THURSDAY, APRIL 6, 1911.

ARTS AND INDUSTRIES IN THE ENCYCLOPAEDIA BRITANNICA.

Collection of Articles on Industries and Manufactures (loose sheets) from the New (Eleventh) Edition of the "Encyclopaedia Britannica." (Cambridge: University Press, n.d.)

THIS collection of technical articles from the *Encyclopaedia Britannica* must be taken as consisting of samples only, since it does not go beyond the first half of the alphabet—"Alkali Manufacture" to "Iron and Steel"—and even for that half it is certainly incomplete. There must be more than as many more articles which in any reasonable classification would be included in the category of technical. Hence even if the reviewer were endowed with a mind encyclopædic enough for the task, it would not be possible from the examples to criticise the work as a whole, to test it as it should be tested, by hunting up subjects with which the critic is familiar, and seeing how the work comes out of the trial. All that can be done is to take the specimens, and to form such opinion upon them as we may, minimising any deficiency in omniscience by the simple (and usual) expedient of dwelling on the familiar and ignoring the unknown. But, after all, the material is ample enough even if it be but a tenth of the whole—πλέον ἥμισυ πάντος—we really have got more than we want.

It would be too much to say that there is real uniformity in the method of treatment. Humanly that were impossible. But there is a much nearer approach to uniformity than in the older editions, so far as can be judged from the selected articles. Perhaps it would be more evident in other than the technical sections. In these there seems to have been a good deal of compression. On the whole, the articles, especially the longer articles, seem to be shorter than those in the ninth edition. Perhaps in some cases the material has been transferred to other headings. Often the historical part has disappeared, or been abbreviated. The modern articles seem more sternly practical than their predecessors. Sometimes this is a pity, and it makes one hope that not all the old series will be exchanged for the new version, and sent to be pulped. Perhaps now that we are all utilising the completed applications of science, it does not much matter how they have been developed, but to some misguided folk the history of invention is not the least interesting of the various branches of human history.

It is, of course, in the method of treatment that the various articles show a certain lack of uniformity. Some are too technical. The first on our list, "Alkali Manufacture," which seems quite new, though perhaps part of the information in it may have appeared under some other heading in the ninth edition, errs, to our mind, in this respect. It is an excellent and clearly written account of the manufacture in its modern forms, but it would be hardly intelligible to anybody who had no knowledge of chemistry. The allied articles "Bleaching" and "Dyeing," are quite different in character, and are better adapted for their immediate purpose. The expert does not need to apply for information about his own subject to an encyclopædia, and the writer of an article for an encyclopædia has no right to assume that his reader has even the small amount of technical knowledge required to make him understand the sort of article which to the expert might seem commonplace.

The article on "Electricity Supply" seems an admirable model for any writer to follow. It contains just the information which would be needed, say, for the owner of a country-house, who is thinking of installing the electric light, while it is also an admirably condensed and clear account of the latest development of the subject. "Electrometallurgy" is good, but incomplete, no doubt because certain parts of the subjects are dealt with in articles such as "Electrochemistry," not included in our bundle.

Some of the articles are very interesting, because when compared with the corresponding articles in previous editions they show very clearly the progress of invention. Notable in this way, for instance, is "Bicycle." In 1875 the latest novelty was the old "Ordinary," really an extremely dangerous machine. The supplement had "cycling," but not "bicycle" (encyclopædia articles are wont to find themselves under the latest convenient letter of the alphabet), and now we have a very full and excellent account of the modern machine.

Other articles indicate that certain industries have changed but little in the past two and twenty years. Take "Clocks," for instance. The long and admirable treatise contributed by the late Lord Grimthorpe to the older edition has been rewritten and shortened by some three pages. If we omit the account of electrical clocks, there does not seem very much new matter in it, but a good deal appears to have been judiciously left out.

Perhaps the most important, as it is the longest, of our batch is the article on "Iron and Steel." It is much less than half the length of the corresponding article in the previous edition (some thirty-four pages as compared with eighty-four), by the late Dr. Alder Wright. The opinion may be expressed, though with considerable hesitation, since it could only be justified by a minute and careful comparison of the two articles, that on the whole the longer article of the ninth edition gave a better account of the state of the manufacture in 1881, the year of its publication, than the present one does of its condition in 1911. At the same time, it does give a full, and no doubt accurate account of recent advances, and perhaps most of what is omitted has become of little more than historical interest. As time goes on Bessemer and Mushet and Siemens must take their place with Cort and Darby and Dud Dudley, but it is early days yet for that. We should have thought that some account might have been given of the

application of the microscope to the study of metals, which, extensively applied by Roberts-Austen to the examination of alloys, has, in the hands of Rosenhain and others, so much increased our knowledge of the nature and structure of iron. Its results are fully utilised, and there are a couple of photomicrographs of iron, but the process is not described. If space were wanted, we might have spared the remarks on the evidence of design afforded by the abundance of iron, and the somewhat vague speculations as to how primitive man was led to the reduction and utilisation of the metal.

Of the three great divisions of the textile industries, only one is included in our purview. The linen and woollen trades must of necessity come later in their proper alphabetical place. Even hemp and jute belong to the second half of the list. Cotton alone comes into an early volume. It is the subject of three long and important articles, one dealing with the supply of the raw material and the trade, the second with the manufacture generally, and the third with cotton-spinning. The first of these seems very complete, and the information is brought well up to date, but the technology of the subject proper is dealt with only in the other two. The remark was made above that the history of trade and invention came in for less than its fair share of notice. This criticism certainly does not apply to the article on "Cotton Manufacture." No better summary of the history of this great industry need be desired. Doubtless it might be amplified, but that would carry it beyond reasonable limits. The author has availed himself of all the usual sources of information, and has also discovered others which are certainly not familiar to all students of the subject. It is indeed an admirable essay. The article on "Cotton-spinning Machinery" is good, but will have to be studied in connection with other articles—"Carding," "Spinning," "Weaving," &c., not included with those before us.

Another article dealing with a department of the textile industry is the one on "Carpet." This has been rewritten, and some inaccuracies in the previous edition have been set right. Alike from the historical and from the artistic point of view this is an excellent paper. As regards purely technical information it is deficient. The appended bibliography is very complete. If "Carpet" is not quite technical enough, "Damask" is nothing else, and is scarcely intelligible to a reader ignorant of weaving terms.

"Bookbinding" is a subject of such general interest that the editor might well have allotted more than five pages to it, or might have allowed his contributor the space now devoted to four large but quite unnecessary pictures of machinery. Within the narrow limits, the account of artistic binding is sufficient, but the description of machine binding is quite inadequate.

Turning now to the shorter articles, we find many which are models of what such work should be, crammed with information condensed into the smallest possible space. Potted knowledge, in fact, such as we may properly expect in an encyclopædia. Perhaps the editor found his minor contributors more amenable to his Procrustean rule than the self-willed experts upon whom he had to rely for special knowledge. Among such articles may be noted "Basket," "Fireworks," "Flax," and "Goldbeating," though many others might be mentioned.

A word of protest may be permitted about some of the illustrations. Where space is so valuable why devote whole pages to photographs of machines and factory rooms, which convey no valuable information whatever? For instance, there are four half-tone blocks, occupying two pages, which illustrate "Cotton-spinning" machinery by views of carding engines and spinning-rooms. As pictures they are ugly; as photographs they are indifferent; as conveying information they are worthless. All description of machinery and mechanism requires diagrammatic illustration, but it should be diagrammatic, not pictorial. Such illustration is abundantly provided in articles like "Clocks," "Forging," "Founding," &c., and in many cases such simple sketches might wisely have been substituted for more elaborate views of machines and apparatus, the action of which it is quite impossible to follow from a mere external picture. The phototype illustrations of carpets and of bookbindings are inoffensive and excusable, but they convey so poor an idea of the rich beauty of the coloured originals that we could do better without them.

Photographic reproductions, properly applied, are, of course, invaluable. The photomicrographs of fibres in the article on that subject show structure in a way that no other pictorial device could show it, and the same remark applies to the magnified views of sections of iron given in the article on "Iron and Steel."

ORGANIC CHEMISTRY OF NITROGEN.

The Organic Chemistry of Nitrogen. By Dr. Nevil Vincent Sidgwick. Pp. xii+415. (Oxford: Clarendon Press, 1910.) Price 14*s.* net.

THIS book will be welcomed by students of organic chemistry as one of the highly desirable monographs which, unfortunately, have been so rarely produced in this country.

In the preface the author informs us that the object of the book is primarily educational, and that it is in no sense intended as a work of reference; this object it fulfils admirably in most cases, but occasionally a few more references to literature would have been useful to the student who wished to acquire a fuller knowledge of a subject.

The subject-matter is treated under four divisions: (1) compounds with no nitrogen directly attached to carbon; (2) bodies containing one nitrogen atom attached to carbon; (3) compounds containing an open chain of two or more nitrogen atoms; and (4) ring compounds.

The first three divisions contain a much fuller and more detailed treatment of the subjects included in them than the fourth division, in which a few only of the more important cyclic compounds have been selected for discussion, and no mention is made of many groups, such as the pyrazolones or glyoxalines.

In chapter i. the nitrous and nitric esters are dealt with, while chapters ii. and iii. contain an excellent account of the amines.

Throughout the book the application of physical methods to the study of the problems of organic chemistry is continually brought to the notice of the reader, and the importance of the study of the mechanism of reactions and the quantitative side of the subject is emphasised: the latter is introduced by an excellent discussion on the strength of the amines as bases.

The constitution and reactions of the triphenylmethane dyes are treated very fully, but the account of the stereoisomerism of quinquevalent nitrogen compounds is not entirely satisfactory.

Chapter iv. contains an account of the amides, including a good discussion of the mechanism of the Hofmann reaction.

Derivations of hydroxylamine are dealt with in chapter v., in which the transformations of phenyl hydroxylamine are described very fully, and an admirable account of the isomerism of oximes is presented. The evidence for Hantzsch and Werner's hypothesis of stereoisomerism, culminating in the strongest argument yet adduced in its favour, namely, the resolution of oximino-cyclohexane carboxylic acid and into optically active components by Mills and Bain, is clearly expounded, but the statement that this theory is universally accepted is scarcely justified even now. A lucid account of the Beckmann transformation and its mechanism is also included in this chapter.

Chapters vi. and vii. deal with the nitroso- and nitro-compounds, and include a discussion of the constitution of the nitrophenols and their salts, the bearing of this on the problem of the relation of colour to constitution in these and similar substances, and also a very good account of the reduction of nitro-compounds and of the oxidation of amines.

The cyanogen compounds are described in chapter ix., in which the problem of the constitutions of hydrocyanic and fulminic acids and their salts occupies a prominent place. The evidence brought forward by Nef and other workers in support of the view that fulminic acid is the oxime of carbon monoxide seems now incontrovertible. None of the hypotheses suggested to account for the properties and reactions of hydrocyanic acid and the cyanides can be regarded as entirely satisfactory, but few will agree with the statement that "prussic acid is tautomeric, and is probably a mixture of two forms," since the same line of reasoning, as shown by Wade, would necessitate a similar assumption in the case of silver cyanide.

In division iii., chapter xi., which deals with the diazo-compounds, is the most interesting; here, however, we feel that the subject is not presented to the student in a way which makes him understand clearly the difficulties of the problem under discussion. Certain statements are put forward as if they were definitely established facts; whereas, on account of the experimental difficulties with which the problem is beset, the evidence on which some of these statements are based is not conclusive enough to justify one in accepting them without question. In the case of the diazo-compounds, the hypothesis of stereoisomerism does not rest on such a secure basis as in the case of the oximes, and it is still possible that the facts may be explicable on the basis of the structural laws without assuming stereoisomerism.

Uric acid and related compounds are treated briefly in chapter xv.

In division iv. the fatty diazo-compounds receive due attention, the pyridine and quinoline group are treated briefly, while coniine, piperine, and nicotine are the only alkaloids discussed.

A few errors, such as formaldehyde for formanilide (p. 82), and minerals instead of mineral acids (p. 209), were noticed, but we regret to find certain colloquial expressions, such as "A readily goes over into B," occurring so frequently; and the statement that a substance "can be broken up into two optically active forms," (p. 103), is hardly a correct or conventional description of the process.

The book contains excellent summaries of the present state of our knowledge on a large number of subjects, including many of the most controversial matters that have recently occupied the attention of chemists.

Usually the account of each subject will be found to include the most recent work of importance, though we notice the omission of the recent work on the mechanism of the transformation of chloroamines into chloroanilines.

Unfortunately the author often gives the impression that he treats a hypothesis or a theory as a fact, an attitude which we cannot regard as a desirable one for the student to adopt.

The student, for whom the book is intended, will find it will well repay careful study, and will discover in it much food for thought, while the author is to be congratulated on the production of a very useful work.

H. O. J.

SCIENCE AND HISTORY.

The Cambridge Modern History. Planned by the late Lord Acton. Vol. xii.: "The Latest Age." Pp. xxxiv + 1033. (Cambridge: University Press, 1910.) Price 16*s.* net.

A COMPREHENSIVE and philosophical history of science in "The Latest Age" would be one of the most valuable and interesting works which it would be possible to produce, but it was not the purpose of the volume before us to produce it. Of its thousand pages only fifty have any special interest for students of science, the twenty-six pages of Mr. Whetham's chapter on "The Scientific Age" and the twenty-four pages of Mr. Rogers' "Modern Explorations." In so narrow a space it is not to be expected that there will be much that is novel or profound. Mr. Rogers can do little more than record a long list of names and dates; he cannot describe the effect upon modern civilisation of the discoveries without duplicating the work of other authors, to whom the reader is frequently referred. The present reviewer cannot express any judgment as to the accuracy or completeness of the list, but for these qualities the author's reputation is a sufficient guarantee. Mr. Whetham has rather more scope for comment, expressed with

the elegance which we expect from him; but even he can scarcely find room for any facts which are not familiar to every well-informed person, or any conclusions which are not the commonplaces of every journalist.

While nothing but praise can be given to the authors for the performance of their tasks, the decision of the editors that all the modern historian requires to know of the science of the last century can be contained in two short chapters seems at first to challenge criticism. But, so far as pure science is concerned, we believe that they are right. Pure science is the most esoteric of all studies; the power of appreciating the value of the ideas contained in the most fundamental scientific theories appears to be totally uncorrelated with any other form of mental ability. It is just because the scientific instinct is such a rare and peculiar gift that it is so intensely valuable. Even if it were possible for the mass of mankind to know truly the meaning of science, it is very doubtful whether it would have any effect upon those actions which history studies. Science cannot define a worthy aim for action; at most it can show what aims can be attained, not what ought to be attained. It was, of course, thought very widely forty years ago that what was "natural" was good, but the fallacy is quite exploded to-day. Indeed, it is probable that Spencerian sociology, based on the confusion of the biological and ethical meanings of the word "fit," would have never received any serious attention, had not the doctrine that what has survived ought to have survived been so comfortable to those in authority. All that the doctrine of evolution can teach us in the matter of aims is that man is master of his destiny, that it is neither sufficient nor necessary to wait for the dispensations of a mysterious providence, but neither the science of the last or of the next century will decide the eternally disputed question of what that destiny ought to be.

However, though pure science cannot give us ends, applied science can give us means, and in respect of applied science "The Cambridge Modern History" appears to us defective. There is no connected account whatsoever of the great inventions or the progress of engineering during "The Latest Age." Mr. Whetham, concerned with pure science, naturally only mentions discoveries which have been the by-products of pure research. We have bare references to photography, dynamos, telegraphy, and two pages concerning medicine, surgery, and hygiene. But many of the inventions which have had the greatest economic or historical effects have no immediate connection with pure science. Can the historian of to-morrow analyse the events of to-day if he has never heard of such things as telephones, explosion engines, modern armaments, water-power, or electric lighting? The most trivial invention in appearance may revolutionise the world. Mr. Whetham rightly says that "the locomotive engine and the electric telegraph effected the great industrial and social revolution of the middle of the nineteenth century"; we suggest that it would not be ridiculous to claim for an invention so uninteresting technically and scientifically as the bicycle a comparable influence upon the end of it. Besides its economic effect in increasing men's radius of action, its social effect in furthering the independence of women must surely make it worthy of the attention of a student of the modern state; and yet the editors of "The Cambridge Modern History" have no official knowledge of it.

THE THEORY OF FUNCTIONS.

Introduction à la théorie des fonctions d'une variable. By J. Tannery. Deuxième édition; tome 2. Intégrales définies, Développements en Série, Langage géométrique, Fonctions de Variables imaginaires. Avec une Note de M. Hadamard. Pp. iv+480. (Paris: A. Hermann et fils, 1910.) Price 15 francs.

THE most interesting chapter in this volume is that which is entitled "Langage géométrique," especially from a pedagogic point of view. The main object of the treatise is to deduce everything from purely arithmetical assumptions; but as a practical teacher, Prof. Tannery was well aware of the value of diagrams as an aid to the imagination, or, as he puts it, for purposes of orientation. Consequently he has given a series of quasi-geometrical definitions, by means of which the ordinary formulæ and methods of analytical geometry are valid, and may be used practically for constructing diagrams to define boundaries of aggregates, &c. In the ordinary sense, of course, we thus get a locus corresponding to an equation $\phi(x,y)=0$; but in order to emphasise the fact that only arithmetical conditions are really imposed, the author replaces the term "locus" (*lieu*) by "bond" (*lien*), and practically confines this to the case where we may put $x=\phi(t)$, $y=\psi(t)$, ϕ, ψ being definite functions for a certain range of the real continuous variable t. The principal results of the chapter are the proof of the existence of simple contours in a plane, which separate it into two distinct continua (this is given after Mr. Ames), and the further conclusion that a domain which is $(m+1)$ times connex can be reduced to two simply connex domains by drawing $(m+1)$ simple curves.

Another notion that occurs in this chapter is that of the order of a point A with regard to a closed contour C. If a point P traverses C once in the positive direction, the variation of the amplitude of the vector AP is of the form $2k\pi$, where k is some integer or zero; and k is called the order of A with respect to C. This very important idea was generalised by Kronecker, and the present volume concludes with an important note by M. Hadamard (pp. 437–77) on some applications of Kronecker's index. The main point of this theory is that the property of a Jacobian, that it changes sign when two rows are interchanged, is brought into connection with topology (or *analysis situs*) in a very general sense. Every advance in the analytical treatment of this subject is noteworthy; because it is here that the contrast between geometrical intuition and analytical proof is so often a glaring one. For example, take Minding's surface, which is obtained by taking a strip of paper, giving it a half-twist, and then pasting the free ends together. It is easy to see that this surface has only

one boundary and only one face, and that this property remains if the surface is "deformed" in the usual sense of that word. But it would be very troublesome to prove these facts analytically, and an ordinary person finds it hard to think of such a proof as being anything more than a superfluous *tour de force*.

Before leaving this chapter, attention may be directed to the use which is made of cuts (*coupures*) in the plane of reference. For certain purposes, as shown for instance by Hermite and Heine, it is more simple to use a plane with cuts in it than to construct a Riemann surface; and the beginner in function-theory may be recommended to master this method before proceeding to Riemann's.

The remaining chapters may be more briefly summarised. There is one on definite integrals introducing the indispensable notions of integrals by excess and defect, and functions of limited variation; one on development in series; two on complex variables and their functions; and one on the differentiation and integration of such functions. Very properly, the author has confined himself to well-known and comparatively simple functions as examples, and he has given figures to illustrate the conformal transformations effected by $\zeta=e^z$, $\zeta=\sin^{-1}z$, and so on. As incidental examples, we may mention the Eulerian functions, and Weierstrass's factorial formula for a function the zeros of which are given.

Mathematical teachers will doubtless find this work of great value, because it helps to suggest what is really practicable in a course of lectures on this subject. The fact is that the theory of aggregates, and the classification of functions, have become such an essential part of all analysis that they cannot be ignored. A serious mathematical student must understand what is meant by such terms as closed and open aggregates, limiting points, uniform convergence, &c., and know something of the conditions for differentiation and integration. But if, with excess of zeal, the lecturer tries to bring out every point, and to be impeccably logical, he runs a serious risk of boring his audience. G. B. M.

PHYSIOLOGY OF REPRODUCTION.

The Physiology of Reproduction. By Dr. F. H. A. Marshall. Preface by Prof. E. A. Schäfer, F.R.S., and contributions by Dr. W. Cramer and Dr. J. Lochhead. Pp. xviii+706. (London: Longmans, Green, and Co., 1910.) Price 21*s.* net.

THE progress of science is very haphazard. For centuries the problems of breeding and heredity have engaged the attention of intelligent men, but it is only within the last five decades that any accurate scientific knowledge on the subject of breeding has been reached. Even now almost all our knowledge of this subject has been derived chiefly from a study of the results of the mating of two germ-cells. This one-sidedness is due to the processes which take place during reproduction being so little known.

This unequal advancement of the sciences is seen again in physiology. Here the physiology of digestion, of muscular contraction, of the nervous system, has been extensively studied, but that of reproduction has been largely neglected. Dr. Marshall has set himself to remedy this defect, and has collected all the available information on the subject. Reproduction incidentally concerns many different categories of people, and they have recorded their observations in numerous and varied periodicals and books. It must have been a task of considerable magnitude for the author to have collated all his sources of information; a glance at the references to quoted literature will convince us of this. The bibliography is in consequence not the least valuable part of the book.

But Dr. Marshall's volume is not merely a digested abstract of scattered papers taken from a great many journals; the author's own extensive work has given him an insight into his subject which enables him to impart information to his readers in a clear and lucid way. He has compiled a treatise which will remain a standard work for some time to come.

The work is to a great extent morphological, but, as everyone knows, it is absolutely necessary to have a sound knowledge of the structure of any organ before physiology is investigated. In studying such a process as the œstrus cycle, the exact morphological changes which take place in the uterus must first be known. This knowledge we owe to Heape, to whom we are glad to see the volume is dedicated, and it is the foundation of all our knowledge of the physiology of the œstrus cycle.

The author commences with a chapter on the breeding season of animals, examples being taken from invertebrates as well as vertebrates, but in subsequent chapters the higher mammalia are, with few exceptions, alone referred to. He then deals with the œstrus cycle and the changes which take place in both sexes both before and during reproduction. After this we have detailed all the evidence bearing on the changes in the maternal organs during pregnancy. The chapter on the biochemistry of the sexual organs seems only to show us how little we know, the information in it is so sparse and disconnected, and surely here is a valuable field for research. The last three chapters are on general questions of breeding, such problems as fertility and the determination of sex being dealt with.

Interspersed with the subject-matter we find the author's views on many theories as seen in the light of his own research. Thus, in the chapter on fertilisation, he gives a criticism of Mendelism. Close study of the actual physiology of reproduction does not lead the author to believe in the conception of unit characters, which the Mendelians have put forward. He speaks of the idea of attempting to locate latent characters of organisms in different parts of the germ-cell, as a survival from the times when all qualities, abstract or otherwise, were supposed to reside in different portions of the body. Whatever be the merits of this particular criticism, it seems that when further work has been done on the physiology of reproduction, a new mechanism may have to be supposed which will account for Mendelian facts, and fit in as well with the teachings of physiology.

Dr. Marshall has produced a masterly treatise

which gives us a very complete and critical review of all the facts of the physiology of reproduction. It will make a new "jumping-off place," as the Americans says, in research, and it is, moreover, admirably written. As an eminent gynæcologist said, "It is as interesting as a novel." It is a text-book which will be a great help to all those who are already working at the science, and a stimulus to encourage new workers. To everyone who is interested in breeding we would recommend this book, though it is not, however, in any sense a popular work.

SOUTH AFRICAN CRUSTACEA.

Annals of the South African Museum. Vol. vi., part iv., 6: *General Catalogue of South African Crustacea* (part v. of S.A. Crustacea, for the Marine Investigations in South Africa). By the Rev. T. R. R. Stebbing, F.R.S. Pp. 281–593, plates xv–xxii. (Cape Town: South African Museum; London: West, Newman, and Co., 1910.) Price 27*s.*

IN the study of the geographical distribution of marine animals, certain regions are of special significance from the fact that they lie on the border-lines between contrasted faunal areas, and offer, or may have offered in the past, possible routes of migration from one to the other. One of these critical regions is found at the Cape of Good Hope, where the faunas of the Atlantic, the Indo-Pacific, and the great southern oceans meet and, to some extent, overlap.

In recent years much information regarding the fauna of the Cape seas has been obtained in the course of investigations conducted under the superintendence of Dr. J. D. F. Gilchrist for the Cape Government, and published under the general title of "Marine Investigations in South Africa." To this series Mr. Stebbing has already contributed four important memoirs on the crustacea. In a fifth memoir, now published, he brings together the results of his own work and that of his predecessors who have dealt with this groups of animals, in a "General Catalogue of South African Crustacea," including the freshwater and terrestrial as well as the marine species.

In the present state of faunistic carcinology it is hardly possible to over-estimate the usefulness of such a catalogue, prepared, as it has been, with the thoroughness and detailed precision characteristic of all Mr. Stebbing's writings. Apart from the descriptions and figures of the numerous new and interesting species, the compilation of the bibliographical references alone must have involved a great amount of labour, of which subsequent students will reap the benefit. Although Mr. Stebbing touches only incidentally on geographical problems, his catalogue will provide a sure basis for future work on this subject.

As an example of the interesting points of detail contained in these memoirs, the case of the Cape lobster, *Homarus* (or, as Mr. Stebbing prefers to call it, *Astacus*) *capensis* may be mentioned. This pretty little species has been involved in obscurity since its first description in 1792 by Herbst, who stated that it lived in mountain streams at the Cape. H. Milne-Edwards later gave a brief description of the species; but added no information as to its habitat. Huxley, referring to it, says:—

"I must confess myself to be in a state of hopeless perplexity respecting the crayfish or lobster which is said to occur at the Cape of Good Hope."

Mr. Stebbing now supplies a full description of the species from specimens sent to him by Dr. Gilchrist, and finally disposes of the story as to its freshwater habitat. Like the other two species of the genus, the European and American lobsters of the north Atlantic, it lives in the sea, and its remoteness from the areas occupied by its congeners offers a noteworthy example of "discontinuous distribution." It may be mentioned in passing that the only figure of the Cape lobster referred to by Mr. Stebbing is the original one of Herbst, which is very inaccurate. An excellent figure was given by H. Milne-Edwards ("Ann. Sci. Nat., Zool." (3), xvi., 1851, plate xi., Fig. 1); but as it occurs among the illustrations of a morphological paper, it is easily overlooked.

Mr. Stebbing's use of the generic name *Astacus* for the Cape lobster affords an instance of the difficulties into which "reforms" of nomenclature may lead the unwary student. In this case the detailed synonymy which Mr. Stebbing gives prevents any ambiguity, but, unfortunately, other writers are not so careful, and, in view of the long-standing error as to its freshwater habitat, it may not be superfluous to warn the student of geographical distribution that "*Astacus capensis*" is *not* a crayfish.

In many other points of nomenclature the catalogue challenges criticism. Mr. Stebbing is well known as an uncompromising advocate of the strict rule of priority, but he is by no means ready to surrender the right of private judgment, and is even capable of treating disrespectfully the decisions of the International Commission on Zoological Nomenclature. At all events, whatever may be the case with genera and species, there is no law to compel, nor any perceptible advantage to recommend, a renaming of the accepted orders and subclasses of crustacea; and there can be little doubt as to the opinion of zoologists in general on the proposals to substitute Thyrostraca for Cirripedia and Ostrapoda for Ostracoda.

W. T. C.

SCIENCE FOR THE GENERAL READER.

Science in Modern Life. Prepared under the Editorship of Prof. J. R. Ainsworth Davis. Vol. v. Pp. ix+207. (London: The Gresham Publishing Company, 1910.) Price 6*s.* net.

THIS volume comprises four contributions, namely, by Prof. James Wilson on agriculture (32 pp.), by Dr. John Beard on philosophical biology (32 pp.), by Prof. Benjamin Moore on physiology and medicine (90 pp.), and by Dr. H. Spencer Harrison on anthropology (52 pp.).

The first article is almost entirely historical; it contains an account of the chief advances in British agriculture from Saxon times, but has little to say on present-day problems and researches. More space

might, with advantage, have been devoted to these subjects.

Dr. Beard gives, in his opening chapter, a concise statement of the views associated with the names of Lamarck, Spencer, Darwin and Wallace, and Weismann. The following chapter, on heredity, deals in turn with Galton's law, Weismann's theory of the germ plasm and with germinal continuity. The third chapter discusses Mendelism, biometry, and the mutation theory of De Vries. Dr. Beard's views can be best summarised by quoting the statement at the head of the concluding chapter—

"The phenomena of heredity and genetic variation appertain to the germ-cells, that is, they are germinal in nature. All ancestry passes through a continuous line of germ-cells, and never through the cells of the individual (somatic cells) containing the germ-cells. An 'inheritance of acquired characters' is impossible, for there is no handing on of anything. The individual is merely a terminal and lateral offshoot. In the higher animals direct development, a building up of the individual, and a somatic origin of germ-cells, do not exist. . . . The formation of an individual is a mere incident in a certain chain of events."

He concludes by stating his belief that unconscious memory, in Hering's sense, is sufficient to account for heredity as exhibited by living things, and that if this be recognised "much that has been imagined becomes, not merely futile, but an unnecessary multiplication of causes."

Prof. Moore has given an interesting account of the functions of many of the different kinds of cells of the body, for instance, the leucocytes, the red blood-cells and their adaptation of form to their special functions, the intestinal cells and their secretion, the ductless glands and internal secretions, &c. Clearly written explanations, as free from technicalities as possible, are given of many of the new terms used in modern medical science, *e.g.* agglutinins, antibodies, opsonins, precipitins, antisera, hormones, &c.

The chapter on tropical diseases is much too short. The only diseases considered are malaria and sleeping sickness, and the account of the former contains a considerable number of imperfect or inaccurate statements. The following occur on one page (144) (1): "The mosquito was found to develop a special cycle of the malarial parasite in the glands of the stomach," which is a very loose statement of the matter; nothing is said of the presence of the parasites in the salivary glands of the mosquito, or of their mode of entry into a new human host. (2) The changes in the organism of malaria which take place in the mosquito are designated "certain preliminary stages of development," which surely gives but a faint idea of the fundamental changes which actually occur. (3) Mosquitoes do not deposit larvæ, as asserted, but lay eggs. (4) It is stated that the larvæ, "in order to develop further, must at a certain period ascend to the air at the surface of the water"; as a matter of fact they must ascend periodically, and in most cases frequently, in order to obtain the necessary air. Laveran is not Italian, as stated on p. 143, and the first trypanosome in a European was described by Dutton, not Dalton (p. 145). We should have thought that the recent campaigns against Stegomyia (not Stegomya, p. 144) and yellow fever were worthy of more than casual mention, and that several other tropical diseases were of sufficient general interest to make reference to them desirable. Figures of Anopheles and a tsetse-fly would have been helpful to the reader.

In the short chapter on public health, the author shows how the general health of the community has improved, and urges the necessity for segregation of, and vigilance regarding, cases of consumption.

Dr. Harrison outlines in an interesting manner the chief phases of development of anthropology; the origin of man, of inventions, of civilisation, and of the races of man, are discussed, and an account is given of the races of Europe and of Britain. The article is illustrated by several excellent photographs and a number of coloured and line drawings.

OUR BOOK SHELF.

The Niger and the West Sudan, or the West African's Notebook. A Vade Mecum containing Hints and Suggestions as to what is Required by Britons in West Africa, together with Historical and Anthropological Notes, and Easy Hausa Phrases Used in Everyday Conversation. By Captain A. J. N. Tremearne. Pp. viii+151. (London: Hodder and Stoughton, and A. H. Wheeler and Co., n.d.) Price 6*s.* net.

THIS book is written by a former Hausa scholar of Cambridge, who is also a doctor in anthropology, and the work is the result, seemingly, of some years' residence in Nigeria, with visits to the British colonies *en route*. It contains a good many vocabularies of English-Hausa interspersed amongst the chapters, and some of these will no doubt be of much use to officials and travellers residing in or visiting these regions. There is a great deal of general information about British West Africa, but little evidence of independent research on the part of the author, while the quotations with which the book is studded are of a somewhat ancient and well-worn character. Some recent French and German works (historical, geographical, anthropological, &c.) are overlooked, though they throw a new light on the ancient history of British possessions in West Africa, as well as of the adjacent regions under other flags.

A somewhat contemptuous attitude is taken up with regard to the educated negro, which seems to be derived less from the author's own observation and experience than from the pessimistic views expressed by writers and travellers of half or a quarter of a century ago. In reference to the youth trained at Government or missionary schools—in Sierra Leone, for example—the author seems to be quite unaware of the part played by these intelligent and active young men—engineers, artisans, clerks, &c.—in the opening up of the interior of that colony, or in like manner of the Gold Coast.

In drawing up a list of societies and institutions which may be of use to the African official or student, the writer of this book omits all mention of the African Society, which is surely one of the most useful, for its journal contains the best and latest information on West African subjects. The portion of the work which deals with the Hausa people (chiefly by quotations) possesses some interest, but contains fantastical notions, original and borrowed, which may only mislead the student, such as, for example, the suggested derivation of Hausa from Habeshi

(Abyssinian). Nevertheless the book under review sums up in small compass much of the interest of northern Nigeria.

Lehrbuch der allgemeinen Pflanzengeographie, nach entwickelungs-geschichtlichen und physiologisch-ökologischen Gesichtspunkten. Bearbeitet von Prof. P. Graebner. Mit beiträgen von Prof. P. Ascherson. Pp. viii+303. (Leipzig: Quelle and Meyer, 1910.) Price 8 marks.

No branch of botany has advanced more rapidly in the last quarter of a century than the study of plant geography or distribution. Although the foundations were laid by Humboldt (1805), de Candolle (1855), and Grisebach (1872), much of the impetus is due to the influence of the already classical works of Warming and Schimper, and to the valuable contributions by Dr. Engler; further, the numerous recent papers devoted to the descriptions of vegetation in all parts of the world have provided additional data for establishing general principles.

Plant geography presents the two main aspects of distribution in space and distribution in time. The former has received more attention, and provides the sole topic of most books on the subject. Dr. Graebner has devoted a third part of his book to an account of development in past geological ages and in historical times. This provides a serviceable epitome, although some of the statements—as, for instance, the suggested aquatic habit of the Sphenophyllaceæ—are questionable. The discussion of events in the Tertiary and Glacial periods leads up to such matters as plant migrations, centres of distribution, origin of new species, variation, casuals, aliens, and colonists. Distribution in space is taken in two sections, of which the first relates to floristic kingdoms, the second to ecological conceptions. The consideration of the subject from these two points of view would serve a useful purpose if the advantage was not discounted by the excessive condensation necessitated. The description of causes influencing plant distribution in the present day contains a store of details gleaned from scattered papers, and provides much material for elaboration. Very little space is apportioned to the account of plant formations; their classification is based upon the paucity or richness of the available food supply in the soil. Numerous references to original publications are supplied in the footnotes, which it would seem worth while to collect into an appended classified bibliography.

The Natural History of Coal. By E. A. Newell Arber. Pp. x+163. (Cambridge: University Press, 1911.) Price 1*s.* net.

WITHIN the narrow compass of this little volume, which forms one of "The Cambridge Manuals of Science and Literature," Mr. Newell Arber has condensed a great amount of solid information with respect to the nature of coal, and much speculation with regard to its probable mode of formation. Perhaps the most notable feature of the work is the emphasis which it lays on the fact that "coal" is merely a group-name, applied popularly to a number of carbonaceous substances, very varied in character and doubtless very diverse in origin. No one mode of formation is applicable to all coal. If it can be proved in a particular case that the vegetation from which the coal was originally formed must have grown on the spot where it is now found, we are by no means justified in denying that in other cases the vegetable *débris* may have been drifted to its present site.

The author holds that each group of coal-bearing rocks, even each seam of coal, must be studied and judged on its own merits. The material from which coal has been formed he calls "the mother-substance of coal"—an expression not to be confused with the term "mother of coal," which has long been applied, perhaps not very appropriately, to the substance known otherwise as mineral charcoal. Mr. Arber discusses, with much command of his subject, the character of the coal-forming vegetation, the mode in which its relics accumulated, and the changes to which they have been subjected in the process of coal-making.

The view which regards the formation of palæozoic coal as having been comparatively rapid finds favour with the author, whilst doubt is thrown on the popular "peat-to-anthracite theory." As to the vexed question of the climate of Upper Carboniferous times, Mr. Arber hesitates, for apparently good reason, to term it tropical.

Eine Botanische Tropenreise. Indo-Malayische Vegetationsbilder und Reiseskizzen. By Prof. G. Haberlandt. Zweite Auflage. Pp. viii+296. (Leipzig: W. Engelmann, 1910.) Price 11.60 marks.

THERE is very little change to note in the present edition of Haberlandt's "Botanische Tropenreise" as compared with the original that was published in 1893. A few paragraphs have been inserted here and there, some excellent reproductions from photographs have been added, and three coloured reproductions from water-colour sketches by the author. It would have been unwise to reconstruct the general text, which records the fresh impressions of a first visit to the tropics. The chapters on tropical leaves and trees, lianes, epiphytes, and mangroves are specially instructive, and the bold pencil sketches delineate characters which are not discernible in a photograph.

Star People. By Katharine Fay Dewey. With illustration by Frances B. Comstock. Pp. x+232. (London: Longmans, Green, and Co., 1910.) Price 6*s.* net.

SOME of the mythological characters which figure among the constellations are here introduced into a fantastic story. We cannot believe that the original legends have been improved by their setting, or that there is anything particularly inspiring in the association of stars with nonsense talk and a giggling company. Draco is afflicted with a lisp, and is made to say on one occasion "That'th all right. I gueth I can walk with three girlth. I'm long enough!" The constellations are so beautiful and the dramas they represent are so rich in imaginative ideas that we should prefer not to introduce children to either through a story of this kind, which can scarcely be regarded as good literature and is certainly not good science.

With Nature and a Camera: Being the Adventures and Observations of a Field Naturalist and an Animal Photographer. By Richard Kearton. Illustrated by 180 pictures from photographs by Cherry Kearton. Popular edition. Pp. xvi+368. (London: Cassell and Co., Ltd., 1911.) Price 5*s.*

ITS re-issue in a cheaper form should increase the already wide popularity of this attractive book. The character of the work was described in NATURE soon after its appearance (vol. lvii., p. 154).

British Birds in Their Haunts. By the late Rev. C. A. Johns. Twelfth edition, with 16 coloured plates. Pp. xxxii+626. (London: Society for Promoting Christian Knowledge, 1911.) Price 5*s.*

A BOOK which has reached its twelfth edition needs no commendation. It is evident that its clearly expressed descriptions have proved of real assistance to students of bird-life.

Das Wasser. By Dr. O. Anselmino. Pp. vi+122. (Leipzig: B. G. Teubner.) Price 1.25 marks.

THIS booklet is the 291st volume of a popular scientific and literary series. It embodies the material used in a course of experimental lectures given at Griefswald in 1907. The subjects dealt with include the chemistry of water, mineral waters, the purification of water, drinking water, mineral waters, and diffusion. The text is illustrated by forty-four diagrams, most of which have been taken from text-books of chemistry, to which due acknowledgment is made. The author has brought together a large array of facts, the tabulated analyses of various waters, including a long series of mineral waters, being a conspicuous feature of the book. The chapter of chemistry covered by the title is an important one, and it is probable that its treatment in a separate volume may prove to be a convenience to a considerable class of readers.

What Nature Is. An Outline of Scientific Naturalism. By Chas. K. Franklin. Pp. iv+74. (Boston: Sherman, French and Co., 1911.) Price $0.75 net.

A WELL-WRITTEN argument for "scientific naturalism" as against the argument from design, which sees intelligence in nature, inferring therefrom a creator. Mr. Franklin rejects anthropomorphic theism, also idealism, but seems to finish up in a kind of mysticism. "It is the character and quality of matter and energy to develop" man and the social process, just as it is for them to manifest themselves in the inorganic and organic processes. New thoughts, feelings, volitions, religion, &c., are merely manifestations of "radiant and gravitant energy." But somehow we shall eventually "be able to comprehend what the universe is, conceive infinite time and infinite space by looking in upon ourselves and seeing the infinite repeated in us, and understand the inmost nature of things. Just as the time was when life was not self-conscious, then became self-conscious and class-conscious, and to-day is imperfectly socially conscious; and so the time will come when we shall be universally conscious" (pp. 71–72).

Perhaps so; it is interesting as a speculation, and the author has probably been reading Dr. Bucke's "Cosmic Consciousness." But Mr. Franklin is rather dogmatic, and is a little apt to slide into speculation suddenly after writing a good deal of sensible science; the reader therefore has to keep an eye on him, and to guard against too hasty following. Moreover, the reduction of everything to "energy" does not in the least resolve the ultimate mystery of things, as Tyndall, for instance, saw plainly enough.

Morale de la Nature. By M. Deshumbert. Second edition. Pp. 96. (Paris: Schleicher Frères, 1911.) Price 1.50 francs.

WE have here the second French edition of a book which, since its first appearance, has been translated into English by M. I. M. Hartmann, and published by Mr. D. Nutt, under the title, "The Ethics of Nature." The original work led to the formation of the "Ethics of Nature Society," which is an association for the harmonious development of life. The present edition of M. Deshumbert's book has been revised and enlarged.

Carnations and Pinks. By T. H. Cook, J. Douglas, and J. F. McLeod. With eight coloured plates. Pp. xi+116. (London: T. C. and E. C. Jack, n.d.) Price 1s. 6d. net.

THE latest addition to the "Present-Day Gardening" series will be welcomed by all active horticulturists. Being the work of expert cultivators of the flowers with which it deals, the volume should soon become widely known and consulted on account of the practical hints it contains.

LETTERS TO THE EDITOR.

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

Stability of Aëroplanes.

THE following simplification of Lanchester's formula for longitudinal stability of tailed monoplanes may be useful.

His formula is

$$\Phi = \frac{4lH_n^2 \tan\gamma}{I\left(\frac{1}{K} + \frac{1}{cC\rho\epsilon a\beta}\right)}.$$

("Aërodonetics" ρ 101).

Here H_n is the height corresponding to the normal velocity of the machine $= V_n^2/2g$ and $I = WR^2$ where R is the radius of gyration about a transverse axis through the centre of gravity, and K is gW/V_n^2, where W is the mass in pounds.

$c = 3{\cdot}0$, $C = 0{\cdot}7$, $\rho = 0{\cdot}08$ pounds per cubic foot, ϵ = about $0{\cdot}6$ for tails of moderately high aspect ratio, so that $cC\rho\epsilon = 0{\cdot}1$ nearly.

Hence

$$\Phi = \frac{lV_n^4 \tan\gamma}{g^2R^2\left(\frac{V_n^2}{g} + \frac{10W}{a\beta}\right)}.$$

(See "Problem of Flight," 2nd edition, p. 114.)

For most machines with pterygoid aërofoils of approved camber γ and β are about $\frac{1}{6}$ radian.

Further the value of W (pounds not poundals) is connected to the supporting area by approximately the equation $W = 0{\cdot}0016\,AV^2$ so that $V = 20$ to $30\sqrt{(W/A)}$, or say $30\sqrt{w}$, where w is the lift in pounds per sq. foot.

Hence approximately

$$\Phi = \frac{l \times 30^4 \times w^2 \times \frac{1}{6}}{1024R^2\left(\frac{30\sqrt{w}}{32} + \frac{10W}{a \times \frac{1}{6}}\right)}$$

taking $\Phi = 1{\cdot}5$ and writing $W = wA$, we get very nearly

$$l = \frac{R^2}{500}\left(w^{-\frac{3}{2}} + 60w^{-1}\frac{A}{a}\right)$$

thus expressing the length of the tail in terms of the radius of gyration, the loading per sq. foot, and the ratio of the supporting area to the tail area.

For example, if $\frac{A}{a} = 10$, and $w = 2$ lbs. per sq. foot,

$$l = \frac{R^2}{500}\left(0{\cdot}35 + 300\right) \text{ or roughly } \tfrac{3}{5}R^2.$$

Thus a machine the radius of gyration of which is 7 feet, loading 2lbs. per sq. foot, and having 10 per cent. tail area, needs a tail with $\frac{3}{5} \times 7^2$, say 30 feet radius of action (*cf.* Bleriot machine).

HERBERT CHATLEY.

Tâng Shan, Chih-Li (*via* Siberia), February 27.

The Daintiness of the Rat.

ONE of the principal sights in Bordighera is the garden of the Villa "Charles Garnier." It is called after its late owner, the famous designer of the Grand Opera at Paris and the Casino at Monte Carlo. It was probably when he was engaged in building the Casino that he acquired the large and valuable property which bears his name.

The garden covers more than five acres, and is a mass of tropical and subtropical vegetation. The banana trees bear fruit which ripens every year. The gardener, a very civil and intelligent man, speaks English, and he told me he had worked for more than a year in Kew Gardens, which he much admires, and endeavours to imitate when his means permit. He was especially proud of his ticketing the plants after the Kew model.

Not being a botanist, I was unable to appreciate adequately his attention in showing me the treasures of his garden, and it was perhaps owing to his perceiving

this that he directed my attention to an allied circumstance which interested me much.

He informed me that the greatest trouble which he had was with rats, the *forest rats* he called them. They spend the winter in the garden, and, while causing a good deal of general damage, they evince a remarkable selectiveness in their taste for fruit. It appears that they have a great preference for the lemon and the mandarin, which are abundant in the garden. A number of the trees carried zinc guards on their trunks to prevent the ascent of the rats; but in a terraced garden on a steep slope there are many which cannot be protected in this way, because a rat easily jumps from a higher terrace on to the upper branches of a tree growing on the terrace below. By this means they had boarded and plundered quite a number of trees. They touched only the lemon and the mandarin trees, disregarding the common orange. But what seemed to be most remarkable was the different way in which they treated the fruits of these two trees. Of the lemon they eat the rind, removing it completely, and leaving the peeled fruit, clean and without a blemish, still attached to the branch which carried it. On one tree there were eight or ten such freshly peeled lemons still in their places on the tree, and they presented, among the others, a very curious aspect of nakedness. Having boarded a mandarin tree, the rat treats the fruit in the opposite way; he eats the inside and leaves the empty skins hanging on the tree. On one tree that I saw, nearly the whole of the fruit had been treated in this way. Something similar may be witnessed with us on gooseberry bushes in a summer when wasps are abundant. The reason for the different treatment of the two fruits is probably not to be sought further than in the fact that the inside of the mandarin is sweet and that of the lemon sour.

So long as there are mandarins and lemons, the common orange remains untouched, but when there are no more of these two they eat the common orange. By the time these are finished the fields and woods outside are beginning to furnish food, and the rats leave the garden, not to return until the winter begins again.

In answer to my inquiry, the gardener said the rats never attempt to enter the villa; they are forest rats. I asked him if they were a special kind; he said they were brown rats; and I asked him if they were different from the rats he had seen in England, and he said no.

The daintiness of the rat, shown not only in the choice of his fruit, but also in the part of it which he will eat, is not the only feature of rat life which is illuminated by the experience of the gardener of the Villa "Charles Garnier." The annual migration back and forward from the open and natural surroundings of the field and forest, where in summer food is being naturally produced in abundance, to the restricted environment of the highly cultivated garden, where in winter food is produced only by artificial devices, becomes more remarkable the longer it is contemplated. The whole area of semi-tropical garden on the Riviera is an insignificant quantity compared with that of the open ground, so that the proportion of the rat population which is able to enjoy the winter *villegiatura* must be very small, and must be chosen or evolved by a rigorous system of selection, which probably rests on the fundamental principle, the right of might.

In a fertile country like that of Liguria the rats, which are obliged to remain *fore le muri*, are no doubt able to pick up a subsistence during the winter, but they cannot afford to be so dainty as those that are able or privileged to occupy the gardens. In any case, I suppose, it may be taken to be true that a hungry rat will not hesitate to eat a healthy brother rat if he can waylay him or overcome him in combat. It is not improbable that this is the natural winter food of many tribes of rats which inhabit countries where food has its seasons of plenty and scarcity. The shortage thus produced in the winter is quickly made up by the splendid fruitfulness of the mother rats when the food season returns, and the population, over the year, need show no diminution; indeed, there is nothing to prevent it showing an increase. In nature there are accumulators of all kinds.

We have seen, on the evidence of the fruit trees of the garden, that the rats occupying it must live in that state of luxury in which the sensation of real hunger is not felt. How do they keep such a garden of Eden to themselves?

That the common oranges remain as a reserve to the end of the season shows that overcrowding is effectively prevented. We have seen that the lemon and the mandarin are preferred by the rats actually occupying the garden, and apparently indifferently, because the two fruits are consumed *pari passu*. As it is contrary to the animal nature for the strong to give way to the weak, we may feel certain that there is no relative aversion to either the lemon or the mandarin as there is to the common orange, or one of them would be consumed before the other.

All these facts go to show that the occupying force must be a very well-organised body, and must be directed by that degree of intelligence which teaches it, not only to drive and keep out strangers, but also rigorously to keep down its own numbers to the point at which it can, on the basis of experience, expect to pass the winter without being reduced to the necessity of eating common oranges.

Bordighera, March 20.

J. Y. BUCHANAN.

The Fox and the Goose.

THE interesting story concerning a fox and its fleas related by Prof. McKenny Hughes recalls one told me many years ago by an old gamekeeper on Lord Ilchester's estate at Redlynch, in Somerset. The park at Redlynch is enclosed with a rough wall about 5 feet high; the keeper's cottage is in the line of this wall.

He saw one day, whilst sitting in one of his rooms, a fox coming towards the wall carrying a goose, which it had slung over its shoulders and was holding by the neck. Upon reaching the wall it tried to jump or clamber upon it, but failed. It repeated the attempt two or three times, going back a little distance and readjusting its burden each time before doing so. Finding that it could not get over in this way, it stood on its hind legs with its front feet against the wall, and, holding the goose by the neck close to the head, pushed the bill into a crack between the stones. The goose fell down, the crack being apparently too wide. A second attempt was successful, and the bird dangled from the wall suspended by the bill at almost 4 feet from the ground. The fox then leapt upon the wall, and leaning over withdrew the bill from the chink, hoisted up the bird, and disappeared with it on the other side.

E. W. SWANTON.

Sir Jonathan Hutchinson's Educational Museum, Haslemere, March 28.

The Rusting of Iron.

IN an article in NATURE of March 2 on the rusting of iron, an objection was raised to the work of Lambert and Thomson (Trans. Chem. Soc., 1910) on the ground that their experiments were carried out in fused quartz vessels. The writer of the article puts forward the view that fused quartz dissolves in water to produce silicic acid; that the acid produced is sufficient to dissolve the iron; that enough iron will be dissolved by the process in the course of a few hours to produce, in the presence of pure oxygen, a visible quantity of ferric oxide! He cannot have supposed that the *probability* which he discusses was not considered by the authors. The object of the work was to bring together iron, oxygen, and water, all of the highest obtainable purity, and to let them react in vessels which would be least likely to affect the reaction.

It was only after most careful experiments on the suitability of quartz vessels that they were finally chosen. A long series of experiments, lasting over several months, was carried out, in which (1) fused quartz vessels, carefully cleaned, as described in the paper, (2) fused quartz vessels lined with purified paraffin wax, (3) Jena glass vessels lined with purified paraffin wax, were used under exactly the same conditions.

The experiments were carried out as described in the paper. The apparatus was evacuated down to 0·0001 millimetre (as measured by a McLeod gauge); water was distilled in from a solution of pure baryta, the conditions being such that the water which came in contact with the

iron could only have condensed on the inside of the tube in which the metal was contained.

Oxygen, made by electrolysis of pure baryta solution, was finally allowed to enter the vessels. The paraffin wax used to line the quartz and glass vessels was purified by boiling with many changes of "conductivity" water, with frequent shaking, for about 100 hours. The iron used was a commercial electrolytic sheet iron containing 99·9 per cent. iron. It was carefully cleaned with finely divided carborundum.

The results were the same in the quartz vessels and in the quartz and glass vessels lined with paraffin wax. Rusting was visible in all cases within a few hours.

It was only when pure iron, made as described in the paper, was used that no rusting took place.

After these and other experiments, it was considered that quartz vessels, which lend themselves admirably to cleaning and purification, were the most suitable vessels in which to study the reaction.

It is claimed by the authors that they have established the following facts:—(1) Pure iron does not rust when placed in contact with pure water and pure oxygen. (The term pure is used, of course, in a relative sense.) (2) The contention that "the *dominant* factor in the atmospheric corrosion of commercial iron is carbonic acid," or any other acid, is untrue. This must not be taken to mean, however, that carbonic acid plays no part in the atmospheric corrosion of ordinary commercial iron.

BERTRAM LAMBERT.

Chemical Department, University Museum, Oxford.

THE reference made to Mr. Lambert's work in my note on the rusting of iron has already proved of value in eliciting from the author a statement in reference to tests carried out in vessels lined with purified paraffin wax. His statement does not, however, provide a solution of the problem to which attention was directed, namely, that commercial iron exposed freely to air and water under the conditions described by Moody and by Friend does not rust, whereas in his own experiments rusting took place in the case of all but the most highly purified samples. It is difficult to predict whether the essential difference which still awaits discovery will ultimately be found in the iron, in the air, in the water, or in the vessel, but it is to be hoped that further discussion—in the columns of NATURE or elsewhere—may speedily throw light on this difficult and important matter.

It is a common experience, of which Mr. Lambert's work has provided excellent illustrations, that an unsuspected impurity (such as platinum in iron) is far more likely to promote than to prevent chemical change. It was for this reason that attention was directed first to the experiments in which rusting actually took place rather than to those in which it was successfully prevented. My suggestion in reference to silicic acid is correctly described, but I do not think that a note of exclamation was called for in view of the fact that mere contact with glass, as Moody found, actually produces the effects referred to, not in oxygen, but in purified air. The quantity of acid required to initiate the rusting must be extremely small, but its complete removal seems to outweigh in importance every other factor that may be taken into consideration. This view is amply supported by the fact that Friend, using common iron, common air, and the simplest apparatus, was able to stop the rusting by the simple device of washing the iron with a common alkali and then rinsing it with common water evaporated from the alkali and condensed on the iron.

With the first of Mr. Lambert's claims I am entirely in agreement; his second claim I regard as unproved and fallacious. To the statement that "the dominant factor in the atmospheric corrosion of commercial iron is carbonic acid" I adhere unreservedly, not only because the corrosion can be stopped by the addition of an alkali or by the removal of acid, but even more emphatically because the carbonic acid leaves behind an irrefutable proof of its activity in the presence of something like 10 per cent. of ferrous carbonate in the rust formed under the commonplace conditions to which I referred. T. M. L.

April Meteors.

THE following are the most important meteoric events that become due from about April 6 to April 30 in the present year:—

Epoch April 5, 21h. (G.M.T.), approximately second order of magnitude. Principal maximum April 6, 21h. 55m.; secondary maximum April 6, 1h.

Epoch April 7, 17h, eighteenth order of magnitude. Principal maximum April 9, 9h. 40m.; secondary maxima April 8, 2h. 15m., April 8, 11h. 30m., and April 9, 21h. 30m.

Epoch April 10, 17h., twenty-third order of magnitude. Principal maximum April 9, 0h. 15m.; secondary maxima April 8, 21h. 15m. and April 10, 14h. 30m.

Epoch April 11, 4h., twenty-eighth order of magnitude. Principal maximum April 11, 11h. 15m.; secondary maximum April 12, 7h. 15m.

Epoch April 13, 22h. 30m., thirty-third order of magnitude. Principal maximum April 14, 15h. 40m.; secondary maximum April 15, 14h. 40m.

Epoch April 17, 17h., twenty-ninth order of magnitude. Principal maximum April 18, 2h. 15m.; secondary maximum April 18, 4h. 50m.

Epoch April 19, 8h., twenty-fourth order of magnitude. Principal maximum April 17, 13h. 40m.; secondary maximum April 17, 21h. 45m.

Lyrid epoch April 19, 14h. 30m., approximately eighth order of magnitude. Principal maxima April 17, 20h. 50m., and April 19, 9h. 50m.; secondary maxima April 19, 9h. 30m., and April 19, 11h. 40m.

Epoch April 23, 3h. 10m., approximately sixth order of magnitude. Principal maximum April 21, 16h. 40m.; secondary maxima April 21, 3h. 55m., and April 22, 20h. 30m.

Epoch April 25, 6h. 30m., eleventh order of magnitude. Principal maximum April 23, 13h.; secondary maxima April 23, 23h. 30m., and April 24, 22h. 50m.

Epoch April 26, 6h., thirty-first order of magnitude. Principal maximum April 27, 12h. 10m.; secondary maximum April 27, 4h. 40m.

Epoch April 27, 1h., approximately tenth order of magnitude. Principal maximum April 28, 22h. 50m.; secondary maximum April 27, 23h. 50m.

Shooting stars should be numerous on April 19, as several maxima occur shortly before midnight on this date, among which Lyrids and bright meteors from allied radiants will probably be strongly in evidence. There is also another Lyrid display on the night of April 21, but it will only be partially visible on this side of the Atlantic.

April 3. JOHN R. HENRY.

Insurance against Rain.

As this scheme of insurance is one of the few of which data can be obtained by "the man in the street" from which the odds in favour of the underwriters can be calculated, I went to the trouble of investigating the matter. Possibly the results may interest your readers.

In "British Rainfall" for 1909, by Dr. Hugh Robert Mill, statistics are given of the number of days on which varying quantities of rain fell. The figures give the average for thirty-seven rainfall stations in England and Wales over a period of seven years, 1903–9. From these, by a method of interpolation, it is found that fifty-eight days in a year may be expected to show a fall of 0·20 of an inch or more, and seventy-four of 0·15 or more.

Working out the probabilities on the basis of these figures, assuming that rain on one day is independent of rain on any other day, the following results are obtained:—for every 100*l.* received in premiums the underwriters may expect to have to pay, in the case of Policy A, 66*l.*; Policy B, 74*l.*; Policy C, 43*l.*; and Policy D, 64*l.*

In favour of the underwriters is the fact that in the south and south-east, where alone the scheme is applicable, the probability of rain is less than in England and Wales generally. A further point in their favour is that the summer months are less wet than the mean of the whole year on which the above figures are calculated.

C. O. BARTRUM.

32 Willoughby Road, Hampstead, N.W., March 30.

The Use by Men of Science of an Artificial Language.

IN NATURE of March 30 (p. 155) the remark is made that "if it were possible to arrive at a general agreement [as to the use of an artificial language], even in one or two isolated sciences only, a real step in the diffusion of science would be made."

I desire to protest strongly against this view. Is it in the least likely that those Italians, Spaniards, Russians, Poles, &c., who will not now write their scientific papers in English, French, or German would write them in an artificial language? If they did so, while making themselves understood by a few *esperantists* or *idoists*, they would render themselves unintelligible to their own countrymen and all the rest of the world.

Science is sufficiently unattractive to the layman without being handicapped by an artificial language. Surely it is not too much to expect Poles and others to learn one of the three great modern languages—English, French, or German.

What is required is some organisation by which all important papers not published in English, French, or German shall be translated into one of those languages if it is found impracticable to *induce* the writers originally to publish them in one of the three great languages.

BERNARD HOBSON.

Thornton, Hallamgate Road, Sheffield, March 31.

A Wave Theory of Gravitation.

IN the paper by Mr. C. F. Brush on a kinetic theory of gravitation, published in a recent number of NATURE, a theory is suggested in which gravitational attraction is attributed to radiation pressure on the outsides of two gravitating bodies, so that "attraction" is rather a push than a pull. In fact, in outline the theory may be compared to Le Sage's corpuscular theory, in which the impinging atoms are replaced by a special type of æther wave exerting a pressure. That view is not altogether new.

I published an article in *The New Ireland Review* for August, 1907, in which that view was suggested as a speculation. Mr. Brush's theory differs in some of its details from the view I proposed, as, for example, the origin of the radiations. This view was suggested by Prof. Poynting's experiments on the "pressure of light." In my paper no mention is made of a very similar suggestion made some years earlier by Sir J. J. Thomson in a lecture delivered in Yale University in 1903, and afterwards published under the title of "Electricity and Matter." At the time of writing the article referred to I had not become acquainted with Prof. Thomson's suggestion. On p. 160 of the work just mentioned we read:—"We have seen in the first chapter that waves of electric and magnetic force possess momentum in their direction of propagation; we might therefore replace Le Sage's corpuscles by very penetrating Röntgen rays." The difficulties in the way of such a view are also indicated.

H. V. GILL.

Belvedere College, Dublin.

An occurrence of the Barium-felspar Celsian in North Wales.

SOME finely crystallised mineral specimens from North Wales, kindly sent to me by Mr. G. J. Williams, H.M. Inspector of Mines, have proved on a preliminary examination to be the rare mineral celsian, hitherto recorded only from Sweden (by H. J. Sjögren in 1895). The beautifully developed monoclinic crystals are colourless and transparent, and extremely rich in faces. They are accompanied by other crystals of orthorhombic habit, which possibly represent a dimorphous form of barium-felspar. I am at present engaged on a chemical analysis of these crystals, and Mr. L. J. Spencer has undertaken to determine their crystalline form and optical properties.

ARTHUR RUSSELL.

Swallowfield Park, Reading,
March 27.

AN INTERNATIONAL VULCANOLOGICAL INSTITUTE.

AT the International Geological Congress held last year in Stockholm, Signor Immanuel Friedlaender proposed the foundation of an Institute for Vulcanological inquiries. The matter was submitted to a commission which reported on it to a general meeting of the congress in a highly favourable manner. The object of the institute is to carry out continuously and systematically researches connected with volcanic phenomena. It is proposed to build a laboratory furnished with instruments for the measurement of the temperature of rocks and of gas at different points of Vesuvius; to analyse the gas from *fumaroles*, and to note seismic disturbances.

The existence of the present observatory at Vesuvius is known throughout all the world, but unfortunately at it continuous systematic researches have not been carried out, neither have they been carried out at any other volcano in the world. Thoroughly to accomplish what is proposed it is necessary to have an international union, not only for the purpose of collecting the necessary monies, but also to furnish the opportunity to men of science of all nations to make investigations at the new institute. The number of vulcanologists in Italy and in other parts of the world is few, a matter that can be easily understood, because there does not exist any permanent positions for specialists in this subject. The scientific importance of the undertaking does not require discussion. It has, however, a practical aspect. The enormous damage and loss of life by the eruptions of Krakatoa, Monte Pelée, and of Vesuvius in 1906, are fresh in our memory. Our present knowledge of volcanic phenomena is based upon intermittent observations, and therefore it is not sufficient to enable us to predict eruptions. Notwithstanding this, we now know that vulcanicity shows a series of regular phenomena. From this it appears that it is not only possible, but it is highly probable that after conscientious and exact registration of all the phenomena, science will shortly advance so far as to foresee more or less the time of occurrence of a new outburst. There exists another practical reason why we should study vulcanology. By the study of the activity of *fumaroles* and the metamorphosis of rocks, we may explain the origin of many minerals. Recent volcanoes are known to contain metalliferous minerals in course of formation, and a profound study of the phenomena of metamorphosis would therefore greatly increase our knowledge of the genesis of metalliferous deposits.

The organisation of the institute at its commencement will be as follows:—Signor Immanuel Friedlaender, who has already contributed 100,000 lire and an annual contribution of 10,000 lire, undertakes to collect subscriptions. These will only become payable if up to the first of January, 1912, the total sum promised for the construction and the plant reaches a minimum of 1,500,000 lire, and at the same time an income is guaranteed of not less than 50,000 lire. The legal position of the institute will at the outset be that of a society in which members with a right to vote have contributed at least 10,000 lire or pay 1,000 lire per annum. Members contributing less, so long as it is not under 25 lire per annum, will receive the printed papers and publications of the institute. The idea of an international institute of this description is by no means new. It has been proposed by Prof. Johnston Lavis, Prof. Mercalli, Prof. G. Platania, and five years ago Mr. Cool, a Dutch engineer, published a pamphlet on this matter. The project is already supported by sixty-two prominent names; twenty-five of these are Italians, nineteen are Germans, and three are English.

THROUGH PERSIAN DESERTS TO INDIA.[1]

DR. SVEN HEDIN'S latest book, describing the first section of his famous last journey to Tibet, in which he travelled overland to India, has at the present moment a special political and economic interest, in addition to its varied scientific contributions to our knowledge.

FIG. 1.—Salt Crust in the Kavir. From "Overland to India."

Deliberately avoiding the hackneyed caravan routes through the famous centres of ancient Iran, Dr. Hedin travelled from Teheran eastwards by way of the little explored salt deserts (Kavir), and through Seistan and Baluchistan, to Nuska, near Quetta, where he struck the Indian system of railways. He thus traversed a considerable part of the route over which it has just been proposed, by a group of Russian financiers, to construct a railway to link up the Russian railway lines with those of India, as an alternative, or rather as a rival, to the Bagdad line through Turkish territory to the Persian Gulf. By the proposed line through Persia the journey from London to Bombay is estimated to take less than a week at a cost of 40*l*., as against about 60*l*. for the existing sea route *via* Brindisi, occupying nearly twice that period, whilst the route by Bagdad will not, it is alleged, shorten the existing time very materially. Although Dr. Hedin does not refer to the proposed Persian line, the project for which has been put forward since his book went to the press, the country through which the line is to pass, and the geographical problems in regard to it, are graphically described therein.

Seistan, the most easterly province of Persia, bordering on both Afghanistan and Baluchistan, would be traversed by the line. It has for many years been a territory of great importance in Anglo-Russian politics, owing to its position, standing as it does midway between the Caspian Sea and the Persian Gulf. Although, at present, it is for the most part an arid and inhospitable desert, it is believed that the restoration of its former irrigation works will revive its pristine productiveness, when it was "the granary of mid-Asia"; so that it is regarded as having the possibilities of becoming a second Egypt. Its recovery from the clutches of the desert seems quite feasible. In this connection the process by which the former towns and villages, the traces of which are widespread, have been engulfed by the desert, is considered at some length. The chief factor appears to less climatic change than the cessation of human agency in staying the encroachments of the deserts. The general process of dessication which has been slowly going on in Asia since the Glacial period has proceeded so slowly that it appears to have advanced but little since Alexander's day, subsequent to which the country was much more populous than at present. The early religion of the country has been largely determined and fashioned by what we may call the aggressiveness of the desert. The effect which this has exercised on the minds of the inhabitants finds expression in the old Iranian belief of a beneficent creative power personified in the sun, and one hostile to mankind—Ormuzd and Ahzimrud. As evil associates of the latter are regarded the hot sandstorms, the mirage of the desert, the winter cold, miasmas, and noxious insects and snakes, &c. Hence the practical religious precepts ascribed to Zoroaster are the extermination of those harmful creatures, and especially to stay the ravages of the desert by the planting of trees, constructing water channels, sinking wells, and similar acts. The depopulation of these regions which has permitted the advance of the desert, has obviously been effected mainly by the ravages of devastating wars, intertribal blood-feuds, and the murderous raids of robbers. Under a settled and enlightened Government there seems a fair prospect of these deserts being to a great extent reclaimed, and even the desert of Gobi is not altogether hopeless.

FIG. 2.—Rush Boats on Lake Hamun. From "Overland to India."

At Trebizond, on the Armenian coast of the Baltic, the traveller falls again under the spell of the camel-caravan bells. "I never weary of this same monotonous sound, with its unchanging ryhthm, the ceaseless ding-dong, ding-dong, which I have heard so many times

[1] "Overland to India." By Sven Heden Vol. i., pp. xix+416+map; vol. ii., pp. xiv+357+map. (London: Macmillan and Co., Ltd., 1910.) Price, 2 vols., 30*s*. net.

before, and which awakes a longing for the Sabbath peace of unknown deserts and adventures in untraversed paths."

Not, however, until Teheran was passed does he reach the desert with which the book mainly deals, and on which the traveller camped day after day for several months, excepting at the few oases. In these latter it was occasionally possible to camp under the palms, where "the singing birds which twittered during the day are silent. The jackals start a melancholy serenade, and the soft plaintive song of the desert vibrates through the night." These oases are not entirely pleasurable. They are infested, especially by three venomous creatures: (1) a deadly snake, (2) scorpions, black and white, and (3) a poisonous tarantula spider, which lives out in the desert, but is attracted by the light of the camp fires.

Tebbes, and Dr. Hedin supports Sir Henry Yule's view that the famous Venetian passed here by the direct caravan route between Kuch-benan and Tebbes, in preference to the more modern view of Colonel Skyes and others, that it was by Naibend. It is interesting also to find that Polo's description of this desert "is as correct now as in the year 1272 A.D."

Dr. Hedin's alluring story of his exploration of great scientific interest and importance in itself, is also full of interest for the general reader as well. His numerous sketches and coloured illustrations are admirable and characteristic, but his photographs are exceptionally beautiful. They far surpass in artistic and technical excellence anything to be found in previous books on those regions. The publishers are to be congratulated on their splendid reproduction of these pictures, and on the attractive appearance generally of the book, which is certain to meet with a wide and hearty welcome.

FIG. 3.—The Village of Chahrdeh. From "Overland to India."

Wolves levy a heavy tax upon the village flocks. They are individually so well known to the shepherds that each of them has received names, and their haunts are well known. They even attack the camels: "they leap on to the camel's back and crawl down to his neck and tear his throat." Although it was reported that wild camels existed, "no one had ever seen them."

The northern limit of the date palm was found at Tebbes. Beyond this no palm-groves are met with, only a few single specimens in well-protected sites. At Tebbes, where, as throughout southern Persia, the palm supplies the staple food and is otherwise of inestimable service to man, it was calculated that there were 100,000 of the female tree—the male palms are very much fewer in number, and are called "*nehr*," the same word which is used to denote a stallion camel.

Marco Polo is believed to have passed through

THE PROBLEM OF INDUSTRIAL TRAINING.

DURING the last few years the feeling has been steadily growing that a large part of the money spent on elementary education is wasted for the want of a proper system of education in continuation schools, whether day or evening, which should prepare children for their future work. Unemployment, the decay of apprenticeship due to the changed conditions of labour, the increased number of occupations for boys and girls which lead to no definite future, and the bookish style of our elementary-school education, have been responsible for this feeling of unrest in the minds of all thinking persons. Some have suggested the reform of the elementary-school curriculum by making it more practical; others the rais-

ing of the school age to sixteen. There is much to be said in favour of both suggestions, and indeed the former is essential; but those who have thought over the problem feel that the raising of the school age will provide no remedy unless what may be called post-elementary or secondary education is directed into channels which will lead up to and adequately prepare children for their future work, whether of a professional, commercial, or industrial character. For professional and commercial occupations ordinary education has done something, but not enough; but for industrial occupations very little has been done except by classes which have been attended by students after a break of two or three years, during which time they have forgotten much that they had learnt at school. The need for some reform in our educational work and for an extension of education in continuation schools has been pointed out in papers read at the British Association meetings, in reports by the British Science Guild and the Consultative Committee of the Board of Education, and at conferences of education authorities.

The resolutions passed and the opinions expressed at the recent conference held at the Guildhall (see NATURE, March 2, p. 31), supported as they were by men and women representing all classes of the community, may be considered as evidence of a strong feeling that the time has come for some definite action to be taken. As an industrial nation we cannot afford to neglect the adequate preparation of our children for their future careers any longer.

Doubtless the commercial training required for professional or clerical occupations presents the least difficulty, because such training is more or less intimately connected with an extension of the curricula of higher grade and secondary schools with a definite objective, and generally there is no opposition to such education. The problems connected with the training of those who will take up occupations of a manual or industrial description are more difficult. As soon as such training is talked about there appears to be a general, though erroneous, fear that such training implies definite trade training, and that the market will be flooded with skilled workers; but an inspection of the work and methods of the schools to which we refer later on will show that this is unfounded. The object of these schools is to prepare those boys and girls who intend to enter various trades, so that they will have an opportunity of becoming skilled all-round workers rather than one-branch hands. The changed conditions of manufacture make some system of preparation in schools and technical institutions an absolute necessity.

In any general scheme, local trade conditions will have to be taken into account by local education authorities in arranging the curricula and in selecting the children suitable for the various types of schools. The number of pupils attending the various types of schools will ultimately be regulated by the laws of supply and demand. The training for industrial or trade occupations, if it is to be successful, must be given in special schools, such as preparatory trade schools, schools of arts and crafts, or technical institutes; and the instruction, whilst not neglecting the general education of the pupils, must include sound preliminary training in the theory and practice of the trades, whether of an artistic, scientific, or mechanical character.

There must be no attempt in such schools to supersede the training of the workroom, workshop, or factory; their aim should be to provide an all-round acquaintance, both theoretical and practical, with the particular trade or group of trades which the pupils will enter, and so to make up in part for the loss of those opportunities of learning formerly provided by the apprenticeship system in various industrial occupations.

A good beginning has already been made in this direction in London by the trade schools for girls, and at the London County Council schools and the Borough and Woolwich Polytechnics; there are similar opportunities for boys at the L.C.C. Paddington and Poplar Schools of Engineering, the Shoreditch Technical Institute for woodwork, the Borough Polytechnic Institute for engineering and metal trades, the Stanley School, the L.C.C. Central School of Arts and Crafts, and at the National Bakery and Confectionary School at the Borough Polytechnic Institute; there are others which might also be mentioned. There are also schools of various kinds in many of the principal towns of the country, such as Leeds, Liverpool, Bradford, and Wigan. In nearly all the schools mentioned the work is a full-time course, but railway companies and large employers of labour in various parts of the country have afforded facilities for their young workmen to attend classes for short periods in the daytime, to enable them to improve themselves both by study and practice in the trades in which they are engaged. Some problems in boy-labour in Government departments are also receiving attention, though much remains to be done.

Without considerable elasticity, no scheme of industrial training in schools and institutes can be thoroughly successful or completely satisfy the industrial and commercial needs of a practical nation such as ours; such training must be post-elementary; that is, must come, not under the regulations governing elementary schools, but under those governing technical schools and institutes, as otherwise there is a danger of limitations in various directions; it may be trammelled by religious questions, by large classes, by rigidity of syllabuses, and will probably suffer from lack of freedom in the choosing of suitable teachers for the work. The type of teachers employed in such schools is indeed one of the most important factors of success, and such teachers must be chosen rather for their special trade and workroom experience than for their academic qualifications. The cooperation of employers and foremen on advisory committees will also form an important feature in the work.

In conclusion, it should be remembered that trade prospers only with a nation which has an adequate supply of technically trained skilled workers. It is generally believed by those who have paid attention to the subject, and it is the opinion of those who can speak with authority, that the trades in which we hold our own are those in which apprenticeship or its equivalent is not yet dead. As the opportunities for apprenticeship in various trades are becoming fewer and fewer, something in the way of a substitute is necessary, and this can be supplied by wise modification and extension of our educational system in the direction of industrial training.

C. T. MILLIS.

DAYLIGHT SAVING?

ON the face of it, the proposed Daylight Saving Bill is distinctly good. For a certain season in the year the clerks in the City of London will get one more hour to spare before the sun goes down. As a result of this they will have more time for the enjoyment of fresh air, more time for outdoor amusements, more time to learn rifle shooting, gain more health, become happier men, and enjoy other benefits. If this is really the case, then the clerks in the west of England, who have for years and years enjoyed 33 per cent. more evening sun than those in the eastern counties, ought to exhibit at least some trace of the benefits which accrue from an extra dose of

daylight. Possibly the inhabitants of Cornwall are really more happy and bright, vigorous and enterprising, than the inhabitants of Kent; but is this really a fact?

Next, where does happiness come in if on a cold spring morning you have to get up one hour earlier? What will the wife and children say to the arrangement? Turning out too soon on frosty mornings, groping about at 4 a.m., to find a box of matches to light the fire, may give rise to domestic irritation, bronchial catarrhs, and other illnesses. Thousands upon thousands of workmen in the north of England, to be at work at 6 a.m., when it is really 5 a.m., will have to disturb their households at the time specified. At the commencement of April a man will get up in the dark, walk to his factory in the dark, and commence work by artificial light. Whatever light and fuel has been saved on the previous evening in the house or workshop will be spent in the dark hours of the early morning. For about six months, or 182 days, which I believe is the period over which the new-fangled time is to extend, men will frequently have to rise before the sun; nature will be asleep, but he must be awake and run counter to Divine intentions. As matters now stand during this period workmen get up on 127 days *after* sunrise. The new Bill will reduce the number of these occasions to 52. He will have been robbed of his morning daylight, and have 75 extra days of morning darkness.

There is not so much daylight saving in the Bill as may popularly be supposed. It gives an hour in the evening, but cuts off an hour in the morning. Will a darkness creating Bill please the British workman?

When to give pleasant afternoons to the few who always go to work in daylight, the workmen in this country, in their trains and trams, and on their "bikes" or on their feet, take to blundering about in the morning dark, it suggests an increase in the number of accidents, more litigation, more illnesses, and more funerals. Doctors and lawyers will have more employment, and insurance companies may raise their rates.

Many medical men are supporting this proposed alteration, and have emphasised the benefits that may accrue from the greater amount of sunlight that people will enjoy if these changes are adopted. Obviously, of course, those requiring more sunlight can, if they will, get up earlier in the morning without any dislocation or changes in standard time. But to compel all workers to get up an hour earlier some months of the year may have effects upon the health quite other than seems to be supposed. Man is largely the creature of habit, and the habits acquired by long usage cannot be broken through suddenly without ill results. When early in April the time is suddenly altered, the result will be that for some days, possibly weeks, workers, clerks, and all others compelled willy-nilly to accommodate themselves to this incompletely considered scheme will find themselves at work, still half asleep, with serious results to their own efficiency, to their own health, and their employers' pockets.

In addition to all this, as I have before said, England, by destroying the time standard of the world, will have gone back on her bargain with other nations, and her steamship and other communications with other countries will have been disturbed.

The defenders of the Bill admit that it has its defects, but they do not point out how these are to be remedied.

To say that different parts of the United States keep different times, and that Cape Colony has found the adoption of the 30th meridian a boon, has nothing whatever to do with the question at issue. These and other countries have adopted a *fixed* time and adjusted their clocks to the Greenwich standard and not to a time that is altered at least twice a year. In these circumstances why references to the United States and Cape Colony have been brought forward I do not understand. The unthinking public might infer that because certain countries have altered their clocks there can be no great harm in altering ours. If this was seriously intended, these arguments are a reflection upon their authors, and indicate that certain reasons for the adoption of the Daylight Saving Bill rest upon curious foundations.

Some years ago, with the assistance of the Foreign, Colonial, and India Offices, I had occasion to inquire into the varieties of time kept by all accessible communities of the world. The only people I remember that have a shifty time are Mahomedans and savages, and it is now suggested that we should take a step downwards and join their ranks.

Astronomers and navigators are, however, to be left in peace. I imagine that those who desire to save daylight recognise that a movable time system might lead to shipwreck and to difficulties in the construction of nautical almanacs, and other astronomical work. If these departments are to be freed from the new arrangements, why should not the same freedom be given to meteorology and all other sciences in which it is necessary to have time observations comparable with those of other countries?

The simplest solution to the whole question would be to commence work one hour earlier in the morning and not confuse ourselves and others by altering the clock. In Japan thousands of schools open in the summer time at 7 a.m., Government offices open at eight and close at two; and what is done in Japan is done in other countries. Surely it is possible for business houses in this country to do something similar.

JOHN MILNE.

THE DESTRUCTION OF LOCUSTS.[1]

A REPORT recently received from the South African Central Locust Bureau bears testimony to the strenuous efforts which have been made during the last four years by the various Government entomologists and others in the systematic collection and tabulation of data regarding the more important phases in connection with the destruction of crops by migratory and other locusts. We congratulate the editor and his colleagues on the most excellent results which they have achieved, and the thanks of the country are also due to them for the valuable assistance which they have rendered to the agriculturists in Cape Colony and elsewhere by the successful methods which they have adopted in checking the ravages of these destructive insects.

In the introduction of the report we are informed that the South African Central Locust Bureau was formed in 1906 through the instrumentality of the Earl of Selborne, then his Majesty's High Commissioner in South Africa. His Excellency saw clearly that several colonies and territories under his supervision would benefit mutually if each were kept informed in regard to locust occurrences and to locust destruction, and measures in the territory of its neighbours, and that it was highly desirable in order that the pest might be intelligently combated, that the origin and movement of invading swarms be elucidated. The 1909 campaign cost the Government a

[1] Fourth Annual Report of the Committee of Control of the South African Central Locust Bureau. Respectfully submitted by the committee to the several Governments supporting the Bureau. Edited by Chas. P. Lounsbury, Government Entomologist, Cape Town, Cape of Good Hope. Pp. 59+15 maps. (Cape Town: Cape Times, Ltd., Government Printers, 1910.)

sum approximating 4000*l.*; even so, it is impossible to estimate its worth to the country, either directly or indirectly; but the editor thinks the saving effected by the campaign may be safely set down as at least a hundredfold. As first of all there is the direct benefit which accrues from the saving of the crops, and, second, the destruction of vast armies of locusts, which will materially lessen if not entirely prevent the recurrence of swarms during the succeeding season.

In comparing the 1909 visitation with that of previous years, it is stated that it was probably the most severe one which has been experienced since 1893, as altogether no fewer than 15,306 swarms were accounted for and tabulated in the monthly returns. These do not, however, take into account the numerous swarms destroyed by the Railway Department or in those districts where there was no locust officer.

The term swarm is of exceedingly vague significance and it is quite impossible to estimate the average size of those which were destroyed. But these may be said to have varied in size from those covering a few square rods to others of such magnitude that they covered hundreds of acres. In the initial stages of the 1909 invasion the insects came down in immense swarms from the Kalahari Desert in March, and subsequently mighty swarms swept the country clean to the coast of the Indian Ocean between Port Elizabeth and East London, the females depositing their eggs more or less all the way from the desert to the sea, where they covered an area of country about 200 miles in width.

The most highly favoured of all the agents used in the destruction of locusts is a mixture of arsenite of soda and treacle. In preparing this the custom is to dissolve 200 lbs. of the arsenite in about 15 gallons of boiling water and then to add water until the bulk is 20 gallons. Half a gallon of this is then poured into an iron drain, specially manufactured for the purpose, and a gallon of the treacle or syrup added; the whole is then thoroughly mixed, the drumhead fixed, and the material is then ready for transport. The dilution of the poison recommended by the department is one part to 66 of water for newly-hatched locusts ("Voetgangers"), and one part to 50 when the insects are about a fortnight old. Mr. C. P. Lounsbury points out, however, that no single means of destruction can be recommended for use in all circumstances, and that spraying with either the arsenical poison or with a soap solution is applicable only where water is available. The soap emulsions make the cheapest spraying solutions for killing the locusts *by contact*, but if the solution is too highly diluted with water the insects may be stupefied for a few hours and finally recover. On the other hand, the arsenical preparation acts as a stomach poison and kills them more or less quickly, according to the strength at which it is used. When poison is used it is lightly sprayed around or over the swarms, or in front of them if they are on the move. This preparation has unfortunately a deadly effect upon the vegetation, and cattle should not be allowed to graze upon the sprayed areas until after a good rain, or after the dead herbage has been fired. Whole areas of crops under cultivation must not be sprayed, and in such circumstances poisoned baits may be used with excellent results, and the most marked feature of the recent work of locust destruction was due to the vastly increased use of such "baits." Various materials are used, but finely-chopped green forage is claimed to be the best. As a substitute bran, mixed with the poison, is also strongly recommended by the officer in charge of the Caradoc district, but it is thought that this may have a deadly effect upon small birds, and is not generally advocated.

One of the most interesting chapters in this report is that which deals with locust-eating birds, the species referred to being the white stork (*Ciconia alba*), though other members of the pelargi are evidently included, and small pratincoles (Limicolæ). It is stated that these birds practically cleared the country of the swarms of locusts that had escaped being poisoned, and that they are the leading factors in the natural control of these pests. This is not the first occasion that the bureau has published information regarding this destruction of locusts by birds; it may be recalled here that information was given in the previous report, in which it was stated that the swarms of locusts which occurred in the country bordering on the Kalahari were practically exterminated by them.

TOTAL ECLIPSE OF THE SUN, APRIL 28, 1911.

ALTHOUGH the eclipse which is due to occur on Friday, April 28, 1911, will only be visible along a narrow track extending from the south-eastern coast of Australia to the islands about Samoa, it has attracted a strong contingent of both official and private observers. In spite of the comparative difficulty of access, it was considered that this, being the last of the series of long-duration eclipses for some years to come, warranted a special attempt being made to secure the important observations, spectroscopic and topographic, which can as yet only be efficiently made during the period of eclipse.

After very careful consideration of all possible situations, most of the parties have proceeded to a small coral island, Vavau, one of the Friendly Group in lat. 18° 39′ S.; long. 173° 59′ W. Three English parties have arranged to observe the eclipse in the vicinity of Neiafu, the chief town of Vavau. The constitution of these, with their instrumental equipment, is as follows:—

(1) *Government Expedition from Solar Physics Observatory.*—Dr. W. J. S. Lockyer, in charge of this party, and accompanied by Mr. F. K. McClean, left London on February 3, 1911, with the necessary gear, and journeyed to Sydney by the Orient s.s. *Otway*. From there the instruments were transhipped to H.M.S. *Encounter*, of the Australian Squadron, and the expedition started for the Friendly Islands on March 25. Their equipment consists of:—

(*a*) *6-inch prismatic camera*, 7 feet 6 inches focal length, with four large objective prisms of 45° angle. With this instrument it is hoped to photograph the spectrum of the sun's atmosphere at second and third contacts, and also to obtain several records of the coronal spectrum during totality. This will be used in connection with a 12-inch siderostat.

(*b*) *Concave Rowland Grating Spectrograph*, of 10 feet radius of curvature, arranged as a slit spectrograph for the first-order spectrum. A special plate holder has been provided, carrying six celluloid isochromatic films, 24 inches long, bent to the curvature of the focal curve. A Cooke photo-visual triple objective of 30 feet focal length, receiving light from a 21-inch siderostat, will form an image of the sun about 3½ inches diameter on the slit plate. An endeavour will be made to photograph the spectrum of the cusps and of the corona during totality.

(*c*) *Cooke Coronograph*, 4 inches aperture and 16 feet focal length.

(*d*) *De La Rue Coronograph*, 4⅝ inches aperture and 8 feet focal length.

(*e*) *Doublet Coronograph*, 5 inches aperture and 30 inches focal length.

(*f*) *Doublet*, 6 inches aperture and 48 inches focal length.

Two small spectrographs will also be used with Thorp replica diffraction gratings placed in front of the camera lenses. To feed these instruments with light two siderostats, of 21 inches and 12 inches aperture respectively, and a coelostat of 16 inches aperture, have been taken by the expedition. On

arrival at Sydney, this party will be joined by several gentlemen who have had experience of eclipse work with Mr. F. K. McClean in Flint Island (1908) and Tasmania (1910). These are Messrs. J. Brooks, W. E. Raymond, and H. Winkelman.

2. *Expedition from the Joint Permanent Eclipse Committee.*—This party will be under the charge of Father A. L. Cortie, S.J., from Stonyhurst Observatory, who will be assisted by Mr. W. McKeon, S.J., and Father E. F. Pigot, S.J. Father Cortie's expedition also travelled by the *Otway* from London, and proceeded to Varau on board the *Encounter*. The equipment is as follows:—

(1) Coronograph of 20 feet focal length.
(2) Coronograph of 4 inches aperture.
(3) Coronograph of 4 inches aperture and 34 inches focus.
(4) 4-prism quartz train spectrograph for recording the ultra-violet spectrum of the chromosphere and corona.
(5) 6-inch Dallmeyer portrait lens arranged as a prismatic camera with a 7-inch objective prism of 42° angle.

3. A private expedition in charge of Mr. J. H. Worthington, who has had a special equipment made for this eclipse. His main instruments will include:—

(*a*) Quartz-rocksalt spectrograph of $2\frac{1}{8}$ inches clear aperture and 4 feet focal length. With this will be used two objective prisms of quartz, 60° angle and $2\frac{1}{2}$ inches high. The length of spectrum given by this combination is 8 inches from D to λ 2600.

(*b*) $3\frac{3}{16}$-inch coronograph with amplifying lens giving an equivalent focal length of 20 feet.

(*c*) $2\frac{3}{8}$-inch coronograph of 4 feet focal length.

(*d*) 3-inch portrait lens coronograph, 24 inches focal length.

Arriving at Vavau early in April, the various parties will have ample time to get their various instruments into the delicate adjustment which is necessary, provided, of course, that they are not seriously hampered by inclement weather. A telegram received from Sydney brings the welcome news that the officers and men of H.M.S. *Encounter* are enthusiastic in their anticipation of helping in the work of the various expeditions, and this augurs well for the success of the eclipse observations if good, clear weather is experienced.

The eclipse occurs at Vavau about 9.15 p.m. G.M.T. on Friday, April 28, totality lasting 217 seconds, with the sun at an altitude of about 43°.

CHARLES P. BUTLER.

NOTES.

A COMMITTEE has been appointed for the purpose of raising in Amsterdam a suitable monument to the memory of the late Prof. van 't Hoff.

SIR J. J. THOMSON, F.R.S., has been elected a correspondant of the Paris Academy of Sciences in the section of physics.

THE Queensland Government recently appointed Dr. R. Hamlyn-Harris as director of the Queensland Museum, and has issued to him instructions to reorganise and put the museum on a proper footing.

SINCE the so-called "Daylight-saving" scheme was first put forward, we have pointed out that a change of custom as to the hours of opening of city offices would secure the better use of daylight without legislative action. We are glad, therefore, to see the announcement that in certain departments of the Board of Education the officials arrived at their offices on Monday at 9 a.m. instead of at 10 o'clock, and left at 4 p.m., an hour earlier than usual. The experiment proved such a success last year that the Board of Education authorities have decided to give it a wider trial during the forthcoming summer.

IT is proposed, in memory of the late Dr. Louis Olivier, founder of the *Revue générale des Sciences*, to publish a book, of from 250 to 300 pages, containing contributions from eminent men of science and letters who knew M. Olivier. The volume is to appear next August for the anniversary of the death of M. Olivier, and will be accompanied by a booklet containing his portrait, a biographical sketch, and a bibliography of his works. Subscriptions of 20 francs will secure a copy of both publications on ordinary paper, and 50 francs will entitle to copies on Japanese paper. Subscriptions may be sent to M. Louis Brunet, treasurer of the committee, 18 rue Chauveau-Lagarde, Paris.

THE Decimal Association has issued a circular with reference to the Colonies and the metric system of weights and measures. The most recent instance of the adoption of the metric system by a British colony is that of Malta, where an Ordinance has been passed making the system compulsory as from January 1 next, or such later date as the Governor may fix. It is understood by the Decimal Association that the question of the introduction of the metric system throughout the Empire will be brought forward by the Australian representatives at the forthcoming Imperial Conference. Accompanying the circular is an interesting summary of official reports on the metric system by Mr. J. H. Twigg, late of the Bengal Civil Service.

THE noteworthy flight of Lieuts. Erler and Markenthun from Berlin to Hamburg, and thence to Bremen, has provided a remarkable example of the immediate military value of the aëroplane. The officers started on March 28 soon after eleven o'clock, reaching Hamburg, 142 miles distant, about half-past six. Two halts, each of about two hours' duration, were made, one at Döllen in Mecklenburg, owing to the overheating of the motor, and the second at Ludwigslust. A wireless message was sent from the machine *en route*, which was received at Nauen, near Berlin. The altitude maintained—492 feet to 984 feet—was comparatively small for military purposes, and the flight was aided by a slight following wind. The next day the officers continued the journey to Bremen, covering the distance of 73 miles in a continuous flight of 1h. 15m., aided again by a following wind. The machine used was a biplane built to the designs of the military authorities, with the passenger's seat placed directly behind that of the pilot, but at a higher elevation to enable the observer to obtain an uninterrupted view in all directions. A dual control was fitted, allowing the observer to take charge in the event of the pilot becoming incapacitated from any cause.

A CENTRAL NEWS message from Christchurch (N.Z.) on April 1 states that the *Terra Nova* has arrived safely at Port Lyttelton from the Antarctic. During the meeting of the British party with the Amundsen Expedition cordial greetings were exchanged. As already announced, the *Terra Nova*, while following the Great Ice Barrier from the direction of King Edward Land with the view of landing the eastern exploration party somewhere near what was formerly known as Balloon Bight, found the *Fram* in the Bay of Whales. Captain Amundsen's sole object for the present is to reach the South Pole by way of the Beardmore Glacier, but he hopes, after having done so, to carry out the programme of Arctic exploration originally drawn up by him. His equipment includes 116 Greenland dogs and a sufficient number of sledges and skis. The *Terra Nova* on her return to McMurdo Sound left a message in the *Discovery* hut announcing the meeting with Captain Amundsen, and this message Captain Scott will find when he returns from his depôt-laying expedition

in the south. The *Fram* is going to Buenos Aires, and will return to the Barrier in 1912.

THE Prehistoric Society of France will hold its seventh meeting at Nîmes on August 6–12.

TWO lectures to engineers, on steel, will be given at the Institution of Mechanical Engineers on Tuesdays, April 11 and 25, by Dr. Walter Rosenhain, of the National Physical Laboratory.

THE Selborne Society has just issued a new prospectus which is well illustrated from photographs by members of the society, and includes pictures by several of the pioneers in nature photography. The prospectus contains a long list of branches and junior branches, with the rules of the society; copies can be obtained by prospective members on application to the honorary secretary at 42 Bloomsbury Square, W.C.

THE death is announced from Rotterdam of Pieter Cornelius Tobias Snellen, the distinguished entomologist, at seventy-seven years of age. A notice in *The Times* of April 5 gives the following particulars of his work:—Snellen devoted his attention almost exclusively to the Lepidoptera, and was one of the founders of the Entomological Society of the Netherlands, in the Transactions of which he published a valuable series of articles both on Dutch and foreign Lepidoptera from 1857 onwards. His work on the Lepidoptera of Holland, published in three volumes in 1867 and 1882, under the title of "Vlinders van Nederland," is the standard work on the subject, and is a model of completeness and accuracy. In addition to his European collection, Snellen brought together a very valuable foreign collection with the assistance of his friend M. C. Piepers, and other Dutch Colonial officials, and on materials thus acquired he based valuable papers on the Lepidoptera of West Africa, Java, Celebes, &c., and he also contributed a long paper on Lepidoptera to Veth's "Midden-Sumatra."

SIR CASPAR PURDON CLARKE, formerly director of the South Kensington Museum, and afterwards director of the Metropolitan Museum of Art in New York, died after a long illness on March 29. Sir Caspar acquired a considerable reputation by his knowledge of Eastern art, of which he was an enthusiastic and earnest student. On behalf of the South Kensington Museum he made several expeditions to the East for the collection of objects of Indian and Persian art, and the very remarkable display of Indian art and Indian architecture, which was one of the most attractive features of the Indian and Colonial Exhibition, 1886, was almost entirely due to the result of the journey which he made the previous year for the collection of suitable examples. After serving at South Kensington in various capacities, he followed Sir Philip Cunliffe-Owen as director of the museum in 1896. Nine years later—in 1905—he was attracted by the liberal offers of the authorities of that museum to the Metropolitan Museum of Art in New York. Illness compelled his abandonment of this post last year, and since his return to England he had been in very failing health.

THE Lötschberg Tunnel through the Bernese Alps was pierced early in the morning of March 31. It has taken four and a half years to bore the tunnel, and it will be another two years before it is open for traffic. The length is rather more than 9¼ miles, and the tunnel ranks third among the great Alpine tunnels. The Simplon is 3¼ miles longer, and the St. Gothard only about a quarter of a mile. One end of the new tunnel, which derives its name from the Lötschen Pass under which it runs, comes out at Kandersteg, in the Bernese Oberland, the other at Goppenstein, 17½ miles from Brigue. The Lötschberg Tunnel differs from the other Alpine tunnels in not being straight, there being three curved lengths of 872 yards, 1222 yards, and 350 yards respectively, amounting in all to about one and one-third miles. This curved course was not part of the original plan, but was necessitated by the accident of July 24, 1908, when the Kander River was tapped and the water rushed into the workings, carrying with it a mass of rock, and killing twenty-five workmen. In consequence of this catastrophe, the total length of the tunnel was increased from 13,735 metres to 14,536 metres, or nearly half a mile. On the approach lines nearly one and a half millions sterling are being spent, while the tunnel itself was to cost 2,000,000*l*. To this sum, however, must be added the extra expenditure, amounting to 80,000*l*., involved in lengthening the tunnel in the manner described. The chief difficulties encountered have been the hardness of the granite during a great part of the tunnel's course, which has involved heavy expenditure for blasting material, and the high temperature on the south side, which sometimes rose to more than 90° F.

THE Corrosion Research Committee of the Institute of Metals is now actively engaged in preparing for an elaborate series of investigations into the causes of the corrosion of brass condenser tubes. A special condenser is being constructed, which will contain forty-eight tubes, twenty-four of these being made of commercially pure brass, the remaining twenty-four tubes being made from brass containing a single selection from the following:—*lead*, tin, aluminium, manganese, or other materials at the discretion of the committee. Experiments will be made with various water speeds in the ratio of 0 : 1 : 2 : 3 : 4, speed 2 being an average speed used in practice. The circulating water to be used will be obtained from deep water at Formby, off Liverpool, in the first instance, and the plant for the corrosion research will be installed in the University of Liverpool, where the experiments will be under the direct supervision of Mr. G. D. Bengough. It is expected by the committee that the research will occupy many months before any definite conclusions can be reached, and it will undoubtedly be costly. An appeal was recently made by the committee for funds to carry on the research, and in response to it the total amount received was 242*l*. This is sufficient to enable the research to be commenced; but if the work is to be carried on properly the expenses will probably amount to not less than 300*l*. per annum. It is therefore hoped that additional donations to the Corrosion Research Fund will be speedily forthcoming. Donations should be sent to Mr. G. Shaw Scott, secretary of the Institute of Metals, at Caxton House, Westminster, S.W.

THE annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, on Thursday and Friday, May 11 and 12, commencing each day at 10.30 o'clock a.m. On the Thursday morning, the Bessemer gold medal for 1911 will be presented to Prof. H. Le Chatelier, and the Andrew Carnegie gold medal for 1910 will be presented to Mr. Félix Robin (Paris). The awards of the Andrew Carnegie research scholarships for 1911 will be announced, and a selection of papers will be read and discussed. The annual dinner of the institute will be held in the evening in the Connaught Rooms, Great Queen Street, W.C. On Friday, May 12, a further selection of papers will be read and discussed. The autumn meeting of the institute this year will, by the invitation of the Associazione fra gli Indus-

triali Metallurgici Italiani, be held at Turin, Italy, and an influential local reception committee has been formed, under the presidency of Mr. G. E. Falck, president of that association, to carry out the necessary arrangements. The meeting will commence on October 2, and with the subsequent tour organised in connection therewith will occupy about fifteen days from the time of leaving London until the return

IN the report of the Royal Zoological Society of Ireland for 1910, the council states that, in spite of the bad weather of last summer, the money taken at the gates has not shown any serious decrease, this being largely due to an increase in the number of sixpenny admissions. On the other hand, the receipts from subscriptions and entrance-fees were distinctly lower. The lions continue to form one of the features of the menagerie, where they are now represented by twenty-one individuals. Lack of funds prevented extensive purchases during the year, but among the additions made in this manner attention may be directed to a young reindeer. The losses by death were serious, and an appeal is made for funds to establish and equip a hospital, by the aid of which it is hoped the mortality may in future be reduced.

IN a paper published in the February number of *The Victorian Naturalist*, Mr. J. A. Kershaw shows that the Australian eel (*Auguilla australis*) migrates to the ocean for breeding purposes in the same manner as its European relative, and that in turn the young elvers ascend the rivers until they find suitable dwelling places. As in Europe, these eels, when prevented by dams or on account of living in land-locked lakes or ponds, from reaching the sea by a direct route, will travel during freshets across flooded grass for long distances. Similarly, the elvers in Victoria not uncommonly ascend the streams in large "fares," when, in case of a barrier intervening, they make their way over comparatively smooth surfaces of rocks, as is well shown in the photographs illustrating the paper.

To the March number of *The Zoologist* Prof. McIntosh, of St. Andrews, contributes a sketch of the organisation and habits of the toothed whales. At the commencement the author endeavours to perpetuate the mistake that the "gigantic" mammoth was larger than living elephants, while later on he states that the teeth of the sperm-whale have been asserted to serve as a lure for prey, whereas he should have said the white lining of the mouth. He also asserts that the limbs of zeuglodonts are unknown, and implies that these animals are restricted to America. This being so, it is not surprising to find that he appears to be unfamiliar with the researches of Fraas, Dames, Stromer, and Andrews into the organisation of zeuglodonts, and the discovery of their apparent descent from creodonts. It is remarked that we are still in almost complete ignorance with regard to the slumber of cretaceans—if indeed they sleep at all; and an interesting reference is made to the belief of whalers that rorquals, after filling their lungs with air to the utmost extent, can remain in a quiescent condition beneath the surface of the water for eight or ten hours at a stretch.

THE scheme for the administration of the 40,000*l.* granted from the development fund to the Board of Agriculture and Fisheries for the encouragement of light-horse breeding, is now in full working order. It will be remembered that the objects of the grant are five-fold, namely, the award of premiums to stallions, awards for the purchase of half-bred working brood-mares to be stationed in selected districts, free nominations for mares to be served by approved stallions, the purchase of stallions for resale, and the voluntary registration of stallions. The awards to stallions are to take the form of King's premiums and the Board's premiums, and in both cases owners will have to agree to their stallions serving not fewer than fifty mares if required, exclusive of those to which a free nomination has been given. In no case will service-fees be paid for more than ninety mares in any one year. It is estimated that about 200 working brood-mares can be purchased annually, and the free nominations for mares are expected to reach about 1400. By the purchase of stallions it is hoped to keep in the country a number of animals which would otherwise go abroad. One of the difficulties will be that the grant will increase the supply of hunters, cobs, &c., without creating a new market for this kind of stock, the demand for which is decreasing. The answer to this depends in some degree on whether the War Office is prepared to raise the stock of army horses to a war-footing.

IN *Meddelelser fra Kommissionen for Havundersögelser*, Serie Fiskeri, Bind III., No. 8, Dr. A. C. Johansen gives a summary account of the recent investigations on plaice and plaice fisheries in Danish waters, treating separately of the fisheries in the North Sea, the Skagerak, and the northern Kattegat. The present memoir gives a very useful and comprehensive summary of the previous reports which have been issued on the same subject. It includes an account both of the market statistics of plaice landed and of the special scientific investigations and experiments which have been carried out. The market conditions in Denmark are exceptional, owing to the fact that the chief demand is for fish which are landed alive. This influences the method of fishing, the plaice being caught in seine nets instead of in trawls. The fish thus caught are for the most part alive when captured, and as there is a size limit (25·6 cm.) below which they are not allowed to be landed, and the fish under this size are returned to the sea, the actual destruction of small fish is insignificant. It appears that since the introduction of the size limit the Danish plaice fisheries in the North Sea have increased, and the report speaks in favour of an international size limit for plaice for all countries carrying on fisheries in the North Sea.

THE Legislature of Montana, since January 20 last, has introduced and enacted into a State law a measure that converts the famous "Hell Creek Bad Lands" country into a State game preserve. Primarily it is for the benefit of the prong-horned antelope, mule deer, and mountain sheep still surviving in that wild and picturesque region; but it is reasonably certain, also, that in the future a nucleus of American bison will be added. The region fronts on the Missouri River, and it lies about 100 miles north by west of Miles City. The total area of the preserve is about 100 square miles. About three-fourths of it consists of very deep and rugged bad-lands, made by the waters of Snow Creek, Hell Creek, and other streams. The remaining fourth of the tract contains some high-level grass lands that can support a herd of perhaps a thousand bison. On the eastern side of the preserve lies the fossil region, now known widely as "the Hell Creek formation," discovered in 1902 by Messrs. W. T. Hornaday and L. A. Huffman, out of which have come the great lizard (*Tyrranosaurus rex*) and the giant three-horned dinosaur (*Triceratops brevicornis*). The new preserve contains a small band of mountain sheep. It is intended, eventually, to ask Congress to make Snow Creek a national preserve.

IN a recent issue of *The Agricultural News*, the journal of the West Indian Department (vol. ix., No. 223), attention is directed to the possibility of growing Castilloa rubber in Jamaica. It is considered that *Castilloa guatemaltica* is better suited to the local conditions than *C. costaricana*, but it is stated that a drought-resisting Castilloa occurs on the Pacific side of Costa Rica which might prove useful, and is to be tried. The tree should be planted as a separate crop, and not as a shade crop for cacao, if the best results are desired.

THE report on the Local Department of Agriculture at Barbados, 1909–10, deals mainly with sugar-cane and cotton experiments. There has been a falling off in the area planted in cotton owing to various discouragements, which, it is stated, would have been greater but for the efforts of the Department. The production and introduction of useful food crops has been continued, with promising results, and a beginning has been made with an export trade to Great Britain. Bananas have been shipped here, and also mangos and Avocado pears, but unfortunately some of the two last crops reached London in bad condition. Sweet potatoes and yams were also sent; from the experience gained it is clear that much has to be learned in regard to time and method of shipment, &c.

DR. THEILER, of the Transvaal Agricultural Department, showed some time ago that redwater is caused by *Piroplasma bigenimum*, and devised a system of inoculation that has proved very successful in rendering immune the South African cattle. But both in the Transvaal and in Cape Colony considerable trouble has arisen when imported cattle have been inoculated, so many as 33 per cent. of the animals being lost in the experimental trials. The problem is discussed in a recent issue of *The Agricultural Journal of the Cape of Good Hope* (No. 4, vol. xxxvii.) by Mr. R. W. Dixon, who recommends that only young animals less than a year old should be imported if possible, as these resist the ill-effects of inoculation better than older animals. It is further recommended that the importation should be in winter or early spring, at which time tick infestation is in abeyance, and redwater, whether natural or artificially induced, is always milder in cold than in warm weather.

THE bush-fire problem in thinly populated countries is discussed by Mr. T. S. Marshall in the Journal of the Department of Agriculture of South Australia (vol. xiv., No. 3). Right through Australia, he states, millions of acres of forest country occur in which many of the trees are ring-barked, others are hollow to the core, numberless dead trees, inflammable as tinder, lie on the ground, while the thick grass and undergrowth become very dry. The fires are started through careless throwing down of burning wax matches—surely the most dangerous of all matches in a forest—by neglect of camp and other fires, by sparks from engines, &c. As a safeguard, breaks are prepared round farm holdings by ploughing a strip one, two, or sometimes more chains wide all round, and keeping it carefully free from growth. In better settled districts brigades are organised and provided with specially constructed carts for sprinkling the ground in front of the fire, and so making a break, or putting out logs and fences that have begun to burn.

THE soy bean (*Soja hispida* or *Glycine hispida*) has during the last two years come into prominence as a cattle food in England, and a certain number of experiments have been made to compare it with linseed and with cotton-seed cakes, which have hitherto been the standard purchased foods employed here. A report on two experiments made by Mr. W. Bruce, of the Edinburgh and East of Scotland College of Agriculture, has recently been issued, and the results indicate that soy-bean cake may be inferior to linseed cake for purposes of fattening bullocks. As Mr. Bruce points out, however, the result cannot be considered final. Feeding experiments are liable to many sources of error, and it is not unusual to find that a result obtained in one experiment is not confirmed on repeating the trial elsewhere. Whether the soy-bean cake proved less profitable than the linseed cake is not clear; in one of the two experiments it proved the more expensive food for making flesh, but, in the butcher's opinion, the flesh was worth more.

IN *The Agricultural Journal of British East Africa* (vol. iii., part ii.), published by the Agricultural Department, Nairobi, is an article on the rainfall of Nairobi giving diagrams, but, unfortunately, few or no figures, to illustrate various phenomena indicated by the records from June, 1899, to December, 1909. The rainfall is at a maximum in April, when it is 8 inches on the average, though the amount has been so high as 16 and so low as 1½ inches; it then falls, and during the months July, August, and September it averages less than an inch a month, the variation being from drought to 2 inches. It then rises to November, when there is a second maximum at 5 inches, the variation being from less than 2 to nearly 8. According to a native tradition, the rainfall runs in cycles of nine or ten years, each of which cycles terminates with a drought. The records have not gone on long enough to test the validity of this tradition. In another article attention is directed to the loss of power in internal-combustion engines at high altitudes. The writer states that he is working engines at an altitude of some 5000 feet above sea-level, and discusses methods by which the loss, due to diminished atmospheric pressure, may be reduced.

A CONTRIBUTION to the morphology of the Nyctaginaceæ, by Dr. H. Fiedler, published in Engler's *Botanische Jahrbücher* (vol. xliv., part v.), is concerned chiefly with the inflorescence modifications and floral diagram variations, from which the author draws conclusions as to the phylogenetic sequence of the included tribes and genera. The tetracyclic character of the flower with two staminal whorls, characteristic of the Centrospermæ, is confirmed, and evidence for two or more lines of development in the family is adduced.

TWO useful compilations by Mr. P. C. Standley relative to the botany of New Mexico are published in vol. xiii., part vi., of Contributions from the United States National Herbarium. The first is an annotated list of type species from New Mexico, together with their localities; to these is added a summary of the itineraries of early collectors, a descriptive list of type localities, and a map of the territory of New Mexico on which the localities are marked. The number of species enumerated is 690, of which one-fifth were collected in the vicinity of Santa Fe, chiefly by A. Fendler in 1847. The second article is a bibliography of New Mexican botany.

A REPORT by Mr. H. N. Thompson, the conservator of forests in southern Nigeria, on his tour through the western districts of Meko and Shaki, provides the subject of a publication by the legislative council of the colony. The forests inland are chiefly open savannah or park-like, in which deciduous-leaved trees predominate; in moist situations along the banks of streams they become denser,

and contain more evergreen species. Extensive areas of the so-called black cotton soil form a special feature that is rare in tropical West Africa. *Pseudocedrela Kotschyi* is the most important tree, both in quantity and quality; *Lophira alata*, the West African oak, and *Pterocarpus erinaceus* are fairly common, and could be increased by judicious fire-protection and cultivation. *Afzelia africana* is more localised, and *Khaya senegalensis* grows mainly above the eighth parallel.

A REPORT on the eruption of Taal volcano (Luzon) of January 30 has been issued by the Rev. M. Saderra Masó, assistant director of the U.S. Weather Bureau in the Philippine Islands. The volcano rises from Volcano Island in Lake Bombon, lies about 39 miles south of Manila, and is 996 feet in height. On the night of January 27–28 the volcano began to emit black smoke from its main crater instead of the usual clouds of white steam. This was accompanied by rumblings and earthquakes. During the next two days the explosions and earthquakes increased in strength and frequency until about 2.20 a.m. on January 30, when a tremendous explosion occurred, which is said to have been heard at a distance of 250 miles from the volcano. A huge black cloud issued from the crater, and there was a heavy fall of boiling mud, which destroyed all the houses and vegetation in Volcano Island and along the western and north-western shores of the lake to a distance of 10 miles from the crater, and caused the loss of more than 1250 lives. Along these shores the mud formed a layer 2 or 3 feet in thickness. The opposite shores escaped with little or no fall of mud, the wind having been from the south-east. The damage was increased by the waves produced in the lake, which reached a height of 10 feet. The rush of air towards the volcano was perceptible for many miles. At Batangos, 17 miles distant, an abrupt fall of 2 mm. in the atmospheric pressure was registered. Volcanic dust was carried so far as Manila. Earthquake shocks, though never of destructive intensity, were extremely frequent, nearly a thousand having been recorded at Manila from January 27 to February 7, when the eruption ended and the ground ceased to tremble.

THE summary of the weather in the several districts of the United Kingdom for the first quarter of the current year, as comprised by the thirteen weeks ended April 1, has just been issued by the Meteorological Office. The mean temperature for the period was nowhere very different from the average, and the record of absolute temperatures was not at all exceptional. The highest temperature in any district during the three months was 63°, which occurred both in the east and south-west of England. The lowest temperature was 11° in the east of Scotland and 13° in the south-west of England. The aggregate rainfall for the period was less than the average in all districts except in the east of England, where the excess for the three months was 0·63 inch. The greatest deficiency was 3·19 inches in the south of Ireland, and in the north of Ireland it was 2·74 inches. The greatest deficiency in any of the English districts was 1·88 inches, in the south-west of England. The largest absolute measurement for the period was 14·42 inches in the north of Scotland, the smallest 3·99 inches in the north-east of England. The number of rainy days was nowhere very different from the normal; the highest number was 58 days in the north of Scotland, the lowest 42 days in the Midland counties. The hours of bright sunshine were in good agreement with the normal; the longest duration was 269 hours in the Channel Islands, the shortest 196 hours in the Midlands. At Greenwich the mean temperature for the three months was in absolute agreement with the average; the rainfall was 0·61 inch less than usual, whilst the bright sunshine was 25 hours deficient. For the six months October to March inclusive, which comprises the whole winter, the mean temperature at Greenwich was 43·0°, which is 0·6° in excess of the average. October and December were decidedly warm months, whilst November was decidedly cold. The lowest shade temperature at Greenwich during the winter is 22°, which occurred both in November and February. Out of 182 days there were 94 days with the temperature above the average, and frost occurred on 37 nights. There were 99 days with rain, yielding a total of 13·31 inches, which is 1·49 inches more than the average; November, December, and March were wet. The total duration of sunshine in the six months was 319 hours, which is 63 hours fewer than the average.

THE meteorological charts of the Atlantic and Pacific Oceans for March and April published by the U.S. Weather Bureau contain useful notices (1) on West India hurricanes, which usually occur between July and October. Particulars are given of some of the more destructive storms, with remarks on the premonitory signs of the approach of tropical hurricanes generally. The tracks of those which occurred in 1900–9 are laid down on charts for separate months. The storms are liable to appear in any part of the region between lat. 7° and 31° N., and east of the ninety-fifth meridian, and to recurve at any point between far to the east of the Bahamas and the west coast of the Gulf of Mexico. (2) Cyclones and anticyclones. The first clue to the rotatory character of storms is attributed to Benjamin Franklin, in 1747. As he was unable to observe an eclipse of the moon at Philadelphia owing to stormy and cloudy weather, while his brother at Boston experienced clear weather, he made inquiries as to the behaviour of the storm in question, and as a result of the investigation he came to important conclusions on the movements of storms in general. Some useful explanations are given by the author of this notice of the conditions at work in weather changes, and of the origin of storms.

THE *Verhandlungen der Deutschen Physikalischen Gesellschaft* for February 28 contains an account of a theoretical and experimental investigation of the best practical method of winding the coil of a needle galvanometer, by Dr. W. Volkmann. Maxwell showed long ago that the wire should increase in diameter as the windings get farther from the centre, and Volkmann finds that the nearest practical approach to this is to make the diameter of the wire used for successive portions of the coil increase in geometrical progression. The loss of efficiency due to this step by step change is proportional to the ratio of the step. The winding should be stopped when the loss due to stopping it is equal to that due to the ratio of the step. By finding experimentally the deflection due to single turns of various diameters, and in different positions, and dividing the deflections by the lengths of the turns, he finds that the best shapes of the parts of the coil are not quite those given by Maxwell, the deviations being greatest for the parts near the needle. With the new winding a coil of only 3·7 cubic centimetres produced the same deflection as a coil of 47 cubic centimetres wound on the old lines. Each coil consisted of four parts, and had a resistance of 5·5 ohms.

The Scientific American for March 18 is devoted to cement and its uses. An interesting article by M. L. Davey gives particulars of methods of saving trees which have partly rotted by means of cement fillings. Once

decay has started in a tree, its progress is rapid. Decay attacks and disintegrates the dormant tissues first, and gradually works outward. Cement in trees fulfils the three-fold purpose of stopping decay, serving as a structural support, and providing a surface over which the bark may heal. Tree surgery may be likened to dentistry; all existing decay must be removed, and means taken to prevent further decay; the cavity must be prepared so that the filling will stay permanently in place, and all foreign substances must be excluded. Chisels and gouges are employed to remove existing decay, which must be followed throughout limbs and trunk so far as it goes. Corrosive sublimate or a similar solution may then be used to destroy any remaining fungi. The walls of the cavity must then be thoroughly waterproofed to protect the wood. Before filling in the cement, the cavity must be well braced, if of considerable size, with steel ribs or truss rods. Skill is required in this matter, so as to allow for the natural swaying of the tree. Water is excluded by cutting a "water-shed" at the edge of the cavity, to which an adhesive waterproofing material is applied. The filling must be under the edge of the bark at every point in order to permit of the bark healing over the filling.

MESSRS. MACMILLAN AND CO., LTD., have published an Index to vols. xi.–xx. (1901–10 inclusive) of *The Economic Journal*, the journal of the Royal Economic Society, which is edited by Prof. F. Y. Edgeworth, assisted by Mr. H. B. Lees Smith, M.P. The index has been prepared by Miss Ethel R. Faraday.

IN our issue of December 26, 1907 (vol. lxxvii., p. 172), attention was directed to Mr. Nasarvanji Jivanji Readymoney's "Science of Nature-History." The author has sent a copy of a reissue of his work—in which he has modified the title and added an introductory page—and also a pamphlet entitled "A Programme of Education," in which he commends the heuristic method of teaching.

MESSRS. BAILLIÈRE, TINDALL AND COX announce that the new edition of Green's "Pathology" will be ready for publication by the end of the month. The work has again been revised by Dr. Bosanquet, much new material added, and rearrangement of subjects made. Its format has also been modified for inclusion in the "University Series of Manuals," which contains such volumes as Stewart's "Physiology" and Dawson Turner's "Medical Electricity."

OUR ASTRONOMICAL COLUMN.

HALLEY'S AND FAYE'S COMETS.—Dr. Max Wolf records, in No. 4486 of the *Astronomische Nachrichten*, recent observations of both Halley's (1909*c*) and Faye's (1910*e*) comets at the Königstuhl Observatory. On March 19 the former was still an easy object for the large reflector, its magnitude being about 14·0; no nucleus was visible, the comet appearing as a round nebulous disc of about ¼ minute diameter.

Faye's comet on the same evening was fainter than Halley's, its magnitude as a whole being about 15·0. A sixteenth-magnitude nucleus of about 10″ diameter was situated nearer to the southern edge of the circular nebulous disc; the comet is still an easy object to photograph with the large reflector; an observation on March 23 gave the magnitude as 14·5.

COMET 1910*a*.—An excellent photograph of comet 1910*a*, taken on January 28, 1910, with a Voigtländer "Dynar" objective by Dr. Karl Bohlin at the Stockholm Observatory, is reproduced as a plate in No. 2, vol. xxxiii., of *The Astrophysical Journal*. The principal tail extends to a length of 18°, and is bifurcated at its extremity; in addition, there issues from the slender head a secondary tail 2° long.

Prof. Riccò gives an account of the Catania observations, photographic and spectroscopic, of this comet in No. 2, vol. xi., of the *Memorie di Astrofisica ed Astronomia*. He reproduces several drawings and photographs showing the magnificent main tail and the small secondary one. In regard to the latter, he suggests, with great reserve, that its formation may have been an effect of the proximity of the comet to Venus, the distance separating them on January 27, 1910, being about 133 million kilometres. The Catania drawings for January 22 and 23 show the nucleus to be on the outer, convex edge of the **U**-shaped tail.

A PROPOSED METHOD OF DETERMINING SPECTRAL TYPES QUANTITATIVELY.—On January 24, 1907, we noted in these columns (NATURE, No. 1043, vol. lxxv., p. 304) the results obtained by Dr. Sebastian Albrecht, then of the Lick Observatory, from a study of the varying intensities of certain lines of compound origins found whilst measuring spectrograms for the determination of radial velocities. Briefly, the author found that, in consequence of the variation in intensity of the components from one spectral type to another, there was a progressive variation of the apparent wave-lengths of the compound lines. Further, it was suggested that, by inverting the problem, it might be possible to determine the finer differences in spectral type by careful measurements of the wave-lengths.

In the current number of *The Astrophysical Journal* (vol. xxxiii., No. 2, March, p. 130) Dr. Albrecht, now at the Córdoba Observatory, gives the preliminary results of such an investigation. One of the chief difficulties is to state definitely and numerically the intervals between the several spectral types F, G, K, and M of the Draper classification, but this is overriden by arbitrarily taking them as equal, and making *Ma* and *Mb* one-tenth of an interval on either side of M. Curves were then constructed with type-intervals as abscissæ and variation of wave-lengths as ordinates, so that accurate measurements of the wave-lengths in the spectrum of the star under discussion would show at once the exact position of that star in the classification; generally speaking, these curves show that the changes in wave-length are regularly progressive from type F to type M.

To illustrate the application of the method, eight stars were chosen, and the selected variable wave-lengths were measured in each, the results being recorded as weighted departures, in tenths of an interval, from the nearest main type. A considerable variation is shown among the individual results from each of the selected lines, although the probable error of the final result from all the lines is, in each case, not great; also, the accordance with the Draper classification is fairly good. Dr. Albrecht considers that the scheme is workable, and that when further developed it will afford a ready method of determining quantitatively the spectral type of the stars observed. He also suggests that in order to avoid special measurement a number of his selected compound lines should be included in all future measurements of spectrograms for the determination of radial velocity; it would appear, however, that for radial-velocity work it is better to use the purest lines possible.

MERIDIAN OBSERVATIONS AT THE ROYAL OBSERVATORY, BELGIUM.—The second part of vol. xii., of the *Annales de L'Observatoire Royal de Belgique* contains the detailed results of more than 2000 observations made with the Repsold meridian circle during 1909–10 (June), by MM. Philippot, Delporte, and Jamar. The principal object was to complete the observations of the *étoiles de repère*, but observations of the sun, the moon, and the planets, and of comparison stars for comets and for use in determining the movements of certain double stars in Burnham's general catalogue, were also made. Since August, 1909, a Repsold registering micrometer has been employed, and during the same year important modifications were made in the meridian room; among other alterations, the foundations of the pillars were encased with insulating material to prevent variations introduced by changes of temperature.

The volume also contains an interesting account of a comparative study of the errors of two chronographs, one by Gautier, the other by Dent.

POPULARISING ASTRONOMY.—From the *Rochdale Times* we see that the Rev. W. G. Pritchard is making an excellent innovation, for the popularisation of astronomy, in connection with the Education Guild of the town. The Guild meets frequently for the discussion of art, science, and literary topics, and the programme for Tuesday night was an open-air talk on the stars. The weather being favourable, the members were to gather in the vicarage field and there discuss the various celestial objects, under the leadership of Mr. Pritchard. We would commend this programme for general adoption among similar associations.

RELATIONS OF PHENOLOGICAL AND CLIMATIC VARIATION.[1]

THE monograph referred to below deals with the flowering date of thirty-nine plants for the years 1896–1909. Unfortunately, only ten, or 25 per cent., were noted for every year, and six were observed in seven to nine only of the fourteen years.

The observations were of herbaceous plants, shrubs, and trees that had grown at least two years in the meteorological enclosure of the Royal Observatory grounds at Uccle, two miles south of Brussels, on level ground, 340 feet above sea-level, all on clay soil. Observations were in each case made on the same individual plant, such as were well exposed being selected. In five chief essentials they were therefore ideal, identity of well-placed specimens, of soil, of location, of elevation, and of the observer, M. Jean Vincent, always on the spot. The series opens with *Corylus avellana*, February 25, and closes with *Aster horizontalis* (1900–7 only), September 15. The months represented are February 1, March 2, April 10, May 14, June 7, July 4, and September 9.

After an introductory survey, in which reference is made to the far greater number of factors now known to influence the flowering date than was once supposed, M. Vanderlinden notes the increasing importance assigned to the completion by each species of its "period of repose," on which, largely, the mean date of flowering depends. The research dealt largely with the influence, in association with this, of meteorological influences, as shown both by observation and experiment.

The test for "flowering," as customary also in this country, was the exposure of the stamens. It is not, however, stated whether for the hazel the pistils were observed instead, these being far less erratic than the staminiferous flowers.

Flowering is much more definite, and therefore better suited for such observations, than other phases, such as leafage, fruiting, and defoliation. The first tables give the flowering date for each year, with the mean for the years observed. It would surely have been well to intercalate dates for the missing years. To do this satisfactorily is indeed rather complicated, and such values are not equal to actual observed dates. But it would be safe to count the error as at most a quarter of that where such precaution is omitted. Thus the mean date given for *Ribes nigrum*, April 10, is that from 1903 on. The corresponding years for *Corylus avellana* give February 19, but that tabulated (on thirteen years of the fourteen) is February 25. For the other years, 1896 and 1898–1902, the average is March 3. The divergence at the later dates, we shall see, would be much less, but the argument would be equally affected. Thus *Ribes rubrum* is given April 10 (1903–9), *R. alpinum* April 14 (1898–1909). But the latter, on the mean of 1903–9, should be April 10·9. These discrepancies are less important for the investigations in hand than had these dealt more specially with relative dates of flowering, but they can hardly be neglected.

In looking at the dates, it is noticeable how much less range there is from the mean in the case of the earlier flowers than in British observations of the few for which there are common records. Thus for the hazel, for Uccle and Purley (Surrey), respectively, the range since 1906 is from February 17 to March 10, and February 1 to March 20; blackthorn, April 11 to May 1, and March 17 to April 27; but for dog rose, May 26 to June 4, and June 1 to 10.

The next subject dealt with is the relation between departures from the mean flowering date and the corresponding variations in the meteorological factors. Comparative curves are given for five such, namely, maximum and minimum temperature, radiation as shown by Bellani's alcohol radiometer, humidity, and rainfall. The last two were found to be relatively negligible, and, in the earlier months, the same is true of the third. Florescence depends, then, mainly on temperature, as the effective food stores are already present. Later on, foliage must precede flowering to supply chlorophyll, which necessitates light. But from June on heat is again the predominating factor, since the interval between foliage and flower is so long. These curves are given year by year. It is by careful examination of these, and confirmation of results, where possible, by experiment, that M. Vanderlinden reaches his conclusions. Naturally, there is always a certain amount of lag, but this is less with the herbaceous plants. The most effective combination is high temperature and radiation, with feeble humidity lasting for several days before the normal flowering date.

The chief experiments consisted in subjecting the plants to warm baths, to moist warm air, to various light conditions, to special warmth treatment over a definite time, followed by ordinary conditions. Some twenty conclusions are drawn, among which, besides those already mentioned, are the following:—

When blooming has been retarded it follows upon less stimulus.

Phenology is practically evidential for temperature and sunshine alone, and then only for approximate values.

Effects may remain latent (and so cumulative) over short periods.

Heredity determines the normal date.

Autumn and early winter have no influence [in Belgium].

Groups flowering concurrently vary concurrently. The evidence given for this is perhaps too limited for the conclusion.

It is certainly so in another case. Anyone who has dealt much with sun-spots would hardly venture on any conclusion from data confined to fourteen years. Hence the statement that no relation shows itself should rather have been that, as the observations have not yet been carried on for fifty or one hundred years, it is too early to investigate the matter. The sun-spot table was hardly the best way to utilise the space. Is not this true also of the fourteen tables of daily temperatures and radiation? One would have been content with a summary to compare with the valuable plates, based upon the figures, if instead we could have had further investigations worked out from the observations. It would have been especially interesting to have had relative results month by month, as, for instance, the relation between annual variation and the cumulative values above some minimum, below which the given plant showed no response to the effective factors of heat and light.

But, in asking for more, it must be understood that this is because of the excellent value of that which is given.

J. EDMUND CLARK.

[1] "Étude sur les phénomènes Périodiques de la Végétation dans leurs Rapports avec la Variations climatiques." By Dr. E. Vanderlinden. Extrait du Recueil de l'Institut botanique Léo Errera, tome viii. Pp. 67, with Tables and 16 plates. (Bruxelles: Hayez, Imprimeur des Académies Royales 1910.)

NON-EUCLIDEAN GEOMETRY.

IT is now well known by all mathematicians that Euclid's theory of parallels is not indispensable for the construction of a self-consistent geometry, but that, on the contrary, there are three coordinate systems, of which Euclid's is one, equally entitled to consideration, and equally general. So far as we can see at present, the strict proof of this statement must be analytical; at any rate, when we suppose that the elements—lines, points, planes, &c.—are, in the space considered, exactly analogous to the corresponding elements in Euclidean space. However, it fortunately happens that we can construct a non-Euclidean geometry in ordinary space by suitably changing the definitions of its elements, and this is, at any rate, of considerable help in convincing a student of the possibility of the non-Euclidean systems. Prof. H. S. Carslaw has recently explained one such method

(Proc. Ed. Math. Soc., 1909–10) which deserves attention as being a very simple image of hyperbolic geometry in Euclidean space.

We start by taking a fixed sphere σ, and define a plane α as a sphere which cuts σ orthogonally, a line as a circle which cuts σ orthogonally, a point as a point-pair inverse with respect to σ. All the ordinary projective axioms are satisfied; the angle between two planes is defined to be the angle, in the ordinary sense, at which the representative spheres intersect. If two planes touch, their point of contact must lie on σ; in this case they are said to be parallel. It is easily proved that through any point (not on σ) two planes can be drawn parallel to a given plane α; triangles exist with each angle zero, and so on. Moreover, it is possible to give a definition of length (as the logarithm of a cross-ratio) which enables us to say that if A, B, C are three collinear points, AB+BC=AC.

If σ shrinks up to a point, the geometry becomes Euclidean, though the elements are not the usual ones. We may, however, abstract from the point S, which is the limiting form of σ, and define a point A in the ordinary sense. Then line and plane elements are represented by circles and spheres through S.

It must be remembered that this theory assumes metrical and other properties of ordinary space, and does not pretend to put hyperbolic geometry on an independent footing. To do this requires a more detailed discussion, and the assumption of a hyperbolic space. In a somewhat analogous way we may consider the question of dimensions in space. We have a real four-dimensional geometry in ordinary space if we take as our primary element a line or a sphere, and so we may construct geometries of any dimension we like. But it is another thing to assume a four-dimensional space where (x, y, z, t) can be taken as, say, rectangular Cartesian coordinates of a point strictly analogous to the corresponding point-element in three-dimensional Euclidean space.

G. B. M.

MICROBIOLOGY IN NEW SOUTH WALES.[1]

WHEN we consider that the report referred to below deals with more than thirty-three thousand examinations, embracing all kinds of subjects, the difficulty of giving any adequate description of the contents will be appreciated. As this report is an introductory one, the plan has been adopted of writing an introduction to each section suitable for non-scientific readers, who may thus be able to follow intelligently the matter discussed; for beyond conducting routine work, the Bureau has set before itself the praiseworthy task of becoming a centre of useful knowledge. But it is further recognised that in the direction of research the Bureau will find its largest sphere of usefulness. This is no doubt true, and it is for the official mind to recognise that the man engaged in routine examinations cannot even succeed at this unless he too is sometimes allowed to engage in research.

To turn to the actual work, we find that tuberculosis ranks first in the numbers of specimens (487) supplied, while typhoid fever ranks second with 214. Perhaps an unnecessarily pessimistic view is taken as to the prospect of being able to control either the "carriers" or the fly in the case of this disease. At present our study of the house-fly is only commencing, and we think it probable that in urban areas it will prove to be very amenable to control. The formula "no dirt, no flies," would express the position we should take up.

It is recorded under the diphtheria examinations that cultures very often do not show diphtheria bacilli in twenty-four, but may do so in forty-eight, hours. But surely one may add the progress of knowledge is slow, for this fact was within the writer's experience twenty years ago when examining cultures in a large hospital. With regard to the protozoa, it is extremely interesting to note that malaria, though prevalent in the northern parts of Australia, occurs only as imported cases in New South Wales, though Anophelines abound there. The unravelling of that somewhat puzzling condition, *paludismus sine malaria*, still demands attention, and here we have another example of it. A large number of new species of bird plasmodia are recorded, though whether these "species" could be distinguished if it were not known from what birds the blood came is, we think, very doubtful. Several new hæmogregarines are also recorded from snakes and tortoises. Besides these scientifically interesting parasites, there are several diseases of unknown causation in cattle of economic importance, *e.g.* endemic hæmaturia in cattle, jaundice in lambs, and black disease in sheep, but piroplasmosis is not recorded. As regards entozoa, those of New South Wales make quite a respectable list, but perhaps by dint of including rarities. Hydatids appear to be the commonest entozoal parasite in Australia, occurring in man, sheep, cattle, and pigs, but rarely in horses.

A very interesting parasite affecting cattle is a filaria-like worm coiled up in subcutaneous tumours, known as "worm-nests." These have excited considerable interest among health officers in London and Liverpool lately, owing to their occurrence in frozen carcases from Australia. They are about the size of a split walnut, and occur, for the most part, over the brisket. It does not appear to be possible that they can be injurious to man. It should be mentioned, however, that it has been stated by one observer that they are associated with tuberculosis, but this is against the weight of evidence. The sanitarian's scruples may, indeed, be allayed by the evidence we have that, although such carcases are used as food in New South Wales, no injurious results have ever been known to arise therefrom.

An examination of telephone mouth-pieces (50) failed to detect tubercle or diphtheria bacilli. The examination of milk preservatives leads to the conclusion that to delay manifest change for even twenty-four hours involves the use of medicinal quantities, the long-continued ingestion of which may be injurious. In the milk question, the means of salvation is, we think, clear—prevention is better than cure. Finally, the rabbit problem must be referred to, and the interesting proposal to destroy rabbits by destruction of females and liberation of males is now being tested.

The director and his colleagues deserve warm commendation for the results of their first year of evidently very laborious work which this report chronicles, and which must soon justify itself, not only scientifically, but also economically.

[1] Report of the Government Bureau of Microbiology for the Year 1909. (Legislative Assembly, New South Wales.)

SCIENCE AND EDUCATION IN THE CIVIL SERVICE ESTIMATES.

THE Estimates for Civil Services for the year ending March 31, 1912, together with a memorandum by the Financial Secretary to the Treasury, have been issued as a Parliamentary Paper. The following particulars with reference to the money under this vote to be devoted to science and higher education are taken from this paper.

Under the sum required for Public Works and Buildings, the Estimate for the Royal Parks and Pleasure Gardens shows an increase of 5725*l.* on the year, in which provision is made for completing the new laboratory in the Edinburgh Royal Botanic Garden at a further cost of 3790*l.* Under Surveys of the United Kingdom (which have shown an annual decrease of cost since 1902–3, when the expenditure amounted to 237,130*l.*), there is a further decrease of 5452*l.* for the year, the estimated net charge amounting to 187,344*l.*

Under the heading Salaries and Expenses of Civil Departments, the Estimate for the Board of Agriculture and Fisheries shows a net increase of 9204*l.*; 43,589*l.* is included in respect of the expenses of a scheme for the Improvement of Light Horse Breeding. The expenditure for this purpose, less a sum of 5000*l.*, will be recouped by a grant from the Development Fund, and the grant of 5100*l.* hitherto paid to the Royal Commission on Horse Breeding ceases after the year 1910–11. 5000*l.* of the increase is, therefore, in effect a transfer from this latter Vote. 2250*l.* is included as grants to local authorities in aid of the provision of local inspectors for the purpose of the Destructive Insects and Pests Acts, 1877 and 1907, and 1050*l.* additional is required for the Collection of Agriculture and Fishery Statistics.

The Estimate for the Government Chemist appears for the first time as a separate Vote. In previous years the salary of the principal chemist was borne on the Treasury

Vote, and the other salaries and expenses of the Government Laboratory were charged to the Customs and Excise Vote.

The Estimate for the Department of Agriculture and Technical Instruction, Ireland, exhibits a net increase of 10,253*l*. Of this amount, 3275*l*. is due to an increased grant-in-aid to the Royal College of Science, and 5500*l*. to an increase in the annual grants to schools and classes of science and art and technical instruction. The sums of 17,000*l*. granted from the Development Fund for the purchase of areas of afforestation, &c., and 10,000*l*. for the improvement of horse breeding, are appropriated in aid of the Vote for this Department to cover the expenses incurred for those purposes.

The total provision for education, science, and art is 19,141,264*l*., being a net increase of 468,900*l*. on the amount voted in 1910. The Estimate for the Board of Education shows a net increase of 310,840*l*., of which 229,355*l*. arises under grants in respect of public elementary schools, 13,000*l*. under grants for training of teachers, and 64,500*l*. under grants for technical institutions, schools of art, evening schools, &c.

The Estimate for Universities and Colleges, Great Britain, and Intermediate Education, Wales, exceeds that for 1910–11 by 64,700*l*., after taking into account a Supplementary Grant of 21,000*l*. in 1910. Of this increase, 10,500*l*. occurs under the subhead for Scottish Universities, and 50,000*l*. under Colleges, Great Britain.

The Estimate for Public Education, Scotland, shows an increase of 82,869*l*. The estimated number of scholars in day schools has risen from 737,576 to 764,397 for the year, and the annual grants for day scholars are increased by 64,647*l*. The provision for grants for continuation classes and secondary schools shows an increase of 16,800*l*.

The increase of 18,176*l*. in the Estimates for Universities and Colleges, Ireland, is due to additional grants for land, buildings, and equipment for the Irish universities.

Among the amounts required for different purposes, the following are interesting:—art and science buildings, Great Britain, 99,900*l*.; surveys of the United Kingdom, 187,344*l*.; Government chemist, 19,088*l*.; Board of Education, 14,375,442*l*.; scientific investigation, 61,603*l*.; universities and colleges, Great Britain, and intermediate education, Wales, 303,800*l*.; public education in Scotland, 2,336,594*l*.; public education in Ireland, 1,653,324*l*.; and universities and colleges, Ireland, 186,256*l*.

A table included in the paper provides interesting information as to the growth of expenditure or otherwise under different headings. Take, for instance, the cases of the Board of Education, and the universities and colleges in Great Britain and intermediate education in Wales, the grants have steadily increased since 1902–3. Under the heading scientific investigations there is no such decided increase to record, as the following table shows:—

	£		£
1902–3	62,932	1906–7	56,858
1903–4	87,300	1907–8	53,823
1904–5	54,484	1908–9	55,349
1905–6	53,343	1909–10	83,338

Grants in Session 1910 for 1910–11, £74,228
Estimates 1911–1912, £61,603.

THE IMPERIAL EDUCATION CONFERENCE.

THE following representatives from the self-governing dominions are expected at the forthcoming Imperial Education Conference, which will be held on April 25–28 inclusive:—*The Dominion of Canada:* The Hon. R. A. Pyne, Minister of Education, Ontario, or Dr. A. H. W. Colquhoun, Deputy Minister of Education, Ontario; Dr. A. H. McKay, Superintendent of Education, Nova Scotia, with whom will be associated the Rev. Dr. MacGill, professor of philosophy, University of Dalhousie; the Hon. George R. Coldwell, Minister of Education, Manitoba; the Hon. Henry E. Young, Minister of Education, British Columbia; the Hon. W. F. A. Turgeon, Attorney-General, Saskatchewan. *The Commonwealth of Australia:* Mr. P. Board, Under Secretary in the Department of Public Instruction and Director of Education, New South Wales; Mr. C. R. P. Andrews, Inspector-General of Schools, Western Australia. *The Union of South Africa:* Dr. Thomas Muir, C.M.G., F.R.S., Superintendent-General, Cape of Good Hope; Dr. W. J. Viljoen, Director of Education, Orange Free State.

The Dominion of New Zealand will be represented by the Hon. Sir William Hall-Jones, K.C.M.G., High Commissioner in London for the Dominion, and the States of South Australia and Tasmania will be represented, respectively, by the Hon. A. A. Kirkpatrick, Agent-General in London for the State of South Australia, and the Hon. John McCall, Agent-General in London for the State of Tasmania.

The following local Governments in India have arranged to be represented as follows:—the Government of Madras by Dr. A. G. Bourne, F.R.S., Director of Public Instruction in the Presidency of Madras; the Government of Bombay by Mr. A. L. Covernton, principal and professor of English literature, Elphinstone College, Bombay; the Government of Bengal by Mr. B. Heaton, principal of the Sibpur Civil Engineering College, Bengal; the Government of the Central Provinces by Mr. S. C. Hill, late Director of Public Instruction in the Central Provinces, and Mr. C. E. W. Jones, principal of the Morris College, Nagpur; the Government of Burma by Mr. W. G. Wedderspoon, Inspector of Normal Schools, Burma.

The representation of the Crown Colonies will be as follows:—Falkland Islands, Mr. T. A. V. Best, Colonial Secretary; Gold Coast Colony, Mr. J. W. Church, Director of Education; Jamaica, Mr. G. H. Deerr, Inspector of Schools; Leeward Islands, Mr. H. E. W. Grant, Colonial Secretary; Malta, the Hon. Prof. Enrico Magro, Director of Public Instruction and Rector of the University of Malta; Straits Settlements, Mr. H. T. Clark, principal of the Malay College, Malacca; Trinidad, Mr. George Goodwille, formerly a Member of the Legislative Council.

The conference will be attended by representatives of the India and Colonial Offices and of all the Home Education Departments—English, Scotch, and Irish. The States of Guernsey, Jersey, and the Isle of Man have been asked to nominate representatives.

The morning sessions of the conference will be confined to official representatives, and devoted to the consideration by them of such matters as the various overseas Governments have suggested for discussion or any delegate may wish to bring before the conference. The arrangements for the afternoon sessions will be announced later. A preliminary meeting of official representatives will be held on Monday, April 24, for the purpose of settling finally the programme for the morning sessions of the conference.

AGRICULTURAL BULLETINS.

THE Agricultural Experiment Station of the University of Wisconsin is one of the most active centres of scientific work in agriculture in the United States. Problems are attacked from two distinct points of view: the economic, in which the object is to show how crops may be produced a little more cheaply than at present, and the scientific, the problem being investigated for the sake of the general principles it may bring out. Two sets of bulletins are therefore issued, the popular bulletin, intended for farmers, dealing mainly with local problems, and always from the local point of view, and the research bulletins. The popular bulletins are fully equal to any others in the United States, and much ahead of anything we publish here for farmers; in the series before us the subjects dealt with include land drainage, curing of seed corn, control of various weeds, draft-horse judging, a discussion of the methods of paying for milk at cheese factories, and so on. The research bulletins are the scientific papers of the staff; as usual in the United States, each paper is published separately, and there is no common journal in which they all appear.

Three of the papers referred to above deal with cheese-making, perhaps the least understood of all agricultural processes. Messrs. Sammis, Suzuki, and Laabs discuss the factors regulating the rate at which whey separates from curd in the cheese vat. High acidity, high temperature, and pressure applied to the curd all facilitate rapid separation, but, on the other hand, variations in the proportions of rennet and the time of action of the rennet have no effect. In another paper Messrs. Suzuki, Hastings, and

Hart deal with the production of volatile fatty acids and esters in the making of cheddar cheese. The acids found were acetic, propionic, butyric, and caproic, but not valerianic acid; none of these seemed to be formed from lactose, although the ethyl alcohol probably was obtained from this compound. Mr. McCollum describes how he succeeded in keeping rats alive for a considerable time on a ration containing inorganic phosphorus compounds and no purine bases; it was necessary for success that the ration should be varied as widely as possible in order to make it palatable. Young rats withstood the unpalatability for a long time, and, indeed, were healthy to the end of the experiment. He concludes that animals can synthesise their complex phosphorus compounds, including nuclein, from inorganic compounds, and, further, that they can synthesise the purine bases from some complex present in the protein molecule. In the last paper of the series Messrs. Hart and Tottingham show the presence of phytin in seeds of maize, oats, and barley. This substance is a complex combination of potassium, magnesium, and calcium with phytic acid, $C_6H_8P_2O_8$, which in turn is broken up on hydrolysis to form inosite and phosphoric acid.

TREE PLANTING IN TOWNS.[1]

THE tree, standing singly, collected in masses forming woods, or grown as a beautiful avenue, is a fascinating object of study once the attention has been arrested upon it. Difficult it is to realise that an object of such size, majesty, and strength as a fine old tree represents has sprung from a tiny seed—a seed which if placed in the palm of the hand may, to the non-expert, prove indistinguishable from the seed of a small herb or grass of the field. Yet in the one case the tiny seed contains within it the germ which will produce a green monument of 100 to 200 feet or more in height, a living monument which will withstand the storms and changes of centuries, and may witness the downfall and uprise of dynasties and nations. Its seasonal garb does not pass through the kaleidoscopic changes of fashion which man in these later days is heir to.

The tree has but the four changes of garment which appear regularly with the changing seasons throughout its life, but this raiment has never failed in its attraction for man. Beautiful as are the tender greens of spring, the deeper, more mature greens of summer, and the brilliant tints of autumn, he who studies trees finds something equally beautiful, even if not more beautiful, in the stern grandeur, with its latent promise of strength, exhibited in winter.

The tree has had a greater influence in the training and civilisation of mankind than is perhaps generally realised, certainly more than is realised by the man of the city and town. Long centuries ago the greater portion of the land of the globe was covered by vast primæval forests in which man lived a primitive existence, and against which he waged an unequal war. But he was dependent upon the forest for the greater part of his means of subsistence, whilst his house, furniture, cooking utensils, such as they were, and implements, offensive, defensive, and cultural, were all fashioned from the materials of the forest.

As man increased in number and became more civilised, he cleared larger and larger areas of the tree growth, and now took to living outside, but still in the neighbourhood of, the forest. Still he depended upon the forest for most of the necessaries of life, from the materials for constructing his house down to a chief portion of his daily food.

It was only with the great increase in number of mankind and with his concentration in certain localities, usually the fertile lowlands from which the forests had been cleared, that these sections of the human race began to depend less and less on the forest as one of the chief staffs of life.

But we see that the instinct of man in the earlier days in the history of the world was to look to the forest as nature's great storehouse from which he could obtain the necessities of his daily life. It is so with the nomadic races of the world at the present day. I wish to make this point, as it explains, I think, the inherent love of trees which lies in the nature of each one of us, though in the city-bred man it may to some extent remain dormant.

It explains another point, on which I propose to briefly dwell, the instinct of man, if left to himself in a bare, treeless region to plant trees or tree growth, or bushes even, to brighten the monotony of his otherwise dreary surroundings. For those of us who have experienced nature in its awesome loneliness in the absence of tree growth of any kind, know full well how appallingly depressing it can become.

In such localities man, if left to himself, will, I say, start planting trees, and will take extraordinary trouble to make them grow. Some years ago I was deputed by the Government of India to visit Quetta, the beautiful capital of Baluchistan—that rugged province situated in the far north-west of India on the frontier of Afghanistan and Persia. Quetta occupies the central Highland of Baluchistan, and is a point of considerable military strategic importance. It is situated at about 5500 feet, and is surrounded by great barren peaks ranging up to 11,700 feet. The railway climbs to it through a dreary rugged waste of rock and sand, with here and there little villages embosomed in trees and surrounded with small areas of crops. It is a wild country, and the history of Quetta fully illustrates my point that man in such a country will plant trees for dear life.

The main station of Quetta was formed after Lord Roberts's march to Kandahar. At the time the first houses were built, save for the fact that the villages around contained some poplars and willows and fruit trees, the site consisted of a barren plain. The planting was first started in 1878 by Mr. Bruce. After the evacuation of Kandahar, the work was taken up mainly by Mr. (now Sir Hugh) Barnes, General Sir Stanley Edwardes, who was in command of the troops, Colonel Gainsford, and Mr. Watson, the forest officer. A tree committee was formed, and large nurseries established. The trees were obtained from Kandahar, a beginning being made in the winter of 1881–2, when some 60,000 cuttings or slips of the chenar or plane tree, poplar and willows, were brought on camels from Kandahar and planted out along the roadsides and in the gardens. The planes were put on the main road, the Lytton Road. They form a magnificent avenue, now thirty years old, which gives a most grateful shade in summer, considerably lowering the temperature. The growth of the trees was wonderfully rapid, irrigation being then, as now, employed to water them; for all the water in the country is brought in channels from the sources of the springs, its value being fully understood by the inhabitants, who show great ingenuity in constructing these water channels. Other roads were lined with poplars or willows, and if a mistake was made it was in planting the trees too close, and in planting the avenues on any one road of one species of tree only; and this mistake had to be paid for later on somewhat dearly, to which allusion may be made. The trees were attacked by a cerambyx beetle pest (*Æolesthes sarta*) the grubs of which fed in the green inner bark—the growing layer—of the trees, and resulted in numbers of the poplars and willows having to be cut out and burnt.

Not only in Quetta, but also in all the cantonments throughout Baluchistan, the planting of trees forms one of the chief recreations of the British community, so great is the distaste of mankind, accustomed and used to tree and plant growth, to exist without it. The whole of the work is carried out by the political and military officers stationed in that portion of the country, few if any of whom had, before reaching the country, any planting knowledge, and many of whom had confessedly previously taken but little interest in the growth of trees. Amongst the most enthusiastic of the planting community at the time of my visit was General Sir Henry Smith-Dorrien, now commanding at Aldershot, but then commanding the Quetta division, and he attacked and wiped out the "borer," as they called the beetle pest, in his cantonments with as much keenness as he planted trees.

I have alluded to the fact that the major portion of the land surface of the globe was formerly clothed with vast primæval forests.

In the opening phases of his connection with the forest

[1] Paper read at the Town Planning Exhibition in the Royal Academy Buildings, Edinburgh, March 23, by E. P. Stebbing, Lecturer in Forestry, University of Edinburgh.

man waged a puny and ineffective war against the relentless growth of the forest, and had as much as he could do to keep a small clearing round his abode, and in many cases this was not attempted. Regions in the tropical world exist at the present day where this unequal and never-ending strife between man and the luxuriant vegetation of the forest still goes on, usually in favour of the forest. With increase of numbers, permanent clearings came into being, but the whole of the materials for house-building, &c., came from the forest. At the present day the aborigines of Central India and the Assam and North Burma Hills, as is the case with aborigines in other parts of the world, construct their habitations of wood, grass, and leaves; their household crockery and glass consists of gourds, with lengths of bamboo for the wineglasses, whilst a considerable portion of their food consists of edible fruits and roots and leaves and shoots of forest trees, and when they can procure it, meat from the wild animals of the same forest.

But man, with increased numbers and civilisation, began a ruthless war against the forest, and is still carrying it on in America, Canada, and elsewhere, with the result which now faces us. In Great Britain, once covered with forests, we have no forests at all and few woods of any size, and are at the present moment entirely dependent on our timber, &c., supplies being brought to us from outside. And the sources of this supply are diminishing, and are also being yearly indented on to a greater extent by other countries.

But long before the awakening as to the importance of forests commenced in Europe—a matter of a century or two only—man, the man in the rapidly growing cities and towns, had realised the importance of the tree and the place the tree held in his existence. His primitive instincts, laid to rest whilst engaged in ruthlessly exterminating his friend, were aroused into an active repentance when he no longer had that friend at his door and could no longer watch it garb itself in its brilliant seasonal changes of raiment, and no longer had its protection for himself and his animals against cold or fierce winds, a hot sun, &c. He then commenced, after the fashion of man, energetically, but more or less spasmodically, to endeavour to repair the effect of his own destructiveness. To his surprise, however, he found it was by no means so easy to replace the trees on spots from which he had ruthlessly cut them. Nature's balance had been unduly interfered with; the rich store of good soil built up through the ages in her own storehouses of the past had been wastefully dissipated, and whereas she herself never asked the trees to grow on bed-rock, man did.

Also, as time went on, the atmosphere, especially in the larger cities and commercial centres, became polluted and vitiated with smoke and acids, and man, having no time or wish to study the methods by which nature reclothes the soil when left to herself after he had passed by, gave up his attempts to maintain trees near or within the areas, rapidly increasing in density of population, in which he worked and lived.

We thus arrive at another stage in the history of man and the tree. The city increased in size; the population doubled, trebled, and quadrupled itself; the single-room tenement, as we were shown by Lord Pentland the other day, made its appearance and came to stay; the streets became narrower, the houses higher, and the tree itself disappeared. If we look at the large densely populated capitals of Europe and the great commercial centres of the present day, we find in both that in the parts occupied by the poor classes and workers the significance of the tree as the close neighbour and companion of man throughout a considerable portion of his existence on the globe has been forgotten or lost to view. But the instinct is there, deep implanted in the heart of each one. Even to the born and bred city child, the descendant of several generations of town-bred men, the craving for a sight of a green field or of a wood comes dimly at times. Probably most of us who are acquainted with great cities have come across instances of such. It was my fortune once to see a little youngster from the slums of London taken into a Kentish hop-field. He came from one of the worst parts of the great city, and in all his little life had only seen a grimy plane tree and a dark, sooty green grass plot. In the train, so soon as the open country had been reached, he remained speechless. Once in the hop-gardens he recovered his voice, and went wild with excitement and delight. It was very easy to see man's instinctive love for wild nature and nature's growth there. Equally apparent is it in most of us born and bred in civilised countries when we come face to face for the first time with a tropical forest. Instincts and thoughts to which we fail to give expression surge up within us as we feel that once again we have come into contact with the original homes of our ancestors; and the feelings, mind you, which are aroused by such a contact, which were aroused in that little London lad in the hop-garden, are the very ones which it is to the interest of mankind to keep alive and stimulate.

Mankind does not seem to improve with his growing habit of congregating in dense masses in cities and towns. He appears, somehow, to lose something of that freshness and breeziness which we associate with the mountain top and find in the dweller on the mountain top. In our more spacious, if less civilised and cultivated, days, we lived in closer touch with nature, and there are those who say that in many ways we were better men for the contact. But the closer life in cities is doing something which, as I think, is even worse for human nature than this. We are losing some of the finer instincts, and certainly our finer senses of sight and hearing, and even of smell. I do not speak from any medical knowledge of the subject, but simply from personal observations made during a number of years' contact with the folk of the jungles and mountainous regions of India. They can give us points and a beating in all of the last three; and yet there is no reason to suppose that our ancestors—the ancient Britons, who dressed in blue paint—were not possessed of these finer senses and were not the equal, in these respects, of the present-day aborigine.

Of course, I do not wish to be understood as saying that the town- and city-bred man can hope to remain the equal of the countryman in his knowledge of nature or in those senses which demand to be constantly used to be kept in high order. But my point is that a good deal more might and should be done to help the dweller in the densely populated portions of the great cities and commercial centres to keep to some extent in touch with nature. He should be able to see and live with trees, and to see daily, not only on holidays or at the expense of a long walk, which he will not take, trees and areas of green grass and flowers. We who live in the open air and habitually enjoy such sights, and those who spend several weeks or months in the year annually in the country, find it difficult to picture the mind of a child who has never seen a field of corn and red poppies rippling under the soft summer wind, or the waving tops of a green forest, or heard the soughing of the breeze in a pine wood; and yet there are probably hundreds and thousands such in these islands.

Now it should be quite possible for the rulers of every large city and town to see that open spaces are provided for the recreation of the inhabitants. Much has and is being done in this respect, and this exhibition is a witness to all it is hoped to do in the future. But I am not concerned here with the provision of the open spaces, but with tree planting and the beautifying, not only of the open spaces, a comparatively easy matter, but of the streets and their neighbourhood. When we talk of trees in streets, the usual idea is, I think, an avenue. Those who have seen the beautiful lime avenue at Trinity College, Oxford, know what a beautiful thing it is. An avenue is a very beautiful thing. But there are many streets far too narrow to take an avenue, and yet it is quite possible that there may be a situation at one or both ends where a tree or a clump of trees can be put; and picture the difference such a clump, changing in colour with the season, will make to the amenity of the street. Or there may be one or more small gardens where small trees or bushes and flowering shrubs might be grown, where bright green grass bands or plots may be put, and which if kept in order can be maintained bright and beautiful. Such clumps and bushes and grass bands and plots are, we know, the natural concomitant of the homes of the more well-to-do portion of the community. But so are they often the accompaniments of the better parts of the city and town. On the Continent, for instance, you do not

want for beauty in the fine boulevards to be found in Paris or Brussels; the Unter den Linden is a thing of beauty in spring in Berlin, whilst the famous Ring of Vienna is as fine a piece of city tree decoration as you could wish to see anywhere.

In these islands we are far behind the Continent so far as the beauty of our streets go. Boulevards as understood on the Continent are entirely absent from most of our big cities. In the exhibition I see on the wall two fine sketches of new proposed roads in Liverpool. These are laid out in the proper spirit, and certainly not one of the least important parts of town planning is the laying out of spacious tree-bordered roads, or even better, because more picturesque, if space is available, with a double line of trees and a walk down the centre of the road, like the Unter den Linden in Berlin. Parks and open spaces we have in our great cities, and very beautiful many of them are. In many cases they are, however, situated at considerable distances from the densely congested poorer parts of the town.

Here in Edinburgh, a city the natural advantages of the setting of which it would be difficult to beat, I can picture George Street as having a very different appearance with a fine green row of trees down each side. I think the addition of a row on the shop side of Princes Street would add beauty to one of the finest streets in Europe, whilst, to mention others, Hanover Street, Frederick Street, and the other streets running off up the slope would look infinitely more picturesque with trees on either side; and once the trees were up they would break the force and chill of the most persistent prevailing wind I have met! But it is not only in the wealthier part of the city that work of this nature should be carried out. Trees should be planted in lines or clumps or as single trees in the poorer and more densely populated quarters of the city. It should not be possible for a child to grow up in any quarter of a city without being in daily contact with trees and plant growth. It should be rendered possible for the town-bred child to know the changes of seasons, not merely by temperature only, but by recognising the early beginnings of life in the year with the first snowdrop, to be followed by the crocus, and shortly after by the budding of the earliest trees. It should be possible for him to know and, if he will, see for himself the trees and other plants flowering and seeding in due season.

It may be said that this will be difficult of realisation in the densely populated poorer quarters of the town. May I tell one more small story which I think points a way?

Some years ago I was stationed in Darjeeling, in the eastern Himalaya. Darjeeling is a town of considerable size, the summer headquarters of the Government of Bengal, and possesses one of the great views of the world, the superb snowy giant Kinchin Junga, to see which and Mount Etna beyond all devout tourists to India make a pilgrimage. The town is situated on a ridge and outlying spurs, the houses embosomed in Cryptomerias, oaks, and other hardwoods. Beautiful as is the place in itself, with its incomparable setting of eternal snows, it came to be recognised that much could be done with the object of beautifying the station. Some of the roads were without trees, the banks and slopes between them overgrown with a tangled jungle growth; the gardens of the houses left much to be desired in many respects; the roads of the bazaar were dirty, and the offshoot paths overgrown with a matted mass of undergrowth, the home and breeding grounds of pestilential flies and microbes. At the instance of the Lieutenant-Governor, the late Sir John Woodburn, K.C.S.I., as fine and broad-minded a type of the British official as could be found anywhere, a motion was set on foot which had for its object identical aims with those, or some of them, the present Town Planning Exhibition is setting before the public—the beautifying of the town so as to render it a better dwelling place for those who had to spend their lives, or a portion of their lives, there. The question, once mooted, was taken up with enthusiasm; and it must be remembered that, as in Quetta, the population concerned mainly consisted of men who would only pass an uncertain number of years in the station, a transfer or final retirement home ending their connection with it. In Darjeeling a strong committee was formed, on which the Government, the municipality, the local bar, merchants, house owners, and private individuals, British and Indian alike, were represented.

The Government recognised, as was pointed out by the Lord Provost at Lord Pentland's speech the other day, that it was not to the municipality (that is, corporation or town council) alone that it should look for the carrying out of the scheme—that the whole responsibility did not rest with the municipality alone. Whilst recognising the necessity of the municipality being the first to move in the matter and promise its support, it was pointed out that every householder in the town had equally a duty to perform in aiding the scheme, and that no scheme could be complete or effectual unless each householder recognised such duty and was prepared to give solid help to further the ends in view. Donations and aid were asked for by the committee from the Government, municipality, and also from the householders, and were forthcoming from each quarter. The committee then proceeded to lay down in broad general lines its recommendations for giving effect to Sir John Woodburn's ideas, and these recommendations dealt with the widening of roads, constructing new roads, building up retaining walls to keep up banks and slopes, planting trees either as avenues or in groups or single trees, the pruning of existing trees which required such work, cutting unsightly undergrowth from banks and slopes and grassing such, cleaning up the gardens of such householders as could not afford to do the work, and in making provision for giving out seed or trees and shrubs where necessary.

The broad principles of the work having been laid down, a strong working committee was appointed, and the whole of the work done in the station in the year I am dealing with was done by that working committee. Householders who were well off were asked to consult personally the working committee as to the details of the improvements to be carried out in their own gardens in so far as they affected the external appearance of the town, and to carry out the recommendations made themselves. They were also asked to aid the working committee by donating seed and plants to be planted in the gardens of the poorer classes. This work was done by the staff of the working committee, and under the personal superintendence of the latter. It was a common sight during that spring, summer, and autumn to see members of the committee supervising work for a couple of hours before breakfast in the morning, men who would be spending the rest of the day in their offices engaged in their ordinary daily pursuits. As a result, the improvement in the appearance of the station was astounding, and fully repaid the time and labour spent on it.

I have quoted this example at some length because it shows that the question of the improvement of a town, and more especially the poorer and more squalid parts of a town, is no Utopian scheme. It should be quite possible to institute similar committees in every large city and town of this country. In the case of the larger ones, such as London, for instance, each local district could have its own local working committee once the broad lines of policy had been laid down.

Here in Edinburgh a working planting subcommittee of the town planning committee might be formed to look after the beautifying of the city so far as such could be advanced by planting work. For the poorer quarters of the town a definite scheme of planting, by which I mean not only the planting of trees and shrubs, but also the formation and upkeep of grass and flowers, should be laid down and worked up too, as funds allowed, it being a *sine qua non* that only such work should be taken in hand as could be looked after and kept up in years to come. To plant a row or avenue of trees and then leave it to take its chance, usually an extremely poor one, of reaching maturity, is to throw away good money. Similarly, to plant areas of grass and leave them to become refuse and rubbish heaps or mud flats is merely to add to the squalor and untidiness of a neighbourhood. For the dwellings of the wealthier inhabitants, advice would be offered when demanded or suggestions made when it was desired to obtain uniformity of treatment in a particular locality or neighbourhood, or when the planting of a group of trees in a garden would afford a pleasing amenity for a neighbouring poorer locality. In the public streets the subcommittee should be given a free hand so far as

tree planting and the formation of grass plots went. I have mentioned above how a street such as George Street, for instance, which has great breadth, could be beautified by an avenue of trees such as black poplars, or sycamores, or elms. In other parts of the city, horticulturists are of opinion that thorns and the service tree might be used, whilst in sheltered situations I should like to try the plane, lime, and even the horse-chestnut. I should like to go into greater detail on what might be attempted in Edinburgh on this head, but for one thing time will not permit of it, and for the other I should require to make a closer survey of the city in this respect than I have yet had opportunity to do.

There is one other point, however, in connection with tree planting in towns which applies alike to Edinburgh and all growing cities and towns. It is concerned, not with tree planting, but with tree felling. It is difficult to speak too strongly in disapprobation of the indiscriminate and pernicious felling of trees which usually takes place when a new block of houses is to be built or a new road laid down. No effort is made to first mark out the foundations or alignment to ascertain whether the trees must come down or can be left to afford a pleasing amenity to the district. Perhaps for the gain of a few shillings or through ignorance or gross stupidity they are ruthlessly hacked down, a few hours destroying the work of a century, and the stumps remain a lasting source of regret to those inhabiting the district, for they can never hope in their time to replace the trees so mercilessly destroyed.

The first rule for a town planning committee to lay down should be that no trees on areas in which building extensions are to take place should be felled or killed without a special permission being previously obtained.

In conclusion, I could wish to point one moral with no uncertain note, and that is the great effect on the amenity of a district and on its inhabitants which tree growth exerts. A barren country is depressing, and has a like effect on mankind, resulting in the coarsening of human nature. Can one be surprised at the low scale of morality and the absence of the finer instincts of human nature generally associated with coal-mining districts when one remembers that alike above and below the surface of the earth the miner finds everything black and lifeless? To merely travel through such a country is depressing. How much more so to live in it? And as it is with the Black Country, as it is called, so is it in the narrow street of the slums, where the blue sky is hidden by the smoke of the great city and plant life of all kinds is absent.

Give the people better homes to live in—it is a first desideratum—but with the houses give them the companions of their ancestors, the trees, the green grass, and the flowers, for there are species of each which, if properly looked after, will grow even in the murk of the great city.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The Senate at its meeting on March 29 accepted the Galton bequest, and authorised the issue of an appeal for 15,000*l.* to defray the cost of the erection and equipment of a suitable building for the Eugenics Laboratory. Hitherto the laboratory has been housed in the applied mathematics department at University College.

The D.Sc. degree in chemistry was granted to Mr. T. P. Hilditch, an internal student of University College, for a thesis on the relation between chemical constitution and optical activity and other papers; and the degree of D.Sc. in geology was granted to Mr. A. M. Finlayson, an internal student of the Royal College of Science, for a thesis on the geology of ore deposits.

Dr. W. P. Herringham takes the place of Dr. H. A. Caley as a representative of the faculty of medicine on the Senate.

SHEFFIELD.—The council has made the following appointments, among others:—Mr. R. J. Pye-Smith, as emeritus professor of surgery; Mr. Arthur M. Connell, to the lectureship in surgery, which was rendered vacant through Dr. Sinclair White's appointment to the professorship of surgery; and Mr. J. D. Fiddes to the demonstratorship in anatomy.

Prof. Beattie has been appointed representative of the University at the celebration of the 500th anniversary of the foundation of the University of St. Andrews, to be held on September 12–15.

DR. ALEXANDER SMITH has been appointed to the Mitchell chair of chemistry in Columbia University, New York, vacant by the retirement of Dr. C. F. Chandler. He is a Scotsman by birth, and graduated at Edinburgh in 1886. For a short time he was an assistant in chemistry at his *alma mater*. In 1890 he went to America, and has since held professorial posts at Wabash College and the University of Chicago. He is president of the American Chemical Society.

THE Joint Matriculation Board of the Universities of Manchester, Liverpool, Leeds, and Sheffield has arranged to examine pupils in the housewifery forms of girls' schools. The examination will be suitable for girls of sixteen years of age and upwards who have studied domestic subjects up to the standard of the school certificate examination. Candidates must offer, in addition to certain other subjects, elementary general science and cookery and two of the following:—housewifery, laundry, needlework and drawing, elementary biology. There will be a practical examination in all domestic subjects.

IN *The Economic Journal* for March Mr. W. M. J. Williams deals with the subject of Exchequer grants, and establishes the need of inquisition and action upon the relation of national to local taxation. He urges that a term should be assigned to grants from the Exchequer, that a delimitation should be made of present grants, and that the whole should be settled with a due regard to economy and care by local authorities. Taking the education grants as an example, he considers the problem of a settlement of the relation to be established between national and local finance. We may assume, he says, that the cost of education publicly provided in the United Kingdom is about twenty-seven to thirty millions sterling. Some one half is derived from national sources, and one half of the cost is borne by local authorities, but in addition the central authority bears the cost of central administration and of grants to educational institutions of various kinds. The quota of the cost borne by taxes has grown very considerably since 1870, and local authorities demand that all education charges shall be borne by the Exchequer. In another place he points out that the same public local authority gets sums of money for educational purposes from two departments of State. Altogether, he makes out a strong case for the separation of national and local taxation and finance.

THE Legislature of the State of Utah, during its recent session, made an appropriation of 60,000*l.* to the State University for the construction of the main building of the institution. This building is, says *Science*, to house the general library, the art gallery, and the administrative offices. The Legislature also passed a Bill, which has become a law, putting the support of the university and the agricultural college on a permanent financial basis. At present the annual income of the university for general maintenance is about 40,000*l.* New buildings and other constructions are to be provided by special appropriations. The Legislature of Indiana has, we learn from the same source, appropriated nearly 40,000*l.* to Indiana University for the next biennium. This grant includes 30,000*l.* additional maintenance. According to the American Press, a graduate of the Philadelphia College of Pharmacy, whose name has been withheld, has offered to give 200,000*l.* toward the erection of a comprehensive group of three buildings, one of which shall be specially devoted to research work, for the institution. *Science* also records that Mrs. Benjamin Hicks, of Old Westbury, N.Y., has bequeathed 20,000*l.* to Swarthmore College, and that Columbia University has received the sum of 138,600*l.* from the executors of the estate of the late Mr. George Crocker, for the establishment of the Crocker Cancer Research Fund.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 30.—Sir Archibald Geikie, K.C.B., president, in the chair.—Captain A. G. **McKendrick**: The chemical dynamics of serum reactions. (1) Amboceptor and complement are opposed in their action on the cell, with the proviso that the former acts as a catalyst to the latter. (2) Complement action is lytic; amboceptoral action is primarily polymerising, or, as the case may be, agglutinative, and secondarily catalytic to complement. (3) The relation of these substances is expressed by the law of mass action, in the form

$$\frac{dz}{at}=y\left(\frac{x}{c}-z\right)-\left(\frac{y}{c}-z\right)^2.$$

(4) When the substance acted upon is in sufficient quantity this expression describes all serum reactions, viz. hæmolysis, bacteriolysis, opsonin and stimulin reactions, agglutination, precipitation, and toxin action. (5) Toxins are compound, and consist of amboceptor and complement.—G. J. **Burch**: Preliminary note on a method of measuring colour-sensations by intermittent light, with description of an unfinished apparatus for the purpose. Briefly, the new method of measuring colour-sensations is as follows:—A series of flashes of monochromatic light produce by a real induction a condition of colour-blindness in a small area of the field of view, which they surround, but do not invade. This small area is occupied, also in flashes properly timed and proportioned, by the part of the spectrum under examination. The colour corresponding to that of the monochromatic flashes is, as it were, wiped out of it, and the observer sees the boundaries of the underlying colour-sensations so long as the flashes succeed one another at the proper rate.—Dr. E. W. Ainley **Walker**: Variation and adaptation in bacteria, illustrated by observations upon streptococci; with special reference to the value of fermentation tests as applied to these organisms. Numerous attempts have been made to differentiate and to identify varieties of bacteria by means of chemical reactions produced by them in special culture media. One of the most interesting of these attempts was that made by Gordon to prove the existence of definite varieties among streptococci by the use of certain test media. Gordon and those who followed him believe that they can thus subdivide the streptococci into a number of fixed and independent varieties, and classify them into what Andrewes and Horder have spoken of as "provisional species." Their conclusions, however, could only be accepted were it proved beyond question that the reactions on which they rely are stable in character and exhibit constancy. In the present communication evidence is adduced from an extended examination of particular strains of streptococci that the reactions concerned are by no means constant. Under the conditions of ordinary cultivation in agar jelly, and still more under culture in the environment supplied by special media, particular strains of streptococci are shown to exhibit wide variations in their reactions to Gordon's test media. Thus it occurs that strains which are at one time totally different in their test reactions may at another time be found to be identical. Further, it appears that after suitable manipulation particular strains may be made to assume the characters now of one, now of another, of the types supposed to be differentiated by Gordon's tests. The conclusion drawn is that no evidence exists of any fixed or specific differences among streptococci pathogenic for man, but that the differences observed are due to merely temporary and casual variations in the metabolism of these micro-organisms, which thus readily adapt themselves to changed environment. Accordingly it is quite possible that suitably selected tests may be made to afford some valuable indication as to the probable habitat or recent environment of any given strain of streptococci.—W. **Bateson** and R. C. **Punnett**: The interrelations of genetic factors. In the sweet pea it was early found that the distribution of factors among the gametes of plants heterozygous for more than one pair was liable to disturbances of two kinds, known as coupling and repulsion ("spurious allelomorphism"). Coupling affects the factors B, blue, and L, long problem, in such a way that the gametic system is

7 BL : 1 *Bl* : 1 *bL* : 7 *bl*.

Other factors may be coupled in systems 15 : 1 : 1 : 15; 63 : 1 : 1 : 63; 127 : 1 : 1 : 127; and presumably other systems of numbers similarly related will be discovered. Repulsion was first seen in the case of B, blue, and E, erect standard, acting in such a way that the gametes are all either *Be* or *bE*. Such repulsion has since been recognised elsewhere both in plants and animals, affecting especially the factor for femalemes. Subsequently it was observed (sweet pea) that two factors, viz. that for dark axil and that for fertile anthers, which had previously been found coupled together, might in another family repel each other. As the result of a long series of experiments, it has been established that if A and B be two factors liable to such disturbances, the F_2 from $Ab\times aB$ (or reciprocal) shows repulsion between A and B, but the F_2 from $ub\times AB$ (or reciprocal) shows coupling between A and B. Two kinds of heterozygote can therefore be recognised, which may be represented as *Ab*.*aB* and *ab*.AB. The first, on segregation, makes two types of germ-cell *Ab* and *aB*; the second makes four, AB, *Ab*, *aB*, and *ab*, with *ab* and AB represented in one of the numbers 7, 15, &c. The polarity of the zygote-cell must therefore be influenced by the way in which the factors come into it, and presumably by the positions which they occupy. The *triple* system, B, L, E, in the sweet pea has only been partially investigated, but it is known that $Ebl\times eBL$ gives B and L coupled, with repulsion between B and E, not between B and L. An order of precedence between factors must thus be recognised, which possibly is that of the system of coupling to which they are subject.—Philippe **de Vilmorin** and W. **Bateson**: A case of gametic coupling in Pisum. A variety of culinary pea has for some time been grown at Verrières-le-Buisson having leaflets in place of the ordinary tendrils; this condition is recessive to the normal. The variety has wrinkled seeds. Crossed with a round-seeded normal pea, F_2 showed coupling between the factor for tendrils (T) and the factor for round seeds (R), the coupling being according to the system

63 RT : 1 R*t* : 1 *r*T : 63 *rt*.

Coupling has not previously been observed in Pisum. Owing to the fact that the seed-characters are not quite sharp, the nature of the starch was determined microscopically for each seed before it was sown. This work was carried out on a large scale by Miss C. Pellew at the John Innes Horticultural Institution.—R. P. **Gregory**: Gametic coupling and repulsion in *Primula sinensis*. In *P. sinensis* the short style is dominant to the long style, and the magenta colour of the flowers is dominant to the red colour. A series of experiments was made in which a short-styled race having red flowers was mated with various long-styled plants carrying the magenta-factor. It was found that in the gametogenesis of the hybrid so produced complete *repulsion* took place between the factor for short style and that for magenta colour. Subsequently another series of experiments was made in which short-styled plants carrying the magenta-factor were mated with long-styled reds. It was found that when the cross was made in this way *partial coupling* occurred between the factors for the two dominant characters.

Royal Microscopical Society, March 15.—Mr. H. G Plimmer, F.R.S., president, in the chair.—Dr. Ralph **Vincent**: Some photomicrographs illustrating the morphology of the organisms concerned in the production of acute intestinal toxæmia in infants. These included *B. subtilis*, *B. mesentericus* "No. 7," *B. m. vulgatus*, and *B. proteus vulgaris*. The photographs showed the organisms stained, unstained, and during life. Photographs were also shown of the *Streptococcus lacticus*, the *Bacillus acidi lactici*, and the *B. bulgaricus*.—E. M. **Nelson**: A new piece of apparatus. This consisted of an objective mount fitted with an iris diaphragm, in which the iris was just clear of the back lens, and its movement was controlled by a collar adjustment. The apparatus would no doubt be of great value to workers who employ dark ground for viewing bacteria, &c., as in many instances, owing to defects in the dark-ground illuminator, it was not possible to obtain a dark field when the objective had a wide angle. This fault was remedied by stopping down the aperture of the objective by means of the diaphragm.—E. M. **Nelson**: New objec-

tives and eye-pieces made by R. Winkel, of Göttingen.—J. **Murray**: Report on the rotifers collected by the British Antarctic Expedition of 1909. Forty-six Bdelloids were collected, bringing the Australian list up to fifty-four species. There were seven new species, and eight others occurred as distinct varieties. The new species were *Philodina australis*, *Callidina armillata*, *lepida*, *longistyla*, *serrulata*, *mirabilis*, and *Habrotrocha strangulata*. The most aberrant form was *Callidina mirabilis*, which had peculiar fleshy processes on the trunk. The rotifera fauna of the Australian Alps resembled that of Britain. The arid lowlands were very unproductive. Three-fourths of the species, and all the new species, occurred in the Blue Mountains, of moderate elevation. Eight species of non-Bdelloid rotifera were also noted from the water supply and ponds in Sydney.

Zoological Society, March 21.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—Mrs. E. W. **Sexton**: The amphipod genus Leptocheirus. In preparing this revision of the genus, the type-specimens of nearly all the species had been examined. The author found that in some cases different stages of growth had been described by different authors as distinct species, in other cases the inadequacy of the original descriptions and figures had led to the introduction of a number of unnecessary synonyms. The specimens of Zaddach's *L. pilosus* and Grubbe's *L. guttatus* had been examined and redescribed, and the number of valid species in the genus was now seven, namely, *L. pilosus*, *L. pinguis*, *L. hirsutimanus*, *L. pectinatus*, *L. guttatus*, *L. aberrans*, and *L. bispinosus*.—J. Lewis **Bonhote** and F. W. **Smalley**: Inheritance of colour in pigeons. The paper dealt with the first results of a long series of experiments. Although chiefly Mendelian in character, the authors laid stress on the fact that in several respects their results seemed to point to a further law or laws, which were able to modify the expected Mendelian results, and in regard to which the Mendelian theory offered no satisfactory solution. They showed, for instance, that in chequer and blue matings there was a regular tendency to an over-production of chequers; in the grizzle matings the tendency was to an over-production of blues. Another point apparently inexplicable on the Mendelian hypothesis was the difference in shades of the same colour; by disregarding these and considering them all as gametically identical, the results gave approximately the expected proportions, but, on the other hand, the shades of the different birds undoubtedly affected their progeny, and hence the gametes must also have been affected. The preponderance of a certain sex in a particular colour was also noted, as well as an increase of white in successive generations. No explanation of these phenomena was put forward, as further experiments were still in progress. In dealing with the purely Mendelian aspect of the results, the following points were clearly brought forward:—(1) silver is dilute blue; (2) blue is dominant to silver; (3) chequering and grizzling are both dominant to absence of pattern; (4) grizzling is dominant to chequering; (5) a mealy is a grizzled bird with the white replaced entirely or partially by red; (6) red in a mealy is dominant to white, hence a mealy is dominant to a grizzle; (7) white and grizzling combine to have a common inheritance; (8) red combines with grizzling in the same way as white.—Dr. G. Stewardson **Brady**: Marine ostracoda from Madeira, based on specimens collected by the Rev. Canon Norman, F.R.S., in the spring of 1897. Apart from the species described as new to science, the collection was interesting as extending the known range of several species from the European and North Atlantic areas much farther southward, though not quite into the tropical zone.

EDINBURGH.

Royal Society, February 6.—Dr. Burgess, vice-president, in the chair.—W. **Watson**: The isopiestic expansibility of water at high temperatures and pressures. The water contained a small quantity of hydrochloric acid. The apparatus employed was the high-temperature compression cylinder described by Prof. Des Coudres in the Leipzig *Berichten* of July, 1910. The volume change was measured by a method modelled on the electrical methods of Tait, Amagat, and Richards. The dilatometer was made of quartz glass. It was found that, soon after the critical temperature was passed, water behaved for all pressures investigated as an ideal gas, inasmuch as the isopiestics became straight lines. At 400 atmospheres and a range of temperatures from 400° to 500° C., the mean coefficient of expansion of water substance was found to be of the order 0·043. Amagat, working between 100° and 200° C., obtained 0·00099.—H. **Briggs**: An investigation into the effects of errors in surveying. The paper discussed the effects of errors in linear and angular measurements on the accuracy of surveys. A fundamental theorem was that concerning the sum of vector errors, viz. the average error in the position of a point influenced by two or more vector errors is equal to the square root of the sum of the squares of the average magnitudes of the vector errors, and is independent of their relative clinures. Many of the results and methods given are believed by the author to be new. Among these may be mentioned the conclusion that the best theoretical shape of a triangle for triangulation is an isosceles one with an apical angle of 67° 30′. The angle may, however, vary between 50° and 90° without appreciably affecting the well-conditioned character of the triangle, and other reasons lead to the selection of the equilateral triangle as the best for practical purposes.—Dr. W. H. **Young**: Fourier's repeated integral, and on Sommerfeld's form of Fourier's repeated integral.

February 20.—Dr. Horne, F.R.S., vice-president, in the chair.—Miss Dorothy **Court**: The determination of small degrees of enzymatic peptolysis. Abderhalden's method for studying enzymatic peptolysis by allowing the enzymatic preparation to act on a solution of pepton prepared from silk and observing the precipitation of tyrosin, is limited in its application by the impossibility in many cases of using clear solutions and by the fact that insoluble products other than tyrosin may be formed as a result of the action. These difficulties are overcome by the filtration of the products of the reaction, and treating the residue on the filter, after drying, with dilute sulphuric acid, and subsequent addition to this filtrate of formol and concentrated sulphuric acid (Mörner's reagent). In the presence of tyrosin a green colour is produced, and the quantity of tyrosin, and thereby the degree of peptolysis, may be estimated by measuring the intensity of this colour by means of the tintometer.—Dr. David **Ellis**: Concerning the new genus of iron bacteria, *Spirophyllum ferrugineum* (Ellis). In this paper, which was a continuation of a former paper, the author met the criticism of Prof. Molisch that Spirophyllum was not generically distinct from Gallionella. In addition to further descriptions, the paper contained some excellent photomicrograms.—Principal A. P. **Laurie**: The temperature coefficient of concentration cells, in which the same salt is dissolved in two different solvents. In addition to the series of experiments described, the paper gave a full discussion of the relationship between the electromotive forces of water and alcohol cells, their thermal properties, and the precipitation of salts by alcohol.

March 6.—Prof. Crum Brown, vice-president, in the chair.—J. P. **Dalton**: The accuracy attainable with a modified form of Atwood's machine. The modification consisted in making one side of the spindle of ebonite, so that as the wheel revolved electrical contact between the two sides of the apparatus became intermittent. By connection with a chronograph, records of distance fallen through and time taken were obtained. The frictional retardation could be determined with great accuracy. The mean of eight different determinations of g gave 980 cm./sec.^{2}, the greatest deviation from the mean being 0·5 per cent. It is probable that a still greater accuracy could be attained with more carefully constructed apparatus than was at the disposal of the author.—J. B. **Ritchie**: The dissipation of energy in torsionally oscillating wires, with the effects produced on the law of torsional oscillations by change of temperature. Peddie's empirical formula $\gamma(x+a)=b$ was applied to the case of wires of brass and other materials, and found to represent the results accurately over a large range of oscillation. The effects of heating were studied fully for brass, aluminium, and copper. In certain cases a sudden change in the value of the constant n was experienced, this change suggesting that a different molecular arrangement was produced at certain definite temperatures. The hardening of the wires

by stretching also produced definite changes in the value of the constants.—J. B. **Ritchie**: An apparatus for inducing fatigue in wires by means of repeated extensional and rotational strains, with the effects produced by such fatigue on the laws of torsional oscillations. The apparatus, designed by Prof. Peddie, is primarily an oscillating pendulum of large moment of inertia electrically maintained, and is provided with an automatic contact breaker. Rotational fatigue was found to have no effect upon the constants in the oscillation equation for brass wire.—Dr. Thomas **Muir**: Boole's unisignant.

MANCHESTER.

Literary and Philosophical Society, March 7.—Mr. Francis Jones, president, in the chair.—Prof. E. **Rutherford**: The scattering of the α and β rays and the structure of the atom. From a consideration of general results on scattering by different materials, the central charge of the atom is found to be very nearly proportional to its atomic weight. The exact value of the central charge has not been determined, but for an atom of gold it corresponds to about 100 unit charges. From a comparison of the theories of large and small scattering, it is concluded that the effects are mainly controlled by the large scattering, especially when the fraction of the number of particles scattered through considerable angles is small. The results obtained by Crowther are for the most part explained by this theory of large scattering, although no doubt they are to a certain extent influenced by small scattering. It is concluded that for different materials the fraction of particles scattered through a large angle is proportional to NA^2, where N is the number of atoms per unit volume and A the atomic weight of the material. The main results of large scattering are independent of whether the central charge is positive or negative. It has not yet been found possible to settle this question of sign with certainty. This theory has been found useful in explaining a number of results connected with the scattering and absorption of α and β particles by matter. The main deductions from the theory are at present under examination, in the case of the α rays, by Dr. Geiger, using the scintillation method.—Dr. H. **Geiger**: The large scattering of the α particles. Geiger and Marsden have shown that a small fraction of the α particles incident on a thin film of matter are so scattered that they emerge again on the side of incidence. In the present paper the fraction of the α particles scattered through various large angles by a thin gold foil has been experimentally determined by the scintillation method. Radium emanation enclosed in a fine glass tube was used as a source. The microscope to which the zinc sulphide screen was attached moved round the arc of a circle; the distance between the scattering material and the screen was constant and equal to about 2 cm. The source of radiation, the scattering foil, and the screen were enclosed in a metal vessel, which was exhausted to a low pressure. The number of α particles scattered through large angles up to 150° was first measured, and, as the emanation decayed, the number of small angles was successively determined. The number of scattered particles per unit area varied, when corrected for decay, nearly 300 times over the range of angles examined. The actual numbers of particles observed varied very approximately as $\mathrm{cosec}^4\phi/2$, where ϕ is the angle of deflection. This is the relation theoretically deduced by Prof. Rutherford in the foregoing paper.—R. F. **Gwyther**: Can the parts of a heavy body be supported by their elastic reactions only?

PARIS.

Academy of Sciences, March 27.—M. Armand Gautier in the chair.—The president announced the death of S. Arloing, correspondant in the section of rural economy.—A. **Lacroix**: The peridotites of New Caledonia.—A. **Müntz** and E. **Laine**: The nitrogen losses during the purification of sewage by bacterial beds. It has been shown in previous papers that the nitrogen losses average 50 to 60 per cent. The present note deals with the forms in which the nitrogen escapes. If organic matter is absent and the nitrogen is present as ammonia salt, no loss occurs, but the losses increase with the proportion of organic matter present. It has been found that the nitrates are reduced to gaseous nitrogen.—Pierre **Termier**: The mylonites of the island of Elba. The existence of these rocks in Elba points to a general and intense crushing action, and leads to a new interpretation of the structure of the island.—J. **Carpentier**: A tension meter, for measuring the pull exerted by metallic wires in aëroplanes.—C. **Guichard**: The C networks, such that the lines of a series should be plane curves.—F. **Gonnessiat**: D'Arrest's comet. A discussion as to the cause of the increase of intensity of luminosity over that calculated according to the law of inverse squares.—Henri **Lebesgue**: The invariance of the number of dimensions of a space and on Jordan's theorem relating to closed varieties.—Georges **Léry**: Green's function for an algebraic contour.—Maurice **Fréchet**: The notion of a differential.—André **Broca**: The constitution of axes of rotation sufficiently stable to permit the measurement of the geodesic angles by the method of repetition.—Félix **Michaud**: The causes which may produce the variation, at constant temperature, of the vapour pressure of a liquid. The curvature of the meniscus is not the direct cause of the capillary variation of vapour pressure.—E. **Henriot**: The radiations of the alkaline metals. Potassium salts emit a very penetrating ionising radiation, that from rubidium salts being less penetrating but more intense. Cæsium salts give no appreciable ionisation, an unexpected result. The causes of the marked differences between the radiation of the metals and their salts is discussed.—A. **Leduc**: Application of principles to a case of magnetostriction.—M. **de Broglie** and L. **Brizard**: The mobility of the ions produced in air by the hydration of sulphate of quinine. The ionisation of air produced by this salt belongs to the type of rapid recombination, and the measurement of the mobility of these ions presents special difficulties. The present note describes how these difficulties have been overcome.—Maurice **Joly**: A static means of tripling the frequency of alternating currents.—Maurice **Costo**: The metallography of the gold-tellurium system. Details are given of the methods adopted for purifying the tellurium and preparing the alloys. Only one compound appears to be formed, $AuTe_2$, and there is direct evidence against the formation of the compound Au_2Te of Margottet.—P. **Pascal**: Magneto-chemical researches on the atomic structure of the halogens.—Ath. I. **Sofianopoulos**: Two new compounds of stannous chloride with ammonia.—E. **Dumesnil**: The preparation of an arsenic amalgam. Arsenic amalgam is obtained by reducing a solution of arsenious acid and mercury bichloride in hydrochloric acid by sodium hypophosphite. The composition of the amalgam corresponded to As_2Hg_3.—Alexandre **Hébert**: The pyrogenous decomposition of the metallic xanthates. Eleven metallic xanthates have been examined, and a table is given showing the nature and amount of the gaseous and liquid products. The canthates of nickel and mercury give the ester $C_2H_5O.CS.SC_2H_5$ in good yields.—Léo **Vignon**: The action of water vapour upon carbon in presence of lime. The principal gaseous products are hydrogen and methane, together with carbon monoxide and dioxide, oxygen, and nitrogen.—Paul **Lebeau**: Some definite bismuthides. Remarks on a recent paper by A. G. Vournasos on a method of preparing sodium bismuthide.—L. **Hackspill** and R. **Bossuet**: The temperature at which water is attacked by the alkaline metals. The globule of the metal, previously distilled in a vacuum, and with a perfectly bright surface, is cooled to a given temperature, and water vapour allowed to condense on the metal; the alteration of pressure caused by the evolution of hydrogen indicates the reaction. Cæsium is attacked at −116° C., rubidium at −108°, potassium at −105°, and sodium at −98°. It would appear that the reaction is between metal and vapour, and not metal and solid ice.—Marcel **Guichard**: The gases given off by the walls of glass, porcelain, and silica tubes. Jena glass gave about 0·03 c.c. of gas per 100 sq. cm. of surface; with porcelain the results were variable, but the quantity was about three times that of the Jena glass. Fused silica gave as much as 2 c.c. of gas per 100 sq. cm. surface.—M. **Lespieau**: A method of preparing certain true acetylenic alcohols. The method indicated in a previous communication, based on the action of methylmagnesium bromide upon monobromacrolein, has been generalised, and additional acetylenic alcohols are described.—M. **Godchot** and F. **Taboury**: The catalytic addition of hydrogen to cyclopentanone. The products of the reaction

are cyclopentane, cyclopentanol, and a compound $C_{16}H_{16}O$, isomeric with camphor, formed by the interaction of two molecules of the cyclopentanone and one molecule of hydrogen.—L. **Duparc** and M. **Wunder**: The serpentines of Krebet-Salatim (North Ural).—MM. **Tschirch** and **Ravasini**: The wild fig in its relations to certain types of cultivated fig.—François **Kövessi**: New researches on the supposed utilisation of nitrogen from the air by certain special organs of plants. The development of the specialised organs studied by Jamieson, Zemplen, and Roth is not interfered with by the complete absence of gaseous nitrogen, and hence cannot be regarded as causing the assimilation of this gas.—M. **Desroche**: The phototropism of the zoospores of *Chlamydomonas Steinii*.—A. **Desgrez** and F. **Caius**: The ptomaines of tinned fish and crustacea. All the samples examined contained ptomaines in proportions between 0·2 to 0·6 gram per kilogram. The bases thus isolated are relatively slightly toxic.—Jean **Gautrelet** and Louis **Thomas**: The influence of the ablation of the suprarenals on the nervous system.—Jules **Glover**: Classification of the voice.—MM. **Bordas** and **Touplain**: Considerations on the estimation of phosphate in the ash of milk. No phosphorus is lost in reducing milk to an ash.—Gabriel **Bertrand** and M. **Javillier**: The combined influence of zinc and manganese on the development of *Aspergillus niger*.—L. **Massol**: The action of ultra-violet light upon starch. Under the influence of rays from a quartz mercury lamp, starch loses its property of bluing with iodine, and the solution acquires reducing properties.—R. **Bierry**: The digestive ferments of the hexotrioses and of stachyose.—E. **Brumpt**: The decimation of the stags of the forest of Chantilly by worms.—E. L. **Trouessart**: The Indian wolf, *Canis pallipes*, and its relations to the domestic dog.—E. **Sollaud**: *Desmocaris trispinosus*, a type of a new genus.—MM. **Grenet** and **Salimbeni**: The resistance opposed to the passage of micro-organisms by filtering candles with collodion layer.—E. **Bataillon**: The two factors of traumatic parthenogenesis in amphibians.—Armand **Dehorne**: The non-copulation of the exchanged nucleus and of the stationary nucleus, and the disappearance of the latter in the conjugation of *Paramecium caudatum*.—Stanislas **Meunier**: The otogenic efficacity of earthquakes.—A. **Briquet**: The morphology of the Gallo-Belgic littoral.—Ph. **Négris**: The discovery of Eocene breccia in Greece and their importance.—Jean **Brunhes**: The confusion produced by the use of the morphological pseudo-term "cala."—Ch. **Moureu** and Ad. **Lepape**: The constancy of the ratio of krypton to argon in natural gaseous mixtures. This ratio was measured in twenty gases of natural origin, and was found to be nearly constant.

DIARY OF SOCIETIES.

THURSDAY, APRIL 6.

ROYAL SOCIETY, at 4.30.—*Bakerian Lecture*: A Chemically-active Modification of Nitrogen produced by the Electric Discharge: Hon. R. J. Strutt, F.R.S.—Papers: The Association of Lead with Uranium in Rock-minerals, and its Application to the Measurement of Geological Time: A. Holmes.—The Path of an Electron in Combined Radial Magnetic and Electric Fields: Dr. H. S. Allen.—On the Dynamical Nature of the Molecular Systems which emit Spectra of the Banded Type: Prof. E. T. Whittaker, F.R.S.

ROYAL INSTITUTION, at 3.—Surface Combustion and its Industrial Applications: Prof. W. A. Bone, F.R.S.

LINNEAN SOCIETY, at 8.—On the Brown Seaweeds of the Salt Marsh: Miss S. M. Baker.—On the Genus Salicornia: Dr. C. E. Moss (History, Synonymy, and Phylogeny), E. J. Salisbury (Characters of the Species), and Dr. Ethel de Fraine (Anatomy).

RÖNTGEN SOCIETY (King's College), at 8.15.—Secondary Rays: Prof. Barkla.—An Improvement in High Tension Discharge Apparatus: Prof. Wilson.

INSTITUTION OF NAVAL ARCHITECTS, at 11.30 a.m.—Diesel Engines for Sea-going Vessels: J. T. Milton.—The Influence of Longitudinal Distribution of Weight on the Bending Moments of Ships among Waves: F. H. Alexander.—Considerations affecting Local Strength Calculations of Ships: J. Montgomerie.—At 7.30: The Acceleration in Front of a Propeller: Dr. R. E. Froude, F.R.S.—An Investigation into the Stresses in a Screw Propeller Blade: Engineer-Lieutenant A. Turner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Wireless Telegraphy Working in Relation to Interferences and Perturbations: J. E. Taylor.

FRIDAY, APRIL 7.

ROYAL INSTITUTION, at 9.—A New Method of Chemical Analysis: Sir J. J. Thomson, F.R.S.

MALACOLOGICAL SOCIETY, at 8.—A List of Marine Shells occurring at Christmas Island, Indian Ocean, with Description of New Species: E. A. Smith.—Description of *Oxytes Beddomei*, n. sp., from Burma: Lt.-Col. H. H. Godwin-Austen, F.R.S.—Note on the Habits of *Eurychlamys platychlamys*: Major A. J. Peile, R.A.

INSTITUTION OF NAVAL ARCHITECTS, at 11.30 a.m.—Results of Trials of the Anti-rolling Tanks at Sea: Dr. H. Frahm.—Steering-gear Experiments on the Turbine Yacht *Albion*: H. S. Hele-Shaw, F.R.S., and F. L. Martineau.—Description of a Stability and Trim Calculator: S. B. Ralston.—General Propositions and Diagrams relating to the Balancing of the Four-cylinder Marine Engine: C. E. Inglis.—At 7.30: The Determination, by Photo-elastic Methods, of the Distribution of Stress in Ships' Plating: Prof. E. G. Coker.—Some Notes on a New Design of Merchant Vessel: M. Ballard.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Retaining Walls: E. E. Farrant.

GEOLOGISTS' ASSOCIATION, at 8.—(1) The Scenery of Gloucestershire; (2) On the Sections of Forest Marble and Great Oolite on the Midland and South-Western Junction Railway between Cirencester and Chedworth, Gloucestershire: L. Richardson.

SATURDAY, APRIL 8.

ROYAL INSTITUTION, at 3.—Radiant Energy and Matter: Sir J. J. Thomson, F.R.S.

MONDAY, APRIL 10.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—On the Plans of the Australian Antarctic Expedition, 1911–1912: Dr. Douglas Mawson.

TUESDAY, APRIL 11.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Improvement of Highways to meet Modern Conditions of Traffic: J. W. Smith.—Recent Development in Road-traffic, Road-construction and Maintenance: H. P. Maybury.

WEDNESDAY, APRIL 12.

ROYAL ASTRONOMICAL SOCIETY, at 5.

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