writes (NATURE, February 24, p. 828): "It is a mere matter of terms and synonyms. The modern biologist would say that the normal hand was hereditary, or innate, or due to certain factors or genes in the chromosomes which usually are handed on unchanged 'down the germ-tract'; that the sixth digit was a mutation, due to some change in the genes in the chromosomes, and therefore gametogenic; and that the scar was due to an injury which resulted in regenerative processes producing new tissue. . . . Sir Bryan Donkin writes that like exactly begets like when parent and child develop under like conditions; if we say, then, that the differences due to unlike conditions are acquired characters, what is the objection?"

The objection is that what is true of individuals is not necessarily true of characters, and that Mr. Cunningham's thoughts drift to and fro, now comparing individuals and now characters. Moreover, he makes distinctions where there are no differences. As a consequence, he is convinced that I contradict myself, and so on. Taken by itself, not a statement he makes is incorrect. Taken as a part of a whole, every statement is incorrect. It is quite true that a hand and a sixth digit are germinal, but the scar also takes origin in germinal potentiality. It is true that the scar is a response to the stimulus of injury, and in that sense acquired; but injury is not the only form of nurture, and hands and sixth digits are as much products of nurture and as much situated in the soma as scars.

Is not the following true?—(1) All likenesses between individuals are innate *and* acquired. For example, men have similar hands because, (*a*) having started with similar germinal potentialities, and (*b*) experienced similar nurtures, they have (*c*) developed similar characters. (2) All unlikenesses between individuals are innate *or* acquired. Thus a sixth digit indicates an unlikeness (variation) which has a germinal origin; for under similar nurtures the individuals develop differently. A scar indicates an acquired or somatic unlikeness (modification); for this unlikeness develops only when unlike nurture is experienced by the individual. (3) All characters as such (*e.g.* when compared together) are innate *and* acquired. Thus a hand is founded on germinal potentiality, and, therefore, is innate; it develops under the influence of nurture, and, therefore, is acquired; and it is situated in the soma, and, therefore, is somatic. The same is true of every character that can be thought of. It follows that while it is correct to distinguish differences between individuals by the terms "innate" and "acquired," it is incorrect so to distinguish characters. A sixth digit indicates an innate difference, but is not in itself especially innate. A scar indicates an acquired difference, but is not in itself especially acquired. If the matter be considered, it will be found that while some biology (*e.g.* the theory of natural selection and the Mendelian theory) is founded on the belief that differences between individuals are innate *or* acquired, much the greater part of biology—or, at least, of biological literature (*e.g.* the Lamarckian and Neo-Darwinian hypotheses)—is based on the assumption that all characters are so distinguishable.

It is admitted that in the germ-cell are, not the characters of the individual, but only potentialities for developing them in response to fitting nurture. Therefore, nothing but potentialities can be transmitted. It follows that when, using a colloquialism which is pardonable, since it neither deceives nor confuses, we say that a child "inherits" his parent's hand, we can mean only that the child, having inherited a like potentiality, has under similar conditions developed a similar character. We then mean that the child is like the parent both by nature and by nurture, both by inheritance and by acquirement. If we used our words with the same meanings, we should say that a child inherits his parent's scar when he develops it under the same conditions as the parent did (in response to injury). The child would then be like the parent both by nature and by nurture. He would really have "inherited" in the only sense in which the word has meaning. But, misled by his misuse of words, the biologist will have none of this. He would regard the scar as inherited only if the child reproduced it in a way in which the parent did not and could not have produced it, only if the child were unlike the parent both by nature and by nurture, only if the child had varied so profoundly and improbably from his progenitors that the scar, this ancient and vitally useful product of evolution, is now produced (and the whole course of evolution upset) under some other influence as a useless and burdensome thing. The misuse of the words "innate," "acquired," and "inherited" conceals the enormity of the notion and gives it an air of probability. As a consequence, biologists have debated for a century as to whether evolution follows the "transmission" of "acquired" characters, and to-day biologists using "exact methods" are trying to ascertain what characters are "innate," and therefore worthy of the attention of the student, and what "acquired," and therefore unworthy of his attention.

When employed to describe differences between individuals, the words "innate," "acquired," and "inherit" are used intelligibly with their ordinary dictionary meanings. When applied to characters they cannot have these meanings. They have then no meanings, or technical meanings. It is claimed that they have the latter. But, as has appeared in this correspondence, no technical meanings can be thought of which accord with past or present usage. Moreover, the claim is unhistorical; for, as may be seen by an examination of literature, biologists have never intended to give their words technical meanings. Their very synonyms, "germinal," "blastogenic," "somatogenic," and the like, were coined to give greater definiteness to the naive belief that, while "some characters have their representatives in the germ-plasm," others are products of "heat, light, moisture, and the like." Historically, all biologists have limited the term "acquired" to characters which develop in response to glaringly obvious stimuli, and applied the term "innate" to all other characters. For example, the musculature of the blacksmith has been termed "acquired," while those of the child, the youth, and the ordinary man which have developed in response to precisely the same stimulus (use) have been termed "innate."

"Innate," "acquired," and "inherit" are the chief terms of biology. We see that the first two have sometimes clear meanings and sometimes no meanings, and that "inherit" sometimes means "inherit" and sometimes its direct opposite, "vary." I daresay that most readers of this correspondence think I am engaged in a mere logomachy. But with the chief terms in such a state of vagueness and confusion, how is it possible to build a science? Confusion is sure to follow. It has followed. As Dr. Norman R. Campbell has well said (NATURE, April 21, p. 234): "Accuracy of thought is intimately dependent upon the constancy of the meaning of the words used to express it." Consider the chaos of biological sects and opinions. Consider the controversies, always unending in the face of abundant evidence, and, therefore, as clearly products of mere prejudice as religious or political disputes. Consider the fact that, alone among interpretative sciences, biology has no body of truth accepted by all its students with the sole exception of the supposition that living beings have arisen through evolution. Consider the parochial littleness of biology, which has more tremendous problems ripe and ready for solution than any other science. Consider the enormous masses of neglected evidence—for example, that available from physiology and pathology and that which demonstrates the evolution of the power of developing in response to functional activity. Consider what happens when a humble outsider such as myself brings his difficulties to biologists. He is told pontifically that he is doing harm, or conceitedly that biologists are quite capable of conducting their deliberations without his help, and so on. The feelings of awe and admiration excited in the humble inquirer are then likely to be—well, of no importance.

What is biology? Who are biologists? So far as I am able to judge, biology is commonly regarded as a side-show of natural history; and any zoologist and botanist is supposed to be, *ex officio,* a biologist. But biology is an interpretative science, and systematic zoology and botany are purely descriptive. They may furnish valuable evidence, but they do not necessarily do so. The zoologist or botanist trained in observation and description may interpret skilfully, but such skill is not a necessary outcome of his studies. Zoologists and botanists have themselves proclaimed the inadequacy of their evidence by founding the experimental and biometric schools, which began as violently opposed sects, and so continue.

To my thinking, biology is that science which sits at the hub of all the studies concerned with life—zoology, botany, physiology, psychology, medicine, bacteriology, embryology, anatomy, palæontology, sociology, even pedagogy and history—gathers evidence from them all, and deals especially with problems too big or deep for these individual studies, *e.g.* problems of heredity, evolution, development, and the like. If the biologist be controlled by the rules which ordinarily guide scientific procedure—for example, the rule that all verifiable and relevant facts (no matter how, or by whom, or when, or where collected) are equal before science, by the rule that all hypotheses must be crucially tested (*i.e.* so tested by *fresh* and *unlike* facts that every alternative hypothesis is rendered inconceivably as true), and by the rule that a fully established theory must be accepted as true regardless of all preconceptions—then a very splendid future immediately awaits not only biology, but also science in general; for the claim of science to the deciding voice in the settlement of numerous burning problems of immense importance will become irresistible.

By way of demonstrating that I am not vapouring, I shall venture to give one or two examples of evidence ignored and problems neglected by biology "as she is spoke" in a future communication. Meanwhile, there is a little more in Mr. Cunningham's letter with which it is necessary to deal. He says that naturalists would not admit that man, as an animal, is "higher" than an insect. It is pleasant to find him so careful of meanings; but will he please excuse the expression as "technical"? It is in common use and deceives no one. He declares that I give no evidence of the evolution of the power of developing in response to use. Is there any need? A man develops from birth to death mainly in response to this influence; does Mr. Cunningham believe that a butterfly develops in the same way to an equal extent? Consider mind. All learning, thought, intelligence, and reason depend on the growth of the mind through functional activity. Mr. Cunningham has done magnificent work on hormones. Does he think a beetle could learn what he has taught? What is intelligence but a power of developing in response to experience, of growing mentally in response to functional activity? What is stupidity but a "natural" or "acquired" incapacity so to profit? A human infant can learn, but has not learned. A human idiot cannot learn, and has not learned. A normal man can learn, and has learned. Almost all that separates the normal adult mentally from the infant and the idiot develops in response to use. The perfect idiot cannot even learn to walk or to speak. From the human point of view every dog is an imbecile, every cat an idiot, every beetle a perfect idiot. The beetle is more efficient than the human idiot merely because he is more completely equipped with instincts and instinctive actions, which, unlike human habits, habitual actions, and the rest, do not develop through use. For example, the beetle does not learn to use his limbs. Does not the difference between man and the beetle indicate an evolution of the power of developing in response to use? What more evidence does Mr. Cunningham want?

G. ARCHDALL REID.

9 Victoria Road South, Southsea, April 23.

The "Flight" of Flying-fish.

IN NATURE of April 21 Prof. Wood-Jones presents some interesting observations on the "flight" of flying-fish made from an especially favourable vantage-point—the overhanging bow-sheaves of a cable ship.

While crossing the Gulf of Mexico on various occasions I made some observations on the same subject with the aid of powerful binoculars (Goerz prismatic, magnifying 12 diameters). With these I had been used to following birds in flight, and with a little practice found that I could keep flying-fish under continuous observation during their passage through the air.

I can confirm Prof. Wood-Jones's account in the following important particulars:—

(1) The initial impulse is always given by rapid lateral strokes of the tail as the fish leaves the water. Since the lower lobe of the caudal fin is elongated, the fish can continue to propel itself in this manner for some time while the whole of its body is out of the water. On very calm days the moving lower lobe of the tail leaves a track in the water in the form of an interrupted line. Presumably the interruptions represent the times of violent lateral motion. The uninterrupted sections of line are each 2–3 in. long, the interruptions rather longer, the whole line often continuing for 5–6 ft. After this, of course, the fish rises wholly into the air.

(2) The fish may regain impetus by again vibrating its tail when it has dropped far enough for the lower tail-lobe to be once more in the water. Fresh impetus may be gained in this way once, twice, or even three times in a flight without the body ever touching the water.

(3) The pectoral fins are usually held stiffly out, as Prof. Wood-Jones states, and act as planes. I have, however, on several occasions seen rapid vibration of the pectoral fins for a short period; but whether this was actual "flight," as I at the time supposed, or whether it was due, as Prof. Wood-Jones suggests, to a passive vibration caused by the air meeting the fin at a certain angle, I am unable to say. The impression made upon me at the time was that the *normal* means of propulsion in air was the tail, but that the pectoral fins *could* be used as supplementary flying organs on occasion. Of the truth of the first part of this impression I have no doubt whatever; Prof. Wood-Jones's anatomical studies make me doubt the second part. However, a good binocular in the hands of anyone trained to field observation will put the matter to the test.

JULIAN S. HUXLEY.

New College, Oxford, April 25.

The Concept of "Space" in Physics.

PROF. EDDINGTON (NATURE, April 14, p. 201) expresses well the properties that a substratum of matter, light, and electric force should have, and the reasons for combining space and æther, the two different, but always co-existing, substrata of the older physics, into one. What is not clear is why he stops there. The ancient rule, "Entities are not to be multiplied beyond necessity," is as applicable now as ever. If a physical æther is to be postulated, it is for those who advocate it to show their reason for doing so, not for those who doubt it to offer arguments against it. So far as I can see, neither the old æther nor the new is more than a metaphysical concept of no utility, either in understanding natural phenomena or in predicting new ones, and accordingly neither forms part of the subject-matter of physics. In Prof. Eddington's own development of the theory he never makes any use of this concept. What he assumes is that physical laws can be expressed by differential equations with a certain mathematical property, and the whole of the verifiable results are deduced from this; but this assumption was chosen, not because it corresponded to any known property of space-time or æther, but because mathematically it was the simplest possible. The theory is not based on the concept of space-time, but on an unstated relation between physical laws and mathematical simplicity. Reasons why such an assumption is needed in any theory of scientific knowledge are given in a forthcoming paper by Dr. Wrinch and myself, and are independent of any views on the ultimate nature of the world, except that quantitative inference is possible.

Again, I must dissent from the statement of the interrelation of experimental geometry and mechanics. The essential feature of geometry, as the term is used by geometers, is that it is purely logical and not experimental. Consequently, "experimental geometry" is a contradiction in terms, and can neither have an outcome nor be one. The subject-matter of the mechanics of the world is the relations between the measured positions of bodies at different measured times; all the concepts involved in this statement are well-known physical magnitudes, and I see no use in trying to redefine them in terms of others that are either totally hypothetical or, at best, less comprehensible than those already in existence.

HAROLD JEFFREYS.

Meteorological Office, South Kensington,
S.W.7.

The Origin of "Churning at 62°" on Dairy Thermometers.

WILL you permit me through NATURE to ask the following question: Why do the makers of floating dairy thermometers, both in the United Kingdom and in the United States, so mark their thermometers that 62° F. is said to be "churning temperature," when dairying experts in both countries are in agreement that it should be taken as 56° F.?

I recently had occasion to make myself familiar with the agricultural literature published in this country between 1831 and 1855, and found that where churning temperatures are given it is stated to be 50° to 55° F., and in doing so reference is usually made to experiments carried out by the Highland Society of Scotland in 1828 on the best temperature for churning butter. Various American authorities in dairying have commented on this curious marking of dairy thermometers, and have come to the conclusion that it is a "mystery" how dairy thermometer-makers arrived at the figure 62° F., and why they persist in recording on the thermometers they are making to-day that 62° F. is "churning temperature."

Perhaps some of your readers may be able to throw light on this "mystery."

R. HEDGER WALLACE.

April 12.

A FIRM of manufacturers of thermometers, Messrs. Pastorelli and Rapkin, Ltd., to which we submitted Mr. Hedger Wallace's inquiry, informs us that though they have supplied tens of thousands of dairy thermometers in recent years, they do not know the origin of the mark "churning at 62°," and no one has ever suggested to them before that this temperature is incorrect. Dr. W. Goodwin, principal of the Midland Agricultural and Dairy College, has favoured us with the following opinion upon the subject:

"I do not know that marking dairy thermometers with a churning temperature of 62° is such a common practice as Mr. Hedger Wallace indicates. Many such thermometers are just marked with the degrees only, and these are what we always recommend for our students. It is quite impossible to fix a churning temperature owing to the large number of factors which have to be taken into account. For example, thickness of cream, the degree of ripeness of the cream, the temperature prevailing at the time, the breed of the cow, and even such other factors as feeding and period of lactation, come into consideration. I agree with Mr. Hedger Wallace that 62° is generally too high, unless the churning is taking place in very cold weather, and I venture as an explanation that possibly this old custom dates back to the time when whole milk was churned, as this necessitates a higher temperature than in the case of separated or skimmed cream. It would be of interest to find how the churning temperature of 62° has arisen, but I can think of no justification for it. Probably on some popular make of thermometer this point was fixed, and has been blindly copied ever since."—ED. NATURE.

Young's Interference Experiment.

YOUNG'S interference experiment is a very difficult one to perform as he describes it. If slits are used for the apertures it requires a distance of two yards from the first slit to the double slit, and two yards from the double slit to the observer, and also a very bright source, the sun or the crater of the electric arc. For this reason the experiment is seldom performed, Fresnel's biprism or mirrors being substituted for it in laboratory courses.

If, however, the double slit is mounted on the table of a spectrometer the experiment can easily be performed with an electric incandescent lamp or a sodium flame, and the bands are considerably brighter than with the other arrangement, though not so bright as the bands produced with a biprism. The double slit can be made by painting a piece of glass dead-black and then drawing two parallel scratches on it with the point of a penknife. If the scratches are six-tenths of a millimetre apart, a natural distance to draw them, the separation of the successive bands is about three minutes in the field of the telescope, and ten or twelve bands can be counted. This method of performing the experiment is not mentioned in the text-books, and so it appears worth while to direct attention to it here.

It should also be stated that the diffraction bands produced by a straight edge are undoubtedly more easily observed with a spectrometer than with the expensive optical benches sold for the purpose. The diffracting edge —the blade of a penknife, for example—is mounted vertically on the prism table, and the telescope object-glass removed. The bands are then seen in the field, the distance between the first two maxima being about four minutes with a spectrometer of average size. In the formula for their position the a becomes infinite and cancels, and the angular distance from the edge of the geometrical shadow is $\sqrt{(\{2n-1\}\lambda/b)}$.

R. A. HOUSTOUN.

University of Glasgow, April 16.

The Electrodeless Discharge in Sodium Vapour.

BY placing a primary Tesla coil about a highly exhausted pyrex bulb containing metallic sodium, and enclosing the whole in an oven, the writer has obtained a brilliant electrodeless discharge at a temperature in the neighbourhood of 300° C. Observation with a Hilger constant deviation spectroscope revealed, in addition to the D lines, doublets at 6162 (and 6158), at 5688 (and 5683), at 4667, at 4497, as well as faint probable doublets at 5153, at 4980, and at 4572—lines all to be found in the arc spectrum. After two or three hours' continuous heating the discharge was almost as brilliant as initially, although the bulb on removal from the oven had the usual brown colour resulting from the action of the hot vapour.

The writer has under way a further study of this type of discharge with sodium and with other metallic vapours, and hopes that with more violent excitation than was used in the above case interesting spectroscopic data may be obtained.

JOHN K. ROBERTSON.

Queen's University, Kingston, Canada,
April 7.

High-speed Aircraft Propellers and the Destruction of Gnats.

SOME of your readers may be interested in an incident which took place during the testing of a propeller at the Royal Aircraft Establishment, South Farnborough. The propeller was being revolved at a very high speed, such that the tips of the blade were moving at about 1000 ft. per second. The test was carried out in the open, and the noise was such that in the neighbourhood of the propeller it was impossible to make oneself heard. Moreover, the noise gave an unpleasant physiological sensation. The interesting fact to your readers is that apparently this noise attracted very large numbers of gnats, and most of these lost their lives by being drawn through the propeller, which on being stopped was found to be covered with their blood and portions of their bodies.

At the commencement of the test, and even when running with a tip-speed of 800 ft. per second, there was no sign of any flying insects, nor was the day such that one would expect them.

I have been present at many such tests, though never at such a high speed, but I have not noticed such an occurrence before. HENRY C. WATTS.

April 21.

Why do Worms Die?

THE REV. H. FRIEND's letter in NATURE of April 7 recalls an observation made towards the end of last November with respect to the death of worms. A shallow gutter or water-drain by the side of a road near Sidmouth had become filled with dead leaves (principally of *Populus alba*) during the late autumn. These by accumulation and pressure had formed a firm, compact bed in the drain. During a night at the end of November last we had exceptionally heavy rain, and the next morning, on passing along the road in the forenoon, my attention was immediately arrested by the number of worms (of several species) lying dead outside the shallow water-drain. In the space of about 20 ft. I counted upwards of a hundred worms. They had evidently crawled out from the bed of dead leaves to the firm surface of the road and died there. My conclusion was that they had crawled out from the gutter in a half-drowned condition and beyond the chance of recovery. A curious point was that they all (irrespective of size and species) appeared to have crawled to about the same distance, so that they formed a fairly even line running parallel with the gutter. G. T. HARRIS.

Vegetation around London Earlier than in the Provinces.

NATURE of April 21, in the Notes columns, p. 245, mentions that a correspondent who travels frequently from the south-west of England to London finds at this time of year vegetation, notably the flowering trees, generally more advanced as the metropolis is approached. In the past I have frequently noticed the spring vegetation in London to be more forward than thirty or forty miles outside. Commonly, in visiting East Grinstead from London, I have noticed and remarked on the lateness of spring vegetation compared with the metropolitan suburbs. This year at Tulse Hill, and generally in the south of London, the pear- and apple-trees were in fairly full blossom at the commencement of March, whilst at Eastbourne similar vegetation was fully three weeks later. The dates from the Phenological Report for 1919 published by the Royal Meteorological Society referred to in your Note can scarcely claim to determine the general difference between south-west and south-east England. The early months of 1919 were abnormally cold and wet, and on April 27 a snowstorm of considerable severity occurred in the south of England.

CHAS. HARDING.

2 Bakewell Road, Eastbourne, April 21.

A Modern Inorganic Chemistry.

IN a very able and courteous review of my "Textbook of Inorganic Chemistry" which appeared in NATURE of April 14, "A. J. A." makes two statements which I think might be misleading to many readers. He states that "in practice calcium cyanamide is not produced in an arc furnace." The Stockholms Superfosfat Fabriks Aktiebolag, Stockholm, make 20,000 tons of cyanamide annually in arc furnaces, and since this modern so-called "continuous cyanamide process" is referred to most respectfully in the report of the Nitrogen Products Committee, I thought it worthy of mention—in an imperfect manner, it is true. It is quite possible that of the two cells described for the manufacture of electrolytic alkali, one is "obsolete" and the other "obsolescent." It is five years since I saw one described in some text-books as "quite obsolete" operating with great activity; doubtless it has now gone out of use. Since these two cells, however, were the only ones I could find authoritatively described as in use, or as having been in use, in this country, I preferred to describe them rather than cells existing only in patent specifications.

J. R. PARTINGTON.

MY knowledge of the continuous cyanamide process is confined to what appears in the Nitrogen Products Committee's report, and I am afraid I did not know that the preliminary heating of the carbide necessary before it can absorb nitrogen was carried out by electric arc heating. The arc itself is, of course, at a temperature far above that at which nitrogen can be absorbed by carbide.

With reference to Prof. Partington's second point, there is nothing in his description of electrolytic alkali cells to indicate that he is only dealing with processes used in this country, and there is no lack of authoritative descriptions of cells used abroad, where electrolytic alkali has assumed greater importance than has been the case here in the past. Even so, I think I am right in saying that the Castner-Kellner rocking cell is no longer used to produce alkali for the market, and, this being so, it appears a pity to devote to it such a disproportionate amount of attention. "Obsolescent" is, I imagine, a fair description of the Hargreaves-Bird cell. THE REVIEWER.

The High Pamir.[1]

THE term "Pamir," when strictly used, connotes the level floor of a wide-based mountain-valley in the uplands that connect the Hindu-Kush and Karakoram ranges to the south with the Alai and Tianshan ranges to the north. On its eastern side this tract rises rather abruptly from Kashgar; westward, it descends more gradually to Ferghana.

While nearly horizontal from end to end, the surface of such a valley-floor is usually undulating, and is almost always drained by a central stream with a boulder-strewn bed which is depressed somewhat below the level of the main valley-floor. Often such streams widen into a lake or lakes with low, bare banks; in the case of one Pamir—the Alichur—the lake is at the western end and has mountainous shores. The rivers of the eastern valleys flow towards the Kashgar plain; the western streams flow to join the Oxus. The valley-floors are generally 12,000 to 14,000 ft. above sea-level, often 5 miles wide, and sometimes exceed 50 miles in length. The slopes overlooking them that have a western or southern exposure usually have huge bare basal screes of talus, and are steeper than the less barren slopes that look east or north. Conflicting views have been advanced as to the formation of these striking flat-floored valleys. Whatever the true explanation may be, they are now being steadily filled up as the result of disintegration of the slopes on either side.

The ranges which separate these valleys are loftier in the eastern portion of this region than elsewhere; one eastern peak, Mustagh-ata, is 27,500 ft. high. Some of the north-western peaks exceed 23,000 ft.; the south-western ranges are only 17,000 to 20,000 ft. high. The latter extend further west than the portion of the region marked by the presence of flat valley-floors, the streams of which, now flowing with more rapid descent, find their way to the Oxus through narrow glens and mountain-gorges.

Ser Marco Polo, six hundred years ago, had heard of this elevated region. He knew that the word "Pamer" signifies a plain, but he appears to have thought that there was in the region only one great plain, "twelve days' journey in length." Modern Russian writers also apply the name "Pamir" to the whole of this upland tract. But they regard, with justice, the ranges that separate the various valley-floors as of most physiographical consequence, and, therefore, include in the Pamir that area in which the valleys between these ranges are steep and narrow, as well as the portion in which the valleys are flat and wide, terming the former Low Pamir and the latter High Pamir. English authors also extend the meaning of the word "Pamir," but in another sense. As used by us, the term connotes not only the floor of a wide mountain-valley, but also the slopes that bound it on either hand. The "High Pamir" of the Russian traveller we therefore speak of as "The Pamirs."

The climate of this region is rigorous, for the winters are long. July and August are the only months when its plants grow and flower. Though the days are then mostly bright, and the thermometer, an hour before sunset on an August afternoon, may register 75° F., the temperature during the ensuing night may be 14° F., and even in July snowstorms occur. As a rule, however, bitterly cold winds blow day after day until sunset, and, even when the days are calm, brief but violent evening gales may sweep down the mountain-slopes, carrying with them gravel and stones. At noon on an overcast August day the water welling from a hot spring may be partly converted into ice as it trickles away. The air is dry; in 1898 the average humidity was 38 in July and 21 in August. Periods of more than three months may pass without falls of rain or snow. Even on the high passes in March the snow is rarely so deep as to impede travel, for at 12,500 ft., the elevation at which the Kirghiz seek winter-quarters, it does not prevent their herds from finding pasturage.

Seen from a high divide, the valley-floors below appear brown save for the narrow green belts which skirt the rivers. One looks north over a valley to a brown mountain-slope the wide screes of which resemble darker shadows; or south to another mountain-slope with a green zone close under its snow-fields, green patches near its mountain-streams, and usually a fainter green tinge elsewhere. In the clear atmosphere, the lines of the watercourses that score the mountain-slopes are well defined, and seem deeper than elsewhere on slopes facing east or west. This appearance is deceptive; what from afar are taken for the shadows of deep clefts one finds on closer view to be lines of vegetation along the south side of each shallow stream-bed (Fig. 1). The reaction of the vegetation both to exposure and to moisture at the root is, in this region, so marked as to be perceptible miles away.

Our floristic knowledge of the High Pamir is considerable. Before 1890 Russian travellers had visited the region. In 1891 Sir F. E. Younghusband collected a few plants in the Taghdumbash, an eastern Pamir. In 1895 an Indian Pamir Boundary Commission, approaching by way of Gilgit and Bozai Gumbaz, entered the region from the south on July 20, and remained there until September 16. During this period Lt.-Col. Alcock was able to visit the eastern end of the Great, and to make a thorough botanical investigation of the Little, Pamir. A list of the species collected, prepared by Mr. J. F. Duthie, was published in Alcock's "Report on the Natural History Results" of this Commission on April 12, 1898. In June, 1898, a Danish expedition, led by

[1] "The Second Danish Pamir Expedition. Conducted by Lieut. O. Olufsen. Studies in the Vegetation of Pamir." By Ove Paulsen. Pp. ix+132. (Copenhagen: Gyldendalske Boghandel, 1920.)

Lieut. (now Prof.) O. Olufsen, entered the High Pamir by the Kisil-art pass (14,300 ft.) on its northern border, spent a month in camp near Lake Jashil-kul (13,500 ft.) in the Alichur Pamir, and in September marched south to the western end of the Great Pamir, and thence through Wakhan and Goran to Chorock (7000 ft.) in Shugnan. After wintering there from November, 1898, to February, 1899, the expedition retraced its steps and left the High Pamir by the Kisil-art at the end of March. The floristic results of this expedition have been published in numerous papers, mainly by Prof. Paulsen, a member of the expedition. In 1901, and again in 1904, the High Pamir was traversed by Mme. Olga Fedtschenko and her son, Mr. Boris Fedtschenko, both well-known authorities on the flora of Turkestan. The route of the Danish expedition was followed in both cases, so that Alcock is still our only authority for the area investigated by him. The systematic results of these journeys have been incorporated by Mme. Fedtschenko in a "Flore du Pamir," published in 1903, with supplements in 1904, 1905, 1907, and 1909. However, our knowledge of High Pamir plants is probably still incomplete. All the valleys investigated by Alcock, by the Danish party, and by the Fedtschenkos are drained by rivers which flow to join the Oxus, and, even as regards these Pamirs, we find that, while many plants are common to all, some are peculiar to each. We still await an equally careful survey of the Pamirs with streams that flow eastward, and of the slopes which overlook Kashgar.

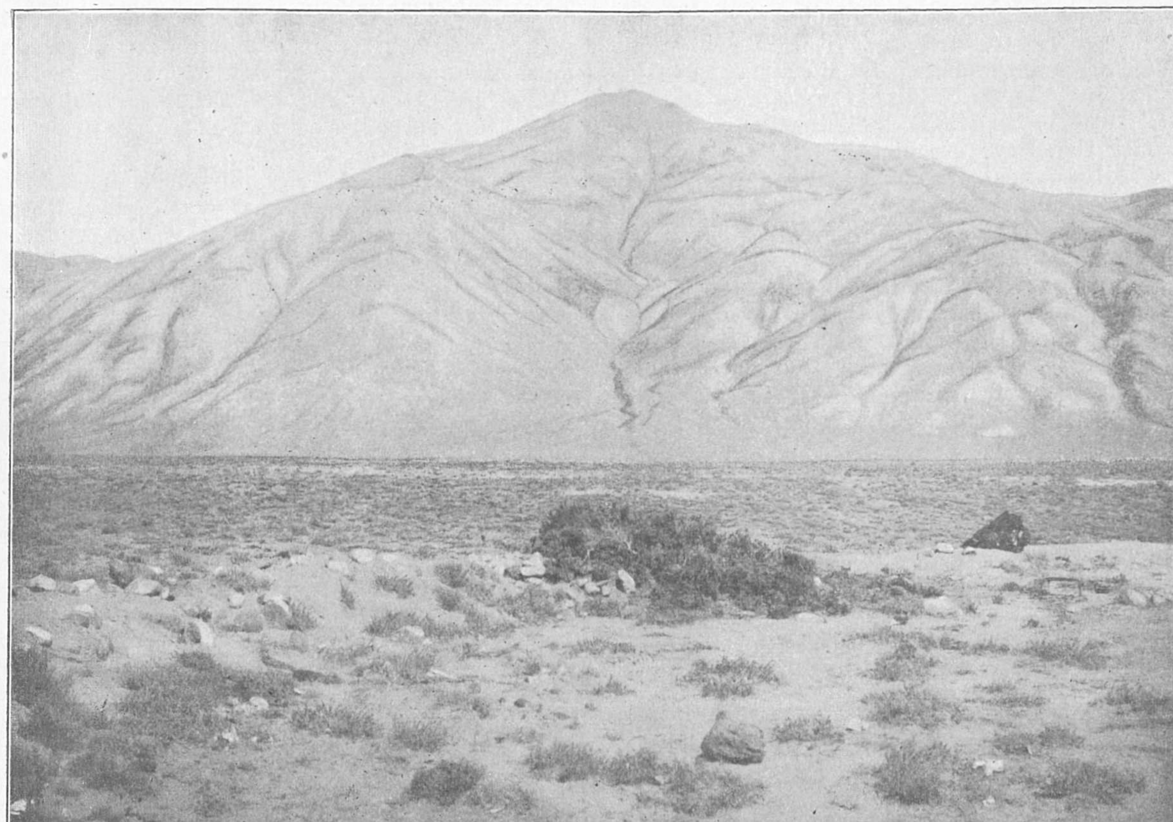

FIG. 1.—The plain east of Mardjanaj. In the foreground a heap of fuel, tufts and stems especially of Artemisia, Eurotia, and *Chrysanthemum pamiricum*. The mountain behind shows dark vegetation lines in furrows of dry watercourses. From "Studies in the Vegetation of Pamir."

While the last word cannot yet be said with regard to the phytogeography of the High Pamir, B. Fedtschenko, probably justifiably, felt, after his first visit in 1901, that the time was ripe for an ecological review of its vegetation. In this he recognised eight distinct plant-associations—aquatics; river-bed bushes; plants of the haughs along the river-banks; plants of the bluffs between the haughs and the true valley-floor; "desert" vegetation of the actual undulating valley-floor and of the major portion of the downs and slopes enclosing the valleys; patches of alpine meadow along brooks fed by melting snows; alpine meadows close under the snow-line; and willow-thickets in one particular sheltered ravine in the Jaman-tal. In summarising his results Fedtschenko has grouped these associations, with an additional salt-marsh-association, in three distinct plant-formations—meadows, subdivided into alpine patches, damp-meadows, and salt-marshes; stony wastes, including what he terms "Eurotia desert" and the vegetation of the bluffs leading from the valley-floor to the riverside haughs; and woody formation, including the Myricaria bushes of boulder-strewn stream-beds and river-banks, and the willow thickets of the Jaman-tal.

In his careful ecological study of the results of the Danish expedition, Paulsen, with arguments that compel conviction, suggests that these "stony wastes" scarcely fall within the "desert" category. Fedtschenko's "Eurotia desert," in particular, Paulsen prefers to regard as "fell," using this term with a connotation corresponding with that of the word "forest," to signify that the plants involved show adaptation to cold and snow rather than accommodation to drought and heat. High Pamir plants display few expressions of adaptation to drought; their habit and their histology alike suggest that they are more influenced by strong light than by dry air. Further, they agree more closely, on the whole, with alpine than with arctic plants, and their structure suggests that they are affected more markedly by the altitude at which they grow than by the climate they have to endure.

The formations recognised by Paulsen for the dry High Pamir are four in number, and are named, from characteristic species in each, the Trigonella-, the Eurotia-, the Arenaria-, and the *Poa attenuata*-formations. Of these the Trigonella-formation is defined as the vegetation, largely xerophytic, of the valley-floors of the High Pamir, and the Eurotia-formation as the xerophytic vegetation on mountain-slopes with a southern or a western exposure; the Arenaria-formation is a special association, only seen well-developed near Lake Jashil-kul, which is a transition between the Trigonella-formation and the mesophytic vegetation on mountain-slopes exposed to the north; and the *Poa attenuata*-formation includes all the mesophytic associations of mountain-slopes with a northern aspect. In his comparison of the two systems, Paulsen regards Fedtschenko's alpine meadows as identical with his own *Poa attenuata*-formation; unites Fedtschenko's damp-meadows and salt-marshes in what he himself terms "swamp-meadow"; and recognises Fedtschenko's "woody formation." As regards Fedtschenko's "Eurotia desert" and "Bluff" associations, Paulsen's concordance is of a tentative nature; he suggests that the former may be his own Trigonella-formation, the latter his own Eurotia-formation. Clearly, however, the Eurotia desert of Fedtschenko includes the Trigonella-, the Arenaria-, and the Eurotia-formations of Paulsen, who apparently does not regard Fedtschenko's "Bluff" association as a definite entity. There is nothing save Fedtschenko's expression "and so forth" to support the suggestion that this author's "Abhänge u.s.w." may include mountain-slopes with a southern exposure; the "Bluff" association plants mentioned by Fedtschenko are not met with on the slopes to the north or east of a flat valley-floor. Interesting though this particular plant-association may be, a student of the High Pamir vegetation may be excused if he regards it as being, like the "woody formation" in the boulder-strewn river-beds, an intruding element that, favoured by special conditions, has extended upwards from the narrow valleys of the Low Pamir. For the sake of convenience we may also exclude the floating and submerged plant-associations of the marshes and lakes, not as being devoid of interest, but as not being distinctive of the High Pamir.

When the vegetation characteristic of these Pamirs is regarded from the English traveller's point of view, account must be taken both of the open surface of the valley-floor and of the slopes that rise from it on either hand. In dealing with the open surface we may begin with the green ribbon of vegetation that skirts the streams and fringes the lakes. This green belt includes two marked plant-associations: water-meadows or marshes, characterised by the presence of tufted sedges; and haughs of mountain meadow grasses mixed with which are many gay alpine plants. These High Pamir marshes may furnish, all told, some forty species, whereof a score are to be expected in any single Pamir. The haughs may supply about fifty species, of which one-half to two-thirds may be present in any one valley. These two plant-associations constitute one plant-formation, composed exclusively of mesophytic plants. In this respect it does not differ from the *Poa attenuata*-formation of the slopes with a northern exposure that bound the valley to the south or the west. Though as rich in species as the rest of the valley-floor, this green belt is less interesting ecologically than the open surface above the Bluff.

That open surface, notwithstanding its bare appearance as seen from above, is far from being devoid of vegetation. If the flora be of a poor type, that type is highly developed, and is made up of scattered tufted xerophytes with an admixture of cushion-plants. The individual plant-clumps are often a yard or more through, and usually a pace or two apart, so that, where vegetation occurs at all, it clothes approximately half the ground, though scattered irregularly over the valley-floor are many bare stretches of hard sand and shingle, variable in extent, and often coated with a saline efflorescence. Sometimes such saline spots sustain a few halophilous species, which thus constitute a distinct plant-association, while in the vicinity of the hot springs that occur in some of these high valleys a few peculiar species constitute yet another association. Excluding these two relatively unimportant elements, the vegetation of the High Pamir valley-floors, taken as a whole, is remarkably uniform throughout the region, and may be regarded as a distinct plant-formation. The number of species involved varies somewhat in different valleys; thirty may perhaps be a fair expectation for a particular Pamir; fifty is about the number for the High Pamir as a whole. The formation is, then, about as rich in species as the riverside mesophytic one, but in this case the species most plentiful in any single Pamir are, with few exceptions, those most plentiful in all the valleys.

Along the route followed by the Danish expedition and the Russian travellers the slopes that overlook the valleys from the north or the east differ greatly from the anticlinal ones. The great screes along the base of a northern or eastern range are nearly, if not quite, bare; the rocky stream-beds and the open slopes are sparingly furnished with some of the more drought-resisting members of the plant-formation on the valley-floor below. The Little Pamir, however, is described by Alcock as having grassy downs on either hand. The long axis of that Pamir runs from west-south-west to east-north-east. We may therefore conclude that the slope which looks south also looks sufficiently east to escape extreme desiccation, while the one which looks north does not look sufficiently west to bring about that condition. The western influence on this slope may explain the absence from Duthie's Little Pamir list of many of the species present in some of the other Pamirs, in spite of the fact that Alcock collected every plant he saw except a rhubarb never met with in flower. In valleys other than the Little Pamir the total number of species recorded from mountain-slopes looking south or west scarcely reaches a score, all of them distinctly xerophytic in character.

On slopes with an eastern, and especially with a northern, aspect a relatively luxuriant flora, rich in species of a more or less mesophytic character, makes its appearance and constitutes a plant-formation closely related to, and perhaps not really distinct from, the mesophytic formation in the haughs along the banks of the main stream below. The two formations are, in fact, continuous through the mesophytic vegetation that accompanies the streams, fed from snow-fields or small glaciers, the broad channels of which open on the valley-floor at right angles, and cross that floor in order to join the river. Nearly four times as many species are met with on mountain-slopes with a northern exposure as may be found on those that front the sun. The increase in amount of vegetation is even more marked than the increase in the number of species. The poor and open furniture of the sun-baked slopes looking south or west gives place to a plant-covering usually closer, on these moister slopes that face the north, than on the open valley-floor.

The relationship between the vegetation of a flat Pamir and that of the containing slopes is fully understood only if it be realised that the valley-floor plant-formation is a "complex" of at least three distinct plant-associations. When this floor is quite horizontal all the species of the formation may be intermingled; but this condition is rare. Usually the surface is undulating, and more plants are to be found on the rises than in the depressions. Some species in the depressions grow equally freely on the rises; a few prefer the depressions; one or two are confined to them. On the rises the plants on the side facing north or east differ from those on the side facing west or south, and this arrangement is repeated with every rise from end to end of a Pamir. Though these slopes are never very pronounced, the adjustment between the species concerned and the conditions that affect them is so fine that, even when the inclination is too slight to be perceptible to the eye or the muscular sense, the alternating bands of species appropriate to the anticlinal exposures demonstrate undulation of surface, and reveal the effect due to the enjoyment of a greater or less amount of heat and light, and of a larger or smaller supply of moisture.

Cushion-plants like *Acantholimon diapensioides*, one of the commonest of High Pamir plants, may occur on either aspect of a rise or in the depressions between successive rises; they may even be met with occasionally on the screes. In spite of this wide power of accommodation, Acantholimon does not appear on slopes exposed to the north. The very xerophytic *Eurotia ceratoides*, another common and widespread species, is, however, almost confined to the southern or western aspect of the undulations; this plant may occasionally be found on the screes, and is perhaps the species most characteristic of dry mountain-slopes facing the south. These slopes, indeed, rather than the valley-floor, might be looked upon as the distinctive home of Eurotia, were it not that the genus invades from the valley-floor those mountain-slopes that face the north. In many places these latter slopes show faintly that alternation of ridge and depression which is so marked a feature of the valley-floor. The depressions on such a hillside provide a footing for vertical bands of green vegetation composed wholly of mesophytic plants; the ridges between, even when barely perceptible to the eye, are marked by the presence of sparsely scattered small tufts of Eurotia. The grass *Stipa orientalis*, another common High Pamir plant, grows freely on either face of the undulations in the valley-floor, but avoids the intervening depressions. It is as much at home on high slopes facing west or south as is Eurotia; often these two are the only plants to be found on such dry slopes.

Among the valley-floor plants that are confined to the eastern or northern aspect of the undulations is *Trigonella Emodi*, and it is on this account that Paulsen has termed the vegetation of the valley-floor the Trigonella-formation. It has, however, to be noted that this species has not been recorded from the Little Pamir, although from Alcock's account the vegetation of that valley-floor is essentially the same as the vegetation of the other flat Pamirs. A species that occurs only in the depressions on the valley-floor is *Arenaria Meyeri*. This plant gives its name to the Arenaria-formation of Paulsen, a local plant-formation which links the vegetation of the valley-floor with that of the slopes exposed to the north. The species most distinctive of these high mountain-slopes with a northern aspect is *Poa attenuata* (Fig. 2), which Paulsen does not record from any valley-floor, but which, it would appear from what Alcock tells us, may be found in the Little Pamir not only on the mountain-slopes to the south, but also on the open surface of the valley, and even on the downs to the north. On this and on other mountain-grasses feed the herds of

Marco Polo's "exceeding great wild sheep, having horns, some of them six spans long," the "forms" of which, Alcock tells us, are to be found especially on the bare, unstable screes to the north of a Pamir. The economic botanist knows that *Ovis poli* is not the only creature which finds this herbage wholesome. Marco Polo had been told that in this region "are excellent pastures, so that in them a lean horse or an ox may be fat in ten days." Five hundred years later the same opinion was expressed in very nearly the same words, for Lieut. J. Wood, who journeyed to the sources of the Oxus eighty years ago, was assured by the Kirghiz that "the grass of the Pamir is so rich that a sorry horse is here brought into good condition in less than twenty days." The experience of the Pamir Boundary Commission of 1895 did not belie these older estimates, for Alcock informs us that, "of the many pack-animals met with on our return march from Gilgit to Kashmir, none approached our baggage-ponies in condition."

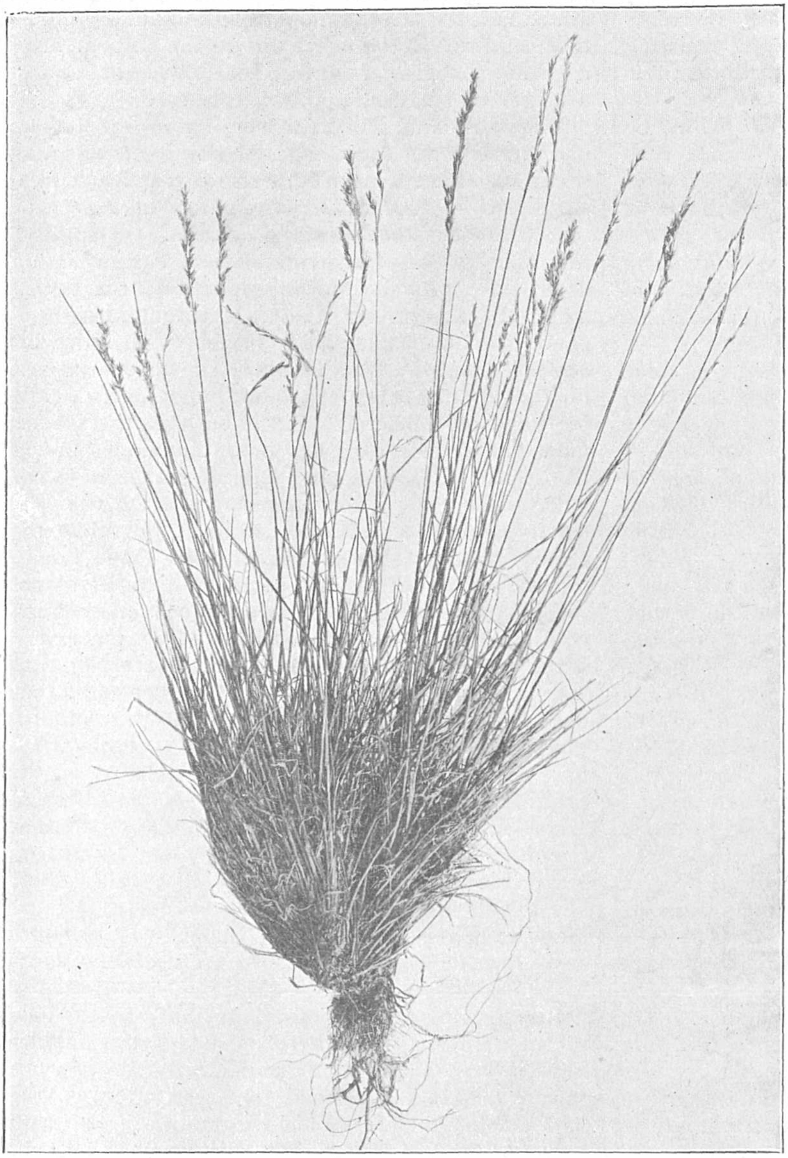

Fig. 2.—*Poa attenuata*, Trin. (about half natural size). From 'Studies in the Vegetation of Pamir."

Pamir air may perhaps assist the Pamir grass, for the climate of these lofty uplands is as healthy as it is severe. Paulsen describes in poetic terms the sense of well-being experienced by the Danish explorers during their halt near Lake Jashil-kul in August, 1898. Their days, it is fair to admit, were days of gentle breeze or calm. If such halcyon seasons be a feature of the valley sheltered by the Shatyr-tash, that Pamir is favoured beyond those that lie between the Ak-baital pass and the Alai range, or those between the Chargush pass and the Hindu-Kush.

However this may be, Prof. Paulsen, in these "Studies," has provided an account of the High Pamir and its vegetation so clear and so fascinating that his readers must feel prepared to face the bitter winds experienced by Alcock in the Aksu Pamir in 1895, and by Fedtschenko in the Kara-kul Pamir in 1904, should fate afford any of them an opportunity of visiting the region and subjecting the eastern valleys to the careful study bestowed by him and his companions on so many of the western ones.

Primitive Chronology.

By Dr. J. L. E. Dreyer.

The study of the ideas of uncivilised races with regard to chronology has generally been left to travellers who derived their information from natives among whom they dwelt for only a short time. The progress of civilisation among such races has often made it difficult to obtain trustworthy information about the way in which the division of time was formerly regulated among them. When attempts have been made to collate the information to be found in books of travel and in works on ethnography, as has been done in the ninth chapter of Ginzel's "Handbook of Chronology" (vol. ii.), the result has been a collection of scraps rather than a systematically arranged account of the first steps made by mankind towards a knowledge of the division of time. The detailed work on this subject by Prof. Nilsson,[1] of Lund, is, therefore, a most welcome addition to the literature of chronology, and, being based on a thorough study of the immense number of publications on the ways of primitive nations, it is fit to form an introduction to the great work of Ginzel, which chiefly deals with the chronological systems of more advanced races.

To the lowest tribes of mankind the seasons are the earliest units of time. Except in the tropics, hot and cold seasons succeed each other, and where the year is not spoken of, the number of summers or winters which have elapsed since a certain event took place is the earliest way of describing intervals of time. This practice is often continued in more civilised times—*e.g.* in the Middle Ages among Scandinavians and Anglo-Saxons time was reckoned in winters. In some localities the atmospheric conditions are such that two divisions of the year may be distinguished by the winds, as in the Marshall Islands, where months of calm and months of squalls succeed each other. In other places there are regularly recurring dry and wet seasons. People who engage in agriculture often divide the year into a greater number of seasons, eight or nine, according to their occupations, and even in China there is found, alongside the luni-solar year and its subdivisions, another system of dividing the year into twenty-four parts, the names of which refer partly to the weather, partly to other phenomena. In northern India there were originally (as there still are in Burma) three seasons, a hot, a rainy, and a cold, among which two or three transitional ones were later interpolated. Similarly, the Indo-European nations had three seasons—winter, spring, and summer—which were later subdivided into shorter seasons of ploughing-time, hay-making-time, etc.

Though we have spoken of the year being subdivided into various parts, this must not be understood as meaning that the use of the solar year is as old as the time-indications referring to natural phenomena. Not seldom the dry and rainy or warm and cold seasons are counted without being combined into a year. In Iceland there still exists a curious calendar, which divides the year into two parts—*misseri*—and the people count so many *misseri,* not years. Until midsummer (or midwinter) they reckon forwards, and say that so many weeks of summer (or winter) have passed; after that they say that so many weeks remain. The climatic year is a cycle which has no regular beginning, but the agricultural year has a natural beginning, which is generally marked by the rising of a certain star or group of stars, often the Pleiades, before sunrise (the heliacal rising).

The word for "year" is usually one referring to produce, but among the lowest races only a few years are counted, perhaps three or four; everything further back is merely said to have happened "some time ago." This is often sufficient, as such savages are frequently not interested in their own age or in that of other people, but only in that of their cattle. As to epochs from which the years may be counted, it is not until the beginning of history that the accession of kings is used for this purpose. Before that time some unusual event marks an epoch, such as a very severe winter or a great war, and as culture progresses such events multiply; and when their succession is known, a longer period is the result. This method of distinguishing the years was employed in ancient Babylonia, in the days of the Sumerian kingdom of Ur, in the second half of the third millennium B.C. The king's accession marks only one year, the others being named by events in the religious cult and politics. Similarly, in the older period of Egyptian history each year is described by an official name borrowed from the festivals—*e.g.* those of the king's accession, of the worship of Horus, of the sowing, etc.

The natural subdivision of the year is formed by the period of revolution of the moon with regard to the sun, or, what comes to the same thing, the period of its changing appearance, its phases. Man's attention must have been directed to the moon from the very infancy of time, as the course of the moon from the first appearance of the new to the disappearance of the old is short enough to be surveyed by the undeveloped intellect. Almost everywhere the "month" as a unit of measure is denoted by the same word as the moon. At first no attention was paid to the number of days in the month, and many primitive peoples cannot even count as far as thirty. But the changing form of the moon is sufficient as an indicator of time, and greater refinement of observation is by degrees attained until every day of the moon's revolution is described by a name. Such names often not only refer to the phases of the moon, but also indicate its position in the sky. The first appearance of the lunar crescent is an important event carefully watched for and often celebrated as a feast day. The full moon also gives rise to special feasts; half Africa dances in the light of the full moon. So did the ancient Iberians and many others.

The next step in the progress of primitive chronology is to group a number of months together into a cycle. At first, uncivilised peoples with an undeveloped faculty of counting can numerically determine only a couple of months before or after the time of the moon at the moment visible in the heavens. The months are then given names from the principal agricultural operations going on when the moon appears and while it lasts, and this often leads to the same moon having several names. If all the names in use among Melanesians were counted, the year of the natives would seem to be made up of twenty or thirty months. At this stage the question how

[1] "Primitive Time-reckoning: A Study in the Origins and First Development of the Art of Counting Time among the Primitive and Early Culture Peoples." By Prof. Martin P. Nilsson. (Skrifter Utgivna av Humanistiska Vetenskapssamfundet i Lund, I.) Pp. xiii+384. (Lund: C. W. K. Gleerup; London: Humphrey Milford; Oxford University Press 1920.) 21s. net.

many months there are in the year does not exist, and in some cases the reckoning by moons is not even extended to the whole year. There is a time when nothing particular happens and nobody takes the trouble to observe or name the moons; such a period is, for instance, the depth of winter in the far north. It is next realised that the succession of seasons is intimately connected with the motion of the sun. In northern countries it is noticed by people having a fixed dwelling-place that as midsummer is drawing near the sun is rising further and further north until a limit is reached. In this way the date of the summer solstice, and similarly that of the winter solstice, are determined, and a rough idea of the length of the year is obtained, and is improved by observing the heliacal risings of certain stars. It is thus found that the year is longer than twelve moons, and shorter than thirteen, and the next problem is how to make the lunar months fit into the solar year by the occasional interpolation or omission of a month. This is the beginning of scientific chronology as we see it arise and developed among the Babylonians and the Greeks.

Prof. Nilsson's valuable work was written by him in Swedish, and translated into English by a colleague in the University of Lund. The translator has followed the original closely, sometimes too closely, and he uses some curious expressions, such as "the phases of the stars," or the "shifting year" of the Egyptians (meaning their vague year). But these are trifling faults in an otherwise excellent book.

Obituary.

Prof. A. W. Reinold, F.R.S.

Arnold William Reinold, who died on April 11, was born at Hull on June 19, 1843, and was the son of John Henry Arnold Reinold, a shipbroker at that place. He was educated at St. Peter's School, York, and matriculated at Brasenose College, Oxford, in 1863, as an open Somerset scholar. He had a distinguished career as a mathematician, obtaining the University junior and senior mathematical scholarships, first classes in mathematics, moderations, and finals, and in the School of Natural Science. In 1866 he was elected to a fellowship at Merton, and in 1869 became Lee's reader in physics and a senior student at Christ Church. H: was the late Prof. Clifton's first demonstrator in the Clarendon Laboratory, being succeeded by A. W. Rücker.

In 1873 Reinold was appointed professor of physics at the Royal Naval College, Greenwich. His life-work was done here, as he held the post for thirty-five years, retiring in 1908 on reaching the age limit, and being made a C.B. in 1911. This professorship was a new appointment, so that a laboratory and courses of physics had to be organised; the laboratory buildings were part of the sick quarters of the old hospital, and finally occupied a considerable amount of space. Besides our own naval officers, gunnery and torpedo lieutenants, naval architects and engineers, etc., there were occasionally foreign students working here, and Reinold received a medal from the Emperor of China in recognition of work with Chinese students. It was at Greenwich that he collaborated with Rücker in a series of investigations on the properties of liquid films, the first paper appearing in the Proc. Roy. Soc. for 1877, and the final one in the Phil. Trans. for 1893, with several between. He was a lecturer at Guy's Hospital for most of his time at Greenwich, and a joint editor for several editions of Ganot's "Physics."

Reinold was signally devoid of any hobbies, and seemed to have no recreations. His interests apart from his work were mainly in the Physical Society, of which he was an original member, if not one of the founders, acting as secretary from the beginning until 1888, when he became president for two years; and in the Royal Society, of which he became a fellow in 1883, and on the council of which he served for some years. He was a sensitive man with a charming manner, and was liked by all who came in contact with him, being always courteous and gentlemanly in the fullest sense. Reinold retained his activities, mental and otherwise, to the end, which occurred very suddenly; he had just undertaken to write an obituary notice for the Royal Society of his old chief, Prof. Clifton. Married about 1866 to Miss Marian Studdy Owen, he leaves a family of one daughter and three sons.

W. N. S.

Robert Allen Rolfe.

Systematic botanists, and especially orchidologists, have sustained a grievous loss by the death on April 13, after rather more than three months' illness, of Mr. R. A. Rolfe, who, for upwards of forty years, was an assistant in the Herbarium of the Royal Botanic Gardens, Kew. Mr. Rolfe was born at Ruddington, near Nottingham, on May 12, 1855. He joined the Kew Herbarium staff in 1880, as a result of a public competitive examination, having previously gained some experience among cultivated plants in the famous gardens at Welbeck Abbey, Notts, and at Kew. It was anticipated that he would retire from service next month, and a visit to Central America was projected, for which a grant in aid had actually been voted by the Government Grant Board of the Royal Society.

Mr. Rolfe's contributions to botanical literature have been numerous and important. For many years past he was the generally accepted authority in this country on the Orchidaceæ; it might truthfully be said that his reputation was world-wide. He founded the *Orchid Review* in 1893, and edited and wrote to a large extent the twenty-eight annual volumes published. He paid attention to several widely different groups of plants, while he was keenly interested in the problems concerning hybridisation.

Mr. Rolfe was elected an associate of the Linnean Society in 1885. He received many distinctions. In February last he was awarded the Victoria medal of the Royal Horticultural Society and the gold medal of the Veitch Memorial Trust Fund. Mr. Rolfe's work was well done. He was esteemed by all who knew him, and his many amiable qualities won for him the affectionate regard of his numerous colleagues and friends.

Prof. Isao Ijima, who died of apoplexy in Tokyo on March 14, was born in 1861, and received his training as a zoologist in Tokyo from Prof. C. O. Whitman; and his first papers, on the leech Nephelis, were contributed to the *Quarterly Journal of Microscopical Science* and *Zoologischer Anzeiger* (1882). Continuing the study of various worms, he was attracted to the laboratory of Leuckart; but after his return to Japan, about 1890, he began a long series of researches on the beautiful Hexactinellid sponges of the neighbouring seas. In a series of papers published in the Journal of the College of Science of Tokyo University, Ijima threw light on the structure and development of many of these siliceous sponges. On the death of Mitsukuri, Ijima became senior professor of zoology at Tokyo University. Though administrative duties checked the flow of papers, he had prepared the manuscript of a large monograph on the Hexactinellidæ, which, it is to be hoped, will soon see the light. Ijima was a good shot, a keen fisherman, an all-round naturalist, and a charming companion. He leaves many friends and a succession of distinguished pupils.

The death is announced, in *Science* of April 8, of Dr. John Iridelle Dillard Hinds, at the age of seventy-three years. Dr. Hinds was one of the founders of the American Chemical Society, and for forty years acted as professor of chemistry, first in Cumberland University and later in the University of Nashville and Peabody College. At the time of his death he was chemist to the Geological Survey of Tennessee.

Notes.

The first of the two annual soirées of the Royal Society will be held at Burlington House on Wednesday, May 11.

In consequence of industrial disturbances, the Congress of Radiology, fixed for April 14 and following days, has been postponed until the spring of 1922.

It is announced that the King has approved the conferment of the honour of knighthood on Dr. James Craig, King's professor of medicine at Trinity College, Dublin, and president of the Royal College of Physicians of Ireland.

The *British Medical Journal* for April 16 states that the Government of Panama has assigned the sum of 10,000,000 dollars for the erection in Panama of the proposed Institute for Tropical Diseases in memory of the late Surg.-Gen. Gorgas.

Notice is given by the Ministry of Agriculture and Fisheries that applications for grants in aid of scientific investigations bearing on agriculture will be received until May 15 next. Copies of form A.230/I., giving particulars of the conditions under which the grants will be made, are obtainable from the Secretary of the Ministry of Agriculture and Fisheries, Whitehall Place, S.W.1.

It is announced in *Science* for March 25 that the American Engineering Council has joined with the National Association of Manufacturers, the American Patent Law Association, the American Chemical Society, and the National Research Council in a movement to bring about reforms in the United States Patent Office. A committee on patents has been appointed which is representative of mechanical, electrical, civil, mining, and metallurgical engineers in the United States in order to deal with this subject.

The subjects for discussion at the seventh International Fisheries Congress, which will be held at Santander, in Spain, on July 31–August 8, are:—(1) Oceanography, physical, biological, and meteorological; (2) technique of sea- and river-fishing; (3) fish, oyster, and mussel culture; (4) the industrial exploitation of the produce of the fisheries; (5) social problems; and (6) statistics and legislation. Papers for consideration ought to be sent to the Secretary-General of the Congress (*via* the Ministry of Agriculture and Fisheries) before June 1. The British Fisheries Society (which expects to be in being very shortly) is opening a subscription for the purchase of medals (six at 45*s*. each and six at 21*s*. each), and it is proposed that these should be awarded by the society for the two best papers in each of the above sections of the congress. The society invites British writers to submit papers.

The Faraday Society is organising a general discussion on physico-chemical problems relating to the soil to be held during the afternoon and evening of May 31 in the rooms of the Chemical Society, London, and presided over by Sir Daniel Hall, Chief Scientific Adviser to the Board of Agriculture. The discussion will be opened by Dr. E. J. Russell, director of the Rothamsted Experimental Station, who will give a general survey of the subject. A series of papers dealing with soil moisture, organic constituents, adsorption, and colloidal phenomena will then be put forward as a basis for discussion. It is expected that among those present will be Prof. Sven Oden, of the University of Upsala. Further particulars of the meeting may be obtained from the Secretary of the Faraday Society, 10 Essex Street, London, W.C.2.

Three Chadwick public lectures on "Fevers in England: Their Prevention and Control" will be delivered by Dr. William Hunter at the lecture-room of the Medical Society of London, 11 Chandos Street, Cavendish Square, W.1, on May 5, 12, and 19 at 5.15 p.m. The lectures are intended as a review of the progress made in the science of public health during the past century, special attention being given to the Public Health Acts (1848–1918). The first lecture will deal with sanitary reforms achieved during the period 1800–70; in the second the effects of the establishment of fever hospitals and the recognition of the value of antiseptic measures and protective inoculation during the period 1871–90 will be discussed; and in the third lecture, covering the period 1891–1920, the effects of compulsory notification and isolation will be described and some account given of the present position of medical knowledge on the subjects of typhus and relapsing fevers, measles, whooping cough, and influenza. Admission to the lectures is free in all cases.

The presentation of the first award of the Kelvin medal will be made by the Right Hon. A. J. Balfour in the hall of the Institution of Civil Engineers to Dr. W. C. Unwin on Wednesday, May 4, at 4 o'clock. The medal was founded in 1914, principally by British and American engineers, to commemorate the achievements of Lord Kelvin in those branches of science which are especially applicable to engineering. The award is dealt with by a committee of the presidents of the representative British engineering institutions after their consideration of recommendations received from similar bodies in all parts of the world, and, in accordance with the terms of the trust, it is made to the person whom the committee finds to be most worthy to receive this recognition of pre-eminence in the branches of engineering with which Lord Kelvin's scientific work and researches were identified.

The council of the Institution of Mining and Metallurgy presented the thirtieth annual report (for the year ending December 31, 1920) at the annual general meeting held on April 21. During the year a joint conference was held with representatives of the Institution of Mining Engineers with the view of promoting co-operation between the two bodies. The recommendations of the conference were adopted, with the result that the Institution of Mining Engineers will in future be accommodated in the house of the Institution of Mining and Metallurgy; each body will retain its identity, but they will be administered by one secretariat. The important question of the registration of engineers came into prominence during the year, when the council of the Institution of Civil Engineers decided to promote a Bill in Parliament for the registration of civil engineers. While accepting the principle of registration, the council of the Institution of Mining and Metallurgy deprecated the control over all branches of the profession of engineering which this Bill would confer, and, in company with other bodies representing various branches of the profession, protested to the council of the Institution of Civil Engineers. The latter has since decided not to proceed with the Bill, but to apply for a supplemental Royal Charter to authorise the use of "Chartered Civil Engineer" by its members. Two awards have been made by the Institution of Mining and Metallurgy during the past year; the institution's gold medal has been awarded to Sir Thomas Kirke Rose, in recognition of his services in the advancement of metallurgical science, with special reference to the metallurgy of gold, and the New Consolidated Gold Fields, Ltd., gold medal and premium of 40 guineas to Mr. H. Livingstone Sulman, for his paper "A Contribution to the Study of Flotation." Mr. F. W. Harbord has been elected president for the year 1921–22 in succession to Mr. F. Merricks.

The Peabody Museum, Harvard University, issues in vol. viii., No. 1, of its Proceedings an account of the excavation of an Indian village site and cemetery near Madisonville, Ohio, which has furnished much interesting archæological material. In all, 1236 bodies were exhumed, probably belonging to the Shawnee tribe, and occupied prior to 1672. Three forms of burial—horizontal, contracted, and in a sitting posture—were observed; they indicate a grouping resulting from numerous simultaneous interments or a species of division into family lots. There was no consistent rule of orientation, but the south, east, and south-east were generally selected. Full details of the skeletons, with the objects associated with them, are given.

In the Journal of the Royal Anthropological Institute (vol. l., January–June, 1920) Mr. J. H. Hutton gives a curious account of a form of lycanthropy current in Assam among the Naga tribes. All these people regard the ultimate ancestry of man and the tiger or leopard as very intimately associated. Man and the tiger are still regarded as brothers, and if an Angami kills a tiger he says, "The gods have killed a tiger in the jungle," never "I have killed a tiger"; while the village priest proclaims a day of abstention from work "on account of the death of an elder brother." Though the Angamis suppose that lycanthropy exists and can be acquired, they do not indulge in it themselves, but believe in the existence of a village far to the east peopled by lycanthropists—a belief perhaps based on the claim of the Changs to possess the faculty of taking tiger or other animal forms. The soul usually enters the leopard during sleep and returns to the human body with daylight, but it may remain in the leopard for several days at a time, in which case the human body, though conscious, is lethargic. The soul, however, is more or less conscious of its experiences in leopard form, and can to some extent remember and relate them when it has returned to its human consciousness.

We have received Bulletin No. 2 of the Bureau of Bio-Technology (January, 1921), a newly established quarterly publication issued from the biological department of Messrs. Murphy and Son, of Leeds. Although it runs to only 25 pages, it contains two articles of considerable interest. One concerns the destruction of stored malt by the agency of a Dermestid beetle, *Trogoderma khapra*, Arrow. This species has been recorded as an occasional rarity, but there appears to be no previous instance of its occurring in sufficient numbers to cause appreciable damage. There seems to be no doubt that the presence of this beetle is due to infected shipments of barley from Karachi and other Indian ports. The second article refers to Nematode worms in relation to leather manufacture, these organisms being found in large numbers during the process of removing wool from skins by means of "sweating." It is undoubtedly a healthy sign that a business house deems it worth while to issue a periodical of this nature. Apart from any function by way of advertisement, it should serve as an outlet for the publication of research work carried out in the firm's own laboratories. It is well printed and the illustrations adequately fulfil the purpose intended.

THE evolution of the lachrymal bone in vertebrate animals is discussed at great length and illustrated with nearly 200 beautiful figures by Dr. W. K. Gregory in one of his studies of comparative myology and osteology (Bull. Amer. Mus. Nat. Hist., vol. xlii., No. 4). The bone can now be traced back by almost every gradation to a dermal plate in the circumorbital ring of certain Devonian fishes. In the earliest amphibians this and the other bones of the circumorbital series become better differentiated, and in early reptiles the anterior part of the lachrymal is covered by the progressive upgrowth of the maxilla. In mammals the lachrymal and jugal are the only two parts of the primitive circumorbital series remaining, and the lachrymal is reduced as the upgrowth of the maxilla increases. There can be no doubt that the lachrymal of mammals is homologous with the bone similarly named in reptiles. The anatomy of the lachrymal and malar fossæ in the skull of horses and other hoofed mammals is also discussed by Dr. Gregory (No. 5). He concludes that the large lachrymal fossa of the extinct horse was occupied neither by a facial gland nor by muscle, but by the end of a greatly enlarged nasal diverticulum. The malar fossa seems to have lodged part of one of the lip-muscles.

THE structure and uses of balsa wood are fully described by Mr. R. C. Carpenter in Trans. Amer. Soc. Civil Engineers (vol. lxxxi., No. 125, 1917). This wood is the lightest known, a cubic foot weighing only 7·3 lb., yet its strength is fully half that of spruce. It has been used for rafts, floats, and life-preservers, and is now much employed, since it is a non-conductor of heat, for ice-boxes and refrigerators. Frozen butter sent from Virginia in a small balsa box arrived after an eight days' journey in summer weather at Los Angeles still hard and frozen. It is possible that containers made of balsa wood will eventually displace thermos flasks. Untreated balsa wood is of little value for most purposes because it soon rots and decays in consequence of its liability to absorb water. This has been overcome by R. A. Marr's process of waterproofing timber with a bath of which the chief ingredient is paraffin. Balsa wood is the product of various species of Ochroma, trees allied to Bombax, which have lately been elucidated by Prof. W. W. Rowlee in Journ. Washington Acad. Sciences (vol. ix., p. 157, 1919). The best known is *Ochroma lagopus*, Swartz, which occurs wild in Cuba and Jamaica. Eight other species, including seven new to science, occur in the tropical forests of America, ranging from Guatemala and Honduras to Ecuador and Bolivia. *Ochroma limonensis*, Rowlee, is extraordinarily rapid in growth; a seedling in Costa Rica was 16 in. in diameter at the end of three years, and this individual is said to be in no way exceptional.

THE Geological Survey of Western Australia has published a series of memoirs intended especially to aid prospectors and miners. In addition to sections dealing with the occurrence, distribution, and production of the various minerals, there are a number of chapters designed to teach the prospector the rudiments of geology, mineralogy, and petrology so far as these are of use in discovering or developing the mineral resources of the country.

THE Imperial Mineral Resources Bureau has issued a small volume of statistical and technical information upon zinc covering the period 1913–19. It contains an excellent review of the zinc industry at the close of 1919 by Mr. Gilbert Rigg. Unfortunately, sufficient care has not been bestowed upon the all-important statistical portion; thus for 1913 the production of zinc-ore in the United Kingdom is given as 17,294 tons, capable of producing 5823 tons of spelter, while the quantity of imported ore is given as 64,670 tons. The production of smelted zinc is given as 66,000 tons, so that the quantity of imported ore given above must be assumed to have yielded about 60,000 tons of spelter, which is clearly quite impossible. Surely, too, an official British publication should not use the term "long" tons when "statute" tons are meant.

THE Meteorological Department of the Government of India has issued its report on the administration in 1919–20. Observations in connection with the upper air have been developed on behalf of the aviators who are from time to time crossing India. Storm warnings for stations in the Bay of Bengal and in the Arabian Sea are said to have been carried out successfully. It is, however, admitted that the warning of the storm which caused much damage to life and property in eastern Bengal on the night of September 24, 1919, was inadequate. Inland stations were not communicated with until early evening, and were then informed that a "slight to moderate storm" was expected. Special arrangements have been made to avoid the repetition of a similar mishap. The storm, which was tracked from September 22–25, developed rapidly as it approached, and crossed the Bengal coast as a cyclone about noon on September 24. It reached Dacca at about 2.30 a.m. on September 25, and finally broke up on that day in the Assam hills. At the centre the deficiency of pressure was about $1\frac{1}{4}$ in., and the calm area at least 15 miles in diameter. The total loss of life is estimated at 3500. The value of property destroyed was probably greater than in any storm in Bengal for the last two hundred years, but the destruction of human life was probably greater in the Bakarganj cyclone of 1876. An additional terror was caused by a vivid red glow appearing in the sky during the period of the lull. Details are given of the several storms which occurred during the year. Flood warnings are issued, and the results are said to be very satisfactory. Rainfall data were received for publication from nearly three thousand stations for the year.

IN the January issue of the *Journal de Physique* Prof. G. Bruhat, of the University of Lille, deals with some conclusions with regard to the variation of the specific heats of substances at low temperatures, in partial accordance with experiment, to which Nernst's theory of the solid or liquid state at absolute zero leads. The values of the specific heats of the same substance in different physical states at the lowest temperatures for which observations are available cannot be held to confirm the theory that the entropy of each modification tends to the same value at absolute zero. All that can be said at present is that Nernst's hypothesis is not contradicted by observation. Prof. Bruhat also points out that while the difference between the energies of two modifications of the same substance may be expanded in a series in ascending powers of temperature differences near the points of observation, there is no justification for continuing this expansion down to absolute zero.

MR. L. W. AUSTEN, of the U.S. Naval Radio Research Laboratory, contributes an interesting paper to the Journal of the Washington Academy of Sciences for March on the wave-front angle in radio-telegraphy. He gives the results of experiments made with a pivoted, straight-wire, antenna system mounted at the top of a 55-ft. wooden pole in such a way that it is capable of rotation about a vertical and a horizontal axis. The results show that for wave-lengths greater than 10,000 metres the deviation of the wave-front from the vertical cannot much exceed 3°. The average value of the deviation of the waves from Nauen, 3600 miles away, was 3·4°. It was found that the waves from San Diego, although they passed overland for 2000 miles, were practically vertical. Observations were made to see whether the well-known shift in the apparent direction of a sending station at night as determined by a radio compass was accompanied by any corresponding phenomenon in the value of the deviation of the wave-front. Although the apparent direction of the station shifted at times by as much as 30°, no appreciable change in the deviation of the wave-front could be detected.

THERE are many cases in engineering in which intense loading pressures are inevitable; for example, knife-edges, the line-contact of gear-wheels, the contact pressure of the wheels of a locomotive on the rails, etc. The results of a long investigation on contact pressures and stresses are given in a paper read before the Institution of Mechanical Engineers on March 18 by Prof. E. G. Coker, K. C. Chakko, and M. S. Ahmed. It is not possible to do justice to this paper in a short note. The authors have determined the stress distribution in a number of cases, *e.g.* the distribution of stresses, over different bearing areas, of a rectangular block pressed against another flat surface of greater area by a load applied at the centre of the opposite face. Another matter investigated is the effect on the strength of tensile test-specimens of the minute indentations required for the attachment of extensometers and of the pressures produced by the extensometer grips. The latter case has been worked out completely, and diagrams giving the stress distribution are included in the paper. Prof. Dalby has abandoned the ordinary method of attaching his extensometer and uses special test-specimens having collars against which the mechanism of the extensometer presses lightly. The authors of the present paper have investigated the effect of the collars of the Dalby specimen, and find that there is ample justification for the use of this form of test-piece. The paper constitutes an extremely valuable record of the special methods of testing by means of polarised light with which Prof. Coker's name has long been associated.

WE welcome the first number of *Photographic Abstracts*, for it fills a distinct gap in scientific literature. This is not the first attempt of the Royal Photographic Society to do work of this sort, but it is the first time that the scheme has been properly financed and arranged by an enthusiastic committee, assisted by a large staff of efficient abstractors. The abstracts are classified under eleven headings:—Colour photography; kinematography; manufacture of photographic materials; photographic appliances (cameras, etc.); photographic optics; photo-mechanical processes; radiography; applications of photography (astronomy, spectroscopy, photomicrography, etc.); sensitometry, actinometry, photometry; theory of photography; and photographic processes. This first number is a distinctly creditable production, although the publication committee apologises for not having attained the ideal that it had in mind.

OUR knowledge concerning the chemical structure of catechin has been considerably increased by the series of papers recently published by Dr. Nierenstein and his collaborators, entitled respectively "The Constitution of Catechin, Parts I.–III.," and "Studies in the Chroman Series" (Journ. Chem. Soc., 1920, vol. cxvii., and 1921, vol. cxix.). A successful effort has been made to complete the work of Ryan and Walsh, who attempted to decide between the chroman structure proposed for catechin by A. G. Perkin and the coumaran structure suggested by Kostanecki and Lampe. Acacatechin and several derivatives have now been synthetically produced and proved to be identical with acacatechin and its derivatives obtained from natural sources. This work of Dr. Nierenstein proves that catechin is a chroman, but that the chroman formula suggested by Perkin requires some modification, as acacatechin is 2 : 4 : 6 : 3′ : 4′-pentahydroxy-3-phenylchroman.

THE new list of announcements just issued by Messrs. Macmillan and Co., Ltd., contains the titles of many works of scientific interest. Among the books to be published between now and the end of June is one by Sir Clifford Allbutt entitled "Greek Medicine in Rome," being the Fitzpatrick lectures on the History of Medicine delivered at the Royal College of Physicians of London in 1909–10, with other historical essays. The essays will deal with Byzantine medicine; the Finlayson memorial lecture; Salerno; public medical service and the growth of hospitals; a chair of medicine in the fifteenth century; the rise of the experimental method in Oxford; medicine in 1800; medicine in the twentieth century; and Palissy, Bacon, and the revival of natural science. Another work in the list is "A Treatise on Probability," by J. M. Keynes, the author of "The Economic Consequences of the Peace." It will be in five parts on, respectively, fundamental ideas, fundamental theorems, induction and analogy, some philosophical applications of probability, and the foundations of statistical inference. In addition, there will be an extensive bibliography. Messrs. Macmillan will also publish "The Angami Nagas, with some Notes on Neighbouring Tribes," by J. H. Hutton. It will appear under the direction of the Assam Administration.

A WORK entitled "Pre-history," by M. C. Burkitt, is announced for publication in the autumn by the Cambridge University Press. It will be a study of early cultures in Europe and the Mediterranean basin, and contain a preface by the Abbé Breuil, with whom the author has collaborated in the study of prehistoric caves in France and Spain. Another autumn publication of the same publishers will be "A Manual of Seismology," by Dr. C. Davison, which will summarise present knowledge on the subject. It will be issued in the Cambridge Geological Series.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, W.C.1, have just published at 1s. net a Supplementary Catalogue for 1918–20 of their medical and scientific circulating library; also, gratis, their list of new books and new editions added to the library in January to March of the present year. The two catalogues should be in the hands of all who wish to be kept informed of the latest books in medical and general science.

Our Astronomical Column.

THE ACCELERATIONS OF THE SUN AND MOON.—The Journal of the British Astronomical Association for January contains an address by Dr. Harold Jeffreys on this subject. He starts by quoting the results obtained by Dr. J. K. Fotheringham from ancient observations of eclipses and other phenomena (Mon. Not. R.A.S., December, 1920), viz. 21·6″ for the moon and 3″ for the sun. These are the velocities gained per century per century; on the less logical system that gives the space gained in a century the figures are halved. Of the lunar figure 12·2″ is due to the diminution of eccentricity of the earth's orbit. The remaining 9·4″ for the moon and 3″ for the sun are ascribed to tidal friction, which diminishes the earth's rotational speed, thus lengthening the day. It would, at first sight, appear that the effect on the moon should be thirteen times that on the sun, this being the ratio of their mean motions. Since, however, the mutual action of moon and earth does not alter the moment of momentum of the system, a retardation of the earth's rotation is accompanied by a recession of the moon and the consequent lengthening of her period, which cancels a considerable part of the apparent acceleration due to the slower rotation. Dr. Jeffreys notes that the theoretical values of solar and lunar accelerations due to tidal friction are uncertain, and may be anywhere between 1 to 3 and 1 to 10. He then describes in detail the recent work of Major G. I. Taylor and himself (already described in this column) which determined the regions on the earth's surface where the friction is taking place; the Bering Sea is the largest contributor, but the action in the Irish Sea is quite sensible.

1646 SPECTROSCOPIC PARALLAXES.—The *Astrophysical Journal* for January last contains an important list of 1646 spectroscopic parallaxes by W. S. Adams, A. H. Joy, G. Strömberg, and Cora G. Burwell. The paper commences with a re-discussion of the spectral graduation tables in the light of the extensive series of trigonometrical parallaxes recently published, especially those at the Allegheny, McCormick, Yerkes, and Mount Wilson observatories. In the case of the Cepheid variables and giant M stars use has also been made of the parallactic motions, since these stars are, in the main, too remote to lay much stress on their trigonometrical parallaxes.

The new list includes revised values for 495 of the stars in the 1917 list. It is satisfactory that many A stars are now included in the list, which formerly did not extend beyond F. A few of the larger or more interesting results are quoted below, marked S, the trigonometrical results (T) being given for comparison:

OAN 4961, P.M. 0·53″, S 0·100″, no T; Aldebaran, S 0·096″, T 0·055″; Capella, S 0·076″, T 0·067″; Betelgeux, S 0·012″, T 0·021″; Castor (faint distant companion), S 0·091″, T 0·079″; Pollux, S 0·126″, T 0·064″; Boss 2199, S 0·110″, T 0·081″; Regulus (companion), S 0·052″, T 0·033″; Boss 3047, S 0·105″, T 0·235″ (only one determination); Arcturus, S 0·158″, T 0·075″; γ Serpentis, S 0·120″, T 0·063″; Antares, S 0·017″, T 0·029″; λ Sagittarii, S 0·115″, T 0·069″; β^1 Cygni, S 0·033″, T 0·000″; β Aquilæ, S 0·100″, T 0·076″; and Boss 5976, S 0·209″, T 0·172″.

For the peculiar variable or nova 7 : 1917 Serpentis the value of S is 0·003″, the absolute magnitude being 2·9.

Several large parallaxes have not been quoted, since they are practically replicas of the accepted values.

A CATALOGUE OF RADIAL VELOCITIES.—Many workers in stellar statistics must have felt the inconvenience of having to ransack the publications of several observatories in order to obtain complete details of known radial velocities. The need for a catalogue has at last been supplied by Mr. J. Voûte, who was for some time at the Cape Observatory determining stellar parallaxes. While he does not claim that his catalogue is absolutely complete, it includes all the stars, 2071 in number, for which radial velocities were given in publications that were accessible in the library of the Cape Observatory. It is arranged in a convenient form, giving R.A. and declination for 1900, magnitude, proper motion, spectral type, radial velocity, parallax, and galactic longitude and latitude.

The numbers of stars of each spectral type are:—Oe 6, B 310, A 358, F 257, G 309, K 517, M 153, R 11, and nebulæ and clusters 148. The largest + and − radial velocities for each type in km./sec. are:—B, +102, −38; A, +96, −170; F, +339, −325; G, +301, −242; K, +177, −132; and M, +98, −185. There appears to be a distinct maximum for types F and G.

The work was published at Weltevreden, Java, by Boekhandel, Visser, and Co.

A statistical study of the results by Prof. George Forbes was presented at the March meeting of the Royal Astronomical Society.

The Microstructure of Coal.

A VALUABLE and original paper on the economic selection of coal was contributed at the autumn meeting of the Iron and Steel Institute by Mr. A. L. Booth. The method usually adopted is to carry out a proximate chemical analysis, which at the best is very unsatisfactory and of little real use, to collate the results with practical experience, and to make a trial on some particular plant. Only too often it proves to be unsatisfactory, and trouble arises from the fact that two coals can have practically the same appearance and give the same analysis, and yet be totally different in behaviour. This occurs quite frequently, and does not seem to be realised by fuel-users generally. Sir W. G. Armstrong, Whitworth, and Co.'s works, with which Mr. Booth is connected, use some 250,000 tons of coal per annum for different purposes, and it was the unsatisfactory nature of chemical methods of classification which led to experiments being made with the microscope to ascertain whether a more trustworthy method could not be devised. The method adopted was as follows:

Sections were cut of a large number of typical pieces of coal from different sources. Some had been proved over a period of years to be suited to a particular class of work, while others had proved unsatisfactory for the same class of work. All were carefully examined under the microscope. It was soon seen that there were three main types, and that each type was suitable for certain classes of work. Further investigation rendered it possible to decide how far a departure from the typical member could be made without getting into difficulties.

The method of cutting sections is similar to that used in making rock sections, but is considerably more difficult and requires more patience. A piece of coal is selected and, if soft and cracked, treated with a transparent, colourless binder. One side of the coal is then ground down, using carborundum powders of finer and finer grades, finishing off with a water of Ayr stone. The result should be a smooth, flat face. The coal is then mounted in Canada balsam on a piece of glass, the face being well pressed against it. When the balsam is set, a slice of coal is cut off and ground down until it transmits light.

In his paper Mr. Booth considers only coals in commercial use in this country, and these fall into three main types: (1) "Humic," composed of leaves, stems, and broken-down woody tissue, together with some spores. (2) "Spore" coals, in which both "micro-" and "mega-" spores predominate. (3) Cannel coals.

The spores are the reproductive organs of the plants, and correspond with the pollen and ovules in present-day flowering plants. The micro-spores are very small, while some of the mega-spores are about ⅛ in. in diameter. The cannel coals contain small, round, yellow bodies. It will be realised, of course, that these three classes merge into one another. Humic coals occur containing more and more spores, while spore coals become more cannellised as the yellow bodies merge with the spores. This is where microscopic work is necessary to enable a decision to be made as to what a particular sample of coal can be used for. The author shows sixteen coloured photomicrographs of thin sections of specimens of the three main types at magnifications varying from 50 to 560 diameters.

So far as the main economic uses of coal are concerned, the study of their microscopic structure has resulted in the following conclusions:

For steam-raising, humic coals which contain a fair proportion of spores are the most suitable. These coals coke fairly well, and give a good, hot fire without too long a flame. For town-gas manufacture humic coals are also suitable, and for this purpose those which swell on heating and burn with a long flame are the best. They give a good yield of gas and by-products. Some humic coals containing much yellow substance constitute the best coking coals, and should be reserved for that purpose.

For producer-gas work the spore coals are necessary. The best coals for non-recovery producers are those which have been partially cannellised. They do not soften, the coke is very fragile, and the fixed carbon is very high. This is a necessary feature in producer practice. If the ash is not very fusible it is possible to work these coals with a low blast saturation, and thus get a dry gas with a high carbon monoxide content, the flame of which has a higher radiating power than the hydrogen flame. In recovery work, coal containing more humic matter may be used, because here a primary low-temperature distillation takes place, and through the high saturation of the blast the tendency to swell is checked.

For direct-fired furnaces (*e.g.* reheating and reverberatory) the hard coals are used. These are almost true cannels, and are usually dull-looking. They are free-burning, having no tendency to coke, and unless iron be present through infiltration it is difficult to fuse the ash.

The microscope has not only been found helpful in the selection of coals, but in some cases it is also of use in deciding whether or no it would pay to wash them, and will explain why an apparently good and clean coal has, for instance, a high ash-content. In such a case a washing may be quite useless. In the event of a shortage of a particular class of fuel the more detailed knowledge of coal which the microscopic study gives will enable the best substitutes to be used; and to obtain satisfactory working with the substitute, any necessary alterations in the running of a plant can be made without waiting for adverse effects to develop.

The author states in conclusion that coal from the same seam is generally very uniform, and mentions that sections cut from a given seam, but delivered on dates twelve years apart, showed that the coal is of the same type. As he says, perhaps one day it will be possible to buy coal to specification as we now buy steel.

Mr. Booth's paper is very timely, and indicates what a considerable saving could be made if the present output of coal were scientifically utilised in the manner indicated.

The Cretaceous-Tertiary Boundary in North America.[1]

By PROF. A. C. SEWARD, F.R.S.

ONE of the most difficult problems with which American geologists and palæontologists are confronted is the correlation of the Later Cretaceous and Lower Tertiary strata in the different regions of the United States. The Professional Paper by Messrs. Lee and Knowlton is concerned with some of the Cretaceous and Tertiary rocks in the Rocky Mountains region of Colorado and New Mexico. A considerable area in the interior of North America was occupied by a Cretaceous sea, and it was part of this area which was afterwards uplifted as the Rocky Moun-

[1] Department of the Interior, United States Geological Survey. Professional Paper No. 101: "Geology and Palæontology of the Raton Mesa and other Regions in Colorado and New Mexico." By Willis T. Lee and F. H. Knowlton.

tains chain. This crust-folding was followed by the deposition of plant-bearing Tertiary strata. The Raton Mesa region is rich in coal-bearing beds containing a large number of flowering plants, with a few twigs of conifers and fragments of sterile fern-fronds. The flowering plants are, unfortunately, represented almost exclusively by detached leaves.

Different views have been held on the geological age of these sediments. Lesquereux referred them to the Tertiary period, and later geologists regarded them as Cretaceous. The evidence now brought forward points to the occurrence of two distinct formations, the Vermejo formation below separated by a well-marked unconformity from the overlying Raton formation. It is believed that this unconformity marks the boundary between the Cretaceous and Tertiary systems in Colorado and New Mexico. In the interval represented by the unconformity there was widespread erosion of the uplifted floor of the Cretaceous sea before the deposition of the Lower Tertiary Raton formation.

From a geological point of view the conclusions based on a considerable mass of information are of great interest as a contribution towards a more precise determination of the Cretaceous-Tertiary boundary. Both the Vermejo and Raton formations are rich in fossil plants, Dicotyledons being the most abundant in each flora; the Vermejo flora is correlated with the Montana flora, while the Raton flora is believed to be Eocene. A noteworthy feature of the Raton flora is the inclusion of some exceptionally fine specimens of palm-leaves, but, as Mr. Knowlton states, it is impossible to refer most of them to a definite position on leaf-characters only.

The palæobotanical portion of the volume is well illustrated and the specimens are concisely described. It is, however, unfortunate that little attempt is made to compare the plants with species other than American. The application of the names of recent genera to many of the specimens, though in accordance with a common practice, suggests a lack of appreciation of the difficulties of systematic work when leaves only are available. In many cases it is clearly impossible to accept the generic determinations of both fern fragments and dicotyledonous leaves without hesitation. Mr. Knowlton has done good service by rendering available much new material, and the excellent illustrations will enable students of palæogeography to institute comparisons between the American and other types. The absence of conifers in the Raton flora as contrasted with their comparative abundance in the older Vermejo flora is an interesting feature, though it is scarcely safe to assume, as Mr. Knowlton does, that the group was unrepresented in the contemporary vegetation of the district.

The greater part of the volume is devoted to Mr. Lee's extended researches, which include the results of field work in many districts and a very useful correlation of the formations in the Raton Mesa region with those in other parts of the continent.

The investigation of the later Cretaceous and earlier Tertiary floras has acquired a fresh importance in view of the recent work of Mrs. Reid, who is ably carrying on the researches initiated by the late Mr. Clement Reid on the younger Tertiary floras. The recognition of many Chinese types of flowering plants in the Pliocene beds of western Europe, as Mrs. Reid has shown, throws light on the interrelationships of floras that are now widely separated. A critical analysis of the older Tertiary floras in both the Old and the New World should enable us to obtain a deeper insight into the early history of the Angiosperms. One of the difficulties in the way of a comprehensive survey of fossil floras is that of correlation, and it is only by the co-operation of stratigraphical geologists and palæobotanists that this difficulty can be met. American investigators have realised the importance of such collaboration, and their example might with advantage be followed more closely in this country. It may be said that if the accurate determination of fossil leaves, especially those of Angiosperms, is impossible, why attempt it? The answer is that palæobotanists do not, as a rule, sufficiently avail themselves of the assistance of experienced systematists, and are too ready to be satisfied with resemblances based upon characters which are common to several recent genera. Though many fossil leaves referred to recent genera are valueless as accurate data, this is no reason for assuming that greater accuracy in the analyses of floras is unattainable.

Isle of Wight Disease in Hive Bees.[1]

By DR. A. D. IMMS.

ISLE OF WIGHT disease is the most serious menace to apiculture in Great Britain. The prevalence of this complaint and the present high cost of bee appliances and of stocks render it extremely doubtful whether any profit can be derived from the keeping of bees solely for honey production. Many bee-keepers find it more profitable to supply bees and queens, together with the necessary apparatus, and hundreds who take up bee-keeping relinquish it after a short time as being non-productive.

The disease has continued without interruption from about the year 1902 until the present time, and no epidemic of an equally permanent and extensive nature has so far been indisputably recognised outside the British Isles. The first preliminary investigation into its cause was carried out in the Isle of Wight in 1907 by the present writer, who described many of its symptoms, but was unable to discover any protozoa connected with it. In 1912 and 1913 Graham Smith and others put forward the theory that it was due to *Nosema apis*. More recent work by Anderson and Rennie and by Rennie and Harvey indicates that Isle of Wight disease and disease due to Nosema are two distinct complaints exhibiting different symptoms and pathological conditions.

In the first of the papers under review the causal organism of Isle of Wight disease is definitely stated to be a new species of mite, *Tarsonemus Woodi*. This Acarine was found in every one of 110 stocks reported by trustworthy bee-keepers, or certified by the investigators themselves, as suffering from Isle of Wight disease. The investigation involved an examination individually of at least 700 bees, and it was discovered that in every instance where symptoms of Isle of Wight disease were evident the mite was also present. No exception has been found. The parasite occupies

[1] "Isle of Wight Disease in Hive Bees." (1) "The Etiology of the Disease." By Dr. J. Rennie, P. B. White, and Elsie J. Harvey (pp. 739–54). (2) "The Pathology of Isle of Wight Disease in Hive Bees." By P. B. White (pp. 756–64). (3) "Isle of Wight Disease in Hive Bees—Experiments on Infection with *Tarsonemus Woodi*, n.sp." By Elsie J. Harvey (pp. 765–67). (4) "Isle of Wight Disease in Hive Bees—Acarine Disease: The Organism Associated with the Disease—*Tarsonemus Woodi*, n.sp." By Dr. J. Rennie (pp. 768–70, pl. 1, fig. 2). Trans. Royal Soc. Edinburgh, vol. lii., part iv., No. 29, 1921.

a very restricted region of the insect, being confined to the respiratory system, and only to those tracheæ which are associated with the anterior pair of spiracles. All stages of the Acarine were met with—eggs, larvæ, and adults; they occur within the tracheal tubes extending from the spiracles inwards. The tracheæ become darkened and ultimately black by the increasing deposition of chitin.

In studying the pathology of the disease Mr. P. B. White points out that the mites perforate the tracheæ and live upon the body fluids of their hosts, and he also raises the question, which is extremely difficult to answer, whether they exercise any toxic action also. When present in large numbers they entail the obstruction of the respiratory system of the head and thorax, thereby reducing the efficiency of the respiratory exchange of the organs supplied. In order to obtain some idea of the effects actually arising from the mechanical obstruction of the spiracles, a series of experiments was carried out upon healthy bees. The first spiracle of one or both sides of each bee was closed by means of melted paraffin-wax. Upon closure of one spiracle the experimental bees at once lost the power of flight, but otherwise remained active in their movements. After a lapse of several days the bees became more sluggish, and about the sixth or seventh day examples were noted with dislocated wings and other features which commonly accompany Isle of Wight disease. The thoracic musculature in many cases exhibited atrophy of the same type as had been found in bees infected with the Tarsonemus. In those experiments in which the first spiracle of each side was closed the power of flight was at once lost as before, but after twenty-four to forty-eight hours the bees developed a reeling gait and appeared to be continually falling over their own heads. It was seldom that any survived the third day.

As Mr. White points out, though too close a parallel must not be drawn with the natural disease, these experiments give a basis to the view that the *rôle* of the Tarsonemus in partially preventing thoracic respiration is of prime importance in the disease, possibly in itself capable of occasioning all the symptoms by which we are wont to diagnose the disease and the muscle atrophy so often associated with it.

There is evidently much still to be discovered; we know as yet very little concerning the migratory stage of the parasites, and provisional experiments in producing artificial infection have so far yielded inconclusive results. The reason for the parasite selecting the first pair of spiracles as its sole means of entry also needs elucidation. The authors of these researches are to be congratulated upon their discoveries, and it is quite evident that the whole subject of bee diseases is the most pressing problem in apiculture in this country to-day; in fact, the future of bee-keeping is dependent upon their thorough investigation.

University and Educational Intelligence.

CAMBRIDGE.—Prof. F. G. Hopkins has been elected to the Sir William Dunn professorship of biochemistry.

Sir Napier Shaw will give the Rede lecture on June 9 on the subject of "The Air and its Ways."

Mr. H. G. Carter has been appointed curator of the herbarium.

It is proposed to make a grant of 75*l*. from the Worts Fund to Prof. Seward towards defraying the expenses of an expedition to Greenland undertaken by Mr. R. E. Holthurn and himself for the purpose of collecting fossil plants from Cretaceous and Tertiary rocks on Disco Island and the mainland and of studying the recent vegetation.

Steps are being taken towards an agreed solution at an early date of the problem of the position of women in the University. It is already clear, however, that the latest proposal will not be acceptable to a considerable section of University opinion, though it may carry with it moderate opinion, and also secure the support of those who voted in December for Report A.

LONDON.—The following public lectures will be delivered at King's College during the Easter term. Admission to public lectures is free and without ticket, except when otherwise stated:—A course of three lectures on Wednesdays, May 18 and 25 and June 1, at 5.30 p.m., by Prof. A. P. Newton, on "The Universities of the Dominions and the United States of America."

In the department of science a lecture or lectures will be delivered by Prof. Einstein early in May. The date and title will be announced later.

A course of four lectures on Tuesdays, May 3, 10, 17, and 24, at 5 p.m., by Mr. J. H. Jeans, secretary of the Royal Society, on "Cosmogony and Stellar Evolution."

In the department of philosophy a course of four lectures on Tuesdays, May 10, 17, 24, and 31, at 5.30 p.m., on "The Present Issue between Realism and Idealism," by Prof. H. Wildon Carr.

In the department of engineering a course of four special lectures for post-graduate and other advanced students on Tuesdays, beginning May 3, at 5.30 p.m., on "Cascade Work in Induction Motors," by Mr. L. J. Hunt. This course is free only to the regular students of the faculty of engineering.

A HOLIDAY course in geology will be held at the School of Metalliferous Mining, Camborne, Cornwall, on July 18–August 27. The course will deal with economic geology, with special reference to West Cornwall, and will consist of lectures and laboratory and field work. The programme includes the mapping of areas both on the surface and underground, a number of excursions to localities around Camborne of interest to geologists, and work in the school dealing with rock-forming minerals, rocks, the mechanical analysis of alluvial sands, and methods of dressing the products. Students wishing to enter for it should apply to the Registrar, School of Metalliferous Mining, Camborne.

IT is announced that Prof. E. Cohen, of Utrecht, will give two lectures on "Metastability of Matter and its Bearings on Chemistry and Physics," probably at University College, London, on May 10 and 12 at 5.30 p.m. Two lectures by Prof. H. E. Armstrong on "Enzymes in Relation to Plant Growth" have also been provisionally arranged; they will be delivered at King's College on June 3 and 10 at 5 p.m. Another course, of three lectures, by Prof. E. W. MacBride, on "Recent Advances in Experimental Embryology," will probably be given at the Imperial College of Science and Technology on June 7, 8, and 9 at 5 p.m. These courses of lectures are intended for advanced students of chemistry, agriculture, and zoology respectively and others interested in these subjects. In all cases admission will be free and without ticket.

Calendar of Scientific Pioneers.

April 28, 1842. Sir Charles Bell died.—Famous for his important discoveries in anatomy, Bell in 1807 distinguished between the sensory and the motor nerves in the brain. Born in Edinburgh in 1774, his principal appointment was the professorship of anatomy and surgery to the London College of Surgeons.

April 28, 1858. Johannes Peter Müller died.—A professor first at Bonn and then at Berlin, Müller has been referred to as the founder of modern physiology. He extended the knowledge of the mechanism of voice, speech, and hearing and of the properties of the lymph, chyle, and blood. Helmholtz, Du Bois Reymond, and Ludwig were among his pupils.

April 28, 1903. Josiah Willard Gibbs died.—Called by Ostwald the founder of chemical energetics, Gibbs enunciated the phase rule and was the first to apply the second law of thermodynamics to the exhaustive discussion of the relation between chemical, electrical, and thermal energy and capacity for external work. For thirty years he was professor of mathematical physics in Yale University.

April 30, 1865. Robert Fitzroy died.—The commander for eight years of H.M.S. *Beagle*, in which Darwin sailed as naturalist, Fitzroy in 1854 became the first head of the Meteorological Department of the Board of Trade, where he instituted a system of storm warnings and daily weather forecasts in 1860–61.

April 30, 1876. Antoine Jérôme Balard died.—The discoverer in 1826 of the element bromine, Balard held various appointments at Montpellier, and then succeeded Thénard in the chair of chemistry in the Faculty of Sciences in Paris.

May 1, 1796. Alexandre Gui Pingre died.—In 1751 Pingre became director of the observatory at St. Geneviève in Paris. He travelled abroad to observe the transit of Venus of 1769, verified Lacaille's work on eclipses, and wrote an important book on comets.

May 1, 1891. Eduard Schönfeld died.—The successor of Argelander at Bonn, Schönfeld continued the great survey of the heavens and formed a catalogue of 133,659 stars between 2° and 23° south declination.

May 2, 1519. Leonardo da Vinci died.—One of the most remarkable and versatile geniuses of any age, Leonardo in turn was painter, sculptor, engineer, and architect, and studied physics, biology, and philosophy. As a man of science he was essentially a forerunner, and anticipated by centuries developments which have but recently been witnessed.

May 4, 1677. Isaac Barrow died.—The first to hold the Lucasian chair of mathematics at Cambridge, Barrow relinquished this post in 1669 in favour of his pupil Newton. At the time of his death Barrow was Master of Trinity College.

May 4, 1827. Mark Beaufoy died.—Beaufoy was the first Englishman to climb Mont Blanc, which he did six days after Saussure. As a scientific investigator he made experiments on the form of ships, carried out magnetical observations to determine the law of diurnal variation, and studied the eclipses of Jupiter's satellites.

May 4, 1892. Karl August Dohrn died.—The father of Anton Dohrn, the zoologist, Karl Dohrn was well known for his writings on entomology. He was a merchant in Stettin, where he died.

May 4, 1916. Prince Boris Galitzin died.—Well known for his inventions and his writings on seismology, Galitzin was professor of physics in the Academy of Sciences of Petrograd.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, April 14.—Prof. C. S. Sherrington, president, in the chair.—Prof. K. **Onnes**, Sir R. **Hadfield**, and Dr. H. R. **Woltjer**: The influence of low temperatures on the magnetic properties of alloys of iron with nickel and manganese. A series of iron–manganese and iron–nickel alloys with a range of percentages of manganese and nickel respectively has been tested in order to investigate the influence of cooling to very low temperatures (liquid hydrogen and liquid helium) on their magnetic properties, especially to ascertain whether the iron–manganese alloys which are non-magnetic at atmospheric temperature become magnetic by so doing. Samples are tested quickly one after another at a temperature of 20° K. The iron–manganese alloys containing the higher percentages of manganese cannot be made magnetic at atmospheric temperature by cooling to the boiling point of liquid hydrogen or liquid helium. The existence of one magnetic and one non-magnetic, or at most slightly magnetic, manganese–iron compound is probable, and the non-magnetic properties of the higher manganese–iron alloys may be explained by their means.—C. N. **Hinshelwood** and E. J. **Bowen**: The influence of physical conditions on the velocity of decomposition of certain crystalline solids. The velocity of decomposition by heat of potassium permanganate and ammonium bichromate. For solids the temperature coefficient of the reaction velocity does not allow calculation of a "heat of activation" or "critical increment" of the reacting molecule, according to the method of Trautz, Lewis, and others, for various physical reasons connected with the propagation of the reaction from the surface into the interior. The lowering of the velocity of decomposition of potassium permanganate in solid solution in potassium perchlorate indicates that the heat of activation of the permanganate is increased by the physical process of solid mixture. By equating this assumed increase in the heat of activation to the observed heat of solid mixture obtained from the calorimetric measurements of Sommerfeld, approximate quantitative agreement is found between the observed rates of decomposition of potassium permanganate in various solid solutions and those calculated.—Prof. H. **Briggs**: The adsorption of gas by charcoal, silica, and other substances. The method of determining the adsorptive capacity of a substance at liquid-air temperature is described, and results are given of the capacity and manner of preparation or occurrence of thirty-six substances. Charcoal and silica are compared, especially as relates to nitrogen and hydrogen, to illustrate preferential adsorption; the influence of chemical composition on gas adsorption is discussed. The effect of the compressibility of the initial layer when the density of an adsorbent is determined by the immersion method is considered. An evaluation is made of (*a*) the volume of solid matter, (*b*) that of the interstitial space between the granules, and (*c*) that of the internal gaseous space for silica and coconut charcoal. The density of the nitrogen adsorbed at −190° C. by silica and charcoal is calculated from experimental data. From these results it is possible to estimate the error affecting the density of charcoal ascertained from water-immersion. The conditions affecting adsorption at low and high saturation are given. The presence of capillaries is not sufficient to account for adsorption. A high-capacity silica may be deactivated, but remain porous. Graphite, which has no pores, adsorbs gas at −190° C. The evidence leads to the conclusion that deactivated silica is vitreous. A vitreous solid, like a crystal, is probably a polymer. Activation is considered to be the effect of disrupting the solid polymers.—N. K. **Adam**: The properties and molecular structure of thin films of palmitic acid on water. Part i. Langmuir's views have been confirmed and extended. Films on water exhibit a resistance to lateral compression commencing at 22×10^{-16} sq. cm. per molecule, and increases linearly with reduction of area until the force is sufficient to buckle the film. Collapse then sets in, and no further increase of force is regularly found necessary to diminish the area to zero. A metastable condition of increased resistance to collapse may occur. The compression curves point to the resistance being due to repulsion between the insoluble molecules, arranged in a single layer on the surface, each molecule being attracted to the water by its carboxyl group. When collapse of the unimolecular film occurs, the molecules ejected are seen to aggregate into fine lines many molecules in thickness. The observed areas agree with the dimensions calculated from molecular volume studies, and the compressibility of the films is of the same order as for liquids in bulk. The effect of acidity of the water on the films may be due to the greater attraction of alkaline solutions than acid for carboxyl groups. The observations indicate that the molecules are immersed further in alkaline than in acid solutions, even when alkalinity is insufficient to cause complete solution. In still more alkaline solutions immersion becomes complete, and the molecules probably pass from the film into aggregates, having the hydrocarbon chains in the centre and the carboxyl groups on the surface. This structure is suggested for the "ionic micelle" of soap solutions.—E. P. **Metcalfe** and B. **Venkatesachar**: The absorption of light by electrically luminescent mercury vapour. Mercury vapour at low pressures, rendered luminous by the passage of small electric currents, exerts powerful selective absorption. A list of wave-lengths found to be absorbed is given. Photometric observations are recorded on the absorption and emission of 5461 Å. by columns of mercury vapour of different lengths and carrying different currents. The relation between the ratio (emission/absorption) and the current density is linear. The lines 5461 Å. and 4359 Å. have been reversed so as to appear dark lines on the white-light spectrum of a carbon arc and of the sun. The reversal of 5461 Å. has been studied in detail.

Zoological Society, April 19.—Sir S. F. Harmer, vice-president, in the chair.—Mrs. J. **Longstaff**: Observations on the habits of the snail, *Cochlitoma zebra*, var. *fulgurata*, and *C. zebra*, var. *obesa*, Pfeiffer, in confinement.—R. I. **Pocock**: The external characters and classification of the Procyonidæ (raccoons, etc.).—Dr. M. A. **Smith**: New or little-known reptiles and batrachians from southern Annam (Indo-China).

Royal Meteorological Society, April 20.—Mr. R. H. Hooker, president, in the chair.—C. E. P. **Brooks**: The evolution of climate in north-west Europe. Commencing with the last (Würmian) Glacial period, the slow variations of climate in north-west Europe are studied in connection with changes in the land and sea distribution, and also with possible astronomical influences. Several successive "phases" are distinguished:—(1) The close of the Glacial period, 30000–18000 B.C. (2) The retreat of the glaciers, 18000–6000 B.C. (3) The continental phase, about 5000 B.C. (4) The maritime phase, about 4000 B.C. (5) The forest phase, about 3000 B.C. (6) The peat-bog phase, about 500 B.C. (7) The recent phase. Charts are drawn to illustrate the probable meteorological conditions associated with each of these phases, and especially the gradual development of the present system of storm-tracks, the Mediterranean being the oldest. The cessation of the peat-bog phase is shown to be contemporaneous with a marked drop in Huntington's curves of rainfall in California and south-western Asia. The whole series of changes in north-west Europe is compared with the corresponding post-Glacial series in North America, which is shown to be similar in its general lines, but not always contemporaneous. Finally, a section is devoted to Pettersson's astronomical tidal theory, which is found to fit in very well with the changes after 3000 B.C., but not before.—Lieut. G. C. **Steele**: A brief review of the influence of meteorology on naval warfare. In almost every action fought in the late war some reference was made to the state of the weather. The last five years have seen new acquisitions to naval service, most notably the C.M.B., a naval air wing, and such weapons as the smoke screen, and even the possibility of the use of poisonous gas at sea. Analysing the effect of meteorological conditions on these new arms, the last two are seen to be contingent on weather conditions, and the others are so in a large degree. Modern invention has thus not overcome the influence of meteorology on naval warfare. Its influence can be traced also in the policy of ship construction. For example, in a programme of shipbuilding the general climatology of the sea or ocean forming the probable theatre of war in a great measure determines the gun-range at which an action will be fought, and, consequently, the amount of armour to be allocated under these conditions.

Paris.

Academy of Sciences, April 4.—M. Georges Lemoine in the chair.—The president announced the death of M. Vallier, correspondant of the Academy.—E. L. **Rouvier**: A work relating to the French fauna. Remarks on a memoir on Echinoderms by R. Koehler, published by the French Federation of Natural Science.—G. **Gouy**: The calculation of the coma. The calculations in a recent note assumed that the aberration on the axis of the lens is zero. A first approximation is now given for the case when the aberration is sensible.—M. **Lugeon**: A new example of striation of a river-bed. The Lower Ardèche, between Vallon and Saint-Martin, presents striations resembling those of the banks of the Yadkin, in North Carolina, described by the author in 1913.—G. **Julia**: A functional differential equation analogous to Hadamard's equation.—A. **Denjoy**: The determination of functions presenting a certain complex character of solvability.—T. **Varapoulos**: The theorem of Landau and multiform functions.—F. **Carlson**: The series of Dirichlet.—H. **Godard**: Observations of the Reid comet made at the Observatory of Bordeaux (38-cm. equatorial). The apparent positions and the positions of the comparison stars are given for March 30 and 31 and April 1. The comet was about 10·5 magnitude on March 31.—P. **Chofardet**: Observations of the Reid comet (1921*a*) made with the *coudé* equatorial at the Besançon Observatory. Positions given for March 30 and 31 and April 1.—J. **Guillaume**: Observations of the Reid comet made with the *coudé* equatorial at the Observatory of Lyons. Positions given for March 28, 30, and 31. The comet is circular, less than 1′ in diameter, with a central condensation; magnitude 9·5.—C. E. **Brazier**: The comparability of anemometers. A direct comparison in the open air of eight types of anemometers, all previously well standardised in the laboratory, showed that unless the inclination of the complex movements of the air constituting natural wind was below 10°, the indications of the different instruments were not comparable. Instruments of the Richard type give low figures, whilst the other types give too high readings.—M. **Pescara**: The results of some recent trials of a helicopter.—P. **Painlevé**: Remarks on the preceding communication.—M. **Marage**: The evolution of the graphical method.—L. and E. **Bloch**: The spark spectra of iron and cobalt in the extreme ultra-violet. Tables of the wavelengths of lines in the extreme ultra-violet are given between the limits $\lambda = 1845$ and 1456.—A. **Bigot**: Kaolins, clays, and bauxites. Variations of volume under the action of heat. The results with five materials are shown in a diagram. The changes in length of the briquettes were measured for each 100° rise of temperature up to the softening points of the materials.—M. **Barlot**: The electrical phenomena accompanying the displacement of metals.—M. **Ehrmann**: An important orogenic movement at the commencement of the Cretaceous period in the Kabylie des Babors.—J. **Thoulet**: The oceanic circulation and the density of sea-water. The density is rapidly determined by the dipping refractometer and the use of appropriate tables.—C. **Vaurabourg**: The density and refractive indices of sea-water. Tables are given showing the relation between the refractive index and density of sea-water for temperatures between 0° C. and 30° C. (5° intervals) and for densities ranging from 1·032 to 1·000.—G. **Kühnholtz-Lordat**: Dynamical phytogeography of the dunes of the Gulf of Lyons.—J. **Pavillard**: *Gymnodinium pseudonoctiluca*. This rare organism, discovered in 1884 by G. Pouchert, and again in 1890, was abundant in the Gulf of Lyons in 1907. It does not appear to be identical with the Gymnodinium found by Miss M. Lebour at Plymouth. —J. **Politis**: The brown corpuscles causing the browning of the vine. The brown corpuscles are not the cysts of a parasite (Debray) or excretion products (Viala and Sauvageau), but result from a transformation of granular mitochondria.—R. **Poisson**: Spermatogenesis and the exceptional chromosome in *Naucoris maculatus*.—A. **Paillot**: *Rôle* of the secretions in the extracellular destruction of micro-organisms in insects. Remarks on a recent communication of MM. Couvreur and Chaovitch.—R. **Bayeux**: The reducing power of the organic liquids and tissues of some marine animals. An application of the methylene-blue reduction method of H. Roger.—M. **Weinberg** and L. **Kepinow**: The leuco-agglutinines.

Books Received.

The Mechanical Principles of the Aeroplane. By Dr. S. Brodetsky. Pp. vii+272. (London: J. and A. Churchill.) 21*s*. net.

Mathematical Papers for Admission into the Royal Military Academy and the Royal Military College, and Papers in Elementary Engineering for Naval Cadetships and Royal Air Force for the Years 1911–20. Edited by R. M. Milne. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*.

Mutations and Evolution. By Dr. R. Ruggles Gates. (New Phytologist Reprint, No. 12.) Pp. vii+118. (London: Wheldon and Wesley, Ltd.) 6*s*.

Meteorology: An Introductory Treatise. By Dr. A. E. M. Geddes. Pp. xx+390+xx plates. (London: Blackie and Son, Ltd.) 21*s*. net.

Telephotography. By Cyril F. Lan-Davis. Second edition by L. B. Booth. Pp. xii+116. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co.) 3*s*. 6*d*. net.

Fijian Society; or, The Sociology and Psychology of the Fijians. By the Rev. W. Deane. Pp. xv+255. (London: Macmillan and Co., Ltd.) 16*s*. net.

Text-Book of Land Drainage. By Joseph A. Jeffery. (Rural Text-Book Series.) Pp. xx+256. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

Management of Dairy Plants. By Prof. M. Mortensen. Pp. xvi+358. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 12*s*. 6*d*. net.

The Practical Value of Ethnology. By Dr. A. C. Haddon. (Conway Memorial Lecture.) Pp. 64. (London: Watts and Co.) 1*s*. net.

The Backbone of Africa: A Record of Travel during the Great War. By Sir Alfred Sharpe. Pp. 232. (London: H. F. and G. Witherby.) 16*s*. net.

Sun, Sand, and Somals: Leaves from the Note-Book of a District Commissioner in British Somaliland. By Major H. Rayne. Pp. 223+12 plates. (London: H. F. and G. Witherby.) 12*s*. 6*d*. net.

Counsels and Ideals from the Writings of William Osler. Second edition. Pp. xxiv+355. (London: Oxford University Press.) 8*s*. 6*d*. net.

The Geology of the British Empire. By Dr. F. R. C. Reed. Pp. viii+480. (London: E. Arnold.) 40*s*. net.

Elements of Natural Science. By W. Bernard Smith. Part i. Pp. viii+207. (London: E. Arnold.) 5*s*. net.

The Modern Teacher: Essays on Educational Aims and Methods. Edited by A. Watson Bain. Pp. xv+272. (London: Methuen and Co., Ltd.) 10*s*. 6*d*. net.

Department of Scientific and Industrial Research: Fuel Research Board. The Winning, Preparation, and Use of Peat in Ireland. Reports and other Documents. Pp. 76. (London: H.M. Stationery Office.) 3*s*. net.

Department of Scientific and Industrial Research: Building Research Board. Special Report No. 1: Sand-Lime and other Concrete Bricks. By H. O. Weller. Pp. 11. (London: H.M. Stationery Office.) 3*d*. net.

The Carnegie Foundation for the Advancement of Teaching. Fifteenth Annual Report of the President and of the Treasurer. Pp. vi+171. (New York City.)

A Brief Account of Radio-Activity. By Prof. F. P. Venable. Pp. vi+54. (Boston: D. C. Heath and Co.; London: G. G. Harrap and Co., Ltd.) 3*s*. 6*d*. net.

Experimental Organic Chemistry. By Prof. Augustus P. West. (New-World Science Series.) Pp. xiii+469. (London: G. G. Harrap and Co., Ltd.) 10*s*. 6*d*. net.

Energétique générale. By Dr. Félix Michaud. Pp. vii+229. (Paris: Gauthier-Villars et Cie.) 10 francs.

Vergleichende Biologische Formenkunde der Fossilen niederen Tiere. By Prof. Edgar Dacque. Erste Hälfte. Pp. viii+336. (Berlin: Gebrüder Borntraeger.) 96 marks.

Human Physiology. By Prof. L. Luciani. Vol. v.: Metabolism—Temperature—Reproduction, etc. Pp. viii+422. (London: Macmillan and Co., Ltd.) 30*s*. net.

Diary of Societies.

THURSDAY, APRIL 28.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.

INSTITUTE OF PATHOLOGY AND RESEARCH (St. Mary's Hospital, Paddington), at 4.30.—Sir Almroth E. Wright: Acidosis and Acidæmia, with Special Reference to Scurvy and Shock.

ROYAL SOCIETY, at 4.30.—Prof. H. Lamb and R. V. Southwell: The Vibrations of a Spinning Disc.—Dr. W. Rosenhain: The Hardness of Solid Solutions.—W. Hartree and Prof. A. V. Hill: A Method of Analysing Galvanometer Records.—F. H. Newman: A New Form of Wehnelt Interrupter.—T. L. Ibbs: Some Experiments on Thermal Diffusion.—B. N. Chakravarty: The Diffraction of Light Incident at Nearly the Critical Angle on the Boundary between Two Media.

BOTANIC SOCIETY (Regent's Park), at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion on Tariffs.—J. R. Blaikie: Electricity Supply—Present Conditions and the Hopkinson Principles. —J. W. Beauchamp: Multi-Part Tariffs for Domestic Electricity Supply.

CONCRETE INSTITUTE, at 7.30.—Prof. F. C. Lea: The Elastic Modulus of Concrete.

ROYAL SOCIETY OF MEDICINE (Urology Section), at 8.30.—R. Thompson: Treatment of Epispadias and of Extroversion of the Bladder, with Some Remarks relating to their Origin and Anatomy.

FRIDAY, APRIL 29.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: Demonstration on the Contents of the Museum.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Section) (at City and Guilds (Engineering) College) (Annual General Meeting), at 6.30.—A. C. Warren: Radio-telegraphic Transmitting Apparatus.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—W. A. Tookey: Rambling Remarks on Expert Evidence.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Frank W. Dyson: Advances in Astronomy.

SATURDAY, APRIL 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—H. Y. Oldham: The Great Epoch of Exploration; (2) Spain.

MONDAY, MAY 2.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. J. Gosset-Tanner: The Tripartite Nature of Man.

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

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. S. G. Shattock: Demonstration on Pathological Specimens in the Museum.

SOCIETY OF ENGINEERS (INC.) (at Geological Society), at 5.30.—A. S. E. Ackermann: The Physical Properties of Clay (third paper).

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Miss H. D. Oakeley: Prof. Driesch's Attempt to Combine a Philosophy of Knowledge and a Philosophy of Life.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.

SOCIETY OF CHEMICAL INDUSTRY (at Chemical Society), at 8.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.

ROYAL SOCIETY OF MEDICINE (Tropical Diseases and Parasitology Section), at 8.30.—Dr. A. F. MacCallan: The Ankylostomiasis Campaign in Egypt, 1913-1915.—Sir Leonard Rogers: The Mortality and Prognosis of Cholera treated by the Author's Hypertonic Saline Method, based on 2000 Cases.

TUESDAY, MAY 3.

ROYAL HORTICULTURAL SOCIETY, at 3.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Keith: Darwin's Theory of Man's Origin in the Light of Present-Day Evidence.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—W. Raitt: Paper-pulp Supplies from India.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. S. Watkins: Colour Photography.

ROYAL ANTHROPOLOGICAL INSTITUTE (at Royal Society), at 8.15.—J. Reid Moir: An Early Chellean Palæolithic Workshop Site in the Pliocene Forest-bed of Cromer, Norfolk.

WEDNESDAY, MAY 4.

THE INSTITUTION OF CIVIL ENGINEERS, at 4.—Presentation of the Kelvin Medal to Dr. W. C. Unwin by the Right Hon. A. J. Balfour.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Geoffrey Butler: Anglo-American Relations: A Personal Impression.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Miss I. A. MacDonald and Dr. A. G. Trueman: The Evolution of Certain Liassic Gastropoda, with Special Reference to their Use in Stratigraphy.—H. Hamshaw Thomas: An Ottokaria-like Plant from South Africa. —Dr. A. B. Walkom: Nummulospermum, gen. nov.: the Probable Megasporangium of Glossopteris.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

INSTITUTE OF METALS (at Institution of Mechanical Engineers), at 8.—Prof. T. Turner: The Casting of Metals (Annual May Lecture).

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—F. G. H. Tate and J. W. Pooley: Detection and Estimation of Illipé Nut Fat used as a Substitute for Cocoa Butter.—G. W. Monier Williams: Notes and Demonstration on Apparatus for determining Hydrogen Ion Concentration.—E. Paul: Note on the Oil of Oats.—H. Atkinson: Estimation of Potassium in Presence of Sodium, Magnesium, Sulphates, and Phosphates.

THURSDAY, MAY 5.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 and 2.30.—H. Brearley: The Welding of Steel in relation to the Occurrence of Pipe Blow Holes and Segregates in Ingots.—Dr. J. E. Stead: Solid Solution of Oxygen in Iron.—H. T. Ringrose: Scientific Control of Combustion.—J. E. Fletcher: Open-hearth and Other Slags—their Composition and Graphic Methods for determining their Constitution.—S. H. Fowles: Notes on the Cleaning of Blast-furnace Gas.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. S. Myers: Psychological Studies: (1) The Localisation of Sound.

ROYAL SOCIETY, at 4.30.—Dr. H. Head: Release of Function in the Nervous System (Croonian Lecture).

LINNEAN SOCIETY, at 5.—Prof. J. Stanley Gardiner: Reports on Collections from the Indian Ocean for Issue in the Society's Forthcoming Transactions, vol. xviii.—E. R. Speyer: Insects in Relation to Reproduction in Coniferous Trees.—Prof. W. J. Dakin: The Collections from the Houtman Abrolhos Islands in 1913.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Miss F. E. Webb and Others: Individual Training in the School.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion on Tariffs (continued).

CHEMICAL SOCIETY, at 8.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Annual General Meeting.—H. Curtis: Angioma of the Vagina Spontaneously Evacuated.—Dr. A. E. Giles and Others: The Causes and Treatment of Sterility.

FRIDAY, MAY 6.

IRON AND STEEL INSTITUTE (Annual Meeting) (at Institution of Civil Engineers), at 10 and 2.30.—S. N. Brayshaw: The Prevention of Hardening Cracks, and the Effect of Controlling the Recalescence of a Tungsten Tool Steel.—Dr. J. Newton Friend: The Protection of Iron with Paint against Atmospheric Corrosion.—K. Honda, T. Matsushita, and S. Idei: The Cause of Quenching Cracks.—W. E. Hughes: Slip-lines and Twinning in Electro-deposited Iron.—A. Westgren: Röntgen Spectrographic Investigations of Iron and Steel.—J. H. Whiteley: Cupric Etching Effects produced by Phosphorus and Oxygen in Iron.

ROYAL SOCIETY OF MEDICINE (Laryngology Section), at 4.45.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Sir Napier Shaw, Col. E. Gold, W. H. Dines, and F. J. W. Whipple: The Structure of the Atmosphere up to 20 kilometres. Chairman: Dr. G. C. Simpson.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Robert Robertson: War Developments of Explosives.

SATURDAY, MAY 7.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. C. C. Baly: Chemical Reaction.

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