NATURE

THURSDAY, JANUARY 13, 1921.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters should be addressed to the Publishers.

Editorial communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.

The Development of Agriculture.

THE latest annual report of the Development Commissioners[1] takes the form of a review of the work of the Commission since its establishment in 1909. It includes another novel feature in a series of reports on the past work and future outlook of the research institutes supported by the Commission. These reports have been prepared by the directors of the laboratories, and, covering, as they do, a large part of the field of biology, would, if space permitted, repay detailed consideration. They bear witness to a considerable output of original work, not only in applied science, but also in fundamental research. Of the progress made in the latter, the report on the Rothamsted Experimental Station contains the most noteworthy examples. In 1909 the scientific staff there numbered five only; the technical staff now numbers nearly seventy, of whom twenty-five are university graduates, and the annual grant made by the Commission (through the Ministry of Agriculture) has nearly quintupled the original income of the station. The output and quality of original work at this station in the last decade are well known to our readers. As an example of successful technological investigations, the Fruit Experiment Station established at East Malling, in Kent, may be instanced. The success achieved by this station in improving the value of orchard trees is an example of the rapidity with which the application of science to industrial problems can achieve results of economic importance. As the Commissioners point out, owing largely to the lack of trained workers, the advance of knowledge in relation to the problems of agriculture after the great achievements of Lawes and Gilbert *circa* 1860 was inconsiderable. In a large degree this sterility was caused by the need of money—a need which the Development Fund has supplied. In these circumstances it was not surprising that agricultural education, too, was in danger of becoming outworn. Research and education are closely correlated; each is dependent on the stimulation provided by the other.

The scheme of the Development Act was novel in so far as it provided a fund for the economic development of agriculture to be expended under the direction of a quasi-judicial body without executive powers, "not responsible to any Minister and to that extent insusceptible to political pressure." The Commissioners apparently wish to contrast the limitation of their powers with the freedom of other bodies concerned with the State support of research recently established. They also refer to the statutory restriction of their advances to non-profit-making concerns, and seem to suggest that this limitation in some degree diminishes their usefulness; it certainly appears to be a restriction which is not congruent with the subsequent policy of the State in relation to scientific research.

Measures have also been taken to promote research in the economic problems of our fisheries. A scheme has been developed which provides, *inter alia*, for a large measure of control by a committee of men of science and for the separate orientation of free (or fundamental) from "directed" (or technological) research. Free research will, very properly, be regarded as the function of universities and other independent bodies, while "directed" research—that directly concerned with economic developments—will be entrusted to the various State departments connected with fisheries. We commend the dichotomy to the consideration of the Commissioners in the other aspects of their activities.

The report is noticeably silent on one administrative aspect of all research schemes which is the subject of active controversy at the present time. In a recent issue we commented on the admirable scheme fostered by the Commission under which research workers in agriculture have

[1] Tenth Report of the Development Commissioners for the Year ended March 31, 1920. (H.M. Stationery Office.) Price 2s.

been guaranteed a quasi-permanent tenure and adequate salaries. A letter from Prof. Stanley Gardiner, which we publish elsewhere, shows that the Commissioners' attitude to this question in relation to fishery research has not been productive of satisfaction. Our correspondent's letter raises an issue of great importance. No State-aided scheme of research will be productive unless it attracts as well as retains men of the highest academic attainments.

In one chapter of the report the general economic position of agriculture at the present day is contrasted with that which followed the Napoleonic wars. The conclusion is drawn that agriculturists must be up and doing if disaster is to be averted. We hope that if the adequacy of future efforts as tillers of the soil is dependent on our reaching the standard of hard work attained by our ancestors in the period 1816 onwards, we shall be encouraged by what their successors achieved in other fields in the period 1914–18.

In conclusion, we may pay a tribute of respect to those who have formed the varying and co-operative *personnel* of the Commission and of the Ministry of Agriculture during the last ten years. There can be no doubt that as pioneers in the field of the deliberate encouragement of scientific research by the State they have fully justified the prescience of the founders of the Development Fund.

The Critic in Physiology.

Warfare in the Human Body: Essays on Method, Malignity, Repair, and Allied Subjects. By Morley Roberts. With an introduction by Prof. Arthur Keith. Pp. xiii + 286. (London: Eveleigh Nash Co., Ltd., 1920.) Price 18*s*. net.

THE author of this book, although well known in the fields of literature and art, astonishes us by the amount and depth of his knowledge of the biological sciences. A great service is done by the subjection to criticism of current views, especially when the critic is one not actually engaged in the investigations on which they are based. Owing to the wide extent of his outlook, he is often able to throw light on questions which those who, by the exigencies of research, are compelled to an intensive study of a narrow field are apt to miss. We may not entirely agree with his criticisms, but they always make us consider what we really mean by the statements we make. It is not to be understood, however, that the book before us consists merely of criticism. There is much in it of constructive and helpful suggestion.

Although in form consisting of apparently separate essays on such problems as cancer, repair, inhibition, immunity, heredity, cannibalism, bathing, consciousness, and so on, there may be said to be a common thread running through them, and this thread is the belief that much assistance may be given in the comprehension of biological problems by bringing them into relation with analogous cases in the sociological sciences. In the first essay, "On Method in Science," a powerful defence is given of the use of analogy. The author is well aware of the caution necessary to avoid pitfalls. Thus a similar result is not always due to a similar cause, while the metaphorical use of words is no real advance. As an illustration the author refers to Adami's "habit of growth" acquired by cancer cells. Moreover, an analogy suggests different things to different people. As to the way in which it may be used with profit, the original must be read.

Owing to the variety of topics discussed, this review is almost of necessity somewhat disconnected. Furthermore, when the reviewer brings forward objections to certain statements, the impression is apt to be given that he is less in sympathy with the work as a whole than is actually the case. The proportion of statements not agreed with to the rest of the book, with which the reviewer is almost entirely in agreement, must be kept in mind.

A consideration suggested by the title needs a few words at this point, and illustrates a remark made above. Owing to the limitations of language, it is probable that the author's meaning has not been quite correctly grasped, and if this be so we may hope for more essays from his pen in order to make things clear. The word "warfare" will almost certainly not be understood by every reader in the same way. If offensive warfare is implied, it is doubtful whether a true impression is given of physiological processes. Indeed, even the conception of defensive warfare is liable to misinterpretation. If we may regard the components of a reversible chemical reaction as being at war with one another, we may let the name pass, and the remarks of the author on p. 30 seem to imply that this is the way in which he looks at the matter. But is it correct to speak of immunisation as "active warfare"? (p. 138). It cannot be denied that the acts of war "tend to develop all the logical and mental faculties of man" (p. 169), but it does not follow that this is the only way to do this, or the most effective way. It might, not unreasonably, be held that certain valuable qualities are not so developed.

When it is stated that the "unfit" are eliminated, we may ask, Unfit for what? Is not the statement on p. 161 that "union is never voluntary" rather too sweeping? Warfare in most minds is associated with the idea of destruction—that is, of waste. This is perhaps not an essential part of its meaning, and the reviewer is aware that his point of view may not be that of other readers of the book.

Turning to the second essay—that on "Malignancy"—we note that the author, after a profound discussion of various views, comes to the conclusion that it is due to the failure of the mutual action of connective-tissue and epithelium on one another, perhaps under the influence of some internal secretion. We may compare the view put forward by Dr. A. Paine in the *Lancet* of October 2, in which the noxious influence of certain irritants, especially of bacterial toxins, is held to be responsible for the degeneration of the specialised functions of the epithelial cell, so that it returns to its embryonic state. If Mr. Morley Roberts's conclusion is correct, we are led to regard much of the cancer research of the present day as beginning at the wrong end, so to speak. We must learn more about the normal dependence of one tissue on the activities of another before we proceed to examine what happens when this dependence is disordered. Too much direct attack is made on disease before an accurate knowledge of what health really is has been obtained. In this connection we may refer to the apt illustration by the author on p. 4, where it is pointed out that it would be absurd to think of learning how to build a ship by examination of wrecks on the shore.

These considerations may be commended to the attention of the Ministry of "Health." In fact, in the investigation of cancer, as in that of immunity, too narrow a point of view is often taken. The author rightly insists (p. 64) on the vital importance of taking account of work in branches of science other than that actually in view. It must often strike even the moderately cultured investigator how sadly lacking in knowledge of general principles so many of the workers in specialised subjects are apt to be. Many industrial "inventors" would save themselves much trouble, as well as loss of money, by learning more about the fundamental principles of science. This lack is perhaps particularly noticeable in those devoted to the subject of immunity, although there are, of course, notable exceptions, and much excuse must be made owing to the unfortunate domination of the Ehrlich phraseology, against which our author justly protests (pp. 127, etc.). As he points out, we cannot explain a bacteriologist by saying that he is bacteriological. One is sometimes inclined to wish that some gifted investigator who knows nothing of previous work on immunity would attack the problem at its foundations.

The third essay is of much interest. Dealing with the problem of repair, it propounds the thesis that the evolution of an organ is frequently a case of the mending of a breakdown. This opinion, although supported with much evidence, will probably evoke some dissent. But all readers will agree that there are gaps in our knowledge of the processes of repair and of hypertrophy resulting from functional activity. The author's views on direct adaptation are also difficult to accept in their entirety. Although the accessibility of the germ plasm to chemical agents, as in Stockard's experiments with the action of alcohol on guinea-pigs, cannot be denied, there is no reason to suppose that a modification would be of such a kind as to be appropriate in combating the change in the environment. One is somewhat surprised to find that the author accepts the statements of Abderhalden with respect to the production of "protective enzymes."

Turning to another interesting question—that of inhibition—it is curious that the author, although making use of the conception in the case of the nervous system, finds difficulties in the action of the vagus nerve on the heart. This may be due to the interpretation he puts on the word "depressant." Inhibition, whatever explanation we may try to give of the way in which it is brought about, means no more than stopping a process or reducing its intensity, no harm being done to the active cells. Neither is it a question of diverting "energy" in another direction. The author has overlooked Sherrington's experiments which show that a reflex can be inhibited without evoking any other reflex. The reviewer must confess, however, that he is at a loss to understand what the difficulty with the cardiac vagus really is. We find also some unnecessary trouble made about "trigger action." The physiologist understands by this expression merely that the work required to set a process in action has no relation to that set free as a result. It may be that a measurable amount of work is needed to move a trigger, but the energy set free in the cartridge is just the same whether the trigger moves stiffly or easily. One would also like to have a little more explanation of what the author means by "shock" as applied to cells.

This list of criticisms may be ended with one of a different kind. On p. 169 it is suggested that there is an advantage in cannibalism owing to the fact that the food has a similar nature to

the body of the eater. But we know that all food is completely broken up in digestion into constituents which are the same for all kinds of flesh, unless there be something present in minute quantity not yet discovered. But this is a very unlikely possibility, and has no evidence in its favour. There seems, then, to be no justification for the statement.

The book abounds in illuminating similes. As an example, one might take the comparison of enzymes or catalysts to the tools with which the cell works, and the nucleus to the tool-room; but the latter is more hypothetical.

What has been said will serve to show how great is the variety of subjects discussed; but a meagre impression has been given of the interesting way in which they are treated. Everyone who cares to put his ideas in order is strongly advised to read the book.

The author deserves our gratitude for providing an index. This is not always to be found even in works of a more special nature.

W. M. BAYLISS.

Life in the Misty Islands.

The Land of the Hills and the Glens: Wild Life in Iona and the Inner Hebrides. By Seton Gordon. Pp. xii+223. (London: Cassell and Co., Ltd., 1920.) Price 15*s*. net.

THIS beautiful book, fine in temper, style, and illustrations, discloses something of the charm of the Inner Hebrides, "the Land of the Hills and the Glens and the Heroes." Mr. Seton Gordon is a keen ornithologist and a master-photographer, but he is much more—a genuine lover of wild Nature. His pictures are at once realistic and sympathetic. In the early morning, on the top of Ben Nevis, he notices the meadow pipit picking little insects off the frozen surface of the snow, but he leaves the main impression salient—a vast sea of mist, changing from cold grey to rose, from amid which the tops of the highest hills stand out clear and sharp, all the rest of the land deeply submerged.

In a small glen "in the keeping of the great hills" a pair of golden eagles make their nest on one of the veteran birch trees. Mr. Seton Gordon had the good fortune to witness the first flight of the two eaglets, and gives us a fine description. He notices that when two are reared, one is always a cock and the other a hen. As the two eggs we have seen have usually been slightly different in colour, we wonder if this is an index of the future sex. Perhaps this is an old speculation. The scene changes to one of the misty islands when there is a first hint (in February) of the approach of spring—ravens somersault, oyster-catchers stand in the sun, companies of turnstones flit restlessly about, and many barnacle-geese rise up from their feeding. It is suggested in passing that the quaint story of the origin of these barnacle-geese from barnacles may have had something to do with the fact that the nesting site—in inaccessible districts of the High North—was until recently quite unknown. About the time the barnacle-geese return to the lone island after summering in the North, the baby grey seals are in possession, and a visit to the wild nursery in the first week in November enabled the author to make some interesting observations and to take some first-class photographs.

Many of us have had experience of the sea that surges round Ardnamurchan—"The Point of the Ocean"—but few have set foot on its weather-beaten surface. Though on the mainland of Scotland, it is scarcely accessible except from the Island of Mull. "On its cliffs the golden eagle has its home, and in former times the erne or sea eagle was wont to nest on its inaccessible ledges. On quiet days of early spring ravens sail and tumble above its rocks, and one may hear the shrill, mournful cry of the buzzard as she leaves her eyrie. Near by is the haunt of the wild cat, now a fast vanishing species in the Highlands, and as early as February she has been known to produce her young in the rocky cairns above the reach of the waves." On one of the low islands far to the west of this the Arctic skuas arrive from the south about the end of May. They are almost unique in their habit of feigning injury in order to deceive the intruder while the eggs are freshly laid. Many birds do this later on. From observations at his "hide" Mr. Seton Gordon satisfied himself that the skua, at any rate, does not count more than one. One of the Gaelic names for the skua means "squeezer" in allusion to the habit of extorting fish from other birds, and it is noted that "even a bird of such command of flight as the tern very rarely indeed succeeds in getting away from a skua—that is to say, with its fish still in its possession."

We are tempted to linger over the fascinating pictures—the "big glen" in Mull, with one stream flowing east and another west, with its ravens and buzzards and deer; the Hill of the Two Winds rising steeply from the Sound, where the sparse ptarmigan have such a keen struggle for existence (because of the hungry eggs of many gulls and crows) that the cock birds are silent during the nesting season, and the hens are very easily frightened from their nests; the snapshots of the densely peopled sea-pool through every month of the year; the deep lochan in a crater-

shaped corrie with eagles sailing above its dark water; the glen of the herons, where one can see eight nests on one small tree (it is noted, by the way, that the heron sometimes feasts on frog spawn); the little islet of Erniesgeir, where the puffins have destroyed all the grass; a seal at Skerryvore playing with a large cod in the water as a cat with a mouse; a great company of Bewick's swans swimming restlessly backwards and forwards along a narrow lane on the freezing loch, trying to keep an open waterway; a flock of dozing whooper swans with their snowy plumage lit up by the moon; but we must stop, for the book is full of these delightful things, to read of which is like taking a holiday. We wish to express our admiration of the succession of seasonal word-pictures of the Western Highlands which form the closing chapters of the book. They form a text worthy of the extraordinarily fine photographs.

Many will enjoy the studies of particular birds, such as the fighting blackcock. "Their curious bubbling note never for one moment ceased, and every now and again, as two individuals struck at each other with their feet, they uttered a sharp hissing sound, reminding one somewhat of the crow of a cock partridge. I think that the more one watches blackcock at their fighting the more one must come to the conclusion that much of this is somewhat half-hearted, and appears to be indulged in mainly with the idea of putting in the time and relieving the birds of their high spirits of an early morning. Of course, combats in earnest do take place, and continue until one of the combatants is either killed or else put to flight." We suppose these tournaments vary in temper, for in the case of the only good show we have seen, the jousting was far from half-hearted, and there were numerous grey hens close by. Mr. Seton Gordon, whose experience is great, says: "It is rarely that the grey hens in any numbers frequent the battlefield. One often sees an odd bird there, or even two or three, but personally I do not think I have ever seen so many as even half a dozen watching the fighting of perhaps twenty cocks." Polygamy notwithstanding, he thinks that there are considerably more blackcocks than grey hens. We should like to hear more of this.

The ringed plover, called in Gaelic "the ptarmigan of the waves," arrive in the Western Isles with the first coming of spring. A glimpse of their courtship is given. "The lady on these occasions stands demurely by while the cock bird rises excitedly from the sun-warmed shingle, and, with curious, erratic flight—a flight that is almost bat-like—twists and tumbles, calling the while with soft and plaintive note. All the time his wings move with scarce half their usual speed, and this characteristic of the love-song of the waders—though I have not seen it set down in any book—is well marked also in the oyster-catcher and the golden plover, to mention only two at random." The newly hatched chicks, like the eggs before them, are very difficult to find in their natural surroundings. "When they crouch at the alarm call of their parents they are almost impossible to locate. It is then that the old birds show signs of very great alarm, and often make believe that they are injured, trailing along just ahead of the disturber of their peace, and perhaps waving a wing helplessly in the air, or lying motionless as though dead, in their efforts to decoy him from the vicinity of their young." Who can help envying Mr. Seton Gordon his close acquaintance with the very interesting red-necked phalaropes which nest by the lochans of one of the far western islands? In their solitude they seem to know no fear, for they allowed the naturalist to come within a few yards of them. "When on the water the red-necked phalarope rides with extreme buoyancy, and progresses rapidly. Its neck is long, and is held erect, and when it approaches the observer the russet-red markings on the cheeks and neck are strikingly handsome. Its call, too, is quite distinctive, a high chirruping cry, resembling no other call that I know of." Here, as elsewhere, the author refrains from comment on the biological peculiarities of the bird; we suppose he prefers simply to tell his own story in his own way, and we think his restraint is wise. The record has a sincere naturalness about it, and a very pleasing style. We wish that we had left space to say a little in regard to the author's references to the people of the islands. Here, as in his natural history, he has the insight that is bred of sympathy and scientific patience.

Modern Oil-finding.

Prospecting for Oil and Gas. By L. S. Panyity. Pp. xvii+249. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1920.) Price 18*s.* net.

IT is to be hoped that by now, when so much publicity is given in the Press to commercial oil undertakings (and, unfortunately, to many which are the reverse of commercial in the true sense of the word), the more intelligent public will have learned that "chance" is a relatively unimportant factor in modern oil-finding. Much of the present-day success of existing fields, and undoubtedly the prospects of ultimately locating new productive areas, lie in the application to

oil prospecting of the more precise methods of geological survey. Such work can be carried out only by competent persons qualified to undertake a survey for oil, and this implies training of a highly specialised character. Those who have had any experience, therefore, in this branch of teaching will readily appreciate the value of a book such as Mr. L. S. Panyity has written, a book which must also make a wide appeal to the student and to the oil geologist of the older school.

Considered purely from the academic point of view, the volume can unhesitatingly be put into a student's hands at the outset of his course without any apprehension as to its suitability as preface to both lecture and practical work. From the composition and origin of oil and gas, their migration and accumulation, through all the intricacies of modern methods of surveying and prospecting, to the sinking of wells and the production of crude oil, the author takes his reader through a thorough course of elementary instruction without burdening him with unnecessary technical detail. The early chapters deal with general geological definitions, conventions, and successions, considered from the point of view of oil technology. From these we pass directly to actual field-work, initiated by a lucid exposition of plane-table survey, including the more exact processes in triangulation. In the succeeding chapters, dealing with actual maps, it is pleasing to note that the construction and reading of isobath and isochore maps receive adequate attention, as both these phases of the subject present difficulties to the novice at first, though we should have preferred that the question of the interpretation of geologic structures had received fuller discussion, even to the exclusion (if necessary) of the long chapter on fossil flora and fauna. Condensed palæontology or palæobotany is seldom a success, and with the great number of useful text-books available for studying these subjects such an omission would need no apology.

The remaining pages of the volume are devoted more to the engineering aspects of oil prospecting, and include chapters on the location, sinking, spacing, and completion of wells, together with some notes on regulating the course of production of the crude oil derived. A somewhat lengthy appendix contains some useful tables of constants for triangulation work, and also for calculating the capacities of gas wells, etc.

As is usual with American publications of this nature, the book is profusely illustrated with maps and diagrams, and the inevitable "Landscape and Topographic Contour Map" (depicted on the inside cover of all the folios of the United States Geological Survey) finds a place here on p. 70. It is undoubtedly an attractive and useful publication, which, by virtue of its clearness of diction, careful arrangement of subject-matter, and freedom from "padding," should make an appeal to a very wide public.

H. B. MILNER.

The Induction Coil of To-day.

Induction Coil Design. By M. A. Codd. Pp. vi+239+14 plates. (London: E. and F. N. Spon, Ltd., 1920.) Price 21*s.* net.

IT is only within the last few years that the induction coil has emerged from the sanctum of the philosophical instrument maker and even approximated to an electrical engineering "job." It cannot yet be said to have shaken itself free of the trammels of empiricism, and it too often serves largely as a medium for the skill of the cabinet-maker and french polisher to impress a susceptible *clientèle*. Moreover, for X-ray work at any rate (and in particular for work with the Coolidge tube), the interrupterless transformer is finding fresh adherents each day, and it was high time that the case for the induction coil should be put by one who is conversant with coil construction and design.

Mr. Codd candidly concedes at the outset that precision measurements of coil phenomena are difficult, if not impossible, and as a consequence present-day design rests mainly on arbitrary standards which have been evolved empirically from practical experience. Holding the view that a knowledge of these standards should not be confined to the coil-maker, Mr. Codd has accordingly collected data from his experience of a number of typical and accepted designs, and set them out comparatively in the present book. To the coil-maker the wealth of practical and diagrammatic detail should be of value; and even the user, primarily concerned with performance, will be interested to learn of the constructional precautions and skill which have to be exercised, and of the relative common-sense values of the several designs on the market, for each of which extravagant claims of super-efficiency have usually been advanced by its author.

Here it may be remarked that the efficiency of even a large coil rarely reaches 50 per cent., and is usually nearer 30 per cent. Nor can the same coil be equally efficient for all purposes. It is in the success with which he reconciles antagonistic factors that the coil-maker's art finds its greatest expression. He knows, as a practical fact, that for a given transformation ratio the secondary winding should be such as to keep the self-induction as low as possible; he has found

that for X-ray work the condenser capacity should be as small as is consistent with preventing undue sparking at the interrupter; and he has grown to realise that the design and performance of the interrupter are all-important and may enhance or undo his work on the coil.

There are certain other features which the coil-maker has learnt to incorporate in his design. He allows for each kilo-volt-ampere input about 15 lb. of iron core, of which he makes the length from six to ten times the diameter. He winds the primary so as almost to cover the whole length of the core, but he keeps the length of the secondary down to about three-quarters the length of the core, and finds that the diameter of the secondary should not exceed about 2·5 times its bore. Among many other guiding facts, he estimates to get about 4 kilo-volts from every 1000 turns in the secondary, knowing also that a transformation ratio in the region of 100 to 1 is a practicable figure.

All this and much besides is to be found in Mr. Codd's book. He supports many of his contentions with the help of a large number of oscillograph records. We regret to find no mention of Prof. Taylor Jones's work, but we gather that the book is limited to the author's own experience. There is a useful bibliography, but no index.

Our Bookshelf.

The Romance of the Microscope. By C. A. Ealand. Pp. 314. (London: Seeley, Service, and Co., Ltd., 1921.) Price 7*s.* 6*d.* net.

To the well-known "Library of Romance" Mr. C. A. Ealand contributes a volume on the microscope. He gives a glimpse of the early days of invention, of pioneer microscopists such as Leeuwenhoek and Hooke, and of the principles of the instrument. He then illustrates the use of the microscope in studying the life of ponds and streams (but why call the amœba "a free swimming denizen"?), the structure of plants, the structure of animals (in the course of this investigation, "Having taken our fill of the spiders' feet we may well turn our attention to their heads"), sections of rocks, impurities of food, bacteria, blood, rusts on leaves, small insects and parts of insects, and so on. We are sometimes forced to doubt the author's sincerity, as when he says that if we put the liver-fluke under the microscope "we can plainly see all its internal organs." That has not been our experience, nor anyone's. Similarly, we are not pleasantly impressed by being told that *Demodex folliculorum* (or, as the author has his specific names printed throughout, *Demodex Folliculorum*) is to be found in the sweat-glands. The book ends with more practical matters: the micro-telescope and super-microscope, chemistry and the microscope, the use of the microscope in manufacture, the camera and the microscope in alliance, the glass used in making lenses, and the choice and use of apparatus.

We think the book will help to diffuse an interest in microscopy, which, of course, means the discovery of a new world and of a new joy in life; but we wish the author had shown more microscopic precision in his workmanship. He tells us that, having found our sea-slug or sea-cucumber, especially the species called *Synapta Inhaerens*, we find by touch that its leathery skin is studded with some flinty matter, which we go on to verify under a low magnification. And so *passim*.

Organic Chemistry for Advanced Students. By Prof. Julius B. Cohen. Third edition. Part i., *Reactions*. Pp. viii+366. Part ii., *Structure*. Pp. vii+435. Part iii., *Synthesis*. Pp. vii+378. (London: Edward Arnold, 1920.) Price 18*s.* net each volume.

THAT a reprint of the above work should be called for in just over a year after the publication of the last edition is clear evidence, if such were needed, of the value of the book; it may further be taken as welcome proof that there exists a large circle of serious students who are not content to acquire their knowledge in "tabloid form," but are prepared to work through a three-volume treatise on advanced organic chemistry. The book has an important mission to fulfil in imparting a sound knowledge of the principles underlying the modern developments of organic chemistry to the rising generation of chemists, and, from the rapid exhaustion of the last edition, one may conclude that it is successfully accomplishing this.

The present edition calls for little detailed comment, since no material changes have been made in the text, the author having confined himself to adding a number of references to recent literature, which will enable the student to bring his information up to date.

Leicestershire. By G. N. Pingriff. Pp. xii+164. (Cambridge: At the University Press, 1920.) Price 4*s.* 6*d.* net.

AN interesting description of the many features of interest in Leicestershire is given in this book by pen and photograph. In the opening chapters the position, general features, rivers, and watersheds of the county are described. Its geology, natural history, and an account of its climatic conditions follow. Four chapters are then devoted to the people of Leicestershire and their industries, stress being laid on the increase of grassland as opposed to arable farming. The remainder of the book deals with the history and antiquities of the county, and the concluding chapter is a useful index to its chief towns and villages. Instructive diagrams, showing graphically the proportions of the acreage of the principal crops, form a brief appendix. The book is throughout well illustrated by interesting photographs and sketch-maps.

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.]*

Science and Fisheries.

THE two letters from Prof. McIntosh and Mr. H. G. Maurice published in NATURE of December 30 last are of great interest. The second points out that an arrangement is now in operation by which the scientific staffs of the English, Scottish, and Irish Fishery Departments are arranging to meet at regular intervals to frame their scientific programmes; and the first refers to the responsibility of the Departments "in selecting for the task scientific men whose training and ability specially fit them for the complex work."

It may not be generally known that the real controlling authorities so far as fisheries research is concerned are the Development Commission and the Treasury. The Development Commission considers all applications from any of the three Departments for funds to carry out the researches that may be proposed. This consideration is not merely an office matter, for the proposed researches are considered by a special Committee, mainly of scientific men, presided over by Mr. W. B. Hardy. This Committee has already presented several excellent reports, and generally fresh applications for funds are referred to it. While the Development Commission is thus responsible for the work to be undertaken by the different Departments, the Treasury is responsible for the supply of properly trained scientific men to carry out the actual work. The real onus is on the Treasury, for the payment of all men in the service of the State is reviewed by this Department when providing funds for their payment. We have, on one hand, a body expert both as to the nature of the work proposed and as to the supply of men properly trained to carry out this work; and, on the other, a body with no qualifications whatever to review the work and no special knowledge as to the conditions of pay in different branches of science, especially in biological sciences. It appears to me that the present arrangement is not businesslike, and would not be tolerated in any commercial firm.

The Fishery Departments of the three countries certainly have progressed to a very considerable extent, and it is surely a peculiarly favourable time for a further step in progress. It is generally agreed that the research in fisheries of the three kingdoms should be carried out on one scheme; at present the Departments of Scotland and England are without any scientific directors. Surely the time has come when the scientific work of the three countries in respect to fisheries should be placed under one Director of Fishery Investigations and the three separate scientific staffs should be merged into one. The control of this Scientific Fisheries Division could obviously not be placed in any one of the Fishery Departments, and would have to be assumed by the Development Commission. The latter could act through an Advisory Committee on which the three Departments could be represented, if it is deemed advisable to do so. The Committee might also contain representatives of the different branches of the industry. There would be no competition between the three countries for such scientific men as are available or in respect to the mere numbers of their so-called scientific employees. The one body would be responsible for the work and for the human material necessary to carry out that work; the result, I venture to suggest, would be greatly to the interest of the country and would ensure good value for the money spent. The fisheries form an industry and the public are the consumers; the staffs which exist to protect and develop the interests of both should obviously be under one head.

My own experience of the three Fishery Departments of England, Scotland, and Ireland and of the industry has been altogether pleasant and decidedly "happy," and I am under obligations to the Development Commission as well. I resigned from the English Department on November 30 last because the Treasury declined to give us a staff of such a nature as I deemed necessary to carry out the work proposed. The Treasury, in fact, took from me the possibility of recommending to the Fisheries Secretary a staff capable of doing this work; it offered a lower rate of pay than the higher grade of the Civil Service, with a prospect of promotion from the lowest grade to the next at the age of forty-three or thereabouts, whereas the Civil Service has a prospect of similar promotion about ten years younger. The Treasury instituted a scale of pay in all the four grades of the Scientific Division of the Ministry distinctly lower than that of a higher grade of the Civil Service; in fact, it proposed to create a fresh grading of inferior rank, with very indeterminate prospects of promotion. Apparently the Treasury was doing this on general grounds—the inferiority of scientific men to the ordinary Civil Servants employed by the State! It certainly could not have had the advice of any biologist as to the supply of the men available for the work.

What is required in fisheries is the scientific man who is broadly trained in the relationship of fish to the chemical and physical conditions of the water in which they live, to the biological conditions of the organisms with which they are associated, and ultimately to the biological conditions in relation to the floating plant-life upon which all water-living animals to a considerable degree depend. The successful fishery investigator must be, as it were, a "medical man" who has fish as his speciality instead of human beings; he has to consider every factor in respect to the living fish just as the practitioner has to consider every factor in respect to his patients; he must even know something of statistics. The number of such men is small, but they may be "created" if there are openings for them. The training involves many years of hard study, but no amount of training will compensate for an absence of the requisite ability to visualise and correlate all the different factors that are involved in studying the living fish.

The men who give up their time and thought to such a study put themselves outside the branches of science that are recognised in our different universities. By so doing they renounce the beaten tracks of ordinary scientific promotion and their prospects therein. The responsible heads of scientific departments in universities cannot recommend their best men to do this unless they see adequate possibilities for their future. By the creation of a single strong Division for the scientific investigation of British fisheries under the Development Commission, adequately paid and with prospects of promotion at least equal to those in any university of the kingdom, there would be a great inducement to the best men to undertake this work; its very complexity would attract them. As it is, there are three Scientific Divisions of Fisheries under three different Departments the positions and prospects in which are not such that the best men can be recommended to them; these three Divisions at present have, I venture to suggest, sufficient first-class men to fill adequately the higher

posts of the proposed single Scientific Fisheries Division, and it can be recruited to full strength as men of the requisite ability become available.

As a professor in a great university I cannot recommend my first-class man—I do not refer merely to a first-class degree—to apply for a post in research in the service of the State which is inferior to that of the higher grade of the Civil Service. The mental qualifications for research posts are far rarer than for the ordinary work of administration. The holders of such posts cannot be transferred from department to department, so that proper recognition must be guaranteed them from the start. All of us must cordially endorse the resolution unanimously passed by the council of the British Association: "That the council considers that no scheme of payment of professional scientific men in the service of the State is satisfactory which places them on a lower level than that of the higher grade of the Civil Service." If science is to work for and with the State the Treasury must cease treating its scientific as inferior to its administrative services. There are difficulties, of course, in blending the two services, for science will be killed if it becomes bureaucratic; at the same time it must not be allowed to become an underling to the present bureaucracy.

In conclusion, it is interesting to note that while the administrative staffs of the fishery departments of most civilised countries are recruited almost solely from men who have been trained in science, that is not so in this country. The tremendous development of Norwegian fisheries is obviously due to one man, who was first and foremost always a scientific man. The great development in Germany before the war was due to scientific men. The employment of fishery officers who have some knowledge of the conditions of life of the living fish is obviously of primary importance. The users of trawlers and the herring drifters are increasingly taking more and more interest in the lives of their prey, and the Fisheries Departments should not merely follow their lead, as they will ultimately have to do, but should also, as in other countries, seek for inspectors who, at any rate, have the fundamental scientific knowledge upon which alone deductions as to the fish with which they have to deal can be made profitably. Every inspector should surely be able to answer from his own knowledge the ordinary points raised in respect to the lives of commercial fish and in respect to the possibilities of deterioration and pollution on their way to market. The training for such is that broad training in science which is provided in all the greater universities of the kingdom, and the Departments need feel no fear as to the lack of competition for their posts if they adopt the right scheme.

J. STANLEY GARDINER.

Zoological Laboratory, Cambridge,
January 8.

The Central Meteorological and Geodynamic Institute, Vienna.

THE Central Meteorological and Geodynamic Institute in Vienna is the oldest meteorological institute in the world. It was founded by the Austrian State in 1851, at the request of the Vienna Academy of Science, with the object of developing the study of meteorology and terrestrial magnetism, and for the past seventy years has served both science and practical life.

In consequence of the war and the subsequent peace the future activities of the institute are in jeopardy. The impoverished little Republic of Austria has not the necessary means for carrying on the work of the Central Institute.

The undersigned feel it their duty, as former and present directors of this old institute, to inform the meteorological institutes, societies, and men of science all over the world who have any scientific or practical connection with the Central Institute in Vienna and exchange publications with it, of the pressing need of the Central Institute.

In acting thus they take the point of view that a scientific institute like the Central Institute is, to a certain degree, the public property of all the cultured nations of the earth, and as such these are all interested in its existence. The undersigned therefore plead for financial aid for the Central Institute.

The low value of the Austrian kroner (less than two Swiss centimes) makes it, on the one hand, easy for foreign States to help, but, on the other, the Austrian State endowment, in spite of repeated increases, is ever insufficient.

The Central Institute can now no longer publish its year-books, even for diminished Austria, although the yearly printing expenses would only be 1000 Swiss francs. The year-books, however, as they contain the results of observations—that is, definite facts—represent the basis of the development of our science.

It is, moreover, impossible for the Central Institute to carry on its work. It has become impossible to procure instruments; hydrogen for pilot-balloon ascents is too expensive; and the same applies to rubber balloons for recording ascents. It is impossible to keep the library up to date, as the smallest foreign books or journals cost hundreds of kroner. Consequently, meteorologists cannot follow the trend of work abroad and so keep up with the times.

It will be possible to issue the weather charts for six months more, until the stock of paper is exhausted, then this issue must cease. It will be possible with difficulty to keep up the seismic observatory in Vienna; the stations at Grätz and Innsbruck must, on the other hand, be given up, as the expenses of running them are too heavy. There can be no question of recommencing the registration of terrestrial magnetism which was carried out at the high-altitude station at Obir before the war.

No matter where we turn we find the same cheerless decay.

We refrain from enlarging on the *rôle* which the Austrian school has played in meteorology during the last fifty years. We venture, however, to name a few books which have emanated from the Central Institute of Vienna:—*Meteorologische Zeitschrift* since 1866; J. Hann, "Handbook of Climatology"; J. Hann, "Text-book of Meteorology"; J. M. Pernter, "Meteorological Optics"; W. Trabert, "Text-book of Cosmical Physics"; and F. M. Exner, "Dynamical Meteorology." We beg that foreign States will remember the Central Meteorological Institute in Vienna from the titles of these books, and that help may be forthcoming.

F. M. EXNER,
Present Director.
J. HANN,
Former Director.

Vienna XIX, Hohe Warte 38, December 2.

Tidal Power.

ESTIMATES of the power to be obtained from the rise and fall of the tide are often greatly in excess of practical possibilities. If it is assumed that an estuary or reservoir of area A is enclosed by a dam at the outer face of which the difference of level between high and low water is H, then (w being the weight of the unit cube of water) the work which might conceivably be extracted from tidal action is $w.A\frac{H^2}{2}$. To

attain this end the relation between the water levels outside and inside the dam must be that shown in Fig. 1 by the full and dotted lines respectively. The motors or turbines must be designed to work efficiently with any head from 0 to H, and able to do all the work in such a short time that the high and low water levels remain practically constant during that interval, say 20 minutes.

If the interval between high and low water is six hours, the motors must be capable of delivering eighteen times the average power, and of this power 17/18 must be stored. It is, of course, impracticable to fulfil these conditions. The turbines have to work with a nearly constant head, and it would be impossible to arrange for the whole work to be done in the short time available at high and low water.

The most practicable plan is indicated in Fig. 2. The flow through the turbines is adjusted to reduce the rise and fall inside the dam to half that of the

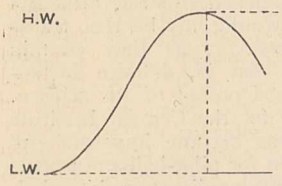

FIG. 1.

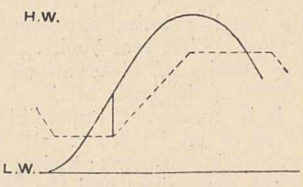

FIG. 2.

tide and the time of working increased to about three hours. The effective head is H/4, and the distance through which it acts (*i.e.* the stroke) is H/2. In this way about one-fourth of the tidal energy $\left(w.A\frac{H^2}{2}\right)$ might be utilised, half of which would have to be stored if the power supply is to be constant. Taking into account the various losses due to turbine, electrical, and storage efficiency, it is improbable that more than one-fifth of the whole tidal power could be delivered as electric current.

If A is 1 square mile and H 30 ft., it will be found that for each square mile of reservoir surface something more than 10,000 h.p. might be expected.

I have no knowledge of the details of the Severn scheme, but if it were possible—which I doubt—to enclose 20 square miles of estuary where the average difference of tidal level was 30 ft., the power available for distribution would be under 250,000 h.p.

It may be remarked that the same power could be obtained from a river having a current of little more than 2 miles per hour and a cross-sectional area of 2000 ft., if in its course there was a fall of 30 ft.

A. MALLOCK.

Heredity and Acquired Characters.

IN NATURE of January 6 there appears a long communication on heredity by Sir Archdall Reid which he conceives to be a reply to criticisms made on a former letter by him on the same subject by Sir Ray Lankester, Prof. Poulton, Dr. Gates, and myself. Leaving these eminent biologists to look after themselves, which they are quite capable of doing, perhaps you will allow me to say a word or two on some points raised in the letter in the current issue.

Sir Archdall Reid accuses me of torturing "a word which has now an established and perfectly clear meaning." The word is "variation." I wished to contribute to clearness by defining it, for, so far from its having a clear meaning, there are at least three senses in which it can be used. Further, let me say that if a five-fingered child were born of a six-fingered parent, I should not describe it as a "variation," but as a "reversion."

Next, Sir Archdall Reid challenges me to define the "quibble" about "acquired character." "Acquired character" is a technical term; by it is meant a quality, *i.e.* the degree of development of an organ, which is produced as a response to function, altered from the normal in response to an alteration of the environment from the normal; but Sir Archdall Reid interprets it as any adult character whatever.

Sir Archdall Reid has, however, understood the point, because he says that "the supposition that 'acquirements' tend to become 'innate' is . . . ridiculous." Such an *ex cathedra* statement contributes nothing useful to the discussion. There are definite experiments on record which, if true, prove this very point, but Sir Archdall Reid apparently knows nothing about them.

Then we are told that "low in the animal scale we find little or no evidence of development in response to functional activity." On reading this the question that instantly occurs to one's mind is: "Where did Sir Archdall Reid learn his zoology?" I have been working with Echinoderm larvæ for many years, and in no animals known to me is structure more sensitive to changes in the environment (Proc. Roy. Soc., B, vol. xc., 1918).

Lastly, Sir Archdall Reid says: "We are now in the morass in which Lamarck and Weismann floundered." I have attended many congresses of biologists, and I have never found evidence of confusion in their minds as to what was meant by an "acquired character." They differed, and continue to differ, as to whether there is evidence that an "acquired character" can be inherited, or, to use Sir Archdall Reid's paraphrase, that "acquirements" can become "innate," and this difference can be settled only by the outcome of experiments which are now in progress, but I have nowhere detected evidence of a condition of thought that could be described as a "morass." I conclude, therefore, that it exists alone in Sir Archdall Reid's mind.

E. W. MACBRIDE.

Imperial College of Science and Technology, South Kensington, S.W.7, January 7.

PROVIDED that biologists understand one another, it is, perhaps, not an insuperable barrier to the progress of biology that Sir Archdall Reid is unable to understand their terminology. I write merely to point out that though he seeks to teach biologists the proper use of terms, Sir Archdall Reid, in his letter in NATURE of January 6, contradicts himself in his own terminology. He states that even in human beings many characters do not develop in the least in response to functional activity, *e.g.* hair and external generative organs. On the other hand, in man most characters develop wholly, or almost wholly, in response to that stimulus. Yet in another paragraph he asserts that all characters are necessarily innate, acquired, germinal, somatic, and inheritable in *exactly the same sense and degree*. If biologists recognise, as Sir Archdall Reid does, a difference between characters that develop in response to functional activity and those which do not, what need is there for him to ask biologists why they describe some characters as "innate," "germinal," and "inheritable," and others as "acquired," "somatic," and "non-inheritable"?

J. T. CUNNINGHAM.

University of London Club, 21 Gower Street, W.C.1, January 7.

Solar Radiation in Relation to the Position of Spots and Faculæ.

ABOUT September 1 last an arrangement was made between the Director of the Argentine Meteorological Service and the Director of the Astronomical Observatory of the University of La Plata for observations of

disturbances visible on the surface of the sun, including spots and faculæ to be recorded on a diagram of the sun's surface and transmitted to the Meteorological Office for the purpose of comparing them with the observations of solar radiation received from the Smithsonian Solar Observatory at Calama, Chile.

The observations at first consisted chiefly of a record of sun-spots, and although the time is short the relation seems so apparent as to be worthy of record. The records have been arranged in three series, two of which are practically independent of each other and the third partly so.

The first series was derived from seven groups of sun-spots by taking the day of their first appearance on the east edge of the sun three days before and five days after, and obtaining the average values observed of solar radiation on these days in calories per square centimetre.

The second series was derived from six groups of sun-spots by taking out the mean solar radiation on the last day of visibility and for five days preceding and three days following.

The third series was derived from seven series of spots by taking the mean solar values on the days the spots crossed the solar meridian and for eight days preceding and eight days following.

The results are shown in the following table:

Mean Radiation Values for Different Positions of Sun-spots.

(1)	Days before.			East edge.	First seen.	Days after.			
	2	1	0	1	2	3	4	5	6
Radiation	40	24	45	55	52	48	37	47	39

(2)	Days before.					Last seen.	West edge.	Days after.	
	6	5	4	3	2	1	0	1	2
Radiation	46	45	35	30	48	50	54	40	38

(3)	Days before.							Meridian	Days after.							
	8	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7	8
	42	38	40	49	41	48	33	46	44	45	35	47	40	49	46	40	38

The mean solar radiation value is formed by adding 1·900 to the values given in the table.

As the spots are rarely seen exactly on the edge of the sun, the day on which they are first seen is numbered 1, and the day before is numbered 0; also, when last seen the day is numbered 1, and the day after 0.

The mean solar values during the interval covered by the observations is 1·943, so that on the day when the spots were first seen the radiation averaged 0·012 calorie above normal, and when last seen 0·007 calorie above, or in the mean about ½ per cent. of the solar radiation.

There was one day common to the two series when spots were visible on both edges of the sun at the ends of a diameter passing through the sun's centre, or, in other words, on a great circle about 180° apart. On this day the solar radiation value was 1·969, or more than 1 per cent. above normal.

The grouping around the central passage of the spots does not bring out the relation so distinctly, although higher values are found five days before and five days after the passage across the meridian, the lowest values being found two days before and two days after the central position. If one takes the mean of the five days about the centre, including two days before and two days after the central passage, a value of 1·941 is obtained, which is slightly below the normal value, as if some absorption of heat resulted from the central passage of the spots.

These results have an interest in connection with the fact that Dr. Abbot found a decrease in the contrast of brightness between the edge and centre of the sun coinciding with short-period increase of solar radiation (Smithsonian Miscellaneous Collections, vol. lxvi., No. 5). Both these results can, I think, be explained in the same way. It is well known that solar faculæ and solar eruptions surround regions where spots are numerous.

These eruptions when seen near the edge of the sun tend to decrease solar contrast and to increase the total solar radiation. On the other hand, when they are near the centre of the sun they are seen directly above the hotter gases from which radiation is coming vertically through the sun's atmosphere, and hence is not greatly absorbed.

The cooler gases within the spots may even absorb more of this radiation than is made up for by the increased radiation of the faculæ in the outer atmosphere.

The results, if confirmed by more extended observations, will also have an important meteorological bearing. Numerous investigators like Loomis, Veeder, Arctowski, and Huntington have found evidences of increased solar influences on the earth's atmosphere when the solar spots were near the edge of the sun. E. Huntington especially has made an extensive investigation of the position of the solar spots as related to the storminess in the North Atlantic, and has found that the most marked effects are shown when the spots are near the edge of the sun, and hence when there is probably increased solar radiation (Monthly Weather Review, U.S.A. Weather Bureau, March–June, 1918). H. H. CLAYTON.

Buenos Aires, November 6.

Odours Caused by Attrition.

THE unpleasant odour which attends the attrition of pebbles, etc., appears to have been noticed at a much earlier date than any mentioned by previous correspondents. Robert Boyle ("The Efficacy of Languid Motion," Works, edited by Boulton, 1699, vol. i., p. 234) remarks: "And that it may further appear, that a peculiar Modification of Motion, may contribute to the various Effects produced by it, I shall observe, That those Stones which *Italian* Glassmen make use of [quartz?], afford Sparks of Fire by Collision; but if moderately rubb'd together, they emit *fœtid* Exhalations; from whence probably proceed those offensive Steams, emitted by Glass; and what is more remarkable, and to our purpose is, tho' Glass when Red-hot emits no such *Effluvia*; yet if two pieces be dextrously rubb'd together, they will send forth Steams copious enough and *fœtid*."

It seems to me that there are at least two suggestions not brought forward by previous correspondents in NATURE contained in Boyle's observations, both of which might well be followed up experimentally. The implicit explanation of the cause of smell is also of some interest. J. R. PARTINGTON.

Lostock Gralam, Cheshire.

The Energy of Cyclones.

I SHALL be glad if you will allow me to refer briefly to the objection Mr. W. H. Dines raises to my theory of cyclones (NATURE, December 23, p. 534). Mr. Dines remarks that if "cyclones are caused by an access of warmth in the stratosphere . . . the troposphere ought to bulge upwards over the cyclone, whereas, in fact, it bulges downwards." My view is that where the stratosphere is warmest it must be thickest, and the troposphere must be thin. As the warmest portions of the stratosphere are at cyclonic centres, the lower boundary of the stratosphere must bulge downwards over such areas and the troposphere be correspondingly thin. I assume that the heat of the stratosphere passes downwards so rapidly that the slowly rising air cannot maintain the troposphere at its normal thickness. R. M. DEELEY.

Tintagil, Kew Gardens Road, Kew, Surrey,
December 24.

Nature of Vowel Sounds.

By PROF. E. W. SCRIPTURE.

The Analysis of Vowel Curves.

SINCE the time of Wheatstone and Helmholtz the vowels have been almost universally supposed to obtain their tones by acting as resonators to certain overtones of the larynx tone. Helmholtz even constructed an apparatus of a set of harmonic tuning-forks by combinations of which he hoped to produce the vowels. Ever since the invention of the speech-recording machine by Scott and Koenig in Paris the analysis of vowel curves has been expected to solve the problems of the nature of a vowel and of the differences between different vowels.

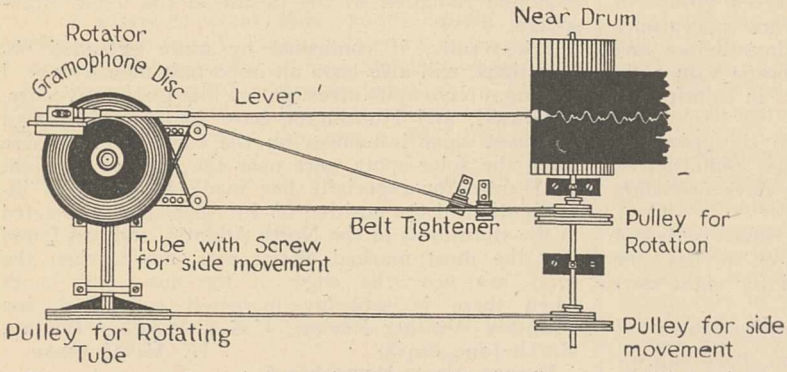

FIG. 1.—Apparatus for tracing gramophone curves. A steel needle near one end of a long lever follows the groove. Its movements are enlarged 500 times and registered on a band of smoked paper.

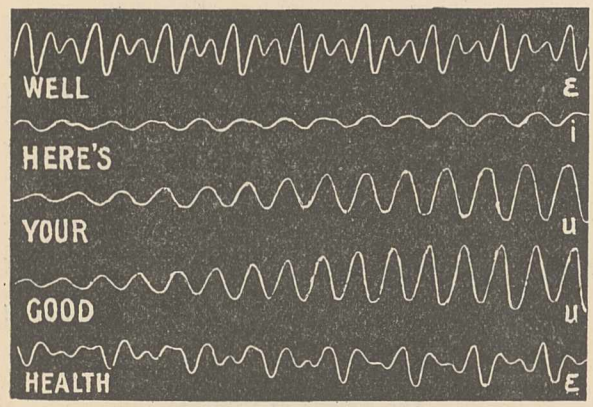

FIG. 2.—Vowel curves. The waves fall into groups; the top line contains eight groups, the next line six, the third seven, the fourth eight, and the last seven. Each group corresponds to one vibration from the larynx. The length of a group gives the pitch of the laryngeal tone; in speech this is always rising or falling. The height of the waves indicates the intensity. This is nearly always small at the beginning of a vowel; there is a steady rise to a maximum and then usually a fall to the end. The small waves within a group give the characteristics of the vowel sound. The top line is a piece out of the middle of the vowel in "well." The second line is from the vowel in "here." The third is near the beginning of "your." The fourth is the first part of the vowel in "good." The last is from the middle of "health." In the second, third, and fourth cases there is evidently present a tone more or less nearly the octave of the laryngeal tone. The other tones and the tones in the other cases can be found only by analysis.

At the present day the vowels can be recorded on talking machines, and their curves can be traced off with an accuracy that leaves nothing to be desired. The work of Hermann on the curves of the vowels and consonants by means of the phonograph is still unsurpassed. For my own investigations the gramophone was chosen as the most available machine.

A disc with the desired record was placed on a very slowly revolving plate (Fig. 1). A long lever of Japanese straw was held in an axle at one end. Near this end a steel point projected downward into the speech groove. At the other end there was a recording point made of a fine glass thread. As the disc revolved, the movements were magnified—up to 500 times—and traced on a moving band of smoked paper.

Pieces of vowel curves cut out of a tracing of a record by Joseph Jefferson are shown in Fig. 2. The curves show that in speech the vowels change constantly in pitch, in intensity, and in character. They also show that the vowels actually used in speaking are often not what the phonetician supposes them to be.

The point of interest on the present occasion, however, is the nature of a single wave of a vowel. At the present day there is only one way of analysing a wave—namely, the harmonic analysis. Any wave can be represented as made up of a series of simple sine waves with the relations of frequency of 1 : 2 : 3 : . . . and with various amplitudes. A harmonic analysis of the wave in the top line of Fig. 3 gives the four curves in the lines below. This means that the four curves, if added together, will give a result like that in the top line.

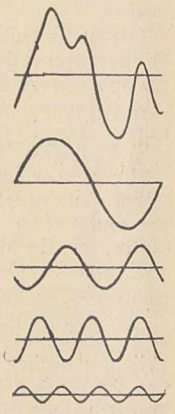

FIG. 3.—A curve composed of four sinusoids.

Suppose, now, that we have a curve that consists of a vibration repeating itself every $3\frac{1}{2}$ times to a wave. The harmonic analysis gives as result a fairly strong fundamental of the frequency 1, a stronger vibration of the frequency 2, a still stronger vibration of the frequency 3, a somewhat less strong vibration of the frequency 4, and ever-lessening vibrations of the frequencies 5, 6, 7, etc. Not one of these vibrations was actually present in the original curve. The strength of the original vibration of $3\frac{1}{2}$ could not be directly given, because there was no place for it in the harmonic series.

The harmonic analysis shows us how a given curve can be represented as made up of a series of harmonic components; it does not say that it

was originally so produced. Such a deduction has to be made on other grounds. The familiar experiment with a piano string touched lightly in the middle, then at one-third of its length, etc., shows that it vibrates in harmonic parts; an analysis that gives the harmonic components in various amplitudes can be accepted at once as indicating the strength of the components. An analysis, however, that gives all the harmonics as being present to some degree with a bunch of strong ones at one or more points would indicate at once that one or more inharmonics were present.

A harmonic analysis of the wave in Fig. 4 from the first vowel in "Marshall" gives the harmonic plot shown in Fig. 5. This merely states that the original wave can be reproduced by using harmonics in the relations indicated. The deduction concerning how the wave was originally produced is left for the person who interprets the harmonic plot.

If such a result were obtained for a wave from a musical orchestra, we should have no hesitation

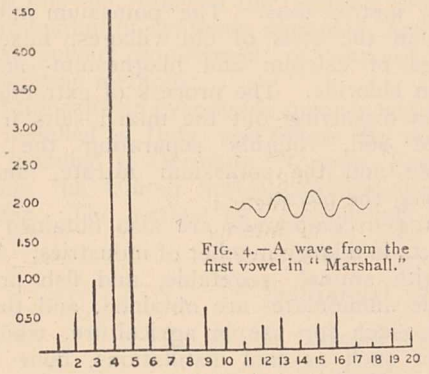

FIG. 4.—A wave from the first vowel in "Marshall."

FIG. 5.—Relative amplitudes of the sinusoids found by harmonic analysis.

in concluding that the wave was produced by a summation of vibrations in the harmonic relation. If the wave originated from a single source, we should certainly not be justified in drawing the same conclusion without further evidence. In seeking for further evidence we find, in the first place, that the waves from musical instruments so far as yet studied—the material is extremely limited—do not give harmonic plots like that in Fig. 5, and do give plots having one, two, or three prominent harmonics with the others lacking. This would agree with the known fact that most musical instruments vibrate in harmonics. If the source of the wave were absolutely unknown, the most plausible deduction would be that it was some body or bodies that might vibrate in either harmonics or inharmonics. We should take the weighted means of the groups of strong harmonics, and should find in this case that the components were the inharmonics

$$1 : 4{\cdot}3 : 9{\cdot}3 : 11{\cdot}5 : 17{\cdot}6 : 19{\cdot}5.$$

The result can be expressed in the inharmonic plot in Fig. 6. This conclusion is of vital importance, because such results are just those that are always obtained from careful vowel analyses. The very harmonic analysis itself leads to the conclusion that the vowel tones may be inharmonic.

In the analyses of vowel waves the fundamental is indicated as weak (as in Fig. 5) or often almost lacking. This fundamental represents the voice tone or the tone from the larynx. We all know that this is the strongest tone of all. We may not be able to hear just what vowel a speaker or singer is producing, but we certainly know whether he is using a high or a low tone of voice. One writer, observing this peculiarity in the analysis of the waves obtained from a phonograph, remarked that this instrument must be deaf to the voice tone. He failed to consider that if it was deaf to this tone it could not reproduce it, and that even the most defective phonograph will produce the voice tone so long as it makes any noise at all. The weakness of the fundamental in Fig. 5, therefore, does not show that

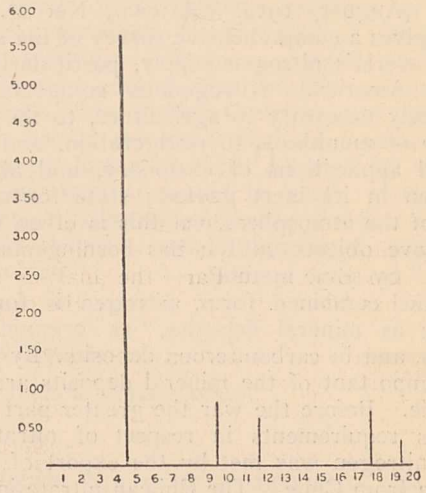

FIG. 6.—Relative amplitudes of the component inharmonics as deduced from Fig. 5.

the fundamental was lacking in the original vibration.

Let us inquire what kind of a strong tone will appear in the harmonic analysis with a weak fundamental. This is the case with a series of sharp puffs. If the period from one puff to the next of a series is subjected to harmonic analysis, the result shows a weak fundamental with all the higher harmonics represented in ever-diminishing amplitudes. The fundamentals in the vowel curves are therefore not of the nature of sine vibrations, but of series of more or less sharp puffs.

This is not a new theory of the vowels. In 1830 Willis published, in the Transactions of the Cambridge Philosophical Society, a paper on the tones of the vowels and reed organ-pipes. He asserted that a vowel was composed of a series of puffs with a set of inharmonic overtones. This was rejected in favour of the harmonic theory by Wheatstone, whose conclusions were accepted and developed by Helmholtz. For nearly a century the harmonic theory has been universally accepted.

In a series of researches beginning in 1889 Hermann found that the analyses of phonograph curves showed the vowels to be constructed of puffs and inharmonics. He thus independently rediscovered the principle of Willis. This theory has been substantiated and developed by thousands of analyses in my work for the Carnegie Institution of Washington, and published in "The Study of Speech Curves" (Carnegie Inst. Publ. No. 44), from which the above results are taken. It should be added that this extensive and somewhat expensive work was made possible by the support of Yale University and the liberality of the Carnegie Institution of Washington.

(To be continued.)

Nitrate Supplies and the Nitrogen Industry.

THE Imperial Mineral Resources Bureau has recently issued a report on the nitrate industry of the British Empire and of foreign countries, containing all available statistics with regard to the production and prices of nitrates during the war period. In conjunction with this report may be considered a paper dealing with the nitrogen industry contributed by H. E. Fischer to the Journal of the Franklin Institute (August, 1920, vol. cxc., No. 2). This paper gives a comprehensive survey of the sources of the world's nitrogen supply, particularly as it affects America. Nitrogenous compounds are absolutely necessary to agriculture, to the manufacture of munitions, to refrigeration, and to the general applications of chemistry, and although nitrogen in its inert gaseous state forms four-fifths of the atmosphere, yet this is of no use for the above objects until it has been combined or "fixed" by some method.

In the combined form, nitrogen is found in Nature as mineral deposits, as organic compounds, and in carboniferous deposits. By far the most important of the mineral deposits are those of Chile. Before the war the greater part of the world's requirements in respect of nitrate and nitric nitrogen was met by the export of nitrate of soda from Chile. The Chilean nitrate industry is one of long standing, and expanded steadily from 100,000 tons per annum in the middle of the nineteenth century to 2,400,000 tons in 1913. It has been stated that the Chilean nitrate deposits are nearly exhausted, but according to the Chilean Nitrate Committee's report "there is no fear of the Chilean nitrate deposits being exhausted for 200 years." The nitrate occurs as scattered deposits in a formation known as caliche, consisting of a conglomerate of rock material cemented with a mixture of soluble salts, in which sodium chloride is the chief constituent as regards quantity, while sodium nitrate is second. It is only in scattered patches that the caliche contains nitrate in quantities large enough to warrant treatment. These patches are sought out and excavated, and the picked ore is hauled to the extraction plant, where the soluble salts are extracted in solution, and the nitrate is separated from the other salts by crystallisation.

A considerable amount of sodium nitrate is also produced in Egypt. For one company in 1913 the output was 4740 metric tons, but the total output is not known definitely. In India potassium nitrate has been produced from very early times, but the trade has always been subject to great fluctuations. It attained its highest values during the American Civil War, for then India had practically a monopoly of the supplies of saltpetre needed for explosives. At that time the average annual exports were 30,000 tons, but the development of the Chilean industry caused the Indian trade to decline, until in the years just before the war the exports were only 13,000 or 14,000 tons per annum. The war period again stimulated the trade, and in 1918 the output was 25,145 metric tons. The potassium nitrate is found in the soils of old villages, mixed with nitrates of calcium and magnesium and with sodium chloride. The process of extraction consists in dissolving out the mixed salts from the surface soil, roughly separating the sodium chloride and the potassium nitrate, and then purifying the nitrate.

Nitrogen compounds are also obtained as by-products in a large number of industries. In dealing with animal, vegetable, and fish products, organic ammoniates are obtained, and these are left as such for use in agriculture, while from sources such as coal distillations, bone carbonisation, oil-shale distillation, and blast-furnace operations, nitrogen is recovered as ammonia and ammonium salts—chiefly ammonium sulphate, which is available in all capacities. The organic nitrogen recovered in these various by-product connections probably constitutes about 40 to 50 per cent. of the total supply, but this nitrogen has to compete for its market against the supplies of nitrates from natural sources and against those of synthetic nitrates, *i.e.* those obtained from combined atmospheric nitrogen.

As early as 1781 Cavendish discovered that a nitric reaction was shown by water obtained by burning hydrogen in excess of air, and since his time very many chemists have studied the problem. In 1900 two Americans erected an experimental plant at Niagara for producing nitric acid from atmospheric nitrogen by means of a very high electric current, but this soon proved unremunerative and was abandoned. The luminous arc process for fixing atmospheric nitrogen was the first to be established commercially. In this process a dilute gaseous mixture of nitric oxides with air is obtained from the oxygen and nitrogen in the air; the nitric oxide is converted into nitric dioxide, and then absorbed in water to form nitric acid. It was started in Norway in 1903, and, owing to the cheap horse-power there avail-

able, and to the fact that the raw materials cost nothing and are always at hand, nitric acid can be produced there by the arc process at less cost than by any other commercial process. Efforts to introduce this process outside Norway have been unsatisfactory, partly because of its uneconomical use of power, and partly because of the difficulty in the subsequent handling of the end-product, a 30–35 per cent. acid against a 50–55 per cent. acid obtained by other processes.

The Haber process for ammonia synthesis was brought to a successful commercial stage in Germany in 1913, when the plant capacity was 30,000 tons of ammonium sulphate. In 1918 the output by this process was 1,060,000 tons of ammonium sulphate. The process consists of forming ammonia by the direct combination, under the influence of a catalyser, of nitrogen from the air and hydrogen obtained from water. The production and purification of the hydrogen involve one of the chief items of cost in this process, but in spite of this the Haber is the cheapest process for the production of synthetic ammonia, and has the lowest power requirement of any of the nitrogen fixation methods.

In 1906 the calcium cyanamide process was successfully installed in Italy, and before the war it was also installed in Germany, Norway, France, Switzerland, the United States, Austria, Japan, and Sweden. The method is a complicated one, and involves a large number of stages, but it has developed extensively, because it requires only about one-fifth the horse-power per ton of fixed nitrogen per year that is required by the arc process, though five times that required by the Haber process.

Several other methods for nitrogen fixation are being experimented with, but they are not yet developed commercially. Mr. Fischer, after a full discussion, concludes that the result is that Germany can produce nitrates at one-half the cost in the United States, and, consequently, the German farmer can be supplied with fertilisers at one-half the cost to the American farmer. This is an enormous advantage to Germany, and if Germany succeeds in monopolising this industry —which she is in a position to do, barring internal disorders—she can either export nitrates at a price which will enable her to supply her farmers with fertilisers at a negligible cost, or undercut the price of nitrogenous products so that it will be unprofitable for the Chilean mines to continue working. Germany would thus in time indirectly control the world's production of explosives. Mr. Fischer therefore urges on the American people the importance of constructing plants for producing synthetic nitrates, by which means "our security would be vastly increased, the burden of obligation carried by our fleet would be greatly reduced, and its functional, effective value doubled."

Industrial Research Associations.

VIII.—The British Photographic Research Association.

By Dr. T. Slater Price.

THE British Photographic Research Association was the first research association to be formed under the scheme of the Privy Council for the promotion of industrial and scientific research. Early in 1918 the manufacturers of photographic materials and apparatus decided to avail themselves of the scheme, and the research association was incorporated on May 15, 1918. The president of the association is Sir J. J. Thomson, and the chairman Mr. Gerald M. Bishop, of Messrs. Marion and Co., Ltd. The council of the association consists of representatives from the various sections of the industry, together with several well-known men of science, who are also represented on the list of vice-presidents. The first director of research was Dr. R. E. Slade, and laboratory accommodation was obtained in the chemical department of University College, Gower Street, where work was carried on until the end of September, 1920. Owing to the large influx of students in the present session, however, it was necessary to vacate the laboratories at University College, and at the beginning of October the research association was transferred to the Institute of Chemistry, 30 Russell Square, W.C.1, where various rooms have been specially fitted and equipped for research work. In March, 1920, Dr. Slade resigned his position as director of research, and the present writer was appointed his successor, taking up his duties in the middle of September last.

As stated in the programme of research which has been issued, the object of the association is to carry out research in photography, photochemistry, and other related subjects with a view to the general increase of knowledge of the subjects, to improve methods of manufacturing photographic materials, and to discover new photographic processes. It is recognised that manufacturers will always insist on determining for themselves the lines on which their businesses shall develop, and the true aim of the association should be, by the proper application of scientific methods, to obtain knowledge which will be of the widest application to the industry, and which it will be left to each manufacturer to apply in his own way to the development of his business.

It is recognised not only that applied research should be undertaken in connection with the improvement of products now being manufactured and of methods of manufacture, but also that pure research on the scientific basis of photography and on related subjects such as colloidal chemistry and photochemistry should be carried out, although

there may not necessarily be any immediate application of the results to manufacturing processes. Pure research of this nature has already been done, as is instanced by the following list of published papers :—

Contrast and Exposure in X-ray Photographs through Metals, by R. E. Slade (Trans. Faraday Soc., 1919, vol. xv., p. 52). A discussion of the effects of various qualities of X-rays on the photographic plate, and the possibilities of using plates to detect very small flaws in the examination of large bodies of metal.

The Fundamental Law for the True Photographic Rendering of Contrast, by A. W. Porter and R. E. Slade (*Phil. Mag.*, 1919, vol. xxxviii., p. 187). A consideration of the conditions which must be fulfilled by photographic materials in order that a true reproduction of the tone-values of an object may be obtained in the final print.

The Emulsion for a Process Plate, by R. E. Slade and G. I. Higson (*Phot. Journ.*, 1919, vol. lix., p. 260). A description of the type of silver halide emulsion most suitable for a process plate giving great contrast.

Photomicrography in Photographic Research, by G. I. Higson (*Phot. Journ.*, 1920, vol. lx., p. 140). A description of a special type of photomicrographic apparatus specially designed for high-power work in the examination of emulsions.

The Photometric Constant, by G. I. Higson (*Phot. Journ.*, 1920, vol. lx., p. 161). A mathematical discussion of the relation between the photometric density and the quantity of silver deposit in a photographic plate.

A New Method of Spectrophotometry in the Visible and Ultra-violet and the Absorption of Light by Silver Bromide, by R. E. Slade and F. C. Toy (Proc. Roy. Soc., 1920, A, vol. xcvii., p. 181). A description of a new method free from certain sources of error, by means of which the extinction curve for silver bromide was determined throughout the visible and ultra-violet regions of the spectrum.

Some Problems in High-power Photomicrography, by R. E. Slade and G. I. Higson (Trans. Faraday Soc., 1920, vol. xvi., p. 101). A contribution to the general discussion on the microscope held by the Faraday Society.

A Simple Non-intermittent Exposure Machine, by G. I. Higson (*Phot. Journ.*, 1920, vol. lx., p. 235). A description of a novel and simple form of exposure machine with which a plate can be exposed to a light of constant intensity for a series of known times.

Photochemical Investigations of the Photographic Plate, by R. E. Slade and G. I. Higson (Proc. Roy. Soc., 1920, A, vol. xcviii., p. 154). An experimental investigation of the photochemical behaviour of the silver bromide grain, from which an expression connecting intensity, time of exposure, and effect on the grains can be deduced.

The Absorption of Light by the Goldberg Wedge, by F. C. Toy and J. G. Ghosh (*Phil. Mag.*, 1920, vol. xl., p. 775). An investigation of the neutrality of the Goldberg wedge, showing that this neutrality is confined to the visible portion of the spectrum.

Before the war the manufacturers of cameras made use of wood which had been stained black right through. It was obtained from Germany, and was not procurable in England after the outbreak of war. The research association undertook the investigation of such a staining process, with successful results, as may be seen by reference to English Patent No. 17,638/19. It now remains for the manufacturers to develop the process on a commercial scale. At the same time, a quick process for staining wood brown right through was devised.

The methods of making sensitive emulsions for coating on plates and papers have been brought to a high standard of excellence by the various English manufacturers. To a large extent, however, the methods used are the result of experience, of trial and error; different manufacturers obtain similar results by widely different methods. An inexhaustible field of work is open for the definite correlation of the physical and chemical properties of the materials used with the methods employed and the sensitiveness and other characteristics of the emulsion obtained. A commencement is being made on this line of work, the technical heads of the various firms putting their experience and knowledge at the disposal of the research association. Any useful results obtained in the research laboratories will then be tested on a large scale in the works, since it is more than usually difficult in emulsion-making to pass successfully from the laboratory to the works scale.

There is also need for improved methods of laboratory testing of the raw materials of the industry so as to establish greater confidence between buyer and seller, particularly in regard to gelatine, bromides, raw and baryta-coated papers, and packing materials.

The literature of photography is very scattered, and, doubtless owing partly to the subtle nature of many photographic phenomena, important details have often been overlooked, with the consequence that the results of different workers often appear very contradictory. One of the objects of the research association is to collect and summarise this literature so that it may be placed at the disposal of the members of the association. Progress is being made in this direction, but it is necessarily slow.

Obituary.

Sir Lazarus Fletcher, F.R.S.

BY the death of Sir Lazarus Fletcher, mineralogy loses one who for a long period was recognised as the leading exponent of that branch of science in this country. Born at Salford on March 3, 1854, Sir Lazarus died suddenly from heart failure at Grange-over-Sands on January 6 in the sixty-seventh year of his age. He was educated at the Manchester Grammar School, and afterwards at Balliol College, Oxford, where he held the Brackenbury science scholarship. He obtained first-class honours in mathematical moderations and in the final schools of mathematics and natural science. From 1875–77 he served as demonstrator in physics under Prof. Clifton at the Clarendon Laboratory, and for the next two years he held the Millard lectureship in physics at Trinity College, Oxford. From 1877–80

he was a fellow of University College, Oxford. While at the Clarendon Laboratory he became interested in the study of crystals, and, as the result, when, in 1878, Mr. W. J. Lewis (now professor of mineralogy at Cambridge) retired, owing to ill-health, from the assistantship which he held in the mineral department of the British Museum, Prof. Story-Maskelyne, who was then keeper of minerals, induced Fletcher to apply for the post. He obtained it, and only two years later succeeded to the keepership.

Almost immediately on taking charge of the department Fletcher was called upon to supervise the removal of the mineral collection from Bloomsbury to its present home at South Kensington. What this meant may best be told in his own words[1]: "Some idea of the nature of this task may be formed if it be pointed out that the cabinets of the table-cases at Bloomsbury were to be made use of in the new gallery, but that the glazed table-tops were to be left behind; that the new table-tops were then lying on the gallery floor at South Kensington, and had as yet no supports; that differences of illumination of the old and the new galleries, and differences of construction of the cabinets, made it necessary that the relative positions of the cabinets in the gallery at South Kensington should be completely different from the relative positions in the gallery at Bloomsbury; that every cabinet had for some time to be turned upside down during the process of being fitted to the new floor; that many of them had to be cut in two because of the interference of the structural columns of the gallery, and new mahogany ends had afterwards to be made and fitted to them. Such a series of operations involves great practical difficulties when the specimens to be removed and arranged are numerous, fragile, and require to be cautiously handled, or are small, portable, and of great intrinsic value, and must be kept under lock and key." Once the collections were put in order, Fletcher devoted his attention to selecting and setting out series of specimens to facilitate the study of meteorites, minerals, and rocks respectively, and prepared a corresponding set of elementary hand books which are models of clear and simple exposition of not readily understood subjects. In 1909 he succeeded to the directorship of the Natural History Museum, which had been vacated by Sir E. Ray Lankester two years before. Unfortunately, a severe illness a year or so before his appointment left him with a crippled constitution, and soon he appeared to lose that keenness and energy which had previously characterised him; and by the time, in 1919, he reached the full age for retirement he was a tired man.

Many honours were conferred upon Fletcher by scientific institutions and universities at home and abroad. He was elected a fellow of the Royal Society in 1889, and was a vice-president from 1910–12, and in 1912 he was awarded by the Geological Society the coveted Wollaston medal. In 1894 he was president of the Geological Section of the British Association at its meeting at Oxford. The Mineralogical Society owes him a special debt of thanks, for to him its success and prosperity are largely due; he was its president from 1885–88, and from the latter year until 1909 served as its secretary. To commemorate such long service mineralogists and other friends subscribed and presented him with his portrait. He was knighted in 1916.

Despite the calls of his official duties, Fletcher found time to devote himself to scientific research, mainly to the subject of meteorites, to their history and constitution and the problems presented in the analysis of these bodies, but also to certain isolated, yet exceedingly important, questions in crystallography. Until the publication of his Optical Indicatrix in 1892 the whole theory of the optical characters of biaxial crystals as presented in the text-books was based on faulty and contradictory premises. With characteristic industry he went back to the original source, and read all Fresnel's early papers on this subject, and found that the latter had followed a perfectly logical and convincing course in his approach to his theory, and had departed from it only when desirous of providing a physical basis for his fundamental hypothesis. Fletcher, in his treatise, shows that the wave-surface for a biaxial crystal can in the manner originally put forward by Fresnel be derived from a simple extension of Huyghens's theorem, and his method is followed in all modern text-books on crystallography and the optical characters of crystals. He was gifted with considerable manipulative skill in delicate experimental work, the best example of which was his remarkable investigation of the morphological and chemical properties of the crystallised form of native zirconia, which was first discovered by him, and to which he gave the name "baddeleyite"; he obtained the whole of the requisite information from a study of a single, ill-developed crystal, which was all the material at his disposal, the analysis being made on the tiny fragments that had adhered to the wax of the crystal-holder.

Sir Lazarus Fletcher was twice married, first to Miss Agnes Ward Holme, who died in 1915, leaving a daughter, and afterwards, in 1916, to her sister, Edith; his widow and daughter survive him. A man of studious habit, of quiet geniality, and gifted with a subtle North-country humour, he will be mourned by a large circle of friends.

THE death is announced, at the age of seventy-seven, of MR. THOMAS A. O'DONOHOE, known by his work in microscopy and bacteriology. Mr. O'Donohoe made investigations on the tubercle bacillus and on the anatomy, habits, and metamorphosis of the house-fly, and at the time of his death was studying the winter stages of this insect. He was an authority on the optics of the microscope and photographic camera, and did much work on the mounting of objects for microscopic research.

[1] "History of the Collections in the Natural History Departments of the British Museum" (1904), vol. i., p. 349.

MANY men of science in this country will learn with great regret that PROF. H. A. BUMSTEAD, professor of physics at Yale University, and president of the National Research Council of the United States, died suddenly at Washington on January 1. Prof. Bumstead was for some time in London during the war, and was the head of the American organisation for keeping touch between the two countries in matters concerning the application of science to war.

Notes.

WE publish in our correspondence columns this week a translation of a letter from Prof. F. M. Exner, director of the Central Meteorological and Geodynamic Institute at Vienna, and Prof. J. Hann, the former director, appealing for financial aid to enable the institute to carry on the valuable work it has done for meteorology for the past seventy years, and to continue its publications. Already, both in Great Britain and in the United States, funds have been provided for meeting the personal needs of meteorologists in Vienna who were without the necessaries of life, but meteorologists are not, as a rule, wealthy men, and they cannot do much more than they have done. Other scientific workers have probably approached much the same limit of their capacity to help. While, therefore, we commend the appeal to our readers, we think it would be difficult for private benefactors to provide the means for carrying on the work of the institute. A much more promising course to urge is that some part of the credits made to Austria by England and France should be ear-marked for the maintenance of essential scientific services. We suggest that the Royal Society or the Royal Meteorological Society should take steps with the object of securing support of this kind for the Meteorological Institute at Vienna.

MR. C. E. FAGAN is expected to retire from the British Museum (Natural History) in the spring of this year. He entered the service of the Trustees in 1873, and became assistant secretary in 1889. He received the title of secretary in 1919, in recognition of the conspicuous value of his services. It is safe to say that Mr. Fagan has done more than any other living man in developing the importance of the museum as a centre of scientific activity. His long experience, his grasp of affairs, and his unfailing capacity for forming a correct judgment have made his co-operation and advice invaluable to the Trustees and to his colleagues. His administrative ability has been of the greatest service to successive directors, whom he has assisted in innumerable ways, while during more than one period of interregnum he has succeeded in maintaining the efficiency of the museum at a high level. Although not himself an investigator, Mr. Fagan has taken a keen interest in many aspects of natural history, and has been quick to appreciate the importance of an opening, whether the chance of securing a valuable collection or the opportunity of encouraging an expedition to some distant country. He has been closely associated with such societies as the British Ornithologists' Union and the Royal Geographical Society, the interests of which are connected with those of the Natural History Museum. Opportunities of making the museum practically useful have a special appeal for him, and he has taken great interest in exhibits of economic importance. From the first he has been a strong supporter of the close connection which happily exists between the museum and the Imperial Bureau of Entomology. Mr. Fagan has rendered exceptional services to science by single-minded devotion to his ideal of increasing and developing the scientific importance of the museum. The fact that he is suffering from a severe illness at the time which he had hoped to devote to putting the finishing touches to his long period of successful service will command the ready sympathy of his many friends.

WE hope that the Victor Horsley Memorial Fund will be well supported. The *Times* publishes a strong appeal for it, signed by the president of the Royal College of Surgeons, the professor of physiology in the University of Edinburgh, and others. "If only each patient whose life he saved," they say, "were to contribute to our fund according to their means, we should have all the money that we require, and more." Contributions may be sent to Sir Frederick Mott, 25 Nottingham Place, W.1, or to Dr. Howard Tooth, 34 Harley Street, W.1. The plan is for a scholarship or a lectureship. We all remember the coming of the news of Horsley's death from heat-stroke in Mesopotamia in July, 1916. Some of us, more fortunate, also remember the wonder of his threefold work in 1884–90: his advancement of the physiology and surgery of the central nervous system, his studies of the thyroid gland and of myxœdema, and his uphill fight, as Pasteur's representative, for the stamping-out of rabies. After 1890 Horsley was for a quarter of a century incessantly teaching, incessantly learning. Alike in hospital practice and in private practice, he set himself to Guy de Chauliac's ideal of a surgeon: "Bold when sure, cautious in danger, kind to the sick, friendly with fellow-workers, constant in duty, not greedy of gain." Moreover, he worked hard, no man harder, for the betterment of his profession, for its greater efficiency in the all-round service of national health, and for the protection of its poorer members against exploitation and the insolence of office. Later he was in the forefront of the fight against drink, the fight for the welfare of children, and the fight for votes for women. He was ever a fighter, and he offended by his vehemence, his intolerance. But those who were altogether opposed to him in politics are none the less thankful for his magnificent work in physiology and surgery; it went over all the civilised world, and we are bound in honour to commemorate his name.

WE refer elsewhere to the annual meeting of the Mathematical Association and the presidential address by Canon J. M. Wilson. The assistance given by

NATURE to the movement for the improvement of geometrical teaching referred to in the address is not without interest to our readers. Prof. Hirst (in his lectures at University College, London, and elsewhere) and a young master at Rugby, the present Canon Wilson (in a paper read before the London Mathematical Society, printed in the *Educational Times* for September, 1868), were among the first to raise the note of dissatisfaction. Mr. R. Tucker, of University College School, was the first to broach the subject in our columns (NATURE, March 24, 1870, vol. i., p. 534), while the next effective contribution was from Mr. Rawdon Levett, of King Edward's School, Birmingham, who (May 26, 1870, vol. ii., p. 64) raised the fiery cross and called for an Anti-Euclid Society. Mr. Wormell then suggested that contributions to the expenses of propaganda should be sent to Mr. Levett. The result was the notice of a forthcoming conference (NATURE, December 29, 1870, vol. iii., p. 169). At the first meeting Messrs. Hirst and Wilson secured the substitution of "improvement" for "reform" in the title of the New Association for the Improvement of Geometrical Teaching, and it was Canon Wilson who suggested that the association would best justify its existence by preparing a syllabus. At the meeting of 1872 he proposed the appointment of a sub-committee to draw up a detailed syllabus of geometry to be submitted to the highest mathematical authorities and examining bodies. The next year he moved that the adopted syllabus should be sent to the British Association for its comments. In 1874 he moved that the five schemes of proportion mentioned in the report of the committee be examined by all the members and their opinions be invited. After that year his attendance became less regular, but it will be seen that he took the foremost place in the actual work of getting out the syllabus. It must be a source of satisfaction to Canon Wilson to find the bantling at the birth of which he was present fifty years ago now in its turn the parent of branches in these islands and the Colonies, and, *post tot annos*, sending forth once more through his lips its message of achievement. Of the venerable canon, who is now eighty-five, it may almost be said that his eye is not dim nor his natural force abated.

THE KING has signified his intention of conferring the honour of knighthood on Dr. Maurice Craig, Consulting Neurologist to the Ministry of Pensions, and Dr. P. Horton-Smith Hartley, senior physician at the Hospital for Consumption and Diseases of the Chest, Brompton.

PROF. E. W. SCRIPTURE, who contributes to this issue the first of two articles on "The Nature of Vowel Sounds," was formerly professor of experimental psychology in Yale University, but is now resident in London, where he has been for some years engaged on studying records of speech in epilepsy, general paralysis, and other nervous diseases. Prof. Scripture has lately returned from Germany, where he has been lecturing on experimental phonetics applied to the study of English. These were the first lectures delivered in Germany since the war by a professor from a former enemy country.

ON Tuesday next, January 18, at 3 o'clock, Sir G. P. Lenox-Conyngham will give the first of two lectures at the Royal Institution on "The Progress of Geodesy in India"; and on Thursday, January 20, Dr. Arthur Harden will begin a course of two lectures on biochemistry (vitamines). The Friday evening discourse on January 28 will be delivered by Sir James Dewar on "Cloudland Studies."

THE council of the Geological Society has this year made the following awards:—Wollaston medal (in duplicate), Dr. John Horne and Dr. B. N. Peach; Murchison medal, Mr. E. S. Cobbold; Lyell medal, Dr. E. de Margerie, director of the Geological Survey of Alsace-Lorraine; Bigsby medal, Dr. L. L. Fermor, Geological Survey of India; Wollaston fund, Dr. T. O. Bosworth; Murchison fund, Dr. Albert Gilligan; and Lyell fund, Prof. H. L. Hawkins, Reading University College, and Mr. C. E. N. Bromehead, H.M. Geological Survey.

THE annual meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 5 and 6, at the Institution of Civil Engineers, Great George Street, London, S.W.1. Dr. J. E. Stead, president, will preside. In March the council will be prepared to consider applications for grants from the Carnegie Fund in aid of research work of such value as may appear expedient, but usually of the value of 100*l.* in any one year. The awards are made irrespective of sex or nationality. Special forms, on which candidates should apply before the end of February, can be obtained from the secretary of the institute. The research work must be on some subject of practical importance relating to the metallurgy of iron and steel and allied subjects. The results of research work must be communicated to the institute in the form of a report.

AT a general meeting of the Royal Meteorological Society to be held in the rooms of the Royal Astronomical Society, Burlington House, at 8 p.m., on January 19, a proposal will be brought forward for the incorporation of the Scottish Meteorological Society with the Royal Meteorological Society. The Scottish society has done useful work in the advancement of meteorology, particularly the meteorology of North Britain, since its foundation in 1855. It was closely connected with the work of the high-level observatory maintained on the summit of Ben Nevis for many years. It is felt that the time has now come when a fusion of the two bodies which represent the science north and south of the Border will be to the interest of meteorology as a whole and advantageous to the fellows of both societies. At 8.30 p.m., after the termination of the business meeting, Mr. R. H. Hooker, president of the Royal Meteorological Society, will deliver an address on "Forecasting the Crops from the Weather." Any workers interested in this subject from either the meteorological or the agricultural side are invited to the lecture.

THE Board of Trade has appointed Sir R. T. Glazebrook to be Chief Gas Examiner under the Gas Regulation Act, 1920, and Mr. C. V. Boys, Dr. J. S. Haldane, and Mr. W. J. A. Butterfield to be Gas

Referees. The Board has also appointed Mr. H. C. Honey to be Director of Gas Administration in the Power Transport and Economic Department, Board of Trade Offices, Great George Street, S.W.1. In pursuance of the provisions of section 2 (4) of the Act, the Board has appointed Sir William Pearce (chairman), Dr. T. Carnwath, Mr. W. D. Gibb, and Dr. T. Gray to be a Committee to inquire whether it is necessary or desirable to prescribe any limitation of the proportion of carbon monoxide which may be supplied in gas used for domestic purposes. It has also appointed Mr. J. H. Gray (chairman), Mr. W. J. A. Butterfield, and Dr. C. H. Lander to be a Committee to inquire whether it is necessary or desirable to prescribe any limitations of the proportions of incombustible constituents which may be supplied in gas. Communications should be addressed to the Secretary to each of these Committees at the Power Transport and Economic Department, Board of Trade, Great George Street, S.W.1.

THE Air Ministry announces that the Cabinet has approved, subject to Parliamentary sanction, the grant of a sum for the direct assistance of civil aviation. During the financial year 1921–22 payments under this grant will be limited to a maximum sum of 60,000*l.*, and will be made to British companies operating on approved aerial routes. The routes at present approved are London to Paris, London to Brussels, and London to Amsterdam. Extensions to these routes and additional routes, such as England–Scandinavia, on which the possibilities of a service employing flying boats or amphibian machines or a mixed service of sea and land aircraft can be demonstrated, may be approved from time to time if satisfactory proposals are received by the Air Council. The maximum time allowed for journeys between London and Paris, between London and Brussels, and between London and Amsterdam will be four hours from aerodrome to aerodrome (or such other time limit as may be determined later by the Air Council). Any British company intending to run on the routes and notifying the Air Council of this intention will become an "approved" organisation by fulfilling the conditions laid down. Such notification should be addressed to the Secretary (C.G.C.A.), Air Ministry, Kingsway, W.C.2, to whom requests for further particulars in respect of the grant should be addressed.

THE KING, on the recommendation of the Home Secretary, has approved the appointment of a Royal Commission to inquire into the existing provision for: (1) The avoidance of loss from fire, including the regulations dealing with the construction of buildings, dangerous processes, and fire risks generally, the arrangements for inquiry and research and for furnishing information and advice to public authorities and others on matters relating to fire prevention; and (2) the extinction of outbreaks of fire, including the control, maintenance, organisation, equipment, and training of fire brigades in Great Britain; and to report whether any, and if so what, changes are necessary, whether by statutory provision or otherwise, in order to secure the best possible protection of life and property against risks from fire, due regard being paid to considerations of economy as well as of efficiency. The Commission will be composed as follows:—The Hon. Sir Perceval M. Laurence (chairman), Mr. J. T. Burns, Sir Vincent H. P. Caillard, Mr. A. L. Dixon, Sir Maurice Fitzmaurice, Capt. V. L. Henderson, Sir Joseph E. Petavel, Mr. H. Peters, Lt.-Comdr. Sir Sampson Sladen, Mr. H. Stilgoe, and Lt.-Col. G. Symonds. In addition, there will be representatives of the County Councils' Association, of the Association of Municipal Corporations, and of the Fire Offices' Committee. The names of these representatives will be announced later. The secretary is Mr. J. C. MacIver, of the Home Office. Any communications on the subject should be addressed to him at 5 Old Palace Yard, S.W.1.

UNTIL its work is completed and the materials are collected, published, and exhibited, it is somewhat premature to forecast the results of the Mackie Expedition to Central Africa under the conduct of the Rev. John Roscoe. It is clear from letters received that much success has been achieved among the Bunyoro tribe, which occupies the country to the east of Lake Albert in the Uganda Protectorate. This information has been summarised in an important paper by Sir J. G. Frazer, published in the December issue of *Man*.

MR. W. W. ROUSE BALL has reprinted through Messrs. Heffer and Sons, Cambridge, the interesting lecture which he delivered last spring at the Royal Institution on string figures, which we noticed at the time in these columns. He has added full directions for the construction of several easy typical designs, arranged roughly in order of difficulty, and, for those who wish to go further, lists of additional patterns and references. This fascinating art can be practised with the simple aid of a piece of good string some 7 ft. long.

THE Welsh Department of the Board of Education has issued, under the title of "Scheme for the Collection of Rural Lore in Wales," a pamphlet containing a series of rules and suggestions for secondary schools and colleges. The scheme has been financed by members of the Honourable Society of Cymmrodorion with the object of preparing a kind of Welsh Domesday Book, the material of which is to be collected by teachers and pupils. One part of the scheme is the collection of all Welsh place-names from the ordinary Survey maps and other sources. Rural industries, survivals of old or curious customs and crafts, peculiar words, local proverbs, primitive agricultural implements, marks on sheep or ponies, notice of places where old pottery and the like have been discovered—in fact, all kinds of information on rural and industrial life are solicited. The scheme is well conceived and the instructions are helpful. Educational authorities in other parts of these islands may well consider how far the Welsh scheme can be adapted to local conditions.

THE Gem Dry Plate Co., Cricklewood, N.W., has forwarded to us a pamphlet on photomicrography. A simple account is given of the process, which includes a description of apparatus, illumination, focussing, exposure, the use of light-filters, printing, and develop-

ment. The pamphlet is illustrated with eight excellent plates showing reproductions of photomicrographs of diatoms, foraminifera, sections of animal and plant tissues, anthers and pollen, etc.

IN *Archives of Radiology and Electrotherapy* for November last (No. 244) Mr. H. A. Colwell continues his sketch of the history of electrotherapy. An account is given of the introduction and use of the galvano-cautery, electrolysis, and influence machines, with illustrations of the first apparatus employed. It is interesting to see that an "electrical room" was started at Guy's Hospital in 1836, and various forms of electrical treatment were investigated by Addison, Golding-Bird, and Gull among others.

THE Tidal Investigations and Results of the Canadian Arctic Expedition, 1913–18, are issued as vol. x., part C, of the report of that expedition. Dr. W. B. Dawson notes that observations were made for varying lengths of time at ten stations on the south and east of the Beaufort Sea. The low temperatures and the consequent hardening of the oil in the clockwork of the registering tide-gauges presented a difficulty, which, however, was largely overcome by installing the instruments in snow-houses. The temperature of snow-houses can be kept at 40° to 50° F. by the use of lamps without the walls thawing. The range of the tide on the open shores was usually less than 1 ft., and seldom as much as 1½ ft. At the head of Amundsen Gulf it occasionally exceeded 2 ft. This small range is too slight to have any direct effect on navigation, but sufficient to move grounded ice. From the few data available it appears that the tide enters the Beaufort Sea from the north and moves southward and westward. Dr. Dawson recommends the establishment of some permanent tidal station for reference, and suggests the suitability of Herschel Island, which is one of the few localities in the region with a settled white population.

THE relation of surface visibility of the atmosphere to suspended impurity is dealt with in the *Meteorological Magazine* for December by Dr. J. S. Owens. In commenting on the difficulty of dealing with the whole subject of visibility experimentally, and especially with reference to the visibility of lights, allusion is made to the scattering of light by the small suspended particles in the air. Allusion is also made to the important part that the perception of colour plays in visibility, and it is stated that the sensitiveness of the eye for blue-greens is greater than for reds when the light is fading. Mr. N. K. Johnson contributes a communication on the visibility of pilot-balloons. He gives the results of an attempt made at Shoeburyness to determine which colour is most suitable for pilot-balloons, and especially for long-distance work. When the sun is shining on a balloon its visibility depends on its reflective power; without the sunshine you have to depend on the opacity of the balloon. The results are summarised as follows:—(1) Against a background of continuous dense white cloud either red or blue should be used. (2) If the sky contains slight cirrus or haze red is the correct colour to employ. (3) On occasions on which the sky is cloudless and of a deep blue colour a white balloon should be selected. The magazine shows that the total rainfall in November varied greatly in different parts of the British Isles. The general amounts were:—For England and Wales, 49 per cent. of the average; Scotland, 106 per cent.; and Ireland, 110 per cent.

WE have received from the firm of Messrs. Adam Hilger, Ltd., pamphlets describing their most recent spectrographs. Instruments with quartz prisms and lenses can be supplied ready for photographs to be taken to give the whole spectrum from 210 $\mu\mu$ to 800 $\mu\mu$. In some cases an accurate scale of wave-lengths is mounted internally so that a contact print of the scale can be obtained on the same plate as the photograph of the spectrum. Concave-grating spectrographs with the mounting designed by Mr. A. Eagle are recommended, as this form is found to possess many advantages in comparison with the classical Rowland mounting. The apparatus occupies very little space and possesses great rigidity. For the investigation of the Schumann and Lyman regions of the spectrum, which may yield most important theoretical results, the same type of mounting is used in a vacuum spectrograph. By the use of two slits the whole spectrum from 210 $\mu\mu$ to 50 $\mu\mu$ may be obtained with one setting of the grating. This is the instrument which has been employed by Prof. McLennan and his fellow-workers. Messrs. Hilger also construct an X-ray spectrometer as designed for Sir W. H. Bragg on the principle of Dershem.

THE problem of the high-frequency resistance and inductance of parallel wires is one that has been studied very carefully by many physicists, including Maxwell, Kelvin, Rayleigh, and Heaviside. The problem, however, which they considered was the symmetrical case of a cylindrical conductor when the return current was so far away that its magnetic effects on the distribution of the current in the cylinder could be neglected. A notable advance in the theory has recently been made by Mr. Harvey L. Curtis in a paper published by the Bureau of Standards, Washington (No. 374). Mr. Curtis has developed a new mathematical method by means of which he easily obtains the ordinary solutions applicable to a concentric main, and, in addition, obtains solutions for two parallel cylindrical mains at given distances apart. His solutions have been verified experimentally by the Bureau of Standards. It was found, for instance, that when an alternating current of 3000 frequency was sent through a circuit consisting of two parallel wires 0·651 cm. in diameter and 0·039 cm. apart the ratio of the alternating-current resistance to the direct-current resistance was 2·4. If the ordinary formulæ had been applied the ratio would have only been about 1·5. Similarly, it is shown both by theory and by the experimental results obtained that the irregular distribution of the current over the cross-section of the wire due to the proximity of the high-frequency return current very appreciably diminishes the co-efficient of self-induction of the circuit.

THE "Index Medicus: A Classified Record of the Current Medical Literature of the World" (Washington: Carnegie Institution of Washington), which has hitherto been a monthly publication, will in future be

issued at quarterly intervals. It will give the full titles of books, pamphlets, theses, original articles in journals, and transactions of medical and scientific societies. In the case of contributions printed in the lesser-known languages, their titles will be rendered into English. Each number will contain a general table of contents, and as soon as possible after the completion of each volume an "Annual Index of Authors" will be issued. Subscriptions to the work should be sent direct to the Carnegie Institution of Washington, Washington, D.C., U.S.A.

A USEFUL catalogue (No. 86) of second-hand books and journals relating to zoological subjects has just been received from Messrs. Dulau and Co., Ltd., 34 Margaret Street, W.1. It contains upwards of 1100 titles. Among the works listed we notice a first edition of "The Origin of Species," "The British Museum Catalogue of Birds" (27 vols.), Dresser's "A History of the Birds of Europe," and Reeve and Sowerby's "Conchologia Iconica"; also complete sets of the *Zoologist* and the *Entomologists' Record and Journal of Variation*. Copies of the catalogue can be obtained from the publishers.

THE latest catalogue (No. 361) of secondhand books and periodicals issued by Messrs. Bernard Quaritch, Ltd., 11 Grafton Street, W.1, is mainly of a general character, but lengthy sections devoted to botany, natural history, and Oriental literature make it worthy of the attention of readers of a scientific journal such as NATURE. As is usual with catalogues circulated by Messrs. Quaritch, many rare volumes are offered for sale.

Our Astronomical Column.

SKJELLERUP'S COMET.—It appears that this comet was first detected by Mr. C. J. Taylor at the Cape on December 8, Mr. Skjellerup finding it independently on December 11. It should, therefore, be called "Taylor-Skjellerup." Mr. R. L. Waterfield observed the comet at Hereford with a 4-in. refractor. His positions are not micrometrical, but eye-estimations from adjacent B.D. stars.:

	G.M.T.	R.A. 1920·0	N. Decl. 1920·0
	d. h. m.	h. m. s.	° ′
Dec.	31 12 0	10 16 38	16 22
Jan.	4 13 40	10 30 41	21 26

These agree within some 5′ with Mr. Wood's ephemeris, which is continued below (for Greenwich midnight):

		R.A.	N. Decl.	Log r	Log Δ
		h. m. s.	° ′		
Jan.	16	11 0 41	33 24	0·1093	9·5783
	20	11 7 17	36 22	0·1192	9·6095
	24	11 12 3	38 51	0·1293	9·6406
	28	11 15 11	40 56	0·1398	9·6715
Feb.	1	11 16 48	42 40	0·1506	9·7024
	5	11 17 28	44 3	0·1615	9·7328
	9	11 16 54	45 9	0·1726	9·7626
	13	11 15 52	45 55	0·1837	9·7920
	17	11 14 16	46 28	0·1948	9·8210
	21	11 11 10	46 53	0·2055	9·8486

HISTORY OF THE CHRONOMETER.—Lt.-Comdr. R. T. Gould read a paper on this subject at the meeting of the Royal Geographical Society on December 13 which presents very vividly the tremendous revolution in navigation which this invention implied. He recalls Anson's disastrous voyage in 1741, when a mistake in the longitude caused such delay in making port that half the crew died of scurvy. After describing earlier abortive attempts, he proceeds to the famous prize of 20,000*l.* offered by the British Government in 1713, and won fifty years later by John Harrison, though he had undeniably earned the reward long before—a delay which reflected great discredit on the Government. The paper dwells on the inventive genius and constructive skill which Harrison continued to display; indeed, the performance of his various machines would be creditable at the present day. It is pointed out that his invention of the maintaining spring has never been superseded, and that the "remontoir" device for equalising the force on the escape-wheel, though no longer required on chronometers, has been introduced into the Riefler clock. Several anecdotes are given of Harrison's voyages, in which he frequently corrected the reckoning of the captain and officers; on one occasion he saved the ship from missing the Island of Madeira, to the great relief of the crew, who were short of beer.

Capt. Cook used a duplicate of Harrison's watch made by Kendall, and noted that "our longitudes can never be erroneous while we have so good a guide." The paper goes on to describe the work of Mudge, Le Roy, Berthoud, Arnold, and Earnshaw, and concludes by referring to the recent introduction of wireless telegraphy for time-distribution and direction-finding. The latter have effected a revolution in navigation almost as far-reaching as the invention of the chronometer.

THE PLANETESIMAL HYPOTHESIS.—This hypothesis, enunciated by Profs. Moulton and Chamberlin, has been favourably received by a number of writers, including Dr. Jeans in his recent work on cosmogony. The *Scientific Monthly* for last May contains an interesting *critique* on the theory by Prof. Reginald A. Daly, of Harvard University. Prof. Daly suggests some amendments to Chamberlin's views on the later stages in the earth's development. Chamberlin concluded that the earth's temperature was never very high, that its mass has slowly increased through the impact of planetesimal dust, and that oceans existed when it had only one-third of its present mass. Prof. Daly argues (1) that the matter composing the different planets is likely to be the same in the main, and (2) that the low density of the giant planets, combined with the phenomena observed on their surfaces, gives conclusive evidence of high temperature. He thinks that the earth was molten, if not gaseous, during its early history. An argument is also drawn from the moon; ascribing the numerous pits either to the fall of planetesimals or to volcanic action, there could scarcely fail to be considerable traces of similar formations on the earth unless the surface had been more or less molten. The remaining arguments are geological rather than astronomical, but one may be mentioned. The amount of salt in the ocean has led to an estimate of about 100,000,000 years for the period during which rivers have been flowing into it. This time-estimate would be much too small if we accepted Chamberlin's view of the early stage in the earth's history at which the oceans appeared.

The Physical and Optical Societies' Exhibition.

THE Physical and Optical Societies held their eleventh annual exhibition of scientific apparatus at South Kensington on January 5–6. There was a record attendance. The demonstrations and discourses were unusually attractive, a considerable number of visitors failing in their attempts to attend the discourses because of the overcrowded condition of the large lecture theatre. Sir W. H. Bragg gave an interesting lecture on "Sounds in Nature," and Mr. C. R. Darling showed by means of beautiful experiments some little-known surface-tension phenomena. On behalf of Prof. Archibald Barr, Dr. Morrison gave two addresses on the optophone, the instrument exhibited being the result of much patient research and development work by Messrs. Barr and Stroud. In the optophone a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of letters as these are passed over in traversing a line of printed type, each letter being indicated in a suitably connected telephone by a characteristic succession of single notes and chords. Printed letters are thus translated by the optophone into a sound alphabet which can be readily learned. Miss Mary Jameson, a blind girl, who attended the exhibition, read ordinary type at about ten words per minute, but when undisturbed her normal rate is about twenty-five words per minute. Many blind people were present.

Thermionic tubes and associated appliances were much in evidence. Prof. C. L. Fortescue and Dr. Bryan gave a very instructive demonstration of well-known circuit arrangements having all the parts exposed to view. The "heterodyne" or "beat" method of reception was demonstrated, and surprised many visitors because of the clearness of the beat tone. Another demonstration involving the use of valves was given by Messrs. Creed and Co. The apparatus which was shown received and recorded wireless messages at a working speed of 200 words per minute. The record is a punched slip of paper which by means of a printer is transcribed into Roman characters. The research laboratories of the General Electric Co. exhibited a number of valves with a new type of filament. This filament runs at a much lower temperature than the ordinary tungsten filament in the valves in general use at present. The increased strength resulting from lower temperature permits the use of finer filaments, the watts for heating these being only one-twentieth to one-fortieth of usual values. Thus it is possible to work a six-valve amplifier with a current consumption of half an ampere. Characteristic curves for these valves are very similar to those for existing types in use for wireless telegraphy.

In the optics section, Mr. Aldis exhibited a comparatively cheap but very perfect projector specially suited for projecting pond-life on the screen. With live specimens and a magnification of 300, the alimentary canal and internal organs of many specimens were shown with great clearness. There should be a good future for this projector for educational purposes. Messrs. Adam Hilger demonstrated a little-known application of the Fabry-Perot interferometer. A beam of white light is caused to traverse successively two plates of air, each with silvered faces, a system of fringes being obtained whenever the differences of path occasioned by each of the plates bear to each other a simple relation. If, then, a Fabry-Perot étalon is placed in series with a Fabry-Perot interferometer (the air plate in the étalon having a constant thickness and in the interferometer a variable thickness) a system of white-light bands is produced every time the distance between the silvered surfaces of the interferometer mirrors is either a multiple or sub-multiple of the distance between the plates of the étalon. Messrs. Hilger also demonstrated the Zeeman effect with a wave-length spectrometer and a Lummer-Gehrcke parallel plate. Messrs. R. W. Paul and F. Twyman demonstrated by the use of a Hilger-type interferometer the distribution of temperature around a hot body. The convection currents produced in air by electrically heated wires were beautifully shown.

Cathode-ray workers were interested in a 12,000-volt direct-current generator set shown in operation by Messrs. Evershed and Vignoles. A cathode-ray tube was placed in circuit and some of the possibilities of the method of investigating rapid changes of current were demonstrated.

The general display of all exhibits was particularly good, and great credit is due to the forty-eight instrument-making firms who exhibited for the excellence of their manufactures and for the care taken in arranging and explaining the purposes of their instruments. The finish of electrical instruments was of a very high order—much higher than last year, when many mass-production instruments were shown. In many cases it was gratifying to find that elegance of production was accompanied by a surprising robustness. As an example a simple galvanometer which appeared to be very good for schools was shown by Messrs. Gambrell Bros.; this has a self-locking device when it is not supported on a table, and, in consequence, it withstands extraordinary shocks in transit. The Cambridge and Paul Instrument Co. showed for the first time a modification of the Einthoven string galvanometer having six strings, the deflections of which are recorded on a moving band of photographic paper. This type of galvanometer was first used in sound-ranging in France, and was of great service during the war. An excellent amplifier for cable work (but it should have many other applications) was exhibited by Mr. H. W. Sullivan; the amplifier is a selenium-cell relay which is acted upon by a light beam from a galvanometer; a magnification of 10,000 was obtained. As usual, the Weston Instrument Co. had an excellent display of meters and parts of meters which only required inspection for one to understand why a Weston instrument is always trustworthy.

The optical section of the exhibition attracted increased attention because of the position of the optical trade as a key industry. The exhibits were certainly of a high class, and it is hoped that the efforts of the optical industry to establish itself firmly and to make its products inferior to none will receive support from the large number of visitors who admired the exhibits.

The Headmasters' Association.

THERE was a large muster at the annual meeting of the Association of Headmasters held in the Guildhall of the City of London on January 5. In his presidential address Mr. J. Talbot, headmaster of the Royal Grammar School, Newcastle-upon-Tyne, handled the new psychology in a sensible way. No one can question the results of psycho-analysis when applied to cases of neurosis. Many a soldier owes his recovery from shell-shock to the skill of men like Dr. Rivers, Prof. Elliot Smith, and Prof. Pear. But when a smatterer who has merely "read a book," or perhaps only listened to a lecture, begins to fumble

round with the souls of healthy boys and girls it is a different matter, and teachers have no more right to experiment upon them in psychical matters than to make them the vile body for testing the properties of a patent nostrum. It may be true, as Dr. Crichton Miller has pointed out, that in nineteen out of twenty cases examined by the expert analysts the results point to faulty upbringing, either at home or at school, but it must be borne in mind that these twenty cases are not normal or typical in any way. When Dr. Mary Bell says there is no sin in a child helping itself to the contents of the mother's purse in order to buy presents for a teacher, this is simply playing fast and loose with the distinctions between right and wrong. Most homes and most schools will be well advised to stick to the Ten Commandments. If a child gets into serious trouble or is not healthily happy, there is a clear case for psychotherapy. Every schoolmaster of experience knows how helpful it may be in suggesting a hopeful method of treatment, for there were cases of shell-shock among children in the raid areas as well as among soldiers at the Front; and so long as boys are boys there will be cases of practical jokes, such as those which drove the poet Gray out of Peterhouse at Cambridge, and there will be cases of bullying, though these are now, happily, very rare. But for the normal treatment of normal school-life, the best training of the unconscious life, as Mr. Talbot said, is through the school games, school camps, scouting, and everything which enables a child's psychical faculties to function freely in relationship both to his teachers and to his fellows. Inasmuch as every child does not find itself in cricket, football, and hockey, it is well to widen the field of opportunity and to offer as large a variety as possible, so that no child in any school may live such a cowed life as Cowper lived at Westminster.

Prof. Percy Nunn's address on testing intelligence was as full of humour as of practical help and suggestion. Clearly the secondary school needs a certain *quantum suff.* of knowledge as well as of intelligence, and therefore written examination cannot be superseded in the selection of free-place holders. Both these forms of test bring out the child that has the power of rapid mental mobilisation, and the ablest child of all may very likely fail to shine. "Sentimental Tommy" failed to win his place on the list because he spent half the time available in thinking out the exact word which he wanted to fit his thought. Clearly the consummate artist in words is not a successful examinee. There is, in addition, the child who thinks below the surface of things, whom psychologists call the "introvert." He will take the question proposed and look at it in its bearings in relation to other deep thoughts which occupy his mind, and, as likely as not, he will want to reformulate the question altogether before he sets himself to answer it. As Prof. Nunn admitted, our present methods pass over this child; a Newton or a Coleridge would in all probability fail to win a scholarship. This is one point which calls for further work for the psychologists. Profs. Terman and Thorndyke have not yet faced this question, and the American Army had probably no use for a Coleridge or other poetic soul. This is only one of many questions which call for further research. It is important to be able to measure the vital force of the competitor, for a fund of vitality is quite as important for effectiveness in study, and, indeed, in life in general, as intelligence. It would be interesting to know how much deep breathing and cardiac strength have to do with that tenacity of purpose which so often wins through to high achievement, when mere brilliance of intellect fails because it is not backed by strength of perseverance.

The Mathematical Association.

AT a crowded annual meeting on January 4, Prof. A. S. Eddington gave an account of relativity. Those who wish to inform themselves on this subject will naturally go to Prof. Eddington's attractive book, "Space, Time, and Gravitation." No experiments to determine the motion or whereabouts of the æther had ever led to any but a negative result, as if one solving an equation should end up with the disappointing result o=o The view had therefore been put forward that there were certain compensating influences concealing the motion of the æther from detection. But Einstein had dared to take up the attitude of Betsey Prig in the matter of Mrs. Harris, "I don't believe there's no sich a person!" The party of Mrs. Harris, however, protested against being called upon actually to produce her.

Two points of pedagogic importance were made. First, there is geometry. In Prof. Eddington's opinion geometry is not the science of space relations in an empty world, but the science of space relations of material objects; its fundamental assumptions are to be ascertained by measurements made on such objects. From this it would follow that the philosophical way to begin the study of geometry is by playing with mathematical instruments and bits of cardboard. This is what teachers have been discovering, beginning at the other side of the problem—beginning, that is, with the boy into whom they have to insert learning. Prof. Eddington reaches the same conclusion by considering the nature of the learning that is to be inserted into the boy. So the two sets of workmen meet in the middle of the tunnel and the line is clear for traffic.

Secondly, there is dynamics. Consider the case of a pendulum. On one side of the equations we have been accustomed to write the forces, including gravity. On the other we write inertia and acceleration, including the acceleration towards the centre. But the last term could algebraically be written on the force side, with sign reversed; it would be identified with what has been known popularly as centrifugal force. Teachers have generally been rather prudish about this term, but Prof. Eddington assures us that centrifugal force and weight are equally real or unreal; it would appear, then, that they should be on the same side of the equation. (But which side?) Similarly, the passenger walking along the aisle of an accelerating tube-carriage is justified in considering himself in equilibrium under a pressure from the floor and a gravitational force equally inclined to the vertical; and gravity is, in practice, not disentangled from the centrifugal force of the earth's rotation.

Dr. Brodetsky followed with a paper proposing to inject fresh blood into dynamics by using the aeroplane. He explained that the problem could be so simplified that, after a year's study of dynamics, the student could work problems on the motion of aeroplanes, including climbing, *vol plané*, and banking. We shall look forward to seeing these suggestions worked out in detail in a forthcoming issue of the *Mathematical Gazette*.

The Rev. S. H. Clarke, of Tonbridge School, pleaded for a more intelligent handling of the older non-mathematical boys, especially those of proved ability in classics. They should not be allowed to drop mathematics, nor should their time be spent in trying to attain an unattainable degree of dexterity in the bits of mathematics that they have already learned to dislike. On the contrary, they should be introduced in a superficial and literary manner to new mathematical regions; here they will find fresh inspiration, and eventually form a public able to view mathematical achievements with sympathy and appreciation. Mr. Durrell recorded that such a scheme has been in operation at Winchester for two years; that it is compatible with success in the school certificate examination; and that examination results on the wider field are bound to be bad. But this does not matter in the least.

Prof. Whittaker, the retiring president, indicated the danger that mathematicians might break up into two non-communicating groups: researchers who do not teach much, and teachers (mainly schoolmasters) who do not research. This was by no means necessary, as the Edinburgh Mathematical Society does useful research work and is composed almost entirely of schoolmasters. There were many problems which might be attacked with fruitful results by schoolmasters whose knowledge does not go beyond an honours course. He described three fields in which oil might be struck near the surface with a very moderate drilling equipment:—(1) A method allied to nomography, at present almost unexplored; (2) the theory of skew determinants and Pfaffians; and (3) the solution of partial differential equations by means of integral equations.

Canon J. M. Wilson, the new president, gave an account of the efforts of mathematical reformers before the foundation of the Association for the Improvement of Geometrical Teaching, now the Mathematical Association (the fiftieth anniversary of this event occurs this year.) He was asked by Dr. Temple, then Headmaster of Rugby, to produce a reformed geometry text-book; this he did after consulting the leading Continental works on the subject. In appreciation of his work he received an address in Edinburgh signed by Members of Parliament, professors, and other leading men. Those on whose shoulders Canon Wilson's mantle has fallen have done little more than to rediscover or develop the ideas put forward by himself and other pioneers more than fifty years ago. Canon Wilson will be pleased to learn that his ideas have now been accepted by all the important examining bodies except London University.

Miss E. B. Read told an interesting story of a recent visit to lycées in Paris and the French provinces—girls' schools, all of them; in boys' schools she never penetrated beyond the director's office. She was impressed by the burden of home-work in these lycées, sometimes occupying the girls up to midnight. This she associated with the predominantly oral method of classwork, little time being spent in working examples in class.

C. G.

The Geographical Association.

THE annual meetings of the Geographical Association were held in the London Day Training College, Southampton Row, on January 7–8. The session opened with a discussion on historical geography, led by Messrs. Fairgrieve and Jervis. Several historians were present, and they agreed with geographers that each subject demands not only a special and intensive study of its own facts, but also a special and differing attitude of mind. Every geographer must have sufficient knowledge of historical facts and conditions to explain those links of the past which last on into the present, and are thus necessary to the proper understanding of present geographical conditions. Prof. J. L. Myres said that both history and geography were concerned in the effort to help young folk to exploit the general experience of humanity for their own benefit and that of their fellow-citizens, and that it was therefore imperative that the two sets of aspects should be presented harmoniously and instructively.

In the discussion on geography in continuation schools the main point which emerged was that geography was being given a place in the L.C.C. schools because it was felt that it gives a training in good citizenship, in a habit of wide outlook, and in interest in the district in which the pupil lives or works.

Dr. Unstead gave a remarkably able exposition of the difficulties and possibilities which face the teacher of geography in his attempts to deal with such international problems as the altered environmental and psychical conditions in eastern Europe, the racial question on the Pacific fringes, and the atmosphere in India and Egypt. While it would obviously be crude to discuss these things in a political way, even in the upper forms of secondary schools, it is yet essential that these aspects of modern human geography shall be presented, and the only safe way is to show the contrasted *ideals* rather than the detailed claims of each nationality.

Dr. Haddon, whose valuable expedition to the Torres Strait was one of the outstanding scientific events of the last generation, delivered an illustrated lecture on racial and cultural distributions in New Guinea, furnishing thereby a first-rate example of the methods of distributional study.

Prof. Gilbert Murray gave his presidential address on the evening of January 8. He emphasised the fact that in every epoch of history there has been a division of humanity into the select few who understand the world and the barbaric multitude who are without the precinct—the Hellenes and the Barbarians, in medieval times the world of Christianity, and without the pale the Jews and infidels. The essential mark of the man "without the precinct" is that the motives which underlie his actions are misunderstood, or even not considered at all. Geography should help to remove that spirit of ignorance and misunderstanding from the world. For geographers the present world-situation is of special interest, for not only have the Great Powers been compelled to try to get this spirit of mutual geographic understanding, but also the whole *orbis terrarum* is meeting. China and Peru are members of that League the business of which is the common good of humanity, the securing not merely of *peace*, but also of goodwill between every nation of the world, whatever its status.

The lectures given by Dr. Haddon and Prof. Gilbert Murray will be published in the spring number of the *Geographical Teacher*, which is sent post free to all members of the Geographical Association. The annual subscription is 5*s*., and the address of the central offices is 1 Marine Terrace, Aberystwyth.

The Origin of Hypergamy.

AT a meeting of the Royal Anthropological Institute held on November 9, Mr. S. H. Ray, vice-president, in the chair, Dr. W. H. R. Rivers read a paper on "The Origin of Hypergamy."

Dr. Rivers said that the term "hypergamy" had been used loosely by both Sir Herbert Risley and Dr. W. Crooke to denote marriage between groups which differ in rank, but for the sake of clearness the term should be confined to those instances in which there was a characteristic difference between the marriage rules for the two sexes. Hypergamy thus understood was that form of marriage in which men mate with women of lower rank than their own, but do not give their women in return, the union of these being confined to men of their own or higher grades. Owing to the fact that women of the highest group can only marry men of their own rank, women of high rank either remain unmarried or the inequality is redressed by the practice of polygyny or by female infanticide. On the other hand, since men of the lowest grade may only marry women of their own rank, while such women are taken by men of a higher group, there is a shortage of women of the lowest grade, and the men must remain unmarried or have recourse to polyandry, or they may seek their wives elsewhere. If the neighbouring communities are hypergamous or endogamous, the only unions open to them will be with any aboriginal women who may live in the neighbourhood. The practice of hypergamy is not only peculiar to India, but is there almost entirely confined to the Rajputs, or castes, such as the Kulin Brahmans, which have come under Rajput influence. Where the custom occurs among the castes of Bengal, it would seem to have been derived from the Kulins. It appears probable that the Kulin custom can be traced to Rajput influence, as the Kulins are derived from Brahmans who about A.D. 700 came to Bengal from Kanauj, at one time the centre of Rajput rule. Hypergamy also occurs among the Nayars of Malabar, but in this case its relation to the practice in other parts of India is not so clear. One form arises out of their relation with the Nambutiri Brahmans, among whom the rule is that only the eldest son may marry; the other sons contract unions with Nayar women. A Nambutiri woman would not be allowed to marry a man, Nayar or other, of a lower caste. The status of the children is determined by the Nayar rule of matrilineal descent. There is no evidence to connect the practice among the Nayars and other cases occurring sporadically in the Madras Presidency with Rajput influence, and it is possible that with them it may have a more ancient history and go back to a remote derivation from the warrior caste.

The institution of hypergamy appears to be a special form of interaction between immigrants into India and the indigenous population, and to be an intermediate stage between the complete fusion which has taken place in such cases in other parts of the world and the segregation which has produced the more characteristic forms of the caste system of India. The development of hypergamy may be referred to three special conditions: (1) The especial strength of a sentiment of the immigrants concerning the union of their women with indigenous men; (2) a short distance of migration, so that the immigrants were accompanied by a relatively large number of women; and (3) the military character of the invaders, which allowed them to obtain indigenous women without giving their own women in return.

An interesting discussion followed the reading of the paper, in which emphasis was laid upon the importance of the principles formulated by Dr. Rivers in their bearing upon questions of racial admixture and fusion of language as a result of peaceful penetration or invasion in other parts of the world. Prof. Parsons pointed out that the Saxons had brought a large number of women with them to this country, as was shown by the skeletal remains, whereas the Norsemen who invaded France constituted a male invasion solely, and this probably explained the almost complete substitution of French among them for their own language, the language of the native mothers having prevailed. Mr. Ray pointed out that while the words denoting close family connection in this country were predominantly Saxon, the language of the children contained Celtic elements, as, for example, the word "dad." Prof. C. G. Seligman said that he had found a practice similar to hypergamy among nomad Arab tribes of the Sudan, in which black slaves, the offspring of Arab men and indigenous women, although permitted to hold very high office in the tribe, were not allowed to marry Arab women. Col. Hodgson pointed out that the restriction of marriage to the eldest son also existed among the Kyasths, the reason in this case being that that son was the only true reincarnation of the father, his younger brothers being the "children of sin."

Studies in British Forestry.[1]

THE Forestry Commission has made a good start, having acquired during the first year of its operations as many as 65,000 acres of land, of which 1500 acres have been planted with trees. During the present year 5900 acres of new plantations are planned. These figures are well ahead of the schedule of the first two years' work which was laid down in the Reconstruction Forestry Sub-Committee Report. This is satisfactory as regards the part played by the State in national afforestation, but we must not forget the work to be done by landowners in replanting the extensive areas which were felled during the war.

The Forestry Commission can assist private enterprise by money grants for planting, by partnership schemes, and by providing nursery plants at a cheap rate, but it can also stimulate owners to active measures of afforestation by the publication of trustworthy facts and figures concerning all forestry matters. We welcome, then, the three interesting bulletins which have been recently issued. Technical skill in the rearing and planting of trees is not lacking in this country, but much ignorance prevails as to the actual results obtainable by afforestation with different species of trees. Bulletins Nos. 1 and 3 are concerned mainly with this question, and their perusal will enable owners to deal intelligently with some problems of replanting and afforestation.

A survey for the collection of statistics as to the rate of growth and production of timber in the United Kingdom was carried out officially in 1917–19, and

[1] Forestry Commission. Bulletin No. 1: "Collection of Data as to the Rate of Growth of Timber." (To be obtained from the Forestry Commission on sending 4*d*. and a stamped addressed envelope.) Bulletin No. 2: "Survey of Forest Insect Conditions in the British Isles, 1919." (H.M. Stationery Office.) Price 1*s*. 6*d*. net. Bulletin No. 3: "Rate of Growth of Conifers in the British Isles." (H.M. Stationery Office.) Price 3*s*. net.

Bulletin No. 1 gives an account of the methods which were actually used by the forest officers in charge of the survey. These methods are based on the measurement of well-stocked sample plots of woods of various ages and on all classes of soils. Five working parties were employed, the actual measurements being made by women assistants under the supervision of a skilled officer who inspected the woods and selected the plots. This bulletin is clearly written, and will prove useful to private owners wishing to lay out sample plots by means of which they will be enabled to measure the volume and increment of their own woods by official and scientific methods.

The third bulletin deals with the results of the survey which was restricted to pure woods of conifers. It furnishes us for the first time with accurate yield-tables of larch, Scots pine, and spruce based on accurate measurements of these species in British plantations. Hitherto we were dependent on Continental yield-tables, which apply only very approximately to this country. Provisional tables for Douglas fir, Japanese larch, and Corsican pine are also given in the bulletin. The yield-tables are of the usual kind, giving for various qualities of soils the average height and diameter of the trees and the number of stems and volume of timber per acre, with other figures, corresponding to ages of 10, 15, 20, . . . 100 years. Any wood, provided its age is known, can be allocated to its proper quality class by the average height of the trees, as it is well established that in a fully stocked wood of any species the volume at a given age is in direct relation with the mean height.

A considerable part of Bulletin No. 3 is taken up with a discussion on the factors of climate and soil in relation to the growth of species, like Scots pine, larch, and spruce. This branch of the subject is very important, and deserves much more extended investigation than was possible in this preliminary survey.

Bulletin No. 2, prepared by Dr. J. W. Munro, the entomologist employed by the Forestry Commission, is based on a survey of the insect conditions of coniferous woods in seventeen districts of the United Kingdom in 1919. This survey was rendered necessary by the great increase in harmful insects occasioned by the heavy fellings of timber during the years of the war. Owing to the shortage of labour it was impossible to clear the ground of the branches and débris which, with the stumps of the trees, form the main breeding-grounds of these pests. Dr. Munro investigated the ravages of fifteen species of insects, and reports that coniferous woods generally are in a very unhealthy state. Young plantations on the site of, or near, a felled area suffer most. This bulletin is well illustrated, and Dr. Munro's remarks on measures of prevention should be studied carefully by all foresters engaged in the formation of new plantations.

Greenland in Europe.[1]

By DAVID MACRITCHIE.

AT the present day the name "Greenland" is limited to the great island lying to the east of Arctic America. Formerly, however, it included an undefined territory of Arctic and sub-Arctic Europe, extending eastward, according to some estimates, into north-western Siberia. Sir William Martin Conway has shown (Hakluyt Series, 1904) that during the seventeenth century, in Britain and the neighbouring countries, "Greenland" primarily denoted Spitsbergen. Even in the year 1812 the leading London publishers were selling a school-book which, ignoring the word "Spitsbergen" altogether, applied to that group of islands the sole name of "Greenland."

But so early as the time of the Norman conquest of England a German chronicler, a minor canon of the Cathedral of Bremen, widely known as "Adam of Bremen," had recorded the existence of a Greenland in Northern Europe. There is good reason for assuming that the region he had in view was the Kola Peninsula and a good deal of contiguous territory. He states that those Greenlanders were *caerulei* (blue men), and that they were cruel, "troubling seafarers by predatory attacks"—from which it may be inferred that they were themselves seafarers. In passing, it may be pointed out that at a very much earlier date the Romans had noted the existence of a caste of *caerulei* in the British Isles. In both cases the name probably arose from the custom of painting or tattooing with blue pigments.

The assumption that Adam of Bremen's "Greenland" was the Kola Peninsula and the parts adjoining receives confirmation from a statement made in 1430 by a Danish traveller and writer of the name of Claus Claussön, Latinised Claudius Clavus; for he tells us, from personal knowledge, that at that time "the infidel Karelians daily come to Greenland in great armies." The Karelians, or Karels, a Finnish people, occupied most of the south-western shores of the White Sea in the fourteenth century. In the fifteenth century they ousted the Lapps from their homes on the western shore of the White Sea, driving them north into the Kola Peninsula. The country thus taken possession of by the Karels is now known as Karelia. But the name applied to it by Claudius Clavus was "Greenland."

To make it quite clear that Clavus referred solely to a European country when he spoke of "Greenland," it is necessary to keep in view the fact that in 1430 there was no European intercourse with the Greenland on the other side of the North Atlantic. The situation is definitely explained by Dr. Nansen, who states ("Encyc. Brit.," eleventh edition, vol. xii., pp. 542 and 548) that the last ship known to have visited the Norse colony in trans-Atlantic Greenland returned to Norway in 1410, and that from that date until 1585 the overseas Greenland was unvisited by Europeans and almost forgotten. It is therefore manifest that when any trustworthy writer of the period 1410–1585 makes reference to Greenlanders as people with whom Europeans are then in contact, he has in view a North European race, and not a race living on the other side of the Atlantic.

A further statement by Clavus has a distinct bearing upon this question. He tells us that to the west of the wild Lapps "are little pygmies, whom I have seen after they were taken at sea in a little skin-boat, which is now [about 1430] hanging in the cathedral at Nidaros [*i.e.* Trondhjem]. There is likewise a long vessel of hides, which was also once taken with such pygmies in it." Again, Olaus Magnus relates how in 1505 he saw two of the leather skiffs of "the Greenland pirates" hanging in the cathedral at Oslo (Christiania). And Jacob Ziegler, in his work "Scondia" (1532), speaks of the "light boats of hide" of the Greenlanders. A complaint

[1] Synopsis of a paper read before the British Association (Anthropological Section) at Cardiff on August 27, 1920.

against "the Greenland pirates" in their "small ships without keels" is made in 1551 by Carsten Grip, Mayor of Kiel.

Visits of similar people in skin canoes are recorded in the Orkney Islands by writers of unimpeachable veracity in the seventeenth century. One of these canoes is still preserved in the anthropological museum of Marischal College, Aberdeen. Its framework and implements are made of North European wood. The estimated maximum height of its occupant is 4½ ft.

A vast field of conjecture opens up if we begin to consider the European skin boat in the first thousand years of the Christian era. Von Düben shows that it was the earliest boat used by the Lapps, and Prof. Julius Pokorny interprets the *Fir Bolg* of Gaelic lore as "skin-boat men." "The Greenlandish Attila Lay" is said to date from the eighth or ninth century.

Prize Awards of the Paris Academy of Sciences.

Mathematics.—Grand prize of the mathematical sciences to Ernest Esclangon, for his memoir entitled "New Researches on Quasi-periodic Functions"; the Poncelet prize to Elie Cartan, for the whole of his work; the Francœur prize to René Baire, for his work on the general theory of functions.

Mechanics.—A Montyon prize to Stéphane Drzewiecki, for his book on the general theory of the helix, with reference to marine and aerial propeller-blades; the de Parville prize to Jean Villey, for his work on internal-combustion motors. No memoir was received dealing with the question proposed for the Fourneyron prize, but the arrears accrued are divided between Joseph Auclair and Alfred Boyer-Guillon (1000 francs), for their theoretical and practical studies on the measurement of the acceleration of a point of a body subject to a periodic motion, and Eugène Burlot (1000 francs), for the whole of his work concerning the propagation of waves of shock in air and water.

Astronomy.—The Lalande prize to Léopold Schulhof, for his revision of the catalogue of the proper motions of 2641 stars published by J. Bossert in 1896; the Valz prize to Ernest Maubant, for the whole of his work on the calculation of the perturbations of comets; the Janssen medal to William W. Coblentz, for his work on the infra-red radiation of terrestrial sources and of stars; the Pierre Guzman prize between François Gonnessiat (5000 francs), for his work on the photography of the minor planets, René Jarry-Desloges (5000 francs), for his physical observations on the planets, especially Mars, and Joanny-Ph. Lagrula (4000 francs), for his work on the rapid identification of the minor planets. The Damoiseau prize was not awarded, and the questions proposed for 1917 and 1920 are again proposed for 1923.

Geography.—The Delalande-Guérineau prize to Georges Bruel, for the whole of his explorations and publications relating to French Equatorial Africa; the Tchihatchef prize to Auguste Chevalier, for his explorations in Africa and Indo-China; the Binoux prize to Marcel Augiéras, for his work in the western Sahara. The Gay prize is not awarded.

Navigation.—The prize of 6000 francs between Fernand Gossot (4000 francs), for his treatise on the effects of explosives, Pierre de Vanssay de Blavous (1500 francs), for the whole of his work, and René Risser (500 francs), for his work on ballistics; the Plumey prize between Charles Dovère (2000 francs), for the whole of his work, especially for the services which he rendered during the war, and Edouard Tournier (1000 francs), for his book entitled "Practical Guide for the Use of Mechanics for Calculating the Internal Losses in Machines and Determining their Yield."

Physics.—The L. La Caze prize to Georges Sagnac, for the whole of his work in physics; the Hébert prize to Léon Bouthillon, for his work and publications on wireless telegraphy; the Hughes prize to Frédéric Laporte, for his work on electrical standards and the photometry of electric lamps; the Clément Felix foundation to Amédée Guillet, for his researches on chronometry.

Chemistry.—The Montyon prize (unhealthy trades) to Léonce Barthe, for his work on the hygiene of workshops, a mention (1500 francs) to Paul Goissedet, for his work in relation to poison gas, and a mention (1000 francs) to Henri Guinot, for his chemical work during the war; the Jecker prize (5000 francs) between Henri Gault, for his work in organic chemistry, and Henri Hérissey, for his researches on the glucosides of plants; the L. La Caze prize to Robert de Forcrand, for the whole of his work in inorganic chemistry; the Cahours foundation between Raymond Cornubert, for his work in the *cyclo*-hexanone series, and Paul Robin, for his chemical studies in relation to the war and for his work on the oximes; the Houzeau prize to the late Emile Baud, for his researches on the compounds of aluminium and arsenic and his work in the national defence.

Mineralogy and Geology.—The Fontannes prize to Olivier Couffon, for his work entitled "Le Callovien du Chalet (Commune de Montreuil-Bellay)"; the Joseph Labbé prize to Albert Bordeaux, for his applications of geology to the solution of mining problems. The Victor Raulin prize is postponed until 1921.

Botany.—The Desmazières prize to André Maublanc, for his work in mycology and plant diseases, an honourable mention to Pierre Sée, for his book on the diseases of paper; the De Coincy prize to Lucien Hauman-Merck, for the whole of his botanical work. The Montagne prize is not awarded.

Anatomy and Zoology.—The Cuvier prize to Alphonse Malaquin, for the whole of his work in zoology; the Savigny prize to F. Le Cerf, for his "Revision des Ægeriidés algériens"; the Jean Thore prize to A. Cros, for his biological studies of the Coleoptera of northern Africa.

Medicine and Surgery.—Montyon prizes to Pierre Delbet and Noël Fiessinger (2500 francs), for their memoir on the biology of war wounds, Joseph Franchini (2500 francs), for his studies on the pathogenic protozoa, and François Maignon (2500 francs), for his researches on the *rôle* of fats in the utilisation of albuminoids. Honourable mentions (1500 francs) to Henri Alezais and Albert Peyron, for their researches on the histogenesis of certain groups of tumours, to Maurice Heitz-Boyer, for his researches on the physiology and surgery of bone, and to P. Lassablière, for his studies on milk and feeding of new-born infants. A citation to Joseph Rigaut and Antoine Orticoni, for their work entitled "L'évolution de la croissance chez les adénoïdiens"; the Barbier prize to Albert Berthelot, for his chemical work on intoxications of intestinal origin; the Bréant prize between Auguste Marie and Constantin Levaditi (3000 francs), for their work on general paralysis, and Henri Violle (2000 francs), for his memoir on cholera; the Godard prize to Henry Chabanier, for his study of the numerical laws of the renal secretion; the Mège prize is not awarded;

the Dusgate prize, Jules Leclercq receives an encouragement (1000 francs) and Albert Terson an encouragement (500 francs), for work on the signs of death; the Bellion prize to Maurice Courtois-Suffit and René Giroux, for their memoir on cocaine, and an honourable mention is accorded to Jean Bec and André Pérès, for their work entitled "Mémento d'hygiène à l'usage des instituteurs de l'Afrique occidentale française"; the Baron Larrey prize to J. Peyrot, for his study on social medicine in the Bavarian Palatinate, and a very honourable mention is accorded to Flavien Bonnet-Roy and to Pierre Talon.

Physiology.—A Montyon prize to Emile Terroine, for his important work on the evolution of fatty materials in the organism; the Lallemand prize to Paul Sollier, Marius Chartier, Félix Rose, and Ch. Villandre, for their book entitled "Traité clinique de neurologie de guerre," and a very honourable mention is accorded to André Guillaume; the L. La Caze prize to Maurice Arthus, for his physiological work, especially his researches on the coagulation of milk and blood and on sero-anaphylaxy; the Martin-Damourette prize to François Heymans, for his memoir on thermo-physiology; the Philipeaux prize to Charles Dhéré, for his work on hæmocyanine.

Statistics.—A Montyon prize to Eugène Fournier, for his work entitled "Gouffres, Grottes, Cours d'eau souterrains du Départemente du Doubs," and a mention (500 francs) to Fr. M. Messerli, for his contribution to the study of physiological corporal growth between the ages of nineteen and thirty-two.

History and Philosophy of the Sciences.—The Binoux prize between Edouard Doublet (1000 francs), for his various historical publications, and Jean Mascart (1000 francs), for his book on the life and work of Jean Charles de Borda.

Medals.—Berthelot medals to Léonce Barthe, Henri Gault and Henri Hérissey, and Robert de Forcrand de Coiselet.

General Prizes.—The Bordin prize to Jacques de Lapparent, for his studies on sedimentary breccia; the Serres prize equally between Octave Duboscq and Louis Léger, for the whole of their work on protistology and general embryology; Vaillant foundation, a subvention of 4000 francs to Paul Le Rolland, for his researches on the oscillation of the pendulum; the Houllevigue prize between François Gagnepain (3000 francs), for his studies on the flora of the East, and Canon Bourgeat (2000 francs), for the whole of his geological work; the Saintour prize to Paul Bertrand, for the whole of his work on palæophytology; the Lonchampt prize to Eugène Lambling, for his researches in organic and biological chemistry; the Caméré prize to Gaston Pigeaud, for his work in civil engineering; the Gustave Roux prize, for his researches on the gases issuing from thermal springs, petroleum wells, coal-mines, etc., with special reference to determination of the rare gases and radio-activity; the Thorlet prize to Adolphe Richard, for his bibliographical work.

Special Foundations.—The Lannelongue foundation divided between Mmes. Cusco and Ruck; the Laplace prize to Charles René Drouard and Paul Maurice Ferdinand Roy; the L. E. Rivot prize between Charles René Drouard. Paul Maurice Ferdinand Roy (each 750 francs), Edmond Friedel, Léon Migaux (each 500 francs), Raymond Alexandre Auguste Fleury, Jean Lapedie (750 francs), Jean Gérard Rouelle, George Jules Lucien Couprie (500 francs).

Foundations for Scientific Research.—The Trémont foundation to Charles Frémont, for his researches on tools; the Gegner foundation to Paul Hallez, for the whole of his zoological work; the Jérome Ponti foundation to Paul Nicolardot, for his analytical researches and work for the national defence.

The Bonaparte Fund.—Out of fifteen applications eight grants were approved to the following:

2000 francs to R. Anthony, for the publication of the catalogue of the collections of osteology in the comparative anatomy section of the National Museum of Natural History.

2000 francs to Philippe Eberhardt, for his researches on the flora of Indo-China.

2000 francs to Henri Martin, for his La Quina excavations (Charente). Of the material collected the human remains are to be sent to the Natural History Museum, and other objects to the Saint Germain Museum.

4000 francs to Emile Mathias, for his researches (in collaboration with M. Kamerlingh Onnes) of the curve of densities of gases the critical point of which is near the absolute zero (hydrogen, neon).

2000 francs to Jacques Pellegrin, for his researches and publications concerning the fishes of the French Colonies.

2000 francs to Charles Pérez, for his researches and publications on the crustaceans (Epicarideæ) of the Persian Gulf.

2000 francs to René Souèges, for his work on the embryogeny of the higher plants.

2000 francs to P. Wintrebert, for his researches on the automatism of the locomotor movement in the embryos of Selacians.

Charles Bouchard foundation to Charles Vaillant, for his work in radiography.

University and Educational Intelligence.

CAMBRIDGE.—Major-Gen. the Right Hon. J. B. Seely has offered to endow a University prize for the best essay on a subject connected with aeronautics.—Mr. F. A. Potts, Trinity Hall, has been appointed demonstrator of comparative anatomy.—Regulations have now been drawn up for the Sir William Dunn professorship of biochemistry, founded under the terms of the benefaction offered to the University last summer.

MR. A. R. HINKS, the Gresham lecturer on astronomy, will deliver four free public lectures on "The Motions of the 'Fixed' Stars" in Gresham College, Basinghall Street, E.C., at 6 o'clock on January 18 to 21.

THE Camborne School of Mines, Cornwall, has issued an appeal for donations towards a memorial in honour of those members of the school who fell during the war. It is proposed to purchase a playing-field and to erect a grand stand on it, on which a memorial tablet will be placed. Communications should be addressed to the Hon. Secretary, Memorial Committee, The School of Mines, Camborne.

WE have received the prospectus of the Faculty of Medicine of the University of Paris for the academic year 1920–21. It includes full particulars of the general organisation of the faculty and of the courses of instruction at the schools and clinics of the University. In addition to the regular courses various revision and advanced courses are also given, and practically all the subjects of the medical curriculum are dealt with. The pamphlet is published by Masson et Cie, 120 Boulevard Saint-Germain, Paris, VI., price 1 franc net.

IT is announced that Mr. W. Edmonds and Miss S. Edmonds have founded a prize in ophthalmology in memory of their brother, Nicholas Gifford Edmonds,

who fell at Magersfontein on December 11, 1899. The prize is 100*l.*, and it will be awarded every two years for the best essay on a subject dealing with ophthalmology and involving original work. The competition will be open to all British subjects holding a medical qualification. A committee nominated biennially by the Medical Board of the Royal London Ophthalmic Hospital will have the adjudication of the prize.

Two Theresa Seessel research fellowships, each of the yearly value of 300*l.*, are being offered in connection with Yale University for the promotion of original research in biological studies. Preference will be given to candidates who have obtained their doctorate and demonstrated by their work their fitness for carrying out successfully original research work. Applications for the fellowships, with reprints of scientific publications, letters of recommendation, and particulars as to the problems proposed by the candidates, must be sent before May 1 next to the Dean of the Graduate School, New Haven, Conn., U.S.A.

REFERENCE was made in these columns some time ago to the Imperial College War Memorial and Athletic Ground scheme. It now appears from papers issued recently that the enterprise has received a large measure of support from friends and old students of the college and its constituent parts, the City and Guilds Engineering College, the Royal College of Science, and the Royal School of Mines. Up to the middle of November a sum of more than 6300*l.* had been subscribed, and the early response to the appeal has been sufficiently satisfactory to enable the committee not only to proceed with the erection of the memorial tablets in the college buildings, but also to complete the purchase of a sports field at North Wembley, over which an option had been secured. Some of the college clubs are already utilising the ground for the purposes of football and hockey. The further sum immediately required to cover outlay on the memorial tablets, the purchase of the ground, and necessary expenses, including payment of the mortgage, is about 2500*l.*, and the committee is appealing to all friends and old students who have not yet contributed to take a hand in bringing the undertaking to a completely successful issue.

A PROGRAMME of university extension lectures for the coming term has been issued by the University of London. Courses of lectures will be delivered at about seventy local centres in different parts of London and the surrounding district. The subjects treated cover a wide range, and courses in literature, history, art, architecture, and economics are included in the list; in the direction of teaching of a non-vocational character important work is being done by the Board. When, however, we remember that the report of Sir J. J. Thomson's Committee on the position of natural science in our educational system emphasised the value of lectures which bring home to the general public the meaning of science and its importance in the life of the nation, it is astonishing to note that only two courses of the ninety-nine which are advertised—one by Prof. J. Cox on "The Bases and Frontiers of Physical Science" and the other by Mr. L. Tayler on "Human Biology and Welfare Problems"—are in any way related to natural science. Prof. Cox's course of thirteen lectures will be delivered weekly, starting on January 14, at Gresham College, Basinghall Street, E.C.2; Mr. Tayler's course, consisting of twenty-four lectures, will be given on Mondays at the Technical Institute, Adelaide Road, Leyton. Particulars of the courses can be obtained from the Registrar, University Extension Board, University of London, South Kensington, S.W.7.

Calendar of Scientific Pioneers.

January 14, 1742. Edmund Halley died.—The son of a rich London soapmaker, Halley began his astronomical work at Queen's College, Oxford, at the age of seventeen, and continued it until his death at the age of eighty-five. The friend of Newton, he succeeded Wallis as Savilian professor of geometry, Flamsteed as Astronomer-Royal, and Hans Sloane as secretary of the Royal Society. His name is associated with the study of the trade winds, the variation of the compass, Halley's comet, and many fundamental points in astronomy. To his "great zeal, able management, unwearied perseverance, scientific attainments, and disinterested generosity" was largely due the publication of Newton's "Principia." Halley is buried at Lee, near Greenwich, in the same tomb as Pond, Astronomer-Royal from 1811 to 1835.

January 14, 1874. Philipp Reis died.—While teaching at Friedrichsdorf, near Hamburg, Reis in 1861 constructed a telephone which was used with good results by Hughes in 1865, but Reis died when forty years of age, poor and almost unknown.

January 14, 1890. Gustave Adolphe Hirn died.—An engineer and physicist of Alsace, Hirn was a pioneer in the scientific testing of steam-engines.

January 14, 1905. Ernst Abbe died.—Born in 1840, Abbe, while a professor at Jena in 1866, joined Carl Zeiss and devoted himself to the theoretical investigation of optical instruments. His report on the South Kensington Loan Collection of Scientific Apparatus of 1876 led to the co-operation of the glass-maker, Otto Schott, and "Jena" glass became famous the world over.

January 14, 1906. Hermann Johann Philipp Sprengel died.—Trained as a chemist in Germany, Sprengel settled in England. He made notable advances in explosives, and by his invention of the mercurial air-pump rendered possible the Swan and Edison glow-lamps, Crookes's radiometer, and the Röntgen X-ray tube.

January 16, 1806. Nicolas Leblanc died.—The discovery of how to make soda from salt was, by J. B. Dumas, compared in importance with the improvement of the steam-engine by Watt. Leblanc made the discovery in 1787, and his patron, the Duke of Orleans, erected a factory for him. In 1793 the duke was guillotined, the factory confiscated, and Leblanc's patent cancelled. After years of poverty Leblanc's mind gave way and he shot himself. A statue of him now stands in the Conservatoire des Arts et Métiers.

January 17, 1910. Friedrich Kohlrausch died.—The successor in 1895 of Helmholtz at the Physikalisch Technische Reichsanstalt, Kohlrausch was an authority in the field of accurate physical measurement.

January 18, 1878. Antoine César Becquerel died.—Becquerel served in the French Army until the peace of 1815, and then gave himself up to scientific pursuits. A voluminous writer, he was a founder of electro-chemistry, for his work on which he received in 1837 the Copley medal of the Royal Society. His statue stands at his birthplace, Châtillon-sur-Loing.

January 19, 1878. Henri Victor Regnault died.—Distinguished alike as a chemist and physicist, Regnault's great researches on the expansion of gases were made at the Sèvres porcelain factory, of which he was director, but much of his later work was destroyed during the Franco-German War. E. C. S.

ERRATUM.—In last week's Calendar the year of Galileo's birth should have been 1564, and not 1571, which was the year Kepler was born.

Societies and Academies.

SYDNEY.

Linnean Society of New South Wales, October 27.—Mr. J. J. Fletcher, president, in the chair.—E. W. **Ferguson** and G. F. **Hill**: Notes on Australian Tabanidæ. The paper deals mainly with synonymy, the results being given of comparison of specimens with the types of Australian Tabanidæ in the British Museum and in the Australian Institute of Tropical Medicine. Seventeen species belonging to five genera are dealt with, one species being described as new.—Dr. A. J. **Turner**: Studies in Australian Lepidoptera: Liparidæ. In Australia the family Liparidæ is represented by sixty species belonging to eighteen genera, of which two genera and ten species are described as new in this paper.—G. A. **Waterhouse**: Descriptions of new forms of butterflies from the South Pacific. One species from Fiji and six subspecies from Fiji (three), Lord Howe Island (two), and the New Hebrides (one) are described as new.—Eleanor E. **Chase**: A new avian trematode. A species of Holostomum is described as new. The specimens described were obtained from a white-fronted heron, *Notophoyx novae-hollandiae*, at Terrigal, N.S.W.—Dr. J. M. **Petrie**: Cyanogenesis in plants. Part iv.: The hydrocyanic acid of Heterodendron, a fodder-plant of New South Wales. The foliage of *Heterodendron oleaefolia* was much used for cattle-feeding during the drought. Chemical examination of the leaves shows them to contain a cyanogenetic glucoside yielding, when hydrolysed, 0·328 per cent. of hydrocyanic acid. The plant is therefore one of the most poisonous cyanogenetic plants known, yielding more than twice as much hydrocyanic acid as bitter almonds. One ounce of the air-dried leaves forms a lethal amount for one sheep. The leaves are invariably found to be deficient in enzyme, and require the addition of emulsin in the estimation to bring about the complete decomposition of the glucoside.—Vera **Irwin-Smith**: Studies in life-histories of Australian Diptera Brachycera. Part i.: Stratiomyiidæ. No. 1: *Metoponia rubriceps*, Macquart. Very little work has been done in any part of the world on the early stages of the Brachycera; many soil-inhabiting, dipterous larvæ, mostly belonging to the Brachycera, have been collected and reared through to the imago or to the pupal stage. The present paper is the first of a series dealing with this work, and gives a detailed account of the life-history of *Metoponia rubriceps*, Macquart. It is also accompanied by a historical review of published accounts of early stages of the Stratiomyiidæ, a list of the species the earlier stages of which have been observed, and a comprehensive bibliography.

HOBART.

Royal Society of Tasmania, October 11.—Dr. A. H. Clarke in the chair.—L. **Rodway**: Additions to the fungus flora of Tasmania. Several new and interesting species of fungi were described. In his introduction the lecturer pointed out that in any community such as Tasmania, where the future largely depends upon agriculture, the study of botany was essential. It was to be regretted that up to the present this study had been absolutely neglected even at the University. Independent of the injury done by some parasitic fungi to our crops and forests, fungi were of the utmost importance to the well-being of the earth. Their principal work consists of decomposing dead vegetable matter and bringing the soil into a fit state to afford food for plant-life.

Books Received.

Survey of India. Professional Paper, No. 15. The Pendulum Operations in India and Burma, 1908 to 1913. By Capt. H. J. Couchman. Pp. 6+vi+190. (Dehra Dun: Trigonometrical Survey.) 2.8 rupees.

Medical Research Council and Department of Scientific and Industrial Research. Reports of the Industrial Fatigue Research Board. No. 5. Fatigue and Efficiency in the Iron and Steel Industry. (Metal Trades Series, No. 4.) Pp. 99+8 plates. (London: H.M. Stationery Office.) 3*s*. net.

Cocoa. By Edith A. Browne. (Peeps at Industries.) Pp. viii+88. (London: A. and C. Black, Ltd.) 2*s*. 6*d*. net.

Kepler. By W. W. Bryant. (Pioneers of Progress: Men of Science.) Pp. 62. (London: S.P.C.K.; New York: The Macmillan Co.) 2*s*.

John Dalton. By L. J. Neville-Polley. (Pioneers of Progress: Men of Science.) Pp. 63. (London: S.P.C.K.; New York: The Macmillan Co.) 2*s*.

Union of South Africa. Department of Mines and Industries. Geological Survey. The Geology of the Northern Portions of the Districts of Marico and Rustenburg. By H. Kynaston and Dr. W. A. Humphrey. Pp. 38. 2*s*. 6*d*. The Geology of Pondoland and Portions of Alfred and Lower Umzimkulu Counties, Natal. By Dr. A. L. du Toit. Pp. 45. 2*s*. 6*d*. Memoir No. 11. The Limestone Resources of the Union. Vol. ii.: The Limestones of Natal, Cape, and Orange Free State Provinces. By W. Wybergh. Pp. 149. 5*s*. Memoir No. 15. Corundum in the Northern and Eastern Transvaal. By A. L. Hall. Pp. 223+xxiii plates. 7*s*. 6*d*. (Pretoria: Geological Survey.)

South African Mammals. A Short Manual for the Use of Field Naturalists, Sportsmen, and Travellers. By A. Haagner. Pp. xx+248. (London: H. F. and G. Witherby; Cape Town: T. Maskew Miller.) 20*s*. net.

Diary of Societies.

THURSDAY, JANUARY 13.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—A. S. Eddington: Dr. Sheppard's Method of Reduction of Error by Linear Compounding.—W. F. Sheppard: Conjugate Sets of Quantities.—E. A. Milne: A Problem concerning the Maxima of Certain Types of Sums and Integrals.—H. J. Priestley: The Linear Differential Equation of the Second Order.—M. Kössler: The Zeros of Analytic Functions.—A. C. Dixon: The Theory of a Thin Elastic Plate, bounded by Two Circular Arcs, and Clamped.—G. A. Miller: Determination of all the Characteristic Sub-groups of an Abelian Group.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Sir William Bragg: Electrons (Kelvin Lecture).

CONCRETE INSTITUTE, at 7.30.—H. K. Dyson: Tests on High Tensile Steels.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 2 Furnival Street), at 7.30.—H. G. Clarke: The Evaluation of White Pigments: with Special Reference to White Antimony Oxide.

OPTICAL SOCIETY (at Imperial College of Science), at 7.45.—Prof. W. Salomonson: A New Ophthalmoscope.—H. Dennis Taylor: An Anastigmatic Flat Field Telescope and its Application to Prismatic Binoculars.—Inst.-Comdr. T. Y. Baker: A Note on Multiple Reflection.

HARVEIAN SOCIETY OF LONDON (at Medical Society of London) (Annual Meeting), at 8.30.—Dr. W. Hill: The Great Advances in the Investigation and Treatment of Diseases of the Œsophagus during the Present Century.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—Informal Meeting for Free Discussion.

FRIDAY, JANUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—E. E. Barnard: Hind's New Star of 1848 (Nova Ophiuchi No. 2).—W. J. Luyten: Note on the Cluster N.G.C. 6633.—Rev. J. G. Hagen: The Astrophysical Problem of Variable Stars.—C. Easton: The Distance of the Galactic Star-clouds.—J. Hargreaves: Note on the Photography of Meteors.—W. M. Smart and H. E. Green: Photographic Magnitudes and Effective Wave-lengths of Nova Cygni (1920), from Photographs Taken at the Cambridge Observatory.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.
JUNIOR INSTITUTION OF ENGINEERS (at Caxton Hall), at 8.—B. E. D. Kilburn: The Tides: Their Cause, Effect, and Use (Chairman's Address).
ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—Dr. R. Pickard: Variations in the Size of the Physiological Cup, and their Relation to Glaucoma.—B. T. Lang: Scotometry.

MONDAY, JANUARY 17.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Bishop E. G. Ingham: Some Reflections on How Empire Came to Us, and Can Alone be Conserved.
INSTITUTE OF ACTUARIES, at 5.—G. King: A Short Method of Constructing Select Mortality Tables.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: The Principles of Craniology applied to Clinical and Racial Problems.
ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Lt.-Col. E. F. W. Lees: International Aeronautical Maps.
INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents, Staple Inn Buildings), at 7.—P. Pitt and Others: Discussion on The Mental Equipment of an Engineer.
ARISTOTELIAN SOCIETY (at the University of London Club, 21 Gower Street), at 8.—Prof. G. Dawes Hicks and Others: Discussion on Space, Time, and Deity.
ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. C. Bradshaw: The Restoration of Praeneste.
CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court), at 8.—H. E. Coley: Some Chemical and Other Notes on His Tour in Borneo.
ROYAL SOCIETY OF ARTS, at 8.—A. E. L. Chorlton: Aero Engines (Howard Lectures).

TUESDAY, JANUARY 18.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Gerald P. Lenox-Conyngham: The Progress of Geodesy in India.
ROYAL STATISTICAL SOCIETY (at Surveyors' Institution), at 5.15.—A. W. Flux: The Measurement of Price Changes.
MINERALOGICAL SOCIETY (at Geological Society), at 5.30.—A. F. Hallimond: The Olivine Group.—W. A. Richardson: A Method of Rock-Analysis Diagrams Based on Statistics.—L. J. Spencer: Identity of Trechmann's "β-tin" with Stannous Sulphide.—Dr. G. F. H. Smith: Linarite, Caledonite, and Associated Minerals from Cumberland.—Dr. G. T. Prior: The Adare and Ensisheim Meteorites.
INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—S. H. Garner: The Carbonisation of Lubricating Oils.
ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Capt. C. W. R. Knight: Falconry.
ILLUMINATING ENGINEERING SOCIETY (at Royal Society of Arts), at 8.—J. C. Elvy and Others: Use and Abuse of Light in Studios for Cinema Film Production.

WEDNESDAY, JANUARY 19.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: The Principles of Craniology applied to Clinical and Racial Problems.
GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. L. J. Wills and B. Smith: The Lower Palæozoic Rocks of the Llangollen District, with Especial Reference to the Tectonics.
ROYAL SOCIETY OF ARTS, at 8.—F. M. Lawson: The Future of Industrial Management.
ENTOMOLOGICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8 (Annual Meeting).
INSTITUTE OF CHEMISTRY (London Section), at 8.—W. G. Young and Others: Discussion on The Institute of Chemistry: What it Can, Cannot, Should, or Should Not Do.
ROYAL METEOROLOGICAL SOCIETY (Annual General Meeting) (at Royal Astronomical Society), at 8.—R. H. Hooker: Forecasting the Crops from the Weather (Presidential Address).
ROYAL MICROSCOPICAL SOCIETY, at 8 (Annual Meeting).

THURSDAY, JANUARY 20.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. A. Harden: Biochemistry (Vitamines).
ROYAL SOCIETY, at 4.30.—*Probable Papers.*—Sir Robert Hadfield, Bart., S. R. Williams, and I. S. Bowen: The Magnetic Mechanical Analysis of Manganese Steel.—Dr. W. S. Tucker and E. T. Paris: A Selective Hot Wire Microphone.—E. A. Milne and R. H. Fowler: Siren Harmonics and a Pure Tone Siren.—Prof. L. V. King: The Design of Diaphragms capable of Continuous Tuning.
LINNEAN SOCIETY, at 5.
ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.—Lord Montagu of Beaulieu: The Cost of Air Ton-miles compared with Other Forms of Transport.
INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—R. E. Palmer: Some Observations on Mining by the Opencast or Stripping Method.—E. A. Wraight: The Standardisation of Materials Employed in Mining and Milling Plant.—A. M. Pontie: Notes on the High-level Diamond Deposits of Brazil.
INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Meeting), at 8.—W. H. Wardall: Cylinder and Piston Wear.
CHEMICAL SOCIETY, at 8.—J. V. Backes, R. W. West, and M. A. Whiteley: Quantitative Reduction by Hydriodic Acid of Halogenated Malonyl Derivatives. Part I., The Amides of Sym. Dialkyl and Aryl Substituted Amides of Mono- and Di-bromomalonic Acid.—B. M. Gupta: An Investigation on the Influence of Negative Groups of Different Character on the Reactivity of Hydrogen Atoms Carried by the Same Carbon Atom. Part I.—J. Brönsted: The Influence of Salts upon the Chemical Equilibria in Solution.—H. Hepworth: The Action of the Grignard Reagent on Certain Nitric Esters.—G. T. Morgan and H. D. K. Drew: Researches on Residual Affinity and Co-ordination. Part III., Reactions of Selenium and Tellurium Acetylacetones.—G. T. Morgan and D. C. Vining: Dihydroxynaphthaldehydes.—G. T. Morgan: Ortho-chlorodinitrotoluenes. Part II.—C. K. Ingold: The Conditions Underlying the Formation of Unsaturated and of Cyclic Compounds from Halogenated Open-chain Derivatives. Part I., Products Derived from α-Halogenated Glutaric Acids.—A. Findlay and W. Thomas: Influence of Colloids on the Rate of Reactions involving Gases. I., Decomposition of Hydroxylamine in Presence of Colloidal Platinum.—M. Nierenstein: The Constitution of Catechin. Part III., Synthesis of *aca*Catechin.—K. G. Naik: The Formation and Properties of Dithioketones ($R_2C{=}S{=}S$) and Dithioethers ($R_2S{=}S$). Part I., The Preparation of Certain Dithioketones and Dithioethers.—W. N. Haworth and E. L. Hirst: The Constitution of the Disaccharides. Part V., Cellobiose (Cellose).—S. H. C. Briggs: The Elements Regarded as Compounds of the First Order.—J. D. Morgan and R. V. Wheeler: Phenomena of the Ignition of Gaseous Mixtures by Induction Coil Sparks.—E. J. Williams: Chloroform Solutions of Hydrogen Chloride.—L. J. Hudleston and H. Bassett: Equilibria of Hydrofluosilicic Acid.—E. Newbery: Chlorine Overvoltages.—P. Rây and P. V. Sarkar: Compounds of Hexamethylenetetramine with Complex Metallic Salts and Acids.
RÖNTGEN SOCIETY (in Physics Laboratory, University College), at 8.15.—M. A. Codd: Increasing the Efficiency of X-ray Tubes by an Improved Design of Coil and Interrupter.

FRIDAY, JANUARY 21.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Prof. R. S. Troup: Indian Timbers.
ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. Keith: The Principles of Craniology applied to Clinical and Racial Problems.
INSTITUTION OF MECHANICAL ENGINEERS, at 6.—H. J. Smith: The Mechanical Loading of Ships.
INSTITUTION OF ELECTRICAL ENGINEERS (at Faraday House, Southampton Row), at 6.30.—H. J. Howard: Electric Welding.

SATURDAY, JANUARY 22.

PHYSIOLOGICAL SOCIETY (at King's College), at 4.

CONTENTS.

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SCIENCE GRADUATE seeks appointment Sound knowledge Biology; specialist in Organic and Bio-chemistry, Research and Industrial experience; expert microscopist.—Box 112 c/o NATURE Office.

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MICROSCOPES, stands, objectives, etc., for disposal. Details can be obtained of the PRINCIPAL, 130 Horseferry Road, Westminster, S.W.1, to whom all offers should be addressed.

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