THURSDAY, APRIL 9, 1914.

A VOCABULARY OF EMBRYOLOGY.

Terminologie der Entwickelungsmechanik der Tiere und Pflanzen. Herausgegeben von Wilhelm Roux. Pp. xii + 465. (Leipzig: W. Engelmann, 1912.) Price 10 marks.

THE science of embryology has its own evolution. Once upon a time it was no more than a science of observation; its task was to describe the form and structure of the embryo during growth, as the naturalist or the anatomist had described those of the organism when it was grown. Later on, in the light of the cell-theory, in the spirit of Darwinism, and with the help of Wolff's and Von Baer's laws, embryology became dominated by, even subjugated to, the historical method; its chief aim was "to form a basis for phylogeny," and its chief problems dealt with such matters as the retention of ancestral characters in embryonic and larval forms, the explanation on similar lines of functionless or atrophied organs, and the discovery of "homologies" between cells, germ-layers, and organs, even in distantly-related organisms.

Such, so far as it can be expressed in a sentence, was Balfour's attitude towards embryology, and so he defined its aims in the preface to his great text-book, adding, however, the important qualification "as restricted in the present work." One great problem, or class of problems, he expressly excluded, when he spoke of the embryological investigations of certain older writers as being "mixed up with irrelevant speculations on the origin of life." But inquiries into the character and inner nature of organic processes, and speculations on the nature and even the "origin" of life, recur continually to men's minds, and upon such inquiries embryological study has a bearing, which is by no means to be dismissed as irrelevant. So we come to a third, and nowadays important, phase of embryology, in which that science has become not merely a morphological, but a physiological, study, and is accordingly approached from the side of chemistry and of physics, with the aid of the known properties of matter and of energy.

The new and growing conception of embryology as a "dynamic" science, or series of dynamical problems, carries us a long way from the older and simpler embryology, with its "statical" outlook, its concrete description of forms and phases of form. It widens out and out into ways of experiment and analysis undreamed of a generation ago; it leads us, for instance (to name but a few names out of many), to the philosophical inquiries of Driesch, to the wide experimental field of Loeb and his followers, and to the general study of "developmental mechanics," which has been the life-work of Wilhelm Roux.

But "the house that is a-building is not as the house that is built." In the growth of a young science there is a stage when facts are heaped up in apparent confusion, out of which order and simplicity presently emerge. For a while, the workman is kept busy making his own tools, and in the growth of new knowledge and of new ideas language itself has to be strengthened by new words.

Common experience, and the Oxford Dictionary, show us how ill the older vocabulary sufficed to keep pace with last century's growth of ideas, even in the ordinary affairs of men. To natural science Huxley's generation contributed a new language, which we now speak familiarly; and once again, in the narrower field of embryology, we wake up to find that yet another language has become implanted in the old. We had better not ask whether all this new nomenclature be essential; some of it will doubtless pass away while part remains; meanwhile, it has grown by a natural process of evolution, and those must learn it who would master the teaching of the new schools. So Prof. Roux, with a little band of botanists and anatomists, has set himself in a true spirit of helpfulness to put in order the new terminology, and to teach this new language to those who have not learned it by the way.

His book is a book of reference, a means of interpretation, and a bibliographical guide; it is a dictionary, and those who find pleasure in the reading of dictionaries are few. Yet, after all, the book is something more than a book of reference or a mere vocabulary, for many of its paragraphs amount to short essays, where the student will find both information and instruction. This is not only the case in some of the larger articles, such as "Entwickelungsmechanik," "Kampf der Theile," etc., but in others also. Take at random, for instance, a little paragraph on "Scherenumkehr," or "Heterochelie"; here we have a concise introduction to a very singular phenomenon, witnessed among certain crabs, which ordinarily possess, on opposite sides, one large claw and one small one; if the former be chopped off, then the latter grows into a big claw, and the former big claw, after repair, comes to be a little one. The crab is perfectly regenerated, but its new form is a "mirror-image" of that with which it began. The article ends with references to papers wherein this phenomenon is discussed in its many curious modifications.

But while we may well be grateful to the writer who has tried in this little book to make a very difficult subject somewhat less difficult, it must be confessed that the book is too condensed, too strenuously logical, and, moreover, too much occupied by questions of priority, to attract the general scientific reader, or, indeed, any but the professed student of its own subject. Prof. Roux has greater powers than are put in action here. Haeckel's "Generelle Morphologie" is now practically obsolete; but it marks an epoch in biological science, and it stands as a monument of clear thinking and lucid scientific expression. Let us hope that some day or other Prof. Roux will give us not only a vocabulary, not only isolated researches, however important, but will crown his labours by the writing of a newer and a better "Generelle Morphogenie." D. W. T.

RUBBER AND RUBBER PLANTING.

Rubber and Rubber Planting. By Dr. R. H. Lock. Pp. xiii + 245 + x plates. (Cambridge: University Press, 1913.) Price 5s. net.

DR. R. H. LOCK was connected, until recently, with the Botanic Department at Peradeniya, Ceylon. In conjunction with other officers of that department, he conducted a series of very valuable experiments in connection with the tapping of rubber trees.

The book before us contains much that has already been published by the author officially in Ceylon. The diagrams and photographs illustrate many interesting features in connection with Hevea, Manihot, Castilloa, Funtumia, Ficus, and Landolphia, such as is rarely found in a book on rubber.

The book deals with the botanical sources and history of rubber, physiology of latex, the usual planting and harvesting operations, and the various pests and diseases of rubber plants. Each chapter is written in a very easy and popular style, and the subject-matter can be easily understood by the general reader.

The special line of work in the book is that which relates to tapping operations. When dealing with the effects of wounding the bark, the author lays stress upon the fact that any system of tapping which involves the cutting of the whole circumference of the tree at one time is bad. He suggests that in no circumstances should more than one-half of the total circumference of the tree be tapped at one time.

The yield of rubber bears a peculiar relation to the volume of bark on the tree. An instance is quoted of one tree which in three years yielded 240 lb. of dry rubber; the rubber was contained in 70 gallons of latex, equivalent to 20,000 cubic inches. This yield of 20,000 cubic inches of latex was obtained by tapping an area of bark which had contained only 500 cubic inches of latex at the beginning of the experiment. The problem, therefore, resolves itself into one of the origin of the balance of 19,500 cubic inches of latex. The author concludes that the greater part of the latex can only have been produced by secretion of latex in the existing laticiferous tissue, thus suggesting that the latter is an organ for the actual manufacture, as well as storage, of the milky liquid.

It is common knowledge among experimenters in the tropics that the yielding capacity of rubber trees exhibits enormous variation. It is this variation which renders the majority of the public records of experiments valueless. Dr. Lock shows in certain experiments that the highest and lowest average yields for particular operations were respectively 106 and 8 cubic centimetres. The yield per unit of bark removed was in the ratio of 317 to 25—a variation of 1,000 per cent. in yields from trees which to the author appeared to be somewhat similar. In addition to this variation in yield, there is an equally marked variability in composition of the latex according to frequency of tapping, season of tapping, altitude, and so forth.

In the middle-East, the majority of planters tap the same area on the same day, or on alternate days, the intervals between successive tapping operations being regarded as sufficient to enable the latex to accumulate to the desired quantity and degree of concentration. Dr. Lock is probably the first experimenter who has continued experiments for a period of four years, and herein lies the great value of his work. The majority of tapping experiments have usually lasted a number of months, and on that account alone are apt to be highly misleading.

Dr. Lock concludes that, after $3\frac{1}{2}$ years' continuous tapping, the yield from trees tapped once a week may become as great or greater than that from trees tapped at any shorter interval. It was this conclusion which gave rise to a controversy in the columns of the *India-rubber Journal*, which in turn led the Rubber Growers' Association in London to take up experimental tapping on various Eastern estates. Later publications from Malaya do not agree with the result obtained from Dr. Lock in Ceylon, but this might very well be due to the fact that the experiments in Malaya have not been continued for the same period of time.

Altogether, the book can be regarded as being of great value, not only to the practical man on the estate, but also to investigators in this country.

H. W.

WATER SUPPLIES.

(1) *Studies in Water Supply.* By Dr. A. C. Houston. Pp. xii+203. Macmillan's Science Monographs. (London: Macmillan and Co., Ltd., 1913.) Price 5*s.* net.

(2) *Water: its Purification and Use in the Industries.* By W. W. Christie. Pp. xi+219. (London: Constable and Co., Ltd., 1913.) Price 8*s.* 6*d.* net.

(1) DR. HOUSTON has gathered together an epitome of his own researches, which have been scattered among a considerable number of reports and papers. In the first chapter, which deals with sources of water-supply, he directs attention to the remarkably low death-rate from typhoid fever in London during the past few years, a rate which in the year 1911 amounted to only 0·03 per thousand of the population. After discussing the rivers Thames and Lea as sources of water-supply, he proceeds in subsequent chapters to give results of his observations upon the purification of water, finally concluding the volume by a discussion and description of the methods carried out under his direction in the laboratories of the Metropolitan Water Board.

The main conclusions which Dr. Houston draws from a large amount of experimental work may be summarised as follows:—River water exposed to manifold pollutions, and furnishing ample chemical and bacteriological evidence of objectionable contamination, may fail to show any or scarcely any of the microbes of water-borne disease; and he raises the question as to whether we have not exaggerated the value, high as it is, of the sand filter as a factor in our long-continued immunity from typhoid fever, and whether some at least of this freedom may not be due to the fact that the water was not primarily so noxious as it has hitherto been regarded. He is convinced that artificially-added typhoid bacilli die fairly rapidly in stored water, even when such water is of great initial impurity, and that a preliminary storage of water is an important factor of safety. This purification of water under storage conditions is chiefly due to the sedimentation, equalisation, and devitalisation of microbes; and he shows that by the second week the reduction in the artificially cultivated typhoid bacilli added to river water is more than 99 per cent. on the average, and that storage reduces the number of bacteria of all sorts and devitalises the survivors, if sufficiently prolonged.

Taking the chemical and bacteriological results together, Dr. Houston demonstrates that the beneficial effect observed in connection with simple continuous flow settlement of water may be considerably enhanced by the use of coagulants, such as aluminoferric, etc. He finds that when a hard water is overdosed with lime a considerable bactericidal effect is produced; and if after a suitable interval sufficient untreated water is added to combine with the excess of lime, a much safer water for drinking purposes is obtained. Speaking generally, these experiments demonstrate that the bactericidal dose of lime for hard waters would appear to be rather less than 1 to 5000, and with very soft waters 1 to 50,000. This method is especially attractive in cases where a water, bacteriologically impure, has in any event to be softened, and where a contaminated river supply has scarcely any available storage accommodation prior to sand filtration.

The author is to be congratulated, not only upon the good work to which the volume bears testimony, but also upon bringing it together in this monograph, and presenting it in a condensed and readable form.

(2) Mr. Christie's small work is mainly composed of a series of articles which appeared in "Industrial Engineering and Engineering Digest" for 1910-1911, and it is to be commended more particularly for its treatment of the use of water in various branches of industry. While much useful information is given upon the subject of the purification of water which would fit it for drinking purposes, this portion of the book is less satisfactorily dealt with than that which is concerned with the use of water for industrial purposes. Indeed, the treatment of the sources of water, its analysis and standards of purity, is fragmentary and unsatisfactory. It is impossible to deal with the subject of the standards of purity of water except in regard to the sources from which the water is derived. More particularly is this necessary with reference to chlorine standards; and the standard given for chlorine in water, of from 3 to 10 parts in a million, is useless and misleading. Extremely few of the drinking water supplies of this country would conform to such a standard. The chapters on water softening, pressure filters, oil filters, and boiler waters are the best contributions to a work which is exceedingly well produced, the illustrations being a noteworthy feature of the publication.

OUR BOOKSHELF.

From the Letter-Files of S. W. Johnson. Edited by his Daughter, Elizabeth A. Osborne. Pp. 292. (New Haven: Yale University Press; London: Oxford University Press, 1913.) Price 10*s.* 6*d.* net.

No teacher of agricultural chemistry can afford to do without Johnson's two books, "How Crops Grow," and "How Crops Feed." If he tries it,

he will miss two most valuable sources of help for his lectures. The first was written in 1868, and instantly achieved a most remarkable popularity, being translated into French, German, Russian, Swedish, Italian, and Japanese, besides being revised and adapted for English readers by Church; the second appeared two years later, and was almost equally successful. Neither book is ever likely to get out of date, because each deals so fully with the fundamental experiments carried out by men who were laying the foundation of what has since become a great subject.

The book before us gives an account of the life of the writer of these books, and incidentally throws much interesting light on the opening chapters of the history of agricultural chemistry. Samuel William Johnson was born in 1831 at Kingsboro, in what was then the new country of Northern New York State. In 1849 he had saved enough to justify his entering Yale to study chemistry under Prof. J. P. Norton; from the outset he took a special interest in agricultural chemistry. Four years later (in 1853) he went to Leipzig to work under Erdmann, and then in 1854 to Munich to study under Liebig. He then came to England for a short time to study gas analysis at the Owens College, Manchester. On his return to New Haven he did a good deal of missionary work among farmers to demonstrate the enormous value of chemistry to the agriculturist, and became appointed chemist to the Connecticut State Agricultural Society in 1857. After eighteen years of work, the first agricultural experiment station in the States was founded; in the spring of 1875 the Legislature of Connecticut State passed a measure securing 700 dollars a quarter for two years for the maintenance of a laboratory placed at their disposal by the University at Middletown.

The history of these pioneer days is well told in Johnson's letters, and they make very interesting reading. The editor is to be congratulated on the way the material has been collected and arranged. E. J. RUSSELL.

The Cancer Problem: a Statistical Study. By C. E. Green. Third edition. Pp. 98+plates. (Edinburgh and London: William Green and Sons, 1914.) Price 5*s.* net.

THIS book belongs to the all too numerous class of harmful publications on the subject of cancer. The author frankly states he is not a qualified medical man, but this fact will have little weight with the lay public. The sub-title, "A Statistical Study," conveys an entirely erroneous impression as to the scope of the book. It is in reality a plea for the infective nature of cancer, and of the active intervention of coal-smoke as an augmenter of the frequency of the disease. The alleged parasite is likened to the well-known *Plasmodiophora brassicae*, which causes finger and toe disease or club-root in turnips and cabbages. This vegetable parasite is not "almost unknown to pathologists," but has had its alleged claims to resemble a supposed cancer parasite discussed *ad nauseam* by pathologists and botanists of the highest repute. The author argues that coal-smoke manures the soil for this "cancer parasite."

The error of likening cancer to finger and toe disease has been often exposed. As for statistics, none are contributed by the author. His figures state the number of deaths from cancer as a percentage of deaths from *all* causes, and he marvels that 1 in 7 is from cancer in the Strand district, but only 1 in 54 in Stepney. This statement is illuminated by photographs of the roofs of these two districts. No mention is made of Charing Cross Hospital being situated in the Strand district.

The statements as to the cure of cancer are deserving of severe condemnation. Only the harm the book may do has justified any notice being taken of it. It is with regret that the reviewer feels obliged to judge thus harshly what the perusal of the book proves has been a labour of love, carried out with the best intentions; but the pursuit of a hobby ought not to be encouraged to the public danger. E. J. B.

The Socialized Conscience. By Prof. J. H. Coffin. Pp. viii+247. (Baltimore: Warwick and York, 1913.) Price 1.25 dollars.

PROF. COFFIN'S purpose in this interesting book is to suggest, using modern psychological and sociological terms, a moral criterion by means of which the different types of moral situations may be met with consistency by ordinary human beings. He applies the criterion to a great variety of questions, including personal relationships, educational agencies, the State and the Church. His chapters are stimulating and thought-impelling.

Descriptions of Land: a Text-book for Survey Students. By R. W. Cautley. Pp. ix+89. (New York: The Macmillan Company, 1913.) Price 4*s.* 6*d.* net.

ALL students of surveying in Canada before securing official recognition are required to pass an examination on "descriptions of land," which is one branch of conveyancing. Many lawyers in all countries are ignorant of the elementary principles of surveying, and few surveyors are able to understand the intricacies of a complicated title. Mr. Cautley has written on the subject in a way which should be useful, not only to students of surveying, but also to acting lawyers and surveyors everywhere.

Elementary Commercial Geography. By Dr. H. R. Mill. Revised by Fawcett Allen. Pp. xii+215. (Cambridge University Press, 1914.) Price 1*s.* 6*d.* net.

DR. MILL'S primer of commercial geography was published first in 1888, and is well known to all teachers of the subject. It is sufficient to say of the latest edition that it has been revised thoroughly by the aid of the latest official publications, and is enlarged by additions to part i., and by more detailed descriptions of countries which have shown recent commercial development.

LETTERS TO THE EDITOR.

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The Funafuti Boring.

IT was with great pleasure that I read the clear statement of Prof. J. W. Judd (NATURE, March 12) in reply to the letter of Prof. E. B. Poulton (February 26) upon this subject. Especially welcome was his definite statement that all idea of solution of calcium carbonate being the causative factor of lagoon formation was negatived by the study of the bore.

But I would direct a caution to those who might be inclined to read into Prof. Judd's letter a vindication of the correctness of Darwin's theory of atoll formation.

Suppose it is definitely proved that an atoll such as Funafuti is established upon a basis which has certainly undergone a movement of sinking. Such a finding can only establish the "validity" of a statement that a sinking basis may become the site of atoll development; it cannot establish the "validity" of a theory which demands this sinking as the *cause* of the development of the peculiarities of atoll growth; especially in the face of the definite knowledge that typical atoll growth may be established upon a basis which shows either, no evidence of sinking, or actual evidence of rising. It is upon this point that I fear the recent correspondence may mislead.

One other question arises: Has it been definitely proved that the site of Funafuti atoll has undergone a movement of sinking?

A bore made upon the extreme windward edge of an atoll some ten miles in diameter has so inherent a probability of penetrating a talus slope, that the most rigid proof should be furnished of its having penetrated anything else. This proof is, I think, not forthcoming.

The lagoon bores are not sufficiently deep to establish, beyond dispute, the supposition that there has been a movement of sinking. The statement of Prof. Judd would leave quite an opposite impression, for he says that the lagoon bore extended "to a depth of 100 ft. below the limit of growth of the reef-forming corals." The lagoon bores extended to 36 and 41 fathoms below the surface of the water. It is obvious that to make Prof. Judd's statement correct he must allow the reef-builders only $24\frac{1}{3}$ fathoms as their bathymetrical limit. But $24\frac{1}{3}$ fathoms is not the "lowest depth at which, as all naturalists agree, reef-forming corals can flourish."

It is only necessary to mention the dredgings of Basset-Smith on the Lizard and Macclesfield Banks in which twelve species of typical reef-forming corals were obtained from between 31 and 45 fathoms. On open oceanic banks, far from any shore line from which suspended matter may be carried in the water, it is possible that even this may not represent the bathymetrical limit of the true reef-builders; but it is enough that we have positive knowledge of their presence at depths exceeding that of the Funafuti lagoon bores to negative any idea that these bores can prove a downward earth movement. Atoll formations are developed in areas in which upward earth movements are evident; they are also developed in areas in which downward earth movements are evident (though the Funafuti bores cannot be accepted as proving it); and in neither case can such movement be invoked as the cause of their peculiar features. The Funafuti bores showed that "solution" was not the cause of lagoon formation; they did not show that "subsidence" was the cause. It is the study of the coral zooid and the coral colony that alone can reveal the picture of atolls caused by "sedimentation." F. WOOD-JONES.

WE are quite ready to admit that the evidence obtained at Funafuti does not prove that *all* atolls are formed by subsidence. A stationary volcanic bank, eroded down to the level at which reef-forming corals could begin to flourish, would serve as well for the basis of an atoll as a sinking island; this was well pointed out by the late Admiral Wharton. So, too, would a deeper bank which had been raised to a similar level by the raining down upon it of pelagic organisms, *if it can be shown that such action is capable of producing any considerable thicknesses of rock*. And there are other conceivable ways in which atolls may arise, as was fully admitted by Darwin in his correspondence with Semper.

We claim, however, that Funafuti proves that atolls can be formed by subsidence from the following facts. The upper part of the main boring, as well as several subsidiary borings, show the existing reef to consist of corals in their position of growth, their interstices being filled with broken fragments of coral mingled with smaller organisms. Now, right down to the extreme depth reached, the cores were of precisely similar character; they showed corals in the position of growth surrounded by detritus and small organisms. Thus the hypothesis of a talus—which, so far as I know, was only suggested after the boring was found not to reveal a substratum of foreign rock—falls to the ground.

Although species of corals belonging to genera which are reef-forming have been found at considerable depths, the luxuriant growths of coral, necessary for building up a great reef, have never been shown to take place below 20 to 25 fathoms. This was a conclusion that was certainly accepted by the late Prof. Alexander Agassiz, from the results of his wide experience, as it has been by so many other naturalists. The ingenious method employed in boring in the middle of the lagoon of Funafuti did not admit of large cores being brought up, but the borings were stopped by hard coral-masses, the fragments obtained from these indicating that they belong to reef-making forms. It is fair, therefore, to maintain that the lagoon borings at Funafuti afford valuable evidence in support of that obtained by the main boring.

J. W. JUDD.

Zoological Classification.

ZOOLOGICAL classification of the present day is unsatisfactory, and the reason is not far to seek. This condition has resulted from the unnecessary multiplication of genera.

The real object of classification is being lost sight of. The objects aimed at in a classification may be put briefly as follows:—(1) To give to each animal a name, by which it will be known internationally, and (2) to give to animals which resemble one another the same name.

The unit-group of animals bearing the same name is the genus. How large may the genus be? There are at present independent genera which have been created out of a formerly existing single genus. Has the diagnosis of the species been rendered simpler by breaking up the genus, and by giving to each subgenus a new name? Certainly not in several cases.

The subdivision of the older genus has resulted from the more detailed examination of the various species. Such investigation cannot be too minutely carried out, for it is necessary both from the morphological and the diagnostic point of view. But the mistake has

been made of giving to the new groupings of species thus revealed names which are so dissimilar from that of the orginal genus, and from each other, as to hide the genus-relationship. The latter is shown when the genera are grouped as a family.

The subdivision of the animal kingdom into groups that receive independent names should not be carried further than is necessary to ensure ready diagnosis of the species. When carried beyond that point the classification is weakened.

What is required at present is the extinction of probably half at least of the genera. The present family-group should in many cases be the genus.

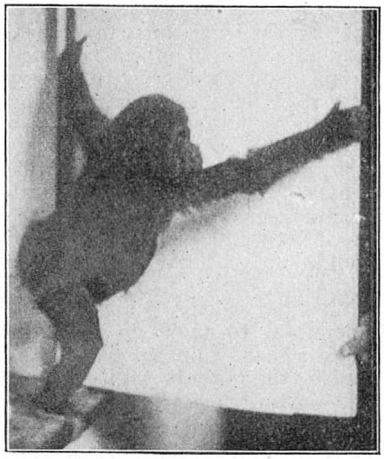
H. CHAS. WILLIAMSON.

Marine Laboratory of the Fishery Board for Scotland, Aberdeen, March 23.

The Dublin Gorilla.

LIVE specimens of the gorilla are still rarities in British zoological gardens, and it is believed that except for one that has lived for several years at Stuttgart, there is no example at present to be seen on the European continent. A few notes on a young female —probably about a year old—that has now lived for three months in the ape-house of the Royal Zoological Society of Ireland, in Dublin, may therefore be of interest to readers of NATURE.

This little ape—"Empress" is her name—was brought to Europe in company with a young male chimpanzee; in consequence of this companionship she is much tamer and livelier than captive gorillas usually are. In the constant sports which the two young creatures enjoy, the chimpanzee is the more active and spirited, frequently cuffing the gorilla playfully or dragging her along the floor of the house. The gorilla, however, is able to hold her own, and has already developed the habit of drumming on her chest as a challenge; usually she is good-tempered both to her companion and to human visitors. She often climbs leisurely but confidently to the top of the house. The photograph (by Mr. W. N. Allen) shows the little ape in a characteristic attitude, and brings out the distinctive shape and pose of the leg and hindquarters. Her eyes are very expressive, and her almost black face is a great contrast to the pale pink skin of her companion chimpanzee. Both the apes have completely recovered from an epidemic cold that ran through the house in February, and it is hoped that "Empress" may survive in the Dublin Gardens for several years.



G. H. CARPENTER.

Royal College of Science, Dublin.

A Property of Chain-Fractions.

FOR convenience, let $(1; a, b, c, \ldots)$ mean the chain-fraction of which $1/a$ is the first convergent, and $a, b, c,$ etc., are the partial quotients. Consider all such fractions which have no partial quotient greater than 9: the greatest of these is the periodic fraction $(1; 1, 9)$, and the least is $(1; 9, 1)$. We have,

$$\alpha=(1; 1, 9)=(-9+\sqrt{117})/2=0{\cdot}9083,$$
$$\beta=(1; 9, 1)=(-9+\sqrt{117})/18=0{\cdot}1009,$$

and any proper fraction outside the limits (α, β) will have at least one partial quotient greater than 9. (The converse is not true.) More generally, one partial quotient at least will be greater than an assigned integer n, if the chain-fraction represents a quantity outside the interval determined by the positive roots of the equations:—

$$\alpha^2+n\alpha-n=0, \quad n\beta^2+n\beta-1=0.$$

As n increases, α becomes more and more nearly equal to 1, and β more and more nearly equal to 0. The curious point is that if we take a proper fraction sufficiently near to 1 or zero, its chain-fraction expansion must contain a partial quotient greater than any integer assigned beforehand, and we can actually (when n is given) assign intervals containing such fractions *and no others*. For instance, when $n=9$ the intervals are

$$\{1, (-9+\sqrt{117})/2\} \text{ and } \{0, (-9+\sqrt{117})/18\}.$$

Thus 0·9089 is within the first of these intervals, and its expansion is $(1; 1, 9, 1, 42, \ldots)$.

G. B. MATHEWS.

New Units in Aerology.

IN NATURE of March 19, p. 58, Prof. McAdie discusses the question of the new units in aerology, and says that now is the time to agree upon a logical and available system, considers the megabar atmosphere the more appropriate, and thinks that some of the readers of NATURE may suggest something better.

I have not the ambition to respond to the last suggestion, but, in order to avoid confusion in the future, I beg to direct attention to what has been done in this respect very recently. According to an official report, M. Pérot has presented to the French Minister of Commerce a report upon the reform of the legalised measures and weights. In this we find among the derived units the *Newton* as a unit of force $=\text{Kg m/sec.}^2$, which equals 10^5 dynes. From this is derived another new unit, *Pascal*, as a unit of pressure, 10 Newtons per sq. cm. (10 Newtons = 1 megadyne). I may add that the *Calorie* is proposed at 15° and 1·02 Pascal (=765·1 cm.).

As France may be called the mother-country of the c.g.s. system, the question arises, whether the name *Pascal* might not be substituted for the *modern* megabar (*not* for *ten* absolute atmospheres)?

BOHUSLAV BRAUNER.

Bohemian University, Prague, March 24.

WINELAND THE GOOD.[1]

THE evidence for the pre-Columbian discovery of North America by Norsemen depends essentially on two sagas: the Saga of Eric the Red, the Saga of Thorfinn Karlsefni in Hauksbook; both of which are repeated with modifications in the Flateybook. The dates of the extant MSS. lie between 1300 and 1400 A.D.; the sagas themselves were probably composed about a century earlier; the main event, the discovery of Wineland by Leif the Lucky, occurred in or

[1] "Early Norse visits to North America." By William H. Babcock. Smithsonian Miscellaneous Collections, vol. lix., No. 19. Pp. iv + 214, x plates. (1913.)

about 1000 A.D. Collateral evidence consists mainly in the references by other writers to the events recorded by the sagas, which, it is plain, were regarded as historical narratives.

The numerous vague rumours of a world in the west, as embodied in strange maps and stranger stories, have little bearing on the relatively precise and plain tales of the Norse sea-kings. Those tales which, where not distorted by later fancy, are straightforward as a sailor's log, must be checked by reference to the geographical data recorded in them. This is the most valuable part of the task essayed by Mr. Babcock in his interesting and well-written volume. He is not the first to make the attempt, but the originality and the strength of his attack lie in his reconstruction of the geographical conditions as they probably were nine hundred years ago. Then the seaboard north of the Gulf of Maine was lower than now, whereas south of that point it was higher. The change, which is still in progress, is due to the oscillation of the earth's crust initiated by the withdrawal of the great ice-sheet. By taking this movement into consideration, Mr. Babcock has been able to identify with much plausibility the features and localities mentioned in the sagas.

Let us take only one point in illustration. Karlsefni and his wife Gudrid on their southward voyage saw to the starboard "a bleak coast, with long and sandy shores . . . they called them Wonder Strands, because they were so long to sail by." The interminable sand-dunes of New Jersey and Maryland supply a modern parallel to these cheerless "Furdustrandir," but the voyagers cannot have been further south than Nova Scotia, and no such wonder-strands are found there now. "Conceive," however, says Mr. Babcock, "the Nova Scotia seaboard lowered by the 25 feet or more of its present height, that is, brought down to water-level and dipped a little under—with slight narrowing of the peninsula in its mainland part, and partial obliteration of the eastern side of the now hollow insular terminal part called Cape Breton Island—and you will have something not wholly unlike the long strands of New Jersey or the peninsula east of the Chesapeake, only with the hill country much nearer. It was the first introduction of the surprised northern visitors to the characteristic American coast line."

By such ingenious but not unwarranted use of the scientific imagination does Mr. Babcock identify the various localities of the saga, thus confirming its essential accuracy. The vines that gave a name to Wineland are the fox-grapes of to-day and the apparent wheat . "self-sown wherever there were hollows," is interpreted as wild rice, still a conspicuous feature.

It is maintained, then, that Leif Ericsson chanced on America circa 1000 A.D., and coasted as far south as New Jersey; that Eric the Red dispatched Thorfinn and Gudrid three years later, as leaders of a large colonising party; that they passed Helluland (Labrador), Markland (Newfoundland), the Wonder-strands (Nova Scotia), and settled near the mouth of Straumfjord (Bay of Fundy), where Gudrid gave birth to Snorri, the first American-born white man. Disappointed in the hard winter, Thorfinn and a party sailed further south about as far as Mount Hope Bay, but were driven back by Indians. After another winter at Straumfjord, all returned to Greenland.

THE IMPERIAL BACTERIOLOGICAL LABORATORY, MUKTESAR, INDIA.[1]

THE Imperial Bacteriological Laboratory, situated at Muktesar in the United Provinces, has been established, and is maintained for the investigation of the diseases of stock in India, and for the preparation of anti-sera and vaccines used for the control of epidemic diseases among animals. The history of the laboratory dates from 1890, when Dr. Lingard was appointed Imperial Bacteriologist, and for some years the work in connection with the diseases of animals in India was carried out at Poona. It was decided, however, to establish a separate institution for this purpose in the hills, and in 1895 a laboratory and a few additional buildings were completed. This first laboratory was destroyed by fire in 1899. The re-building was taken in hand at once, and the present laboratory, much larger than the original structure, was erected and ready for occupation in 1901. The work of the laboratory has increased very rapidly, and it was found necessary to add a wing to the main building four years ago. In addition to the large laboratory there are three smaller buildings for the study of separate diseases, and other buildings for the accommodation of animals, post-mortem examinations, etc., have been added from time to time.

One of the earliest problems to be studied at Muktesar was the preparation of a prophylactic for rinderpest. In 1896 Koch visited Muktesar, and demonstrated his bile method of inoculation against rinderpest. An anti-serum for the disease was first prepared in India by Lingard, and it was first used in field epidemics in 1899, when about 2000 doses were issued. Rinderpest anti-serum is one of the most effective prophylactics known to science, and a striking tribute to its value is to be found in the records of the Muktesar Laboratory. Ten years after its introduction into India half a million doses were issued annually. In 1910 improved methods for the preparation of the serum were discovered, and in the following year a million doses were manufactured. The serum is now supplied to all the provinces of India, to Burma, Ceylon, and the Native States, to the Federated Malay States, and to Egypt. In addition to rinderpest anti-serum, a serum and vaccine for the control of epidemics of hæmorrhagic septicæmia are prepared, as well as a vaccine for black quarter and a serum for anthrax. About 20,000 doses of mallein are issued annually. Pathological specimens are examined, and instruction is given to native veterinary graduates in the practical application of serum and vaccines.

[1] "A Description of the Imperial Bacteriological Laboratory, Muktesar: its Work and Products." By Major J. D. E. Holmes. (Calcutta: Superintendent Government Printing, 1913.)

The officers of the laboratory have carried out numerous investigations in connection with animal diseases. Much of the research work deals with the study of rinderpest, and the results of Dr. Lingard and Major Holmes (the present director of the laboratory) in this field have found practical application in the preparation of rinderpest anti-serum. Investigations on surra were commenced by Lingard at Poona, and continued by him until 1907, when he retired from the service. Holmes directed his attention to the problem of the treatment of surra in equines, and a method has been discovered which, in his hands, has given 75 per cent. of recoveries. The treatment has been successful in animals experimentally inoculated with the disease, and also in cases in which the disease has been contracted naturally. Various other subjects have been studied, and the results of the investigations have been published in scientific journals in India and Europe.

The problem of dealing with infectious diseases of animals in India presents many difficulties which arise from the somewhat peculiar local conditions. Measures of treatment, segregation, and disinfection cannot be imposed without the permission of each individual owner. Formerly a good deal of opposition to serum inoculation for rinderpest was encountered, but this has now almost disappeared, a result which is largely due to the repeated practical demonstrations of the efficacy of serum inoculation in the control of rinderpest epidemics. In dealing with an outbreak of disease it is essential that the measures adopted shall be free from all danger to the lives of the animals treated, and shall in no way interfere with their work. Under these conditions serum therapy has proved to be the safest and most efficient method of operation. Dead vaccines are also used as a preventive measure in districts where disease is seasonally prevalent. Vaccination by means of living or attenuated organisms is not practised, except in the case of black quarter.

A consideration of the subject matter of this pamphlet, and a study of the thirty full-page illustrations, shows that a successful attempt has been made to deal with a subject of great economic importance, viz., the health and well-being of the stock of a great agricultural country. The rapidity of the progress made, since the establishment of the laboratory some twenty years ago, is remarkable, and especially so when one considers the nature of the difficulties which have been encountered. PERCIVAL HARTLEY.

PROF. J. H. POYNTING, F.R.S.

ON the evening of Monday, March 30, surrounded by his family, John Henry Poynting passed quietly away. A memorial service was held in Birmingham on the Thursday following, and was attended by representatives of many universities and learned societies, including Sir J. J. Thomson, Sir Joseph Larmor, Dr. Glazebrook, Sir William Tilden, Prof. W. M. Hicks, Dr. W. N. Shaw, and of course by many colleagues and councillors of the University in which he occupied a chair, as well as by a large number of private citizens and friends. For he was a man universally beloved.

He was born on September 9, 1852, at Monton, near Manchester, son of the unitarian minister of that place. His first education was at home, but the years 1867 to 1872 he passed at Owens College, Manchester, graduating B.Sc. at the London University, and proceeding, in 1872, to Trinity College, Cambridge, where he was bracketed third wrangler in 1876.

He was then appointed demonstrator at Owens College by Balfour Stewart, and began a life-long friendship with Sir J. J. Thomson, who was at that time a student. In due time Poynting became a fellow of Trinity, and in 1880 was appointed to the professorship of physics at Birmingham, which he held to the day of his death.

The four first professors of the Mason College, which was opened by Huxley in 1880 (who delivered, on this occasion, a notable address, reprinted as the first of his collected essays), were Sir Wm. Tilden, Prof. M. J. M. Hill, Dr. T. W. Bridge, who died a few years ago, and Poynting. In this same year Poynting married Miss M. A. Cropper, daughter of the Rev. J. Cropper, of Stand, near Manchester. In 1887 he received the Sc.D. of Cambridge, and in 1888 the fellowship of the Royal Society. In 1891 the Adams prize was awarded to him, and in 1899 he presided over Section A of the British Association at Dover. This meeting was memorable for the clear discovery of the separate existence of electrons, which was announced to Section A by Sir J. J. Thomson on an occasion when many members of the French Association, meeting simultaneously at Boulogne, had come over for friendly fraternisation.

In 1905 Poynting became president of the Physical Society, and was awarded a Royal medal by the Royal Society "for his researches in physical science, especially in connection with the constant of gravitation and the theories of electrodynamics and radiation." In this brief summary an immense amount of work is referred to. The work for which he is locally best known was his determination of the Newtonian constant of gravitation by the very accurate use of an ordinary balance with an adjustable mass under one or other of the pans—a determination which is popularly called "weighing the earth." His account of it appears in the *Phil. Trans.* for 1891. It is a classical memoir of its kind, and very instructive to the physical student, but the papers on electrodynamics eclipse it in value. These were "communicated" to the Royal Society in 1884 and 1885 respectively, their titles being "On the Transfer of Energy in the Electromagnetic Field," and "On the Connection between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field."

The memoir on the transfer of energy aroused universal attention. The paths by which energy travels from an electromotive source to various

parts of a circuit were displayed, and their intricacies unravelled, for the first time; *identity* of energy might legitimately be urged as a supplement to *conservation*; and it is to these papers that we owe that fundamental generalisation, connecting mechanical motion with electric and magnetic forces, which is known all over the world as "Poynting's Theorem."

The work on radiation appeared partly in the *Phil. Trans.* for 1904 and partly in the *Phil. Mag.* for 1905. In these memoirs the tangential pressure of radiation is analysed and demonstrated; and it is shown, both theoretically and experimentally, that a beam of light behaves essentially as a stream of momentum, and gives all the mechanical results which may thus be expected, though of a magnitude exceedingly minute. Nevertheless, he goes on to show that these radiation-pressures, however small, are of much consequence in astronomy, and have many interesting and some conspicuous results. A noteworthy part of his radiation memoirs, however, is independent of considerations of pressure or momentum, and gives a means of determining the absolute temperatures of sun and planets, and of space, in a singularly clear and conclusive manner.

It is impossible, in a brief notice like this, to do justice to these great treatises, or to the rest of Poynting's scientific work; it must suffice to mention the titles of a few of his other papers:—"Change of State Solid-Liquid" (*Phil. Mag.*, 1881); "A Double Image Micrometer" (*Monthly Notices, R.A.S.*, 1892); "Osmotic Pressure" (*Phil. Mag.*, 1896); "On a Simple Form of Saccharimeter" (Proc. Phys. Soc., 1881).

Among his publications is a series of text-books on physics, written in conjunction with his friend, Sir J. J. Thomson; but he has also produced smaller and more popular books, one on "The Pressure of Light" (S.P.C.K.), and one on "The Earth" (Camb. Univ. Press). He also took an interest in statistical science, and wrote on "Fluctuations in the Price of Wheat," and on "Drunkenness Statistics of Large Towns."

His public spirit was shown by his accepting the position of a justice of the peace.

He took some interest also in the philosophical aspects of physical science, and his help is acknowledged by Prof. James Ward in connection with the publication of a series of Gifford Lectures. Poynting was strongly inclined, almost unduly, to limit the province of science to *description*, and to regard a law of nature as nothing but a formulation of observed similarities. He wished to abolish the idea of *cause* in physics. In some of this he may have gone too far, but his rebellion against an excessive anthropomorphism which had begun to cling around the notion of natural laws, as if they were really legal enactments to be obeyed or disobeyed by inert matter almost as if it possessed will-power and could exercise choice, some substances being praised as good radiators while others are stigmatised as bad—most gases being admittedly unable to reach a standard of perfection held out to them as Boyle's law, though a few of excessive merit might surpass it,—Poynting's revolt against this kind of attitude to laws of nature, though doubtless more than half humorous, was in itself wholesome. His philosophic views may be read, as a Presidential Address to Section A, in the Reports of the British Association for 1899.

But I must not delay further on his scientific work; the man himself was even more than his work. When the Mason College became the University of Birmingham Poynting was elected Dean of the Faculty of Science; in that capacity his quiet wisdom and efficiency were very manifest, and keen was the regret of all his colleagues when, some twelve years later, failing health necessitated his yielding this office to another. His judgment was as sound as his knowledge, and his conspicuous fairness endeared him to colleagues and the members of his staff. By the latter it is not too much to say that he was regarded with affectionate veneration; one of them writes to me as follows:—

"As to his character it is impossible to give the right impression to those who did not know him well. I consider him a man of very extraordinary ability, which might have carried him much farther if it had been associated with more self-assertion. But it was largely this modesty and self-suppression which created a very unusual degree of affection in those who had the privilege of knowing him intimately. I always associate him in my mind with Faraday and Stokes."

As a lecturer and teacher he was admirable, and the respect in which he was held by his peers was noteworthy. I am glad to remember that so recently as the last meeting of the British Association, some of the greatest physicists in the world, who were staying with me—Prof. H. A. Lorentz, Lord Rayleigh, and Sir Joseph Larmor—went to his house one evening, and met there in his study Sir J. J. Thomson and Dr. Glazebrook, who were staying with him; thus constituting a remarkably representative gathering, and giving him a pleasure which he remembered to the end of his life.

There is much more that might be said; but let his position in the world of science be what it may, we in the University of his mature life knew him well, and know him best as an admirable colleague, a staunch friend, and a good man.

At the Memorial service, the following true words concerning him were spoken by the Rev. Henry Gow, who knew him well:—

We remember that he did work to make him famous throughout the world of science which gave him a high place amongst the discoverers of truth; but we remember much more than that. We remember how he loved life, how interested he was in little things, how he delighted in children, in flowers, and in birds; what confidence and affection he inspired, how free he was from claims of self and from uneasy egotism; how much happiness he felt and gave. We remember his wise judgments, strong character, cheerful courage, his delightful humour, and a certain peace-

ful beauty and childlike joyousness of spirit behind all his multifarious gifts. He rejoiced to be the friend as well as the teacher of the young. He kept his heart free from all bitterness and disillusion which come so often to us in our later years. He knew and felt always how beautiful and great a thing it was to be alive.

OLIVER J. LODGE.

NOTES.

DR. G. T. BEILBY, Prof. A. Keith, F.R.S., and Mr. J. Swinburne, F.R.S., have been elected members of the Athenæum Club under the rule which empowers the annual election by the committee of a certain number of persons "of distinguished eminence in science, literature, the arts, or for public services."

BY the death of Mrs. Huxley on March 5, in her eighty-ninth year, another link with the scientific society of the latter half of the nineteenth century has been snapped. All who had the happiness of knowing Huxley intimately are aware of the reliance which he at all times reposed on the advice and judgment of his lifelong helpmate. Not only in all domestic concerns, but in questions of literary criticism and even of scientific procedure, he never took a step without consulting her, and her wide knowledge and keen literary instincts made her aid invaluable to him. As is well known, the young surgeon of the *Rattlesnake* found a kindly welcome in the house of Mr. W. Fanning, a merchant in Sydney; and the half-sister of the merchant's wife, Miss Henrietta Heathorn, who had come out to Australia four years earlier, won his affections, though eight years had to elapse before the marriage could take place. Strange to say, Mrs. Huxley's health was a constant source of anxiety to her husband; he believed that an Australian medical man had so injudiciously treated a complaint from which she suffered as to have fatally undermined her constitution, but, nevertheless, she has survived Huxley himself by nearly twenty years. Mrs. Huxley wrote some very striking and thoughtful poems, nonsense verses, for the amusement of her children and grandchildren, and laughable stories, illustrated by one of her gifted daughters, with the same object; she will, however, be best remembered by the little work containing judiciously selected passages from her husband's writings, the admirable "Aphorisms and Reflections from the Writings of T. H. Huxley."

THE HON. FRANCIS ALBERT ROLLO RUSSELL, whose death on March 30 we announced with regret last week, was the third son of the first Earl Russell. He was born on July 11, 1849, and was educated at Harrow and at Christ Church, Oxford. As a youth he became interested in meteorological phenomena, and when about fifteen or sixteen years of age he began keeping records of the weather, especially of clouds and optical phenomena. He became a fellow of the Royal Meteorological Society in 1868, and served on the council from 1879 to 1892, and again in 1914, and was a vice-president in 1893–94. He was a fellow of the Royal Sanitary Institute, and served on the council in 1881–82, and again in 1889–92. Mr. Russell was the author of several works and papers on meteorological subjects, and also on matters connected with public health. He took a great interest in the question of London fogs, and was an advocate for the abatement of coal smoke. In conjunction with the late Mr. Douglas Archibald, he made a report to the Royal Society on the unusual optical phenomena of the atmosphere, 1883–6, including twilight effects, coronal appearances, sky haze, coloured suns and moons, etc., which were due to the volcanic eruption of Krakatoa. For his memoir, "The Atmosphere in Relation to Human Life and Health" (148 pp.), which was submitted to the Hodgkins Fund prize competition of the Smithsonian Institution, he was awarded honourable mention with a silver medal. Among his other works may be mentioned "The Spread of Influenza: its Supposed Relation to Atmospheric Conditions" (1891), "On Hail" (1893), and "The Early Correspondence of Lord John Russell," which was published last year.

THE seventieth birthday, on March 25, of Prof. Adolf Engler, the director of the Royal Botanic Garden and Museum at Dahlem, near Berlin, was celebrated in the presence of many eminent German and foreign botanists, by several functions. On the day itself, Prof. Lindau spoke on behalf of the scientific staff of the garden and museum. Prof. Pax, rector of the University of Breslau, with Profs. Diels and Gilg, as its editors, presented to Prof. Engler a copy of the *Fest-Band* of Engler's "Botanische Jahrbücher." The volume forms a supplement to the fiftieth volume of this well-known publication, and consists of more than forty illustrated contributions, largely from his pupils. The volume will be a lasting memorial of appreciation of Prof. Engler's botanical position, not only in Germany, but also in both hemispheres. As a further mark of this appreciation, Prof. Haberlandt presented Prof. Engler, on behalf of hundreds of subscribers, with his life-size marble bust, the work of the sculptor, A. Manthe, while Prof. Wittmack (to whom we owe these particulars, and the celebration much of its success) read the congratulatory address of the Deutscne Botanische Gesellschaft. Following similar addresses from the Vereinigung für angewandte Botanik, and from the Freie Vereinigung, an album of views of all the meeting places of the systematists was presented. Prof. Warming spoke on behalf of the foreign botanists. The presidents of the German Horticulture and of the Dendrological Societies added their felicitations, and it was announced that Prof. Engler had been made an honorary member of several learned societies in Germany, Russia, and other countries. On March 26 there was a banquet at which the official world was represented; and on March 27 the monthly meeting of the Deutsche Botanische Gesellschaft was converted into an "Engler" meeting, and Prof. von Wettstein gave, by special invitation, a lecture on the phylogenetic evolution of the Angiosperm flower.

IN connection with the establishment of a meteorological observatory at Agra for upper-air observations, the *Pioneer Mail* states that the Government of India has decided that the observatory shall be called the "Aerological Observatory, Agra," and that Mr. J. H. Field, Imperial meteorologist, while in charge of this

work shall be designated the director of the observatory, and Mr. W. A. Harwood, the assistant-director.

AT the suggestion of Mr. R. H. Tiddeman, president of the Yorkshire Geological Society, arrangements are being made by the society to call a conference next autumn, in Leeds, to consider the question of the glacial geology of the north of England. The conference will last a week, and in addition to papers and discussions, excursions will be made during the day to various centres of importance in connection with the glaciation of the north of England. Glacialists from all parts of the country will be invited to attend. A committee has been elected to make all the necessary arrangements.

THROUGH the generosity of M. Spendiaroff, of St. Petersburg, the International Geological Congress presents at each session a prize amounting to about 450 roubles (47*l.*) for the best work in some specified field of geology. The next prize will be awarded at the session in Belgium in 1917 for the best work in petrography giving new light on the general problems of the science. Two copies, at least, of any work presented for the competition must be sent to the general secretary of the last congress, Mr. R. W. Brock, Deputy Minister of Mines, Ottawa, Canada, at least one year before the next session.

THE septennial award under the Acton Endowment has this year been made by the Royal Institution to Prof. C. S. Sherrington, Wayneflete professor of physiology in the University of Oxford, for his work entitled "The Integrative Action of the Nervous System," being a synopsis of his elaborate paper published in the Philosophical Transactions of the Royal Society on experiments in examination of the peripheral distribution of the fibres of the posterior roots of some spinal nerves. Previous Actonian awards have been made to Sir George Stokes, Miss Agnes M. Clerke, Sir William and Lady Huggins, and Madame Curie, for achievements in the field of physical science. Prof. Sherrington is the first investigator in experimental biology to receive this distinction for the third of a century.

WE regret to learn that the recent fire at Wellesley College, Massachusetts, though happily unattended by loss of life, destroyed the results of several years of research work. For the last six years Prof. Marion E. Hubbard has been investigating the problem of variation and heredity in beetles. The disaster swept away in a few moments all her notes and specimens, as well as a valuable original apparatus she had constructed for the purpose of her observations. Prof. Alice Robertson, head of the department of zoology, similarly lost all the specimens and notes relating to a collection of bryozoa dredged up by the *Albatross* expedition. Prof. C. B. Thompson, of the same department, has lost the results of similar work on dredgings by the Bureau of Fisheries and the University of California, together with the memoranda of three years' experiments on the brains of ants and a collection of 4000 slides which had taken eight years to prepare.

THE programme has just been issued of the annual meeting of the Iron and Steel Institute, to be held on Thursday and Friday, May 7–8. On May 7 the retiring president, Mr. Arthur Cooper, will induct into the chair the president-elect, Mr. Adolphe Greiner; the Bessemer gold medal for 1914 will be presented to Mr. Edward Riley; the president will deliver his inaugural address; and a selection of papers will be read and discussed. On May 8 the Andrew Carnegie gold medal (for 1913) will be presented to Dr. T. Swinden, the award of research scholarships for the current year will be announced, and other papers will be read and discussed. Among the papers that are expected to be submitted for reading and discussion are:—"The Forms in which Sulphides may Exist in Steel Ingots," Prof. J. O. Arnold and G. R. Bolsover; "The Hardening of Metals, with Special Reference to Iron and its Alloys," Dr. C. A. Edwards and Prof. H. C. H. Carpenter; "Influence of Molybdenum upon the Corrodibility of Steel," Dr. J. N. Friend and C. W. Marshall; "The Magnetic and Mechanical Properties of Manganese Steels," Sir Robert A. Hadfield and Prof. B. Hopkinson; and "A New Reagent for Etching Mild Steel," Dr. W. Rosenhain and J. L. Haughton.

THE President of the Scientific Association of Rhodesia regrets in his annual address for 1913 that no attempt has been yet made to organise an anthropological survey of the State. He suggests the preparation of tribal and linguistic maps as a preliminary measure. Some good work is being done by the members under the difficulties which attend research in a new country. The report publishes two excellent ethnological and sociological papers on the Matabele, by Mr. P. Nielsen, and the people of the Zambezi valley, by Mr. C. I. Macnamara, which give valuable accounts of tribal organisation, initiation ceremonies, and marriage rites, which deserve the attention of anthropologists.

THE fine collection of glacial boulders now preserved in the grounds of Messrs. Cadbury, at Bournville, Birmingham, is described by Prof. C. Lapworth in part ii., vol. xviii., of the Proceedings of the Cotteswold Naturalists' Field Club for 1913. After describing the advance of the ice-sheet into the midlands, and the numerous boulders conveyed by its action into the Birmingham district, the writer states that the collection at Bournville consists of masses of dark igneous Plutonic rock, usually known as felsite or andesite, identical with the rock which forms a large part of the Arenig mountain ranges, several miles west of Bala Lake, in the basin of the river Dee, North Wales, and fully fifty miles, as the crow flies, from Bournville.

To the March *Zoologist* Col. C. E. Shepherd communicates the first part of an article on methods of determining the position of the auditory sacculus and its contained otoliths in various groups of fishes.

IN an article on the effect of geographical distribution on the development of species, published in the March number of the *American Naturalist*, Mr. A. C.

Chandler enunciates a law that as the distributional area of any given group of animals increases, the number of species increases in proportion to the genera, that of genera to the families, and so on. The theoretical explanation of this law involves the consideration of problems relating to evolution and species-development.

THREE important additions to the Natural History Branch of the British Museum are recorded in the March number of the *Museums Journal*, namely, a series of more than 900 zeolites collected and presented by Mr. F. N. A. Fleischmann, a collection of 800 specimens of plants made in the Eket district of Southern Nigeria by Mr. and Mrs. P. A. Talbot, by whom they were presented, together with descriptions and coloured sketches, and, lastly, a collection of more than 10,000 specimens of Hymenoptera (including 1500 types), brought together by the late Mr. P. Cameron, and purchased from his executors.

THE most interesting feature in the March number of the New York Zoological Society's Bulletin is Mr. Townsend's account of the capture and transport of the bottle-nosed dolphins, or porpoises (*Tursiops tursio*) in the New York Aquarium. There is a regular fishery of these cetaceans at Cape Hatteras, N. Carolina, and in November last a small "school" of them was captured and dispatched to New York in special water-tanks. Nine reached their destination in safety, and of these five were alive and in excellent health at the time the article was written. They are kept in a salt-water pond of 37 ft. in diameter by about 7 ft. in depth, and constitute a unique and highly attractive exhibit.

AMPHIBIANS and reptiles loom large in the March number of Douglas English's *Wild Life*, Mr. E. G. Boulenger communicating an exquisitely illustrated article on some of the well-known species of European toads, while in a second he figures the first living example of the saddle-backed giant tortoise (*Testudo abingdoni*), of Abingdon Island, Galapagos group, received alive in this country. In a note regarding other giant species the author mentions that about 1760 no fewer than 25,000 of these chelonians were exported from Rodriguez to Mauritius for food in a single year. Little wonder that the species of the former island soon became exterminated. In connection with giant tortoises, it may be mentioned that remains of an extinct species from the Pleistocene of Minorca are described by Miss Bate in the March number of the *Geological Magazine*.

A NEW serial, of the first number of which we have received a copy, has been started at Buitenzorg, under the editorship of Dr. J. C. Koningsberger, and published by the Department of Agriculture, Industry, and Commerce, with the title of "Contributions à la Faune des Indes Néerlandaises." It is specially intended for papers emanating from the Zoological Museum and Laboratory of Buitenzorg, and the Biological Station at Batavia, which have hitherto appeared in another local publication. The new issue appears, however, as a section of the well-known "'s Lands Plantentuin," dating from 1817. Its contents include an article by Dr. C. P. Sluiter on holothurians collected by Mr. P. N. van Kampen in the Malay Archipelago, and a list of chelonians from the Dutch East Indies in the Buitenzorg Museum.

IN a recent number of the *Memorias do Instituto Oswaldo Cruz* (vol. v., part 2), a memoir, illustrated by beautiful coloured plates, is published by Drs. Aragao and Vianna on the disease known as *Granuloma venereum*. The authors deny that a treponeme is the cause of the disease, which is quite distinct from syphilis. They associate the disease with a peculiar bacterium occurring in the cells of the granulomatous tissue. The most striking characteristic of this organism is the possession of a peculiar capsule, for which reason they propose to put it in a distinct genus, Kalymmabacterium (or Calymmatobacterium; the name is spelt in both these ways in the same paragraph). The authors have obtained very remarkable success in the treatment of this disease with injections of tartar-emetic; they state that this treatment has effected a complete cure in every case treated by them, and the photographs given of cases before and after treatment are quite astounding. Full descriptions are given of a number of cases and of the progress of the treatment. Incidentally, it is mentioned that injections of tartar emetic have been found most efficacious in the treatment of leishmanioses in Brazil.

THE Carnegie Institution of Washington has published together a paper by Prof. W. E. Castle, "Reversion in Guinea-pigs and its Explanation," and one by C. C. Little, "Experimental Studies of the Inheritance of Color in Mice" (Publication No. 179, issued September, 1913). Prof. Castle shows that some red guinea-pigs when mated with black give blacks, black being dominant, but that other apparently similar reds when mated with blacks give agouti. A series of breeding experiments proves that the cause of the difference is that some reds contain a factor which brings about striping in the hair. It has no effect in the red, from which black pigment is absent, but black, in the presence of the striping factor, becomes agouti. Mr. Little's paper adds some new and probably valuable ideas to the already extensive literature of coat-colour in mice. He points out that yellow, brown, and black pigment are produced by three successive stages of oxidation of a chromogen. He suggests that albinos lack the factor *Y* (yellow) which produces the first stage, and that the higher factors *Br* (brown) and *B* (black) are then unable to act. Brown is produced by the presence of *Y* and *Br*, black by *Y*, *Br*, and *B*. Yellow, which in all the cases he has used is dominant to other colours, is caused by a factor inhibiting the action of *Br* and *B*. There are in addition two classes of "distributive" factors. One of these causes full development of pigment; its absence causes dilute colour. Another is necessary for full development of *Br* and *B*; in its absence the mice are pink-eyed with pale-coloured hair. Both these factors are somewhat variable in intensity. The other pair of distributive factors are that for the agouti barring of the hair, and that which more or less completely inhibits *Br* and *B*, giving

dominant yellows. The question of piebalding is also dealt with, and many pages of tables of experimental results are included.

THE unexpected discovery of hot springs and evidences of recent volcanic activity in Spitsbergen is described and illustrated by A. Hoel and O. Holtedahl in *Naturen* for January, 1913. The occurrences are in Wood Bay, on the little visited north coast of the main island. The springs have formed characteristic travertine basins, in which a species of Chara is recorded, with a moss and twelve algal species which are equally new to the high arctic flora. The characteristic forms in the moving soils of Spitsbergen, with their walls of stones set in circular cracks, are described by W. Meinardus in the *Sitzungsberichte des Naturhistorischen Verein der preuss. Rheinlande u. Westfalens*, 1912 (published 1913), C, p. 1. A useful bibliography is appended. B. Högbom points out the various features in Spitsbergen that indicate the dryness and the desert-character of present conditions in the island (Bull. Geol. Institution of the Univ. of Upsala, vol. xi., p. 242), and A. Smith Woodward describes Lower Triassic fish-remains from Sassen Bay in the same volume.

THE Messina earthquake of December 28, 1908, originated in two foci, both beneath the Straits of Messina, one at its northern entrance, the other between Reggio and Messina. Almost exactly four years later, on December 22, 1912, a strong earthquake occurred, probably within the latter focus. According to Dr. Agammennone, who describes the earthquake in a recent number of the *Rivista di Astronomia*, the shock was not announced by any early tremors; it disturbed an area only 135 miles in diameter; but, though its intensity at Messina was 7 (Mercalli scale), the shock failed to damage buildings erected in accordance with the new regulations.

WE are glad to learn that the United States have again decided to send revenue cutters to the vicinity of Newfoundland Banks for the purpose of reporting on the conditions of the ice. The *Seneca* has already taken up her position, and is sending wireless reports to the Hydrographic Office in New York, in addition to which she will make oceanographic observations while cruising in that district. The meteorological charts of the North Atlantic issued by the offices at London and Hamburg for April show that drift ice has recently increased to a considerable extent. Bergs or field ice were seen on or before February 15 nearly so far south as 42° N., and nearly so far east as 41° W. Several ships have had to alter their course, considerably, off the Newfoundland Banks.

THE question whether thermometers in the double-louvred "Stevenson" screen, now generally used in this country give true measurements of air temperature has been discussed in *Symons's Meteorological Magazine* for several months past. Mr. W. F. A. Ellison considers that the accuracy that some observers are striving for is fallacious, and that on a sunny day no two adjacent masses of air have the same temperature. An important communication from Dr. John Aitken appears in the March number. He considers that, although the whole mass of air is a mixture of more or less heated patches, the thermometers in the screen in question fairly represent the mean temperature, but that the screen must always read higher than the true temperature, while the sun shines. He points out the important fact that some of the screens in use in the north and south of the country are not similar in construction in all respects.

ENGLISH readers of Italian scientific journals have often been rather puzzled when they have come across such names as Giuseppe Larmor, Guglielmo Ostwald, or Enrico Poincaré. From a note published in *Isis*, vol. i., part 4, p. 707 (1914), by Aldo Mieli, we are glad to learn that this practice is being discontinued, and he now opens the further question as to how uniformity can be obtained in the spelling of classical names and others possessing different alphabets from ours. Here it is suggested that the nominative case should be universally adopted, and in the case of Greek a uniform system of equivalents for the Greek letters should be adopted. In this list he still adheres to the custom of replacing the Greek *ph* by *f*.

ARTICLES of a semi-popular character *about* mathematics, as distinct from papers *on* mathematics, are not so common as they deserve to be. The February number of the new quarterly, *Isis* (vol. i., part 4) goes a long way to supply this want. Mathematics is represented by three of the five principal articles. M. George Sarton writes on modern tendencies in mathematical history and criticises the recent works of M. Leon Brunschvicg (Paris: Felix Alcan, 1912) and M. Pierre Boutroux (Paris: Hermann, 1913–14), both of which volumes are also reviewed in this number. In Prof. Gino Loria's paper on the glories of British mathematics, which was read at the International Congress of Historical Studies in London in 1913, the author laments the scarcity of literature dealing with the history of English mathematics, and expresses the opinion that many valuable and interesting manuscripts are waiting to be unearthed. Mr. P. E. Jourdain writes on the origin of Cauchy's conceptions of a definite integral and of a continuous function. In addition there are a number of reviews of mathematical books. The subscription to *Isis* is 24 francs per annum, and the offices are at Wondelgem les Gand, Belgium. Messrs. Max Drechsel, of Berne, are agents.

THE photographs of the tracks of α and β particles obtained by Mr. C. T. R. Wilson with his cloud apparatus illustrate so well the properties of these radiations, that many teachers will be glad to know the Cambridge Scientific Instrument Company is now producing copies of them in the form of lantern slides. The clearness of the photographs raises the hope that it may be possible to obtain stereoscopic photographs which would enable depth to be estimated, or possibly kinema views which, when run through the lantern slowly, would allow the sequence of events to be followed.

ALTHOUGH the incandescent electric lamp when standardised and used with accurate ammeters has proved the most trustworthy standard of light, the

Bureau of Standards at Washington has selected the Harcourt 10-candle pentane lamp as the best of the gas-flame lamps to serve as a secondary standard. This decision has been arrived at after an extensive test of the various lamps, and the conclusions with regard to the best method of using the standard are embodied in a paper by Messrs. E. C. Crittenden and A. H. Taylor, which appears in the tenth volume of the bulletin. They cover the question of the fuel and the effects of pressure and moisture on the candle-power.

A SUCCESSFUL modification of General Sterneck's pendulum apparatus has been designed and employed by Sig. Vincenzo Reina and Gino Cassinis in the determination of gravity (relative) at Rome, Arcetri (Florence), Livorno and Genoa in Italy, and also at Vienna and Potsdam (*Memorie R. Acc. Lincei*, series v., vol. ix., No. 17, pp. 751–839). In the earlier forms, such, for instance, as those used in the gravimetric survey of the Indian Peninsula, and more recently in Egypt, the pendulum support is a solidly constructed tripod resting on and clamped to a masonry pillar. Although maximum rigidity is aimed at, yet under the alternating strains induced by the swinging pendulums the support is found to be appreciably yielding, and the determination of the effect of flexure constitutes one of the necessary pieces of preliminary work. It is obtained by observing the oscillation of the invariable pendulum induced by a heavier synchronous (variable) auxiliary pendulum swinging in the same plane (method of Schumann). In the Italian modification the means for applying this method is made an inherent feature of the design. The trustworthiness of the correction is increased by securing (1) greater equilibrium in the distribution of parts, (2) that the correction is obtained with the invariable pendulum swinging in the position used in the actual determinations. These improvements are realised by mounting the single perforated agate plate on which the knife edges of the pendulums bear when they are in motion on two consoles, which can be bolted to a vertical surface. Only one invariable pendulum is swung at a time. With this arrangement the effect of flexure is less than one-tenth of that of the tripod type, the maximum correction of nine different groups being $-3{\cdot}9\times10^{-7}$ secs., whilst the minimum was $-1{\cdot}5\times10^{-7}$ secs.

WE have received a reprint of a paper read before the eleventh International Congress of Pharmacy, held at Scheveningen last September, by Prof. Hans Haller, of Leyden, on the application of comparative phytochemistry to systematic botany. Illustrations are given of the growing importance of a knowledge of the chemical substances elaborated by plants in elucidating vexed questions of classification and in throwing light on phylogenetic relations. The field is one which has as yet been little worked, but it will in the future undoubtedly become more and more fruitful.

THE *Società Tipografica Editrice Barese*, of Bari, Italy, announces the forthcoming publication of a series of reprints of scientific and philosophical classics under the title, "Classici delle Scienze e della Filosofia." In some respects this series will resemble the valuable collection already issued by Ostwald in Germany, under the title "Klassiker der exakten Wissenschaften," but the venture will be on an even more ample scale; it will render easily accessible to the student of the historical development of science many classical papers which have hitherto been obtained only with great difficulty. Each volume will contain about 300 pages, and will cost about 3 lire. The whole series is under the general editorship of Messrs. Aldo Mieli and Erminio Troilo. All scientific workers will wish success to this praiseworthy enterprise. The following are specimens of the titles of volumes already issued:—Spallanzani's "Saggio sul sistema della generazione" (1777); Biringuccio's "De la Pirotechnia" (1540), vol. i., and a translation of Descartes's "Principia Philosophiæ." Amongst those to appear at an early date are Francesco Redi's "Esperienze intorno alla generazione degli insetti," Galileo's tracts on motion, and several reprints of the scientific works of Leonardo da Vinci, Volta, Giordano Bruno, and Vico, to mention only a few of those announced as already in the press.

MESSRS. NOVELLO AND CO. have published a second edition of Dr. Jamieson B. Hurry's "Sumer is icumen in." The attractive volume was originally published at the time of the unveiling at Reading Abbey of a memorial tablet, bearing a facsimile of the canon, which, it may be remembered, was written by a monk at Reading Abbey, about the year 1420.

OUR ASTRONOMICAL COLUMN.

COMET 1914*a* (KRITZINGER).—Circular No. 145 from the Central Bureau at Kiel contains the following elements and ephemeris, communicated by Prof. Kobold, deduced from observations on March 29, 30, and 31:—

Elements.

$T = 1914$ May $31{\cdot}1816$ M.T. Berlin.
$\omega = 67^\circ\ 0'{\cdot}95'$
$\Omega = 198\ 36{\cdot}68$
$i = 23\ 30{\cdot}86$
$\log q = 0{\cdot}09910$

Ephemeris for 12h. M.T. Berlin.

	R.A.	Decl.	Mag.
	h. m. s.	° ′	
April 8	16 43 30	−3 36·4	10·1
9	46 56	2 53·8	
10	50 24	2 10·2	10·0
11	53 54	1 25·4	
12	16 57 27	−0 39·9	

The ephemeris shows that the comet is reducing its southern declination; it is situated in the constellation of Ophiuchus.

THE NEW SOLAR CYCLE.—The long period of apparent rest which the solar atmosphere has been recently undergoing has now been broken by the comparatively large sun-spot which developed during the course of last week. The sun-spot activity of the last few years has been well summarised in the annual report of the council of the Royal Astronomical Society (*Monthly Notices*, February, 1914). In this we are told that the past year has been a year of minimum activity of sun-spots, more than a century having elapsed since the sun exhibited such complete and

prolonged quiescence. The following brief table is gathered from the report above mentioned, and brings out clearly the exceptional nature of the year 1913 :—

Year	Days without spots	Mean daily spotted area in millionths	No. of separate groups
1911	183	64	62
1912	246	37	39
1913	320	5	15

It is stated that no year since 1810 has given such a barren record as that just elapsed. The new cycle was indicated last year by two groups in high latitude, the chief criterion for the beginning of a new cycle.

RELATION BETWEEN STELLAR SPECTRA, COLOURS, AND PARALLAXES.—In *Astronomische Nachrichten*, No. 4722, Herr P. Nashan describe the results he has obtained in comparing the colours, spectra, and parallaxes of a number of stars. Dealing first with 101 stars, he divides them first into three classes, α, β, and γ, according as the stars are white, yellow, or red; the parallaxes are also grouped with three divisions as follows :—0·000″ to 0·050″, 0·050″ to 0·100″, and 0·100″ to 0·200″. The comparison shows that the white stars decrease with increasing parallaxes; on the other hand, the red stars increase with increasing parallaxes. The fact that there is a close relationship between the colour and the spectrum of a star has led him to compare the spectra of 246 stars with their parallaxes. The results are best shown as follows :—

Spectrum	No. of stars	Parallax 0″·000—0″·050		0″·050—0″·100		0″·100—0″·150		0″·150+	
		n	%	*n*	%	*n*	%	*n*	%
B	11	7	63·6	3	27·3	1	9·1	0	0
A	28	8	28·5	8	28·5	7	25·0	5	18·9
F	59	19	32·2	22	37·3	15	25·5	3	5·1
G	64	13	20 3	22	34·4	27	42·2	2	3·1
K	70	13	18·6	21	30·0	23	32·9	13	18·5
M	14	3	21·4	2	14·3	5	35·7	4	28·6

Herr Nashan then couples up the B and A stars into a white group, the F and G into a yellow group, and the K and M stars into a red group, and concludes that the relative number of white stars decreases with increasing parallaxes, while the relative number of the red stars increases with increasing parallaxes, a result similar to that obtained with colour alone. The communication concludes with the list of the 246 stars employed, giving their positions for 1900·0, parallax, type of spectrum, and colour.

SERIES LINES IN SPARK SPECTRA.[1]

PREVIOUS work on series lines in spectra has dealt chiefly with lines produced in the electric arc, or in vacuum tubes with discharges of moderate intensity. The lines discussed in the present communication are some of those which are specially developed in the condensed spark, belonging to Lockyer's class of "enhanced lines." The investigation was undertaken in connection with the new lines (λ 4686, etc.) produced in 1912 by passing strong condensed discharges through helium tubes, which always contained an impurity of hydrogen. These lines are of great interest in celestial spectroscopy, and, following Rydberg, they were assigned to hydrogen, to the lines of which they seemed to have a simple relation, while having no apparent connection with those of helium. The evidence for assigning the lines to hydrogen, however, was still numerical rather than experimental, and further inquiry was called for, especially in view of the presence of an intermediate set of lines associated with the Rydberg series. A search for other series of this character was therefore instituted in the hope that some generalisation with regard to them might be reached. The well-known spark line of magnesium, λ 4481, was subsequently found to be the leader of a series of this kind, but no relation to other magnesium series was then traced.

The lines of the "4686" series have since become of increased importance, in connection with theories of the constitution of the atom, through the theoretical work of Dr. Bohr, who explains them as being produced during the first stage in the re-formation of helium atoms from which both electrons have been removed by the strong discharges employed. The "4686" and the intermediate series were thus united in a single series of a new type, in which the Rydberg series constant N(=109675) had four times the value associated with hydrogen. A similar modification of the usual formula was found to be applicable to the magnesium series, and also to some lines of calcium, strontium, and barium observed by Lyman in the Schumann region. At this stage a valuable contribution to the investigation was made by the work of Lorenser, from which it results that the enhanced lines of the elements named form groups of series similar to those found in arc spectra. Further calculations have shown that these series are best represented by the Hicks formula with 4N for numerator.

A further experimental investigation of magnesium has resulted in the production of many new enhanced (spark) lines, from which it appears that the "4481" series is the fundamental series of a system of narrow doublets, in which the separation of the pairs is identical with that calculated for the *second* member of the principal series of wider doublets previously known. It has also been shown that the "4481" series consists of very close doublets with constant separation. Two well-defined combination series related to 4481 have also been identified.

From these investigations of enhanced metallic lines it follows that two kinds of series must now be recognised :—(1) Series of the arc type, having Rydberg's "N" for the series constant; and (2) series of the spark, or enhanced line, type, having a series constant equal to 4N. No numerical relations between the two sets of series occurring in the same element have been traced.

The "4686" series produced in helium tubes is of the spark (4N) type, and can no longer be considered to belong to the same group as the Balmer series of hydrogen, which is of the arc (N) type. It is concluded that the lines in question are due to helium, as indicated by Bohr, and it is suggested that they should be designated "proto-helium" lines in accordance with the convenient nomenclature of Lockyer. The "Pickering" lines associated with the "4686" series probably have a similar origin, in which case the series would include intermediate lines nearly coincident with the Balmer lines of hydrogen. Observational evidence on this point is incomplete, but indirect evidence is furnished by the fact that one of the new combination series is related to the 4481 series exactly as the extended Pickering series would be related to the "4686" series of proto-helium.

Dr. Bohr has shown that the slight differences in the observed positions of alternate lines of the "4686" series and those calculated for the principal series of hydrogen by Rydberg are accounted for when his theoretical formulæ are corrected for the mass of the electron (NATURE, October 23, 1913). If the

[1] Summary of Bakerian lecture delivered at the Royal Society on April 2, by Prof. A. Fowler, F.R.S.

formulæ are correct, the inverse calculation provides a spectroscopic method of determining the mass of the electron. The available observations give the mass of the hydrogen atom in terms of that of the electron as 1836 ± 12, in remarkable agreement with the generally accepted value.

Until other evidence is forthcoming, it may be considered that the line spectrum of hydrogen consists only of the Balmer series, with parallel series in the infra-red and extreme ultra-violet. The proto-helium spectrum is of the same simple character, and this simplicity gives the two spectra a special value in theoretical investigations. Bohr's theory implies that arc series in general are produced when only one electron is removed from the atom by the exciting source, and spark series when two electrons are removed.

The change in the character of the series in passing from arc to enhanced lines suggests the possibility of series requiring still greater multiples of the ordinary series constant, but no such series have yet been identified.

PRACTICAL EDUCATION IN SECONDARY SCHOOLS, TRADE SCHOOLS, AND CENTRAL SCHOOLS.[1]

ONE of the most striking features of English education at the present time is the attempt which is being made to give a more practical or vocational bias to the training of boys and girls between the ages of twelve and sixteen years—that is, after the completion of the ordinary primary-school curriculum. So far as day work is concerned, this tendency is operating along two main lines, (*a*) the modification of the traditional secondary-school course by the introduction in some schools of elementary engineering, agriculture, shorthand, typewriting, or of subjects grouped under the general name of "educational handwork" (*e.g.* woodwork, metal-work, domestic subjects for girls); (*b*) the development of schools (central schools, junior technical schools, trade schools) with a pronounced vocational object.

A. *Secondary Schools.*—In the year 1911–12, of the total number (39,726) of new admissions to the secondary schools aided by the Board of Education, no less than 67·7 per cent. came direct from the elementary school. Clearly the great majority of these cannot enter one or other of the learned professions, but must devote themselves on leaving school to some branch of commercial or industrial life. A strong public demand has arisen for a modification of the curricula of these schools so that the education given may be of more direct value to the pupils after leaving school. Employers are demanding better trained assistance; the parents feel that the additional sacrifices they must make in order to keep their boys and girls at the schools after fifteen years of age are not sufficiently justified by the benefits to be derived by their children from an education which is mainly of a literary or classical type. As a result, some secondary schools have specialised to a certain extent, more particularly of course in the higher forms, in engineering subjects, others in science (chemistry, physics, botany, and biology) as applied to agriculture, others in commercial and secretarial work, depending upon the needs and circumstances of the locality. Apparently the results of this specialisation, where it has been attempted, have been satisfactory. The general educational work of the school has gained in interest and vitality by the increased contact with concrete, everyday affairs. Possibly it may help also in checking the exodus of the pupils from the secondary schools at about the age of fifteen, *i.e.* half-way through their full course.

The Consultative Committee of the Board of Education issued a short time ago a comprehensive and suggestive report upon the development of "educational handwork" of various kinds (woodwork, metal-work, gardening, modelling, and domestic subjects for girls) in secondary schools. The report states (p. 5) that the evidence of the witnesses "leaves no room for doubt as to the necessity and the practicability of giving such work a more definite place in secondary education than it has hitherto occupied, and of associating it so far as possible with the rest of the work of the school." While it is not the function of the secondary school to impart technical instruction, it should provide those of its pupils whose future callings may involve manual work or the utilisation and control of such work with a foundation on which technical instruction may subsequently be built. "Systematic work with the hands is a necessary constituent of a liberal education." To train deftness of hand, although important, is not the sole or even the chief aim of handwork teaching. The principal object is to influence the mind and character of the pupils by developing their common sense, readiness, and adaptability. In addition it brings the work of the school into close relation with the needs of daily life outside the class-room, thus giving school work that reality which is so important for arousing the child's interest. Manual training has a valuable steadying influence upon the over-quick and excitable child, and a stimulating effect upon the child who is naturally slow at abstract mental processes.

The recognition of handwork as a compulsory school subject has been objected to on the ground that it involves the addition of one more item to an already overburdened time-table. Experience shows that a reasonable amount of time devoted to handwork does not lead to any lowering of attainment in other branches of school work, but rather the reverse.

The Committee lays down the following general principles for the teaching of all branches of educational handwork. The encouragement of independence and initiative is of fundamental importance, hence each pupil should be allowed to work at his own pace and be encouraged to select his own work. Classes should be sufficiently small to permit of individual instruction. Constructive practice and theory should go hand in hand. The syllabus should be logical, coherent, interesting, and of a direct culture value. A number of syllabuses which are in actual operation in schools are given in the report. These will be of great value to teachers.

Handwork should be recognised in any general examination scheme for secondary schools. External examinations in this subject are particularly undesirable; the assessment of the progress made by the pupil should be based upon the work done during the course.

The Committee points out that at the present time the educational training, status, and remuneration of handwork teachers are unsatisfactory. These teachers should be on an equality in these matters with their colleagues. This type of teaching should not be handed over to artisans, but to men with a good general education and a special knowledge of educational handwork. The universities should provide increased facilities for this branch of education, and adequate recognition of those who complete successfully the prescribed courses of study.

B. *Central Schools, Junior Technical Schools, Trade Schools.*—In this group of schools the work as a

[1] (1) Report of the Consultative Committee of the Board of Education on Practical Work in Secondary Schools [Cd. 6849]. (Wyman and Sons, 1913. Price 1*s.* 9*d.* (2) Report of the Board of Education for 1911–12 [Cd. 6707]. (Wyman and Sons, 1913.) Price 8½*d.* (3) Regulations for Junior Technical Schools in England and Wales [Cd. 6919]. (Wyman and Sons, 1913.) Price 1½*d.*

whole has a more pronounced practical or vocational bias than in the secondary schools, this being most marked in the trade schools and least in the central schools. The students in these schools are in nearly every case drawn from the elementary schools. The usual age of admission is twelve or thirteen years, the courses lasting three to four years. The fees are nominal, ranging from 10*s*. to about 2*l*. 10*s*. per annum. There is usually a generous supply of scholarships with maintenance grants awarded by the local education authority.

(1) *Central Schools*.—The last Board of Education report (*i.e.* for 1911–12) states that central schools have been established only in London and Manchester as yet. In London there are thirty-one such schools containing forty-two departments, fifteen for boys, thirteen for girls, and fourteen "mixed"; nineteen of these departments have a commercial bias, sixteen industrial, and seven a "dual" bias. Manchester has six such schools, including three boys' departments, two girls' departments, and three mixed departments.

These central schools are intended to attract at about the age of twelve or thirteen the best boys or girls from the local elementary schools, who have not previously been drafted off by means of competitive scholarships into the secondary schools. The object of the schools is to continue the general education of the pupils and at the same time to prepare the children to go directly at about the age of fifteen or sixteen into business houses or workshops at the completion of the course. The training is to be such, however, that it will not prevent the pupil proceeding by scholarships or otherwise to a place of higher education.

An examination of the curricula of these schools reveals comparatively little difference between them and those secondary schools which have definitely attempted to introduce vocational work into their programme. A typical central school (with a commercial bias) provides throughout the whole course, in addition to the ordinary subjects, such as mathematics, geography, and history, about four hours a week for a modern language, four hours a week to English, science two hours, manual training two hours, and drawing two hours. In the third and fourth years a few hours a week are devoted to shorthand, business correspondence, office routine, and typewriting. In departments with an industrial bias, about ten to twelve hours a week are given to practical work (laboratory work, drawing, woodwork, and metalwork). No attempt is made to specialise for any one particular industry. The practical work for girls consists of elementary science and housecraft. This type of school as a whole, though doing excellent work, suffers somewhat in the public estimation through it being regarded as inferior in prestige to the ordinary secondary school. The training given in the central schools is probably better fitted to the after circumstances of the majority of boys and girls from the elementary schools than is that afforded by the usual type of secondary schools.

(2) *Junior Technical Schools and Trade Schools*.—This class of schools suffers from a bewildering variety of names—junior technical schools, trades preparatory schools, pre-apprenticeship schools, and trades schools. Generally speaking, the junior technical schools provide a wider training in general education and in theoretical work than the trades schools. Again, junior technical schools are understood not to specialise for one particular trade, but to provide a training enabling a boy to enter any branch of a group of industries, such as engineering or the building trades. The trades schools specialise more severely than this in many cases. Actually, the names of the schools are often misleading, so-called "trades" schools being really "junior technical" schools. At the present time the general tendency is in favour of the "junior technical school," with its wider educational outlook and less severe specialisation, rather than the "trades" school proper.

There are about sixteen junior technical or trades schools in London, with about 800 boys and 3000 girls in attendance. In other portions of England and Wales there are about twenty such schools, with, say 1200 pupils, and in Ireland twelve schools with 500 pupils. Scotland relies upon a system of "supplementary classes," which in effect is very similar to the "central schools" described earlier.

The provincial schools are usually designed to provide only for the engineering, building, and metal trades. Manchester has recently established a Day Trade School of Dressmaking. London trade schools cover a wide field of more or less specialised instruction, *e.g.* furniture and woodworking trades, book production, silversmith's work, tailoring, bakery and confectionery, cookery (for *chefs*), and many women's trades. The net annual cost of the trade schools maintained by the London County Council is approximately 15*l*. to 21*l*. a student. There is no definite provision, except at Cardiff, for instruction in commercial subjects along junior technical-school lines.

The curricula of these schools vary considerably. Broadly speaking, each school allows about three to four hours a week for English, three to four hours a week for mathematics or arithmetic, and of the remaining time, about one-third is devoted to theoretical instruction in the theory or sciences, if any, allied to the special trade or industry, and about two-thirds to the practice of the trade or practical work (including drawing office, workshops, laboratory work, or drawing) connected with the industry. Considerable attention is given to continuing the general education of the pupils, with the result that but for the omission of a modern language, the boy of sixteen in the better type of junior technical school is educationally on a level with the average boy of the same age in the secondary school. The physical welfare of the children is helped through the agency of organised games and gymnastics. The pupils are encouraged to organise clubs and societies in order to foster the social life and corporate spirit of the schools.

On the whole this type of school has been very successful, especially perhaps the trade schools for girls in London. Close contact with the trades and industries is secured in many of the schools by the formation of "advisory committees," consisting of representatives of employers and of labour. The pupils are generally keen upon their work, and the tone of the schools is good. There is comparatively little difficulty in most cases in securing positions in industrial life for the boys or girls at the completion of their course. The work done in these schools generally enables the boy or girl to shorten the period of apprenticeship very considerably and to obtain higher wages than they would otherwise have secured.

The success of the relatively few junior technical schools or trades schools which have been established so far points to the probability of a rapid increase in the number of these schools in the immediate future. Broadly speaking, about half a million boys and girls leave the elementary school each year, less than one-tenth of these passing forward to the secondary school, and only about 2000 to the junior technical or trades schools. Of the remainder, a considerable proportion would probably amply repay further systematic full-time education, not of the customary literary type, but of a more practical character, such as is given in the junior technical or trade schools. One point, however, must be watched. The Board of Education,

in the recent regulations for junior technical schools, states that these schools are not intended to furnish a preparation for higher "full-time" technical work, this being one of the functions of the secondary school. This would make the junior technical schools a "dead end" so far as further day technical work is concerned. In science and mathematics, the fundamental subjects in technical work, the boy in the junior technical school is ahead of the secondary-school boy. The junior technical school should be another avenue, alternative to the secondary school, by means of which the bright boy could pass from the elementary school to the technical college. This is especially important in the case of the boy who develops somewhat late or whose mental activities only become aroused by contact with things rather than with books.

J. WILSON.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE spring meeting of the Institution of Naval Architects opened on April 1 at the rooms of the Royal Society of Arts. The institution's gold medal was awarded to Mr. G. S. Baker, for his paper on methodical experiments on mercantile ship forms. Premiums were awarded to Messrs. A. Cannon and L. Woollard for papers dealing respectively with the effect of loose water on the rolling of a ship, and the effect of water chambers on the rolling of ships. In all fourteen papers were read and discussed during the three days over which the meeting extended.

In a paper dealing with some questions relating to battleship design, Mr. T. G. Owens states that the present tendency in warship construction and design, as exemplified in the later ships of all the principal maritime powers, is towards very large displacements, with the arrangement of all the guns of the primary armament on the centre line, and with the guns of the secondary armament placed in an armoured citadel on, or immediately below, the deck carrying the primary guns. In respect to the above-water armoured protection, there is the usual thick armoured belt, extending, say from 4 to 6 ft. below the water-line, to the height of the main deck, and carried along the length of the vessel for such distance as to protect the machinery and boiler compartments and the magazines. The ends of the ship and the citadel have armour of reduced thickness. In all modern battleships there are horizontal protective decks. Protection against attack from bombs, etc., dropped from aircraft is not yet in the region of practical politics. When the time arrives to arrange measures to meet such attack, they will probably take form in the method advocated by Sir Trevor Dawson, *i.e.* to increase the thickness, and give a greater curvature, or whale-back formation, to the armoured deck.

Mr. W. J. Luke contributed a paper on experiments upon wake and thrust deduction, supplementary to another paper which he presented to the institution in 1910. The present paper has particular reference to experiments with contrary-turning screws on a common axis, with tandem screws, and also of experiments with quadruple screws. It appears from the experiments that the first-mentioned type of screw has not a little to recommend it, and were the engineering difficulties connected with its application to marine propulsion overcome, it would be well worthy of consideration. Tandem screws have nothing to recommend them.

Mr. J. T. Milton read a paper on the present position of Diesel engines for marine purposes, and Prof. W. E. Dalby described some results of trials made on a small Diesel engine in which accurate indicator diagrams were obtained by means of a new form of optical indicator.

Mr. G. S. Baker gave an account of a number of model experiments made to determine the effect of shape of area curve on the resistance at any reasonable speed. This paper gives also a brief account of the work of the year at the William Froude tank. A large proportion of time has been spent on test work for various shipbuilding firms. The resistance of at least five large vessels has been reduced more than 10 per cent. by modifications to the form made at the tank, and several others have been improved in a less degree. The importance and value of these results can be seen from the fact that the saving in cost of coal per annum for a single one of the above five ships would be more than sufficient to support the experimental tank for the same period. The investigation of the resistance and tipping moments experienced by aero-hydroplane floats has been continued. Considerable improvement has been effected in the power required for their propulsion, the tipping moments due to the water forces are now known, and a float which is stable in character and of a low water resistance has been evolved. Ship models have been tested with four different kinds of surface, the paraffin wax being (*a*) bare, (*b*) freshly coated with shellac varnish, (*c*) the same, with blacklead rubbed into a coating of shellac when the latter was "tacky," and then allowed to harden, (*d*) coated with red lead paint. The spots from the four surfaces were indistinguishable, and show that, provided the surface is smooth and free from grit, the same result will be obtained.

Mr. H. Gray gave the results of experience with superheated steam, with special reference to economy and cost of upkeep, based on more than three years' working in engines of both triple- and quadruple-expansion types in the mercantile marine engaged in regular trade, voyage after voyage, to Australia *viâ* the Cape of Good Hope. The system adopted was the Schmidt. None of the steamers have been delayed either in port or on the voyage by reason of superheater defects, notwithstanding the fact that the runs are long—that of the *Port Augusta* being forty-five days without a call at any port. Lubrication of the cylinders and valve faces is of the utmost importance with superheated steam, and it is absolutely necessary to have a trustworthy system of filtration for the feed-water, so as to ensure the abstraction of the oil and to safeguard the boilers from the possibility of any traces of oil being introduced. The author states that the economy of triple-expansion engines of 2000 i.h.p. after being altered to use superheated steam, has been increased about 12 per cent., and of quadruple-expansion engines, about 17·8 per cent.

Mr. C. E. Stromeyer contributed a paper on the elasticity and endurance of steam pipes, and a note on the Foster strain meter, and some data obtained therewith were presented by Mr. W. R. Gerald Whiting.

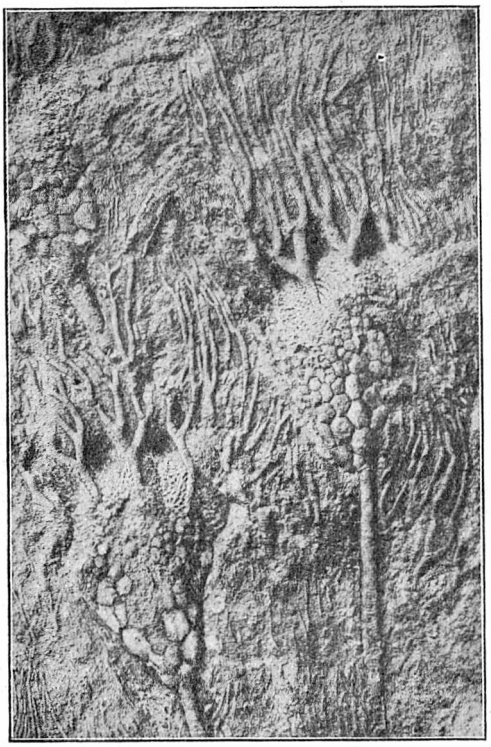
Dr. K. Suyehiro, professor of naval architecture at Tokio Imperial University, described a new torsion-meter which he has devised. This instrument has some interesting features. The angle of twist of the shaft is measured by the relative rotation of two arms, one clamped to the shaft, and the other carried by a long tube clamped to the shaft at the end remote from the other arm. The first-mentioned arm carries a scale having half-millimetres along one edge and a reading scale along the other. The scale faces the shaft, and mounted on the same arm is a plane mirror, situated half-way between the shaft axis and the scale. Hence a virtual image of the scale will be seen every revolution, coinciding with the shaft axis, and therefore at rest. On the other arm is a concave mirror which forms an image of the reading edge of the scale, also on the shaft axis, and side by

side with the first image. Both images are picked up by a reading telescope, and their relative displacement when the shaft is twisted may be read easily. The advantage of the instrument lies in the fact that the scale, as well as the optical parts, rotates with the shaft, and the reading telescope requires but little adjustment. Other types in which the scale does not rotate, require considerable adjustment in a place, viz., the shaft-tunnel, where adjustment is not easy to carry out.

Other papers read dealt with the stability of ships in damaged conditions, and the rolling of ships. Mr. H. E. Wimperis described his instrument for the measurement of velocity of roll, which depends for its action on a small electrically-driven gyrostat.

PAPERS ON INVERTEBRATES.

A REPORT on the Crustacea Schizopoda, collected by the Swedish Antarctic Expedition, 1901–3, has been published, in 4to form, by G. E. C. Gud, of Copenhagen. In his preface, the author, Mr. H. J. Hansen, states that this memoir, which is illustrated by six plates, should be regarded as a further contribution to his account of the Mysidacea and Euphausiacea (the two main groups of the Schizopoda) of the world. A considerable number of new



Two Calyces of Scyphocrinus. From Proc. U.S. Nat. Mus.

species are named, and revised descriptions of others previously known to science given, but as these appeal only to specialists, they must be passed over without further mention.

Of more general interest is Mr. R. S. Bassler's description (Proc. U.S. Nat. Mus., vol xlvi., pp. 57–9) of a remarkably fine slab of fossil crinoids from the Middle Palæozoic strata of the Mississippi Valley, north of Cape Girardean, Missouri, which has recently been placed on exhibition in the American Museum. This slab, measuring 4 ft. by 7 ft., contains eighteen complete crowns of Scyphocrinus, two of which are shown in the accompanying illustration, together with a number of bulbs of the so-called Camarocrinus; the latter, as pointed out by Dr. Bather, really pertaining to the former. In some of the specimens the crown, or calyx, retains to some extent its original globular form, but in the majority it has been flattened by contact with the Camarocrinus bulbs. The strong, many-branched arms, are frequently a foot in length.

The first American representative of the umbrella-shaped sponges of the genus Cœloptychium is described by Messrs. Shimer and Powers in vol. xlvi., pp. 155–6, of the Proc. U.S. Nat. Mus., under the name of *C. jerseyense*. As the type specimen was obtained from the Upper Cretaceous of New Jersey, it is strictly contemporaneous, in the geological sense, with the European forms of the genus to which it is provisionally referred. The American species is characterised by the rounded, in place of flattened, margin of the umbel.

Hitherto the number of species of oligochætous annelids known from Jersey was only eleven, all belonging to the earthworm family (Lumbricidæ). A collection, including fresh-water forms, recently received from the island has, however, enabled the Rev. H. Friend, in an article published in *The Zoologist* for December, 1913, to raise the number of known species to fifty, of which three are described as new. Of the fifty species, the Enchytræidæ claim thirty-one, the Lumbricidæ seventeen, and the Lumbriculidæ and Megascolecidæ one each.

R. L.

METEOROLOGICAL REPORTS.

THE report of the Meteorological Service of Canada for the year 1909 (pp. xxi+567 and plates), has been published recently. The large mass of data furnished by this extensive system is arranged in tables giving (1) monthly and annual summaries; (2) bi-hourly and hourly temperature and barometric pressure; (3) mean and extreme temperature, daily range, rainfall, etc.; (4) daily observations from selected stations; and (5) magnetic results at Agincourt Observatory. Some of the results of observations at the Central Observatory at Toronto were quoted in NATURE of September 7, 1911. The report includes a brief monthly summary of the weather over the whole Dominion, and tables showing the number of weather forecasts and percentage of fulfilment in each district and month. The general percentage of fulfilment amounted to 86·8, after making due allowance for forecasts only partly verified.

The annual reports of the Philippine Weather Bureau for 1910 (parts 1 and 2), containing hourly meteorological observations at Manila, and for 1909 (part 3), containing observations at secondary stations have recently been published. Father Algué states in the preface to part 1:—"Were it not for a few exceptions, the history of the Weather Bureau for the fiscal year 1910 might have been condensed into the three words, 'Everything as usual.'" This statement practically holds good with regard to all the parts; the most interesting details relating to typhoons, storm-warnings, earthquakes, etc., are contained in the Monthly Bulletins, to which we have frequently referred. The number of earthquakes felt in the Philippines during the fiscal year 1910 amounted to 121, exclusive of many microcosmic movements. The most important far-distant earthquakes recorded were those in Mexico, Baluchistan, and Greenland. A new magnetic observatory has been established at Antipolo, about eleven miles east of Manila, owing to the disturbance caused by the electric railroad at the latter place.

The Central Meteorological and Geophysical Institute of Chile has issued a volume containing hourly observations and means for Santiago for the year 1911, including all the principal meteorological elements, prepared under the direction of Dr. W. Knoche. This is the first time that such values have been published *in extenso* in Chile, and it is intended to continue them regularly for Santiago in future. There are several other stations in Chile, where hourly observations are available; the publication of some of these, or at least summaries from them, would be very valuable, but the large amount of work entailed thereby is said to be more than the limited staff is able at present to cope with.

The nineteenth annual report of "Meteorology in Mysore" for 1911 contains, as usual, daily and monthly results of observations for Bangalore and Mysore, and 8h. a.m. observations, with monthly means for Hassan and Chitaldrug. Synopses of the monthly and yearly results made at those observatories are carefully arranged as before, for the purpose of comparison, by Mr. Iyengar, in charge of the Mysore meteorological department. A useful table giving the means for the nineteen years 1893–1911 shows that the absolute maxima of temperature ranged from 100·2° at Hassan (3149 ft.) to 103·0° at Chitaldrug (2405 ft.). The minima at the same stations were 42·7° and 51·2° respectively. Yearly rainfall ranged from 25·0 in. (ninety-one days) at Chitaldrug, to 35·8 in. (121 days) at Hassan. The mean relative humidity was about 60 per cent. at all stations; excessively low readings were observed occasionally.

The Royal Magnetical and Meteorological Observatory of Batavia has published the results of rainfall observations in the Netherlands' East Indies for 1911 (part ii. of the thirty-third yearly series). The volume contains the monthly and yearly amounts at a large number of stations, the number of rain-days, greatest amounts in twenty-four hours, averages for the period 1879–1911, departures from those values in 1911, and other useful details. These data, in addition to their general scientific value, are of great importance locally, and it has been pointed out elsewhere by Dr. Van Bemmelen that rainfall is the ruling factor which determines the weather in the archipelago, because the remaining meteorological elements are almost constant. In Java the yearly amounts for 1911 varied from 23 in. at Sitoebondo (long. 114° E.) to 177 in. at Pelantoengan (long. 110° E.), and even more in the outside possessions. The greatest rainfall in one day was 10·2 in. at Padang (Sumatra) in November. The fullest information is given respecting the stations, but this volume contains no general discussion of the results.

IMPROVEMENTS IN LONG-DISTANCE TELEPHONY.

THE subject of improvements in telephony is one in which the general public is very closely interested, and a large audience, including many experts, therefore followed with attention the expositions given by Dr. J. A. Fleming, F.R.S., at the Royal Institution on March 27, in which he described the inventions that of late years have enabled a great increase in the practicable distance of telephonic communication to be made, and also rendered possible the use of submarine telephone cables over distances not hitherto attainable. In his opening remarks, Dr. Fleming gave first a brief description of the construction of the modern telephone transmitter and receiver, and of the transformations and sources of loss of energy in transmitting electrically articulate speech between two places. He stated that he would confine attention chiefly to the action of the line of cable, neglecting the imperfections of the transmitter and receiver *per se* owing to limitations of time.

An experiment was first shown with an instrument which projected upon the screen in the form of a line of light, the motion of the diaphragm of a telephone, when sounds musical or articulate where made near it The sound of an open organ pipe was thus seen to produce a smooth wavy or simple harmonic curve, whilst the less pure sound of a harmonium reed or of the voice uttering a vowel sound produced a complex curve, and a spoken sentence an irregular wave line.

The use of the oscillograph in recording photographically or visually the wave form of the electric current sent into a telephone was next explained, and photographs of various vowel and syllabic sounds shown.

A few words of explanation were then given concerning Fourier's theorem in virtue of which any irregular but single valued curve can be resolved into the sum of a number of simple harmonic curves of various amplitudes and phase differences having frequencies in the ratio of 1, 2, 3, etc.

It was then explained that the action of the transmitter on the line was equivalent to the imposition of a complex electromotive force which in virtue of Fourier's theorem could be regarded as the sum of a large number of simple harmonic electromotive forces of various amplitudes, wave-lengths, and phase differences.

Every telephonic cable has four primary qualities, two conservative, viz., its inductance and capacity, in consequence of which it can store up kinetic and potential energy in the form of a magnetic or electrostatic field. Also it has two dissipative qualities, viz., its conductor resistance and dielectric leakance, which convert a part of the energy given to it into heat. Hence an electromotive impulse given to the cable at one end is propagated along it as a wave. The current in the cable at each point is oscillatory, but the current is not, so to speak, at high tide simultaneously at all points in the cable, but successively, the maximum value travelling along the cable with a certain speed. The mode of propagation of a wave along a string or wire was illustrated by various wave models.

In the case of a wire or string of finite length the wave is reflected at the far end, and if the time taken by the wave to travel to and fro is equal to some exact multiple of the periodic time of the impulses, stationary waves are produced on the cord or wire. These effects, together with a demonstration of the laws of string vibration, were proved by the aid of Dr. Fleming's vibrating string apparatus in which a light cotton cord has one end fixed to a slide rest and the other end twirled uniformly with an irrotational motion by an electric motor.

The production of stationary electric waves on wires was also beautifully shown by the use of a long wire coiled into a helix on an ebonite rod. One end of this helix was connected to the earth and the other to a high-frequency oscillator. On adjusting the frequency of the oscillator, stationary electric waves of wave-length equal to some exact multiple or fraction of the length of the helix were produced and shown to exist by the brilliant glow of a neon vacuum tube held near the ventral segments and its non-glow when held near the nodes.

Dr. Fleming then explained that in the case of a telephone wire the velocity with which the waves travel along it is greater the shorter the wave-length, and also that in virtue of the resistance and dielectric leakance, these waves attenuate in amplitude at a rate which is greater for short waves than for long ones. In the case of the helix operated on by high-frequency currents the wave velocity is the same for

waves of all wave-lengths, and is inversely as the square root of the product of the capacity and inductance per unit of length. Hence when a complex electromotive force, the result of speaking to a telephone transmitter, is applied to the end of a cable the various simple harmonic waves into which they may be resolved travel along the cable with unequal speed and attenuation. The shorter waves travel fastest, but are worn out soonest. Hence the wave form is distorted by the disappearance of the higher harmonics and the resulting sound is enfeebled by the attenuation.

Dr. Fleming proved these statements by a new and interesting experiment. A complex electromotive force comprising a fundamental wave having a frequency of about one hundred, and including higher harmonics of greater frequency was applied to one end of an artificial cable built on Dr. Muirhead's plan, representing a submarine cable fifty miles in length. By means of a Duddell oscillograph the wave form of this electric oscillation was projected on the screen. A second wire on the oscillograph was then employed to examine the current in the cable at various distances, ten, twenty, thirty, etc., miles from the sending end, and to project on the screen a second curve representing the wave form at various distances along the cable. It was seen that as the distance increases the wave form is reduced in height and smoothed out so as to show that the higher harmonics are gradually extinguished. In the case of a telephone cable this would mean that the received sound is not only fainter but altered in quality so that the syllable or word is no longer recognisable.

Photographs were then shown, taken by Mr. Cohen at the General Post Office Research Laboratory, showing the distortion of various articulate sounds as transmitted through certain cables. A remedy for this distortion was first suggested by Mr. Oliver Heaviside, who proved mathematically more than twenty-five years ago that if the four constants of the cable were so related that the quotient of the inductance by the resistance was equal to the quotient of the capacity by the leakance, then waves of all wave-lengths would travel at the same speed and attenuate at the same rate.

In all ordinary cables the first-named quotient is much smaller than the second. Hence to remove distortion we may either increase inductance or leakance. Heaviside suggested increasing the former, and Prof. Silvanus Thompson in 1891 suggested increasing the latter by providing the cable with inductive leaks. Practical telephone engineers preferred, however, to decrease the resistance of the cable by increasing the copper section so far as possible. There is, however, a limit to this from the point of view of cost. Also the invention of paper-insulated cables for telephony assisted matters by reducing the capacity of the cable. Nevertheless a very important advance was made by Prof. Pupin, of Columbia College, New York, in 1899 and 1900, when he proved that Heaviside's suggestion could be put into practical form by loading the cable with coils of wire wound on iron wire cores inserted at equal intervals, but so close that at least eight or nine coils are included in the distance of one wave-length of the average wave frequency which is always taken at 800. If the coils are placed farther apart relatively to the wave-length they do more harm than good. Dr. Fleming illustrated this by a very pretty experiment of his own consisting of a string loaded at intervals with beads, one end of the string being fixed and the other twirled round by a motor so as to produce on it stationary waves. When the half wave-length was adjusted to be nearly equal to the distance between the beads, the cord refused to transmit the oscillations.

It was also illustrated by the production of stationary electric waves on a series of helices of wire having loading coils, or coils of high inductance introduced at intervals.

An experiment was also shown with an artificial cable representing forty miles of standard cable into sections of which loading coils could be introduced or cut out as required. It was shown that when the cable was loaded the current flowing out of it at the receiving end was greatly increased when constant electromotive force was applied at the sending end.

It is found then that loading telephone wires by suitable coils of high inductance placed at proper intervals of a mile up to ten or twelve miles according to the cable, greatly reduces the attenuation of the waves, although it is difficult to add sufficient inductance to cure distortion completely.

Dr. Fleming gave a mechanical illustration of this effect. He said, suppose two similar ships were to be launched together side by side down ways of equal inclination and allowed to glide out into the sea as far as they would go until brought to rest by friction of the water. If then one of the ships was loaded with ballast so as to make it much heavier than the other, then, although entering the water with the same speed, the heavily loaded ship would glide out further than the other because it would possess a greater store of kinetic energy. So it is, he explained, with the electric waves on wire. By adding inductance to the circuit the wave energy is increased, and the waves attentuate less for a given distance of travel.

This proposal of Pupin has proved to be a very practical solution of the problem of reducing the attenuation of telephonic waves. Both aerial lines, underground cables, and submarine cables can be "loaded" or "Pupinised" by inserting appropriately made inductance coils at equal distances, and the result is to reduce the attenuation to half or less than a half of that of the unloaded cable, and therefore to reduce the enfeeblement of the sound.

In the case of aerial lines there is no difficulty in inserting these loading coils in the run of the cable. The coils are contained in iron boxes attached to the telegraph posts at intervals of six to twelve miles. The coils themselves consist of an iron wire core wound over with wire, and have generally an inductance of about 0·2 henry, and a resistance of 6 or 8 ohms. In the case of underground cables the loading coils are placed in pits at intervals of two or three miles. Such underground cables consist now of paper-insulated double metallic circuits; a large number of such circuits being included in one watertight lead sheath. The problem of loading a submarine cable was more difficult to solve because the insertion of heavy iron-cased coils was out of the question. The cable had to be loaded in such manner as not to thicken it up inordinately at any point, and to permit of its being laid in the usual manner and lifted again if necessary for repairs. This particular problem was solved by Messrs. Siemens Bros. by the invention of a particular form of cylindrical loading coil which could be inserted in the run of a cable of the usual double-circuit type at distances of one nautical mile or so. When once it had been shown that such loading was effectual, telephonic engineers in all countries began to adopt it. In the United States the American Telephone and Telegraph Company has equipped with loading-coils lines up to 2000 miles in length. The longest aerial loaded line is that from New York to Denver. It is composed of No. 8 hard-drawn copper wires, the circuits being twisted to avoid cross talk and loaded every eight miles with coils having an inductance of 0·265 henry (see Table I.).

The attenuation constant of the line is thus reduced to less than half of that of the unloaded line, and good speech is possible from New York to Denver. It is the ambition of Mr. Vail, the president, and Mr. Carty, the able engineer of the above company, to complete a loaded line such that speech will be possible from New York to San Francisco, a distance of more than 3000 miles. Another long loaded aerial line just completed is that from Berlin to Rome. This line, with the exception of a short piece of cable through the Simplon Tunnel, is an overhead line of phosphor-bronze, 4·5 mm. in diameter. It is loaded every ten kilometres with loading coils having an inductance of 0·2 henry. It runs from Rome to Milan, thence to Iselle, then through the Simplon Tunnel to Brieg, then to Bâle and Frankfurt, and so to Berlin.

TABLE I.

Loaded Aerial Land Lines.

All values are per mile or per kilometre at 800 frequency.

Line	New York and Denver	Berlin and Rome	Berlin and Frankfurt	London (St. Albans) and Leeds Trunks	
				No. 6	No. 7
Length ...	2000 miles	2082 kms.	584 kms.	189 miles	189 miles
Coil Spacing...	8 miles	10 kms.	5 kms.	8 miles	12 miles
Coil Resistance	6·5 ohms.	5	8·7	6·6	4·0
Total Resistance	4·95 ohms.	2·9	11·18	7·58	7·08
Capacity in mfds.	0·0091	0·0056	0·0055	0·0098	0·0098
Inductance in henrys ...	0·0365	0.022	0·0461	0·037	0·0173
Attenuation Constant ..	0·0013	0·0011	0·0019	0·00283	0·00372
Total Attenuation	2·6	2·2	1·12	0·55	0·72
Conductor ...	Copper	Phosphor Bronze	Bronze	Copper	
Weight or Size	435 lb. to mile	4·5 mm. diameter	2·5 mm. diameter	300 lb. to mile	

Dr. Bresig and Dr. di Pirro, who have had the charge of the scientific work in connection with it, find the actual attenuation is closely in accordance with the predicted value, and good speech is possible over the whole distance.

In our own country the longest loaded lines are two trunk lines running from London to Leeds, 200 miles, which are loaded every eight and twelve miles.

The engineer-in-chief, Mr. Slingo, states that the General Post Office has now in operation 30,000 miles of aerial and underground loaded circuits, using 12,448 loading coils; also 45,645 miles more are in course of being loaded, so that before long the G.P.O. will have 75,000 miles of circuits loaded with 30,000 coils. In the United States up to 1912 there were 103,000 miles of loaded circuits in all.

In England one of the longest loaded underground lines is that from Hull to Newcastle *viâ* Leeds, 154 miles in length, which is loaded every 2·5 miles. The Post Office has now under construction an underground loaded line from London to Liverpool *viâ* Birmingham, which will contain fifty circuits, and render communication independent of storms. In the United States a long underground line has been constructed from Boston to Washington, 475 miles, passing through New York, Philadelphia, and Baltimore. A loaded line underground from Berlin to Cologne is in contemplation.

Turning then to submarine cables, we find that at present the General Post Office has three such loaded cables, one from England to France, laid in 1910, one from England to Belgium, laid in 1911, and one from England to Ireland, laid in 1913 (see Table II.). An Anglo-Dutch cable of the same type is being manufactured to be laid between a point in Suffolk and the nearest point on the coast of Holland, a distance of 125 miles.

TABLE II.

Loaded Submarine Telephone Cables.

All values are per nautical mile of loop at 800 frequency.

Cable	Anglo-French Coil loaded 1910	Anglo-Belgian Coil loaded (1911) Side Circuit	Anglo-Belgian Phantom Circuit	Anglo-Irish Coil loaded (1913)
Length in nauts	21	48	48	64
Coil Spacing in nauts	1	1	1	1
Coil Resistance in ohms. ...	6·6	11·5	4·6	6·8
Total Resistance in ohms. ...	20·9	25·7	11·7	21·0
Capacity in mfds.	0·138	0·162	0·314	0·166
Inductance in henrys	0·1	0·1	0·05	0·1
Ratio S/C	120	12	12	12
Attenuation Constant	0·017	0·018	0·0173	0·015
Total Attenuation	0·36	0·86	0·83	0·96
Conductor weight per naut ...	160 lb.	160 lb	320 lb.	160 lb.

The Anglo-French uniformly loaded cable has an effective resistance of 8·54 ohms at 1000 frequency, a wire-to-wire capacity of 0·176 mfd., an inductance of 0·0135 henry, and an attenuation constant 0·0185. The total attenuation is 0·39,, the value of S/C is 109, and the conductor weighs 300 lb. to the nautical mile.

These cables were all constructed by Messrs. Siemens Brothers with the cylindrical coils above-mentioned. The Anglo-French and Anglo-Belgian were laid under the direction of Major W. A. J. O'Meara, C.M.G., when engineer-in-chief of the General Post Office, and the Anglo-Irish cable under Mr. W. Slingo, now holding the same position. The French Government also laid from France to England a uniformly loaded cable made by the Telegraph Construction and Maintenance Company, which has a copper core of twice the weight of the Anglo-French cable, and is loaded by being uniformly wound over with one layer of soft iron wire. Each of these cables contains two pairs of wires which can be used as two independent circuits, and also by using each pair conjointly, as a lead and return, can be used to make a third or phantom circuit. These cross-Channel loaded cables have enabled telephonic speech to be transmitted from London to Geneva, London to Berlin, and to cities in the south of France.

Broadly speaking, we can say that by loading cables and lines it has been possible to double or more than double the distance of effective telephonic intercourse, and to speak for 2000 miles overland, 500 underground, and up to 100 miles or more under sea.

It is possible that submarine communication in this manner may be increased to 150 or even 200 miles, and overland to 3000 miles.

Turning then to the question of the abolition of the line by so-called wireless telephony, Dr. Fleming gave a brief description of the apparatus used. The arrangements are closely similar to those employed in wireless telegraphy. At the transmitting station there must be an antenna in which continuous oscillations are set up by a Marconi disc generator, a Goldschmidt alternator, or some form of arc generator, such as that of Poulsen or Moretti.

In the base of the antenna, or coupled to it, must be placed a microphone by means of which the speaker's voice makes changes in resistance of the antenna circuit. The continuous electric waves radiated must have a wave-length of not much greater than five or at most ten miles. If a spark system

of wave generation is employed, the spark frequency must not be less than about 20,000 a second.

When the microphone is spoken to, the result is to vary the amplitude of the waves emitted without altering their wave-length. It produces waves on waves. At the receiving end the arrangements are similar to those used in wireless telegraphy with a telephonic and crystal or valve receiver. In this case, however, the receiver hears the words spoken to the distant microphone and not merely dot and dash Morse signals.

Using a very ingenious liquid microphone, Prof. Vanni, of Rome, has transmitted speech for 1000 kilometres. In the United States, Fessenden has similarly telephoned a few hundred miles, and Poulsen in Denmark, Colin and Jeance in France, Goldschmidt in Germany, and Ditcham in England have covered greater or less distances. Mr. Marconi also has recently devised appliances for wireless telephony with which he has conducted demonstrations for the Italian Navy lately. All are agreed that the quality of the transmitted speech is good. Since electric waves through the æther all travel with the same velocity, no matter what the wave-length, and attenuate at the same rate, there is no distortion of the wave form. The only difficulty that hinders even greater achievement is that of obtaining a microphone which will carry larger high-frequency currents.

These then are a few of the achievements which have been lately made in covering greater distances in telephonic communication.

We are yet a long way from telephony across the Atlantic, whether with cables or by wireless, but progress will continue to be made, and it is possible that one day speech transmission from England to San Francisco with one repetition at New York may be an accomplished fact.

In the thirty-eight years which have elapsed since Bell and Edison and Hughes gave us the means of commercial telephony much has been done, but there is still a wide field open for invention in improving a means of communication now so essential to our modern life.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SHEFFIELD.—Mr. Wilfred Jevons has been appointed to the post of junior lecturer and demonstrator in physics, and Mr. A. E. Barnes to the post of lecturer in materia medica, pharmacology, and therapeutics.

PROF. BERGSON will begin his Gifford Lectures in Edinburgh on Tuesday, April 21. The subject will be "The Human Personality."

IT is announced that Lord Elgin has consented to be nominated for the Chancellorship of Aberdeen University in succession to the late Lord Strathcona.

WE learn from *Science* that Prof. Frederick Slocum, who for the past four years has been in charge of the solar observations and stellar parallax work at the Yerkes Observatory, has been elected professor of astronomy at Wesleyan University, Middletown, Connecticut, and will assume his new duties next autumn. A new observatory will be erected immediately as a memorial to the late Prof. Van Vleck, for many years in charge of that department at Wesleyan.

MUSEUMS are every day being used more generally in teaching, and a committee to deal with the subject was appointed at the Birmingham meeting of the British Association. The Children's Museum arranged by the secretary of the Selborne Society at the Children's Welfare Exhibition, which opens at Olympia on Saturday, is therefore of interest. The points to be emphasised are, preparation of exhibits especially for young people, introduction of a living side, the use of microscopes, the need especially of changing the specimens at frequent intervals, and the advisability of not having too many things displayed at one time.

THE work of the schoolmaster is described in a new light by Mr. E. Boyd Barrett in an article in the current issue of the *British Review*. Early in his essay, to which he gives the title, "How to Complete One's Education," Mr. Barrett lays it down that teaching is worthy of the best minds, and is calculated to repay amply the best minds. He goes on to show that in all the practical effects of school education—character training, intellect training, and the acquisition of knowledge—the schoolmaster benefits more from the teaching he receives from the boys than they do from his. He comes to the conclusion that it would be impossible to devise any educational system of such a nature that the pupil alone would be benefited. To complete his education, every man should devote a few years to teaching; university education, however well it prepares for cultured leisure, does not prepare a man to share his possessions with others—it is too egotistic.

THE Yorkshire Summer School of Geography will be held at Whitby on August 3–22. The school was instituted last year by the Universities of Leeds and Sheffield, in cooperation with Armstrong College, Newcastle-on-Tyne, and with the help of the Education Committees of the County Councils of the East, North, and West Ridings, and of certain county boroughs in Yorkshire. Its object is to provide instruction in the methods of geography and to furnish opportunities for the discussion of problems connected with teaching it. The course will consist of lectures and laboratory and field work. There will be excursions in connection with the field work. All the apparatus used will be simple and inexpensive, and methods applicable to school work will be adopted. The special subject this year will be the British Isles, which will be treated as a whole in a general course and in two alternative courses at the choice of each candidate: (i) on the agriculture, rocks and soils, and (ii) on the oceanography, rivers and river development, and the evolution of transport and communication. Prof. Kendall, professor of geology in the University of Leeds, will be the director of the school.

THE annual report of the Department of Agriculture of the Union of South Africa for the period 1912–13 has just been issued by the secretary, Mr. F. B. Smith, and is a very interesting document. Necessary as agricultural education and research have proved in other countries, there is probably no part of the world where they are more needed than in South Africa. Agricultural problems are very complex; probably more numerous and virulent diseases of live stock and crops exist there than anywhere else in the world; and, owing to the recent occupation of the greater part of the country and the methods of farming pursued, it is more difficult for young men to acquire a knowledge of up-to-date practical agriculture. A number of institutions have been started, and the object of the department has been to place them on an equality as regards educational and experimental facilities, and at the same time to allow them to specialise in the branches of farming for which they are particularly adapted by virtue of their situation. For instance, Elsenburg, in the Cape Province, is particularly devoted to horticulture, viticulture, and Turkish tobacco; Grootfontein, near Middelburg, also in the Cape Province, to Karoo farming, ostriches, and

sheep; Potchefstroom, in the Transvaal, to mealie growing, general agriculture, and cattle; Glen, near Bloomfontein, in the Orange Free State, to live stock and dry-land farming; Cedara, in Natal, to general farming and wattle growing. Provision is made at each institution for the regular in-college courses of instruction, for short courses, extension work, and also for experiments and research and the analysis of soils, manures, and other agricultural commodities. Additional buildings are being erected to meet the needs of the institutions, and their equipment generally is being improved, while the staffs are being strengthened.

SOCIETIES AND ACADEMIES.

Geological Society, March 25.—Dr. A. Smith Woodward, president, in the chair.—Prof. J. W. **Judd**: The geology of Rockall. Rockall is a small isolated rock in mid-Atlantic, lying 184 miles west of St. Kilda, and, except in the calmest weather, is inaccessible. The rock rises from a bank (the "Rockall Bank") upon which there are dangerous reefs. In 1810 Basil Hall, obtained a fragment from this rock, which later found its way into the collection of the Geological Society. More than thirty years afterwards, the specimen was recognised; it was then mislaid for another thirty years, and in 1895 was brought to the author by the late Prof. T. Rupert Jones. He not only studied all the literature connected with Rockall, but was able to trace two other specimens of the rock, the loan of which he obtained and brought to me. They had been procured in 1868 during the survey of the North Atlantic. The microscopic study of these specimens shows that in Rockall there exist rocks of interest, not represented in our islands, but which have analogues in the Christiania district of Norway. These rocks consist essentially of three minerals—quartz, the felspar albite, and the rare soda-pyroxene ægirite, with its dimorphous form acmite. Dredging operations have yielded specimens from the Rockall Bank. The abundance of basalt-fragments among the dredgings suggests the possibility of Rockall belonging to the same petrographical province as St. Kilda, Iceland, the Inner Hebrides, and the north of Ireland. The existence of borolanite and other alkaline rocks in the northern Highlands suggests the possibility of Rockall being the western extension of a much older province. Some months ago Prof. Iddings and Dr. Washington represented to the author the desirability of a detailed analysis of this rock. One of the two fragments available was sent to America, and the following paper gives the result of its study by Dr. Washington.—Dr. Henry S. **Washington**: The composition of Rockallite. A petrographical account is given, with reference to the influence of the constituent minerals upon the bulk-analysis. Rockallite has a fine-grained granitic structure, and is composed of about equal amounts of colourless quartz, alkaline felspar, and soda-pyroxene. The pyroxene is of two kinds: a bright grass-green ægirite and a pale yellowish-brown acmite. Some zircon is present. A chemical analysis has been made, zirconia and the rare earths being especially looked for. Several new points of interest have presented themselves. The outstanding features appear to be the high percentages of silica, ferric oxide, and soda, and the low percentages of alumina, ferrous oxide, magnesia, lime, and potash. The interest of the new analysis, however, lies in the detection of zirconia and cerium oxide in large amounts: the percentage of cerium oxide being larger than that from any known igneous rock, with the exception of the nepheline-syenite from Almunge in Sweden. The norm has been calculated from the old and the new analyses, and the author finds that the rock falls into the subrang rockallose with the general symbol III. 3. 1. 5. These analyses are the only representatives of the subrang rockallose among the 8000 analyses of igneous rocks that the author has now collected. It is proved that the zirconia and cerium oxide enter into the composition of the pyroxenes.

CAMBRIDGE.

Philosophical Society, February 23.—Sir J. J. Thomson in the chair.—Dr. **Searle**: (1) Determination of the effective aperture of the stop of a photographic lens; (2) experiments with a prism of small angle.—A. E. **Oxley**: (1) The molecular field in diamagnetic substances (preliminary note); (2) the internal molecular field, which has been shown by the author to exist in diamagnetic substances, is applied to account for the abnormally high values of the specific heat of such substances in the neighbourhood of the fusion point.—Major P. A. **Macmahon**: The superior and inferior indices of permutations.—N. **Wiener**: A simplification of the logic of relations.—R. **Hargreaves**: The domains of steady motion for a liquid ellipsoid, and the oscillations of the Jacobian figure.—J. E. **Purvis** and E. H. **Black**: The oxygen content of the river Cam before and after receiving the Cambridge sewage effluent.

March 9.—Dr. Shipley, president, in the chair.—Prof. **Wood** and G. Udny **Yule**: A statistical study of feeding trials with oxen and sheep. The authors have studied statistically the results of 400 feeding trials with oxen and sheep collected and tabulated by Ingle in the Journal of the Highland and Agricultural Society, 1909–10. They find that as the amount of food is increased above that required for maintenance the successive increases in live weight become smaller until a limiting value is reached.—G. Udny **Yule**: Fluctuations of sampling in Mendelian ratios. The author compares the fluctuations observed, *e.g.* in the proportion of recessives in F_2, in the seeds borne by individual plants, or in individual litters, with the fluctuations to be expected on the theory of random sampling. For the most part the agreement, in the examples taken, is good and in some cases striking.—M. S. **Pease**: Inheritance in Brassicæ.—G. Udny **Yule** and F. L. **Engledow**: The determination of the best value of the coupling ratio from a given set of data.—F. L. **Engledow**: A case of repulsion in wheat. The characters concerned are "roughness" and "blackness" of the chaff. In a cross between "smooth black" and "rough white" the numbers in the second generation indicate a repulsion on the 1 : 3 : 3 : 1 basis.—T. **Rigg**: Soil and crop relations in the Biggleswade market garden area. The author has conducted a soil and crop survey of this district. The soils have been classified and the extent of each soil formation has been determined. Maps were shown illustrating the relationship of the soil formations to the geological formations.—H. A. D. **Neville**: Digestibility of pentosans. Rats were fed on a basal diet, to which was afterwards added a quantity of some pentosan substance, such as (*a*) gum, (*b*) a vegetable mucilage, or (*c*) the pentosan constituent of a cereal straw. The pentosans of (*c*) almost entirely disappeared in the animal, those of (*b*) were almost wholly rejected, while those of (*a*) occupied an intermediate position. The results support the idea that the diverse opinions held on the food value of the pentosans have arisen by reason of the analytical method used yielding furfuraldehyde from differently constituted substances or from substances containing pentose sugar molecules differently united in the parent substance.—W. H. **Parker**: A case of correlation in wheat. A high cor-

relation was found to exist between the total rachis length and the average internode length in ears of wheat. Should the correlation be found to be as high in the case of all varieties of wheat, it seems possible that the relation between these two characters will be found to be the best criterion for classifying wheats according to the density of their ears, as this relation, in this case at least, is much more constant within a variety, than the average internode length.—H. C. **Pocklington**: The factorisation of large numbers.—Dr. **Horton**: The ionisation produced by certain substances when heated on a Nernst filament. Experiments have been made to test (*a*) the negative emission from lime, (*b*) the positive emission from sodium phosphate, when heated upon a Nernst filament, with a view to ascertain whether the effects observed when these substances are heated upon platinum are due, as has been suggested, to contact with the metal. It has been found that this is not the case; an enormous negative discharge can be obtained from lime heated on a Nernst filament, even in a very high vacuum, and sodium phosphate considerably increases the positive discharge, but for the latter test the filament must not be allowed to glow brightly or the salt sublimes away.

PARIS.

Academy of Sciences, March 30.—M. P. Appell in the chair.—G. **Lippmann**: A direct photographic method for the determination of differences of longitude. Photographs of the zenith are taken simultaneously at two stations by means of an optical device, and the difference of longitude determined by the position of the zeniths in the star groups. The method is simple, rapid, and accurate.—Armand **Gautier**: The minervites. Analyses of minervites (complex hydrated aluminium phosphates) from different places and a discussion of their constitution.—H. **Parenty**: The freezing of wine, milk, and other alimentary liquids.—Emile **Yung** was elected a correspondant for the section of anatomy and zoology in the place of E. Metchnikoff, elected foreign associate.—J. **Clairin**: Some Bäcklund transformations.—Jules **Drach**: Differential equations of the first order and first degree.—George **Rémoundos**: The series of multiform functions in a domain.—A. **Korn**: The problem of pulsating spheres and the theory of gravitation.—Edouard **Canneval**: A new arrangement of mirrors for lighthouses and other light projectors.—P. **Vaillant**: Tate's law and the variation of the size of the drops with the speed of fall. The weight of a drop from a given tube varies with the number of drops a minute, and there is a discontinuity in the law of variation.—L. **Décombe**: The heat of Joule considered as the heat of Siemens.—Albert **Perrier** and H. Kamerlingh **Onnes**: The magnetisation of liquid mixtures of oxygen and nitrogen and the influence of the mutual distances of the molecules of paramagnetism. The coefficient of specific magnetisation of liquid oxygen increases as the concentration diminishes; the additive law fails for mixtures of liquid oxygen and nitrogen.—Maurice de **Broglie** and F. A. **Lindemann**: A new method for rapidly obtaining spectra of the Röntgen rays.—V. **Auger**: The basic carbonates of copper.—E. **Rengade** and N. **Costeanu**: The heats of formation and some other properties of the alkaline sulphides. The sulphides of the alkali metals can be obtained in the pure state by the action of sulphur vapour upon the metals in a vacuum, separating the excess of metal by distillation. The sulphides of sodium, potassium, and rubidium have been studied in the present paper.—Mlle. H. **Cavaignac**: The precipitation of alumina in presence of fluorides. Aluminium cannot be completely separated from its solutions by the addition of ammonia in the presence of fluorides, and this is very marked at the boiling point.—MM. **Cousin** and **Volmar**: The salicylic nitriles. Of two substances which have been described as nitriles of salicylic acid, one is shown to be disalicylamide and the other trioxytriphenyltriazine. The true nitrile is obtained from salicylaldoxime.—Michel **Longchambon**: The primitive structure of the Pyrenean dolomites.—Edmond **Rosé**: Study of the gaseous exchanges and the variation in the sugars and glucosides in the course of the formation of the anthocyanic pigments in the flowers of *Coboea scandens*. The anthocyanic pigment is not formed at the expense of preexisting glucosides.—Raoul **Bayeux** and Paul **Chevallier**: Comparative estimations of oxygen and carbon dioxide in arterial and venous blood at Paris, Chamonix, and on Mont Blanc. High altitude determines a variation in the amounts of oxygen and carbon dioxide in the blood, the increase in the carbon dioxide being greater than with the oxygen. Mountain sickness does not appear to cause notable modifications in the amount of carbon dioxide, but this state is accompanied by a marked diminution in the oxygen of the venous blood.—J. **Bergonié**: The variation in the energy expenditure of man during the nycthemeral cycle.—Edm. **Sergent**, H. **Foley**, and Ch. **Vialatte**: The transmission to man and to the ape of exanthematic typhus.—Marcel **Belin**: The action of oxidising substances upon toxins *in vivo*.—Adrien **Lucet**: Researches on the evolution of *Hypoderma bovis*, and the means of destroying it. The injection of tincture of iodine is suggested as a treatment. The larvæ are killed and resorption effected without ill-effects on the animal.—E. **Sollaud**: Researches on the ontogeny of the Caridea. Relation between the mass of the nutritive vitellus of the egg and the order of appearance of the abdominal appendages.—M. **Warcollier**: Contribution to the study of a disease of cider called "verdissement."—A. **Fernbach** and M. **Schoen**: Some products of the decomposition of dextrose in an alkaline medium. Acetic acid is one product of this decomposition, and there is evidence that pyruvic aldehyde is also formed.—Ch. **Dhéré** and A. **Burdel**: The crystallisation of an oxyhæmocyanine from an arthropod.

BOOKS RECEIVED.

The Cambridge British Flora. By Dr. C. E. Moss, assisted by specialists in certain genera. Vol ii. Text. Pp. xx+206. Vol. ii. Plates. Pp. vii+206. (Cambridge University Press.) 2*l.* 10*s.* net.

Neue Grundlagen der Logik, Arithmetik und Mengenlehre. By. J. König. Pp. viii+259. (Leipzig: Veit and Co.) 8 marks.

Die Individualität der Zelle. By S. von Schumacher. Pp. 12. (Jena: G. Fischer.) 60 pfennigs.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft 96. Jahresversammlung vom 7–10 September, 1913, in Frauenfeld. I. Tiel. Pp. 213. II. Teil. Pp. 249. (Aarau: H. R. Sauerländer und Cie.)

The Flora of the Dutch West Indian Islands. Second volume, The Flora of Curaçao, Aruba, and Bonaire. By Dr. I. Boldingh. Pp. xiv+197+plates. (Leyden: E. J. Brill.) 7*s.* 6*d.*

Bijdragen tot de Dierkunde Uitgegeven door Het Koninklijk Zoölogisch Genootschap Natura Artis Magistra te Amsterdam. 19e. Aflevering. Pp. 235+iv plates. (Leyden: E. J. Brill.) 13.50 marks.

Journal of the Royal Agricultural Society of England. Vol. lxxiv. Pp. 448+clvi. (London: J. Murray.) 10*s.*

Handbuch der naturgeschichtlichen Technik für Lehrer und Studierende der Naturwissenschaften. Edited by Prof. B. Schmid. Pp. viii+555. (Leipzig und Berlin: B. G. Teubner.) 15 marks.

The Eastern Libyans. By O. Bates. Pp. xxii+298+xi plates. (London: Macmillan and Co., Ltd.) 42*s*. net.

The Viscosity of Liquids. By Dr. A. E. Dunstan and F. B. Thole. Pp. vii+91. (London: Longmans and Co.) 3*s*. net.

Anales del Museo Nacional de Historia Natural de Buenos Aires. Tomo xxv. Pp. 249+xx plates. (Buenos Aires.)

Dr. Montessori's Own Handbook. By M. Montessori. Pp. viii+136. London: W. Heinemann.) 3*s*. 6*d*. net.

Yorkshire Type Ammonites. Edited by S. S. Buckman. Part xiii. (London: W. Wesley and Son.) 3*s*. 3*d*. net.

The "Conway" Manual, being a Complete Summary of all Problems in Navigation and Nautical Astronomy, etc. By J. Morgan, T. P. Marchant, and A. L. Wood. Pp. 79. (London: J. D. Potter.) 5*s*.

Animal Life by the Sea-shore. By Drs. G. A. and C. L. Boulenger. Pp. xii+83+plates. (London: "Country Life," Ltd.) 5*s*. net.

An Introduction to the Study of Integral Equations. By Prof. M. Bôcher. Second edition. Pp. 72. (Cambridge University Press.) 2*s*. 6*d*. net.

Anæsthetics: Their Uses and Administration. By Dr. D. W. Buxton. Fifth edition. Pp. xiv+477+viii plates. (London: H. K. Lewis.) 10*s*. 6*d*. net.

The School and College Atlas. (London: G. W. Bacon and Co., Ltd.) 3*s*. 6*d*. net.

Animal Flight. By Dr. E. H. Hankin. Pp. viii+405+index. (London: Iliffe and Sons, Ltd.) 12*s*. 6*d*. net.

Practical Instructions in the Search for, and the Determination of, the Useful Minerals, including the Rare Ores. By A. McLeod. Pp. ix+114. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 5*s*. 6*d*. net.

Clean Water and How to Get It. By A. Hazen. Second edition. Pp. xii+196. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 6*s*. 6*d*. net.

Continuous and Alternating Current Machinery. By J. H. Morecroft. Pp. ix+466. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 7*s*. 6*d*. net.

Forty-Fifth Annual Report of the Trustees of the American Museum of Natural History, 1913. Pp. 192+plates. (New York.)

Geologischer Führer durch Nordwest-Sachsen. By E. Krenkel. Pp. viii+202+xiv plates. (Berlin: Gebrüder Borntraeger.) 4 marks.

Report of the Danish Biological Station to the Board of Agriculture. By Dr. C. G. J. Petersen. Pp. 67+6 plates+3 charts. (Copenhagen.)

DIARY OF SOCIETIES.

TUESDAY, APRIL 14.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Some Hopi Textiles from the Pueblo of Hano: Miss B. F. Marreco.

WEDNESDAY, APRIL 15.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—

AERONAUTICAL SOCIETY, at 8.30.—The Value of Ballooning as a Training for Flying: G. Brewer and Major E. M. Maitland.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Insect Pests of Wheat Crops: F. Enock.

THURSDAY, APRIL 16.

CONCRETE INSTITUTE, at 7.30.—The Design of Steel and Reinforced Concrete Pillars with special reference to Secondary and Accidental Stresses; O. Faber.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, APRIL 17.

MALACOLOGICAL SOCIETY, at 8.—Notes on Australian Mactridæ: E. A. Smith.—On the Generic name Martensia, Semper: Some more notes on Polyplacophora, part I.: T. Iredale.—Description of a new recent Pholadomya from Tasmania: C. Hedley and W. L. May.—Description of a New Helicoid from South Australia: G. K. Grude.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—A Few Typical Carburetters: R. S. Fox.

SATURDAY, APRIL 18.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at Royal College of Science), at 10 a.m.—The Organism of Common Potato Scab. (*Actinomyces scabies*. (Thaxter) Güssow): H. T. Güssow.—Potato Diseases: A. S. Horne.—Insects causing Blotch on Potato Foliage: A. S. Horne and H. M. Lefroy.—Standard Fungicides and Insecticides: A. G. L. Rogers.—Observations on *Aphis rumicis*: J. Davidson.—The Golf Green Fly: A. W. Westrop.—Observation on the Winter Stage of the American Gooseberry Mildew. (*Sphaerotheca mors-Uvae*): E. S. Salmon.—The Darkening of Oak: P. Groom.—The Phytopathological Conference: A. G. L. Rogers.—Apple and Pear Sucker: P. R. Awati.—An Experiment in House Fumigation: H. M. Lefroy.—Life-history and Habits of *Aleurodes vaporariorum*: E. Hargreaves.

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