THURSDAY, MARCH 23, 1911.

A CRITICISM OF THE DARWINIAN THEORY.

The Mutation Theory. Experiments and Observations on the Origin of Species in the Vegetable Kingdom. By Prof. H. de Vries. Translated by Prof. J. B. Farmer and A. D. Darbishire. Vol. ii., *The Origin of Varieties by Mutation.* Pp. viii + 683. (London: Kegan Paul and Co., Ltd., 1911.) Price 18*s.* net.

THE first volume of Prof. de Vries's great work was devoted in the main to an account of the results of the experimental cultivation of an *Œnothera* of uncertain origin, and of the conclusions he deduced from them. The second volume is more general in its scope, and is in effect a criticism of the Darwinian theory. The two might conveniently have been published in the reverse order. That, at any rate, will be found the best way to read them to get a clear idea of the author's point of view.

It is remarkable that pangenesis, the part of Darwin's theory which was received with least enthusiasm at the time of its publication, now almost overshadows all the rest. As Strasburger remarks:—

"Darwin's idea that invisible gemmules are the carriers of hereditary characters, and that they multiply by division, has been removed from the position of a provisional hypothesis to that of a well-founded theory."

De Vries thinks that the phenomena of variability and mutation follow deductively. And for this he claims the support of Darwin himself, who points out ("Variation," ii., 396), "on the hypothesis of pangenesis that variability depends on at least two distinct groups of causes":—(i) when the gemmules are unmodified, but deficient or superabundant, or are rearranged, or become active after being dormant; (ii) when they are modified through changed conditions. The former, Darwin thought, explained "much fluctuating variability"; the latter, the appearance of "new and changed structures." It is worth notice that Darwin uses here the word "mutation," but only apparently in the algebraic sense of permutations of the gemmules.

It is interesting to compare with Darwin's conclusion the form in which de Vries restates it in terms of his own views. I have inserted for clearness the corresponding numbers:—

"(i) Numerical changes of the pangenes are . . . the basis of fluctuating variability. Changes of the position of the pangene in the nucleus lead to the retrogressive and degressive mutations; (ii) whilst to account for progressive mutation we must assume the formation of new types of pangenes" (p. 645).

To de Vries, "fluctuating variability is a function of nutrition." It is also "linear, and oscillates only in a plus and minus direction." Mutation, on the other hand, "necessarily assumes a variability in all directions." It seems abundantly clear that "fluctuating variability" has by no means the same meaning to Darwin and to de Vries. It must be explained that in retrogressive mutation, characters become latent; in degressive, latent characters become active (p. 72).[1] De Vries states (p. 56) that

"one of the chief objects of the book is to show that ordinary or fluctuating variability does not provide material for the origin of new species."

But if it is merely a case of an individual organism being a little better or a little less nourished, I do not know that I should disagree. Darwin, however, would certainly not have agreed that ordinary variability was linear, or that, seeing he traced its cause to "changes of any kind in the conditions of life," that it was dependent exclusively on nutrition. The conditions throughout a population can never be so uniform that some amount of fluctuating variability is not excited. But if they are constant on the average, there is no resultant selective action. Thus the flora of Egypt has remained stable since at least the date of the Trojan war.

De Vries is extremely anxious to make Darwin responsible for the mutation theory. "It was Darwin who first attempted in various cases to distinguish between" mutability and variability. It is quite true that Darwin distinguished between the multiplication or reshuffling of his pangenes and their modification. But there is no warrant for asserting that he thought the former played no part in the origin of species. He assumed that "variability of every kind is directly or indirectly caused by changed conditions of life" ("Variation," ii., 255). Without variation, "natural selection can do nothing." All that he conceded was that variation might have a considerable range. But he was far from rejecting the efficiency of fluctuating variability. "Under the term 'variations' it must never be forgotten that mere individual differences are included" ("Origin," sixth edition, p. 64); "natural selection is daily and hourly scrutinising, throughout the world, the slightest variations" (*l.c.*, p. 65).

Another misconception, for which, however, de Vries is not responsible, is that Darwin's theory of pangenesis ultimately led him to a modified acceptance of Lamarckism, *i.e.* that new structures might arise in direct response to the environment. De Vries himself would not accept this. In Darwin's view, the modified pangenes would simply supply material for more ample variation, but natural selection would still determine the result.

De Vries is convinced, nevertheless, that Darwin was at heart a mutationist, and that his belief in discontinuous variability "under Wallace's influence gradually shifted into the background." There seems here to be a double misconception, which it is not difficult to clear up. Darwin, writing to Wallace in 1869, said:—

"I always thought individual differences more important than single variations, but now I have come to the conclusion that they are of paramount importance, and in this I believe I agree with you" ("Life and Letters," iii., p. 107).

It is clear that by individual differences he means fluctuating variability. He was preparing at the time

[1] This seems explicitly stated; I cannot reconcile it, however, with the equally explicit statement on p. 576, where the meanings of progressive and degressive appear to be interchanged.

the fifth edition of the "Origin," and in this there appears a passage of which it is sufficient to quote the first sentence :—

"It may be doubted whether sudden and great deviations of structure, such as we occasionally see in our domestic productions, more especially with plants, are ever permanently propagated in a state of nature" (p. 49).

But, as explained on p. 104, it was Fleeming Jenkin, and not Wallace, who led him to minimise the importance of "single variations, whether slight or strongly marked"; and as these are mutations, Fleeming Jenkin's argument cuts to the root of de Vries's theory.

But the real divergence between Darwin and de Vries is not so much as regards variability, but selection, the importance of which the latter consistently minimises. To Darwin, variability of any kind merely supplied the field in which selection works, and "sinks to quite a subordinate position in comparison." With de Vries it is exactly the opposite. "Specific characters do not arise by selection." The combinations of characters which arise from sexual reproduction are, however, subject to it. With respect to adaptations, which is the crucial point, de Vries speaks with a more uncertain voice than in his "Plant Breeding." "Everything points to the conclusion" that mutation "will explain adaptations just as completely, or, rather, just as incompletely," as natural selection acting on fluctuating variability. This is a cryptic utterance at best. But if natural selection cannot produce specific characters, it cannot endow them, except at haphazard, with survival-value; in that case, its inability to account for adaptations seems a necessary consequence. He finally sums up his position :—

"I willingly admit that almost anything can be squared with the theory in a very plausible way; . . . but this is not science."

Some of us think that it is, and there we must leave it.

De Vries has devoted immense labour to the investigation of the cases, not infrequent, where seedlings occur with more than two cotyledons. Two is a reduced whorl, and a whorl may be explained as due to the suppression of internodes. The number of leaves in a whorl is often variable, though seldom so in the case of opposite leaves; this is in accordance with the principles of the "repetition of similar parts." That two cotyledons should be the rule may well be adaptive, seeing that they have to be packed in the seed. That there should occasionally be more is a not improbable mutation. It is interesting to note that de Vries entirely failed to fix tricotyly by selection. Nor is tricotyly, although it appears to be not uncommon, often followed by trimerous leaves. De Vries has been more fortunate than I have been with the sycamore, as he raised two high trees with "branches in trimerous whorls." He says nothing about the leaves. I signally failed in raising a number of tricotyledonous seedlings; in the third year they all reverted to the opposite-leaved arrangement. And I have only come across a single case of the wild maple with trimerous leaves. This serves as an illustration, if one were wanted, of how little survival-value mutations possess in nature.

There can be no doubt that what we want is a purely empirical study of the variation under artificial but precise conditions of some clean-cut species free from any suspicion of hybrid origin. It would have to be done on a considerable scale, and as it would have to extend over a long period of years it would be a tedious and laborious business. I have some hopes that it may be undertaken in America. The horticultural papers are now full of what is taking place with *Primula obconica*, which from a condition of stability has passed into one of high variability. But, as de Vries very justly remarks, the available records in such cases "lack precision." But he arrives at the interesting conclusion that

"in horticulture . . . mutations are largely of the retrogressive or degressive kind. Discontinuous formation of species on the progressive line is much rarer" (p. 602).

Here species is used in the de Vriesian, not the Linnean, sense. The meaning, I take it, is that latent characters become active or the reverse. On an earlier page (p. 4) he seems to imply that all the cultivator can do is to evoke latent characters. "The first condition necessary for raising a novelty is to possess it."

Some fifteen years ago I made a careful study of what could be ascertained as to the cultural evolution of *Cyclamen latifolium*. I may state the conclusion, which I confess I was not prepared for :—

"The general tendency of a plant varying freely under artificial conditions seems to be atavistic, *i.e.* to shed adaptive modifications which have ceased to be useful, and either to revert to a more generalised type or to reproduce 'characters which are already general in other members of the same group.'"

As might have been expected, this had not escaped Darwin, from whom ("Origin," sixth edition., p. 127) I had quoted the concluding words of the sentence.

De Vries still maintains the singular distinction which he draws between cultural variation in horticulture and in agriculture; perhaps on the Continent the two arts are more distinct than with us, where it can hardly be maintained. "Horticultural varieties are generally constant" (p. 76). Agricultural races "remain dependent on continued selection, and do not really become constant" (p. 422).

The Darwinian theory rests on a number of converging lines of argument, and derives its probability from their cumulative force; just as in a law court each branch of evidence may be slender in itself, yet the conclusion to which they all point has a higher degree of probability than any one taken separately. De Vries's attack on natural selection, I must confess, would not shake my faith even if I found it more convincing than I do. But he is entitled to the merit, which he justly claims for himself, of having probed variability by a rigorous experimental method. It is much to be wished, but scarcely to be hoped, that others will follow him in his lifelong devotion to so laborious a research.

W. T. THISELTON-DYER.

MOVEMENT OF MOLECULES.

Brownian Movement and Molecular Reality. By Prof. M. Jean Perrin. Translated from the "Annales de Chimie et de Physique," 8me Series, September, 1909, by F. Soddy, F.R.S. Pp. 93. (London: Taylor and Francis, 1910.)

THIS small volume of ninety-three pages is a translation by Mr. F. Soddy, F.R.S., of a memoir published by Prof. J. Perrin in the *Annales de Chimie et de Physique* in September, 1909. In this paper, Prof. Perrin gave a detailed account of his work upon the distribution in fluids of small particles, which show the Brownian movement, and the bearing of these results on the kinetic theory of matter. An interesting survey is first given of the historical development of this subject. The English naturalist, Brown, directed attention in 1827 to the fact that small particles suspended in liquids were always in a state of rapid but irregular movement. Comparatively little notice was paid to this observation until 1889, when Gouy showed that the Brownian movement could not be ascribed to temperature differences, but was a persistent effect which was probably a necessary consequence of the kinetic theory of matter. Since that time a large amount of interesting work has been done, especially by Continental workers, to throw further light on the magnitude and nature of the Brownian movement.

After a brief account of the kinetic theory of matter and its application to the determination of the dimensions of atoms, Perrin gives a full description of his own experiments. Using an emulsion of gamboge and of mastic, he was able to determine the distribution in liquids of nearly equal granules, the diameter of which in different experiments varied between $0{\cdot}1\mu$ and μ ($\mu = 1/1000$ millimetre). By counting the number of granules at different levels by means of a high-power microscope, he found that the concentration of uniform granules decreased in an exponential manner with the height, in the same way as barometric pressure due to our atmosphere decreases with the altitude. The diameter of the granules was determined by direct weighing, and also by means of the formula of Stokes. From the data thus obtained, he has shown clearly that these granules distribute themselves exactly like a gas of very high molecular weight. It follows from this that each of these granules has the same kinetic energy of movement as a molecule of any gas or liquid at the same temperature. This is a very important deduction, for it shows that the law of equipartition of energy in all probability holds, not only for single molecules, but for granules containing many millions of molecules. From the experimental data, it is not difficult to deduce directly the numerical value of Avogadro's constant, *i.e.* the number of molecules in one cubic centimetre of any gas at standard pressure and temperature. The determination of this constant allows us at once to deduce the mass of any molecule, and also the value of the fundamental unit of charge carried by the hydrogen atom.

The experiments of Perrin are highly ingenious and interesting, and throw much further light on the behaviour of these granules. By examining some large granules of diameter, about 13μ which contained an inclusion visible in the microscope, he has been able to show that a particle, in addition to a slow Brownian movement, exhibits a spontaneous irregular rotation, and that the mean energy of this rotation is about equal to the mean energy of translation, thus establishing another deduction from the law of equipartition of energy.

In the last few years a number of methods have been developed for the determination of atomic constants, and a brief account of these is given at the end of the volume. It is of interest to compare the values obtained by Perrin with those obtained by other observers by entirely distinct methods. It is simplest to compare the results in terms of the value deduced for the charge e carried by a hydrogen atom. Perrin finds $e = 4{\cdot}1 \times 10^{-10}$ electrostatic units, while Rutherford and Geiger, from their counting experiments, found a value of $4{\cdot}65 \times 10^{-10}$. Recently Millikan, as a result of an admirable series of experiments on small drops of oil, has found a value equal to $4{\cdot}90 \times 10^{-10}$. In the course of his work, Perrin made special experiments in order to test the validity of the application of Stokes's formula for determining the diameter of a globule by its rate of fall, and concluded that it held accurately over the range of diameters of granules employed in his experiment. On the other hand, Millikan finds that Stokes's rule is not valid for small particles, and that the error becomes considerable for particles of diameter about 2μ, which is about the diameter of the granules used by Perrin in his most accurate series of experiments. The deviations from Stokes's law observed by Millikan are in general agreement with the conclusions recently deduced by Cunningham as a result of a mathematical investigation. If Millikan is correct, the size of the granules deduced by Stokes's method requires correction, and this would tend to bring the value of e found by Perrin in closer accord with that of Millikan. It seems possible, also, that the apparently large variations observed by Ehrenhaft in the value of the fundamental charge carried by very small particles, visible in the ultra-microscope and showing large Brownian movement, may be due to the failure of Stokes's formula for very small particles.

The questions discussed in this volume are of great interest and importance in molecular physics, and the reader cannot fail to be impressed by the remarkable advances which have been made in recent years in showing the validity and essential reality of the kinetic theory as an explanation of the properties of matter.

The work of translation is on the whole well done, and the vigorous style of the author is retained. The translation is in a few cases somewhat peculiar. For example, on p. 5, "Le mouvement brownien . . . persiste la nuit, *dans un sous-sol*, à la campagne," is translated, "The Brownian movement . . . persists equally, for example, at night on a *subsoil* in the country." Again, on p. 8, "nous *constatons* un équilibre" is given "we *establish* an equilibrium."

Mr. Soddy has done a valuable service in bringing to the attention of the general and scientific reader the very interesting and clearly written account of this subject given by Perrin. E. R.

MEDICAL BIOLOGY.

Biology, General and Medical. By Prof. J. McFarland. Pp. 440. (Philadelphia and London: W. B. Saunders Co., 1910.) Price 7*s*. 6*d*. net.

PROF. McFARLAND tells us in his preface that "medical science is, in fact, a branch of biology, and should be studied as such." With this opinion we heartily agree, and we were fully prepared to find that the present volume would supply a long-felt want in demonstrating the importance of biological studies from the medical point of view. We still believe that the author has succeeded in doing this, but he has also succeeded in demonstrating the fact that a medical man is not always the most trustworthy authority on biological questions. The plan of the book is interesting, and, to some extent, original, commencing very appropriately with the cosmical relations of living matter and ending with a chapter on senescence, decadence, and death; and the author has successfully avoided the pitfalls of the type-system. Nevertheless, we can hardly share his somewhat curiously expressed hope "that the writing will not be found too technical to be beyond the comprehension of any intelligent reader."

The work is largely a compilation and is of a curiously mixed character, derived partly from text-books—some of a very elementary character—and partly from highly technical writings of a more or less controversial nature. For elementary zoological facts the author appears to have relied largely upon Masterman's "Elementary Text-book of Zoology," and Galloway's "First Course in Zoology," from which numerous illustrations are borrowed. The "New International Encyclopædia" has supplied a superfluity of information upon parasites, arranged zoologically, but we should be sorry to attribute responsibility for the author's statements to any of the works mentioned.

The theory of heredity is treated mainly by means of copious quotations from Herbert Spencer, Darwin, Galton, Weismann, and Adami. The amount of space devoted to the complicated lateral chain theory of the last-named author seems quite out of proportion to that given to other subjects.

We are obliged in justice to our readers to point out that the work contains numerous inaccuracies and misleading statements. Thus, for example, the shell of a tape-worm egg is described as a cell-wall; flagella and cilia are described as rigid protoplasmic threads; the shells of Foraminifera and Radiolaria are said to "find their homologues in the dermal coverings, the limbs, and fins, &c., of the higher animals"; the medusa of Obelia is said to have a water-vascular system, and so on. On p. 103 we are told that the germinal cells have twice the number of chromosomes possessed by the somatic cells, and our astonishment at this statement is only partially abated when we come to p. 189, and find that the author is referring to the doubling of the number of chromosomes which is supposed to take place in the maturation of the germ-cells prior to reduction, and fully realises that the actual gametes have only half the somatic number.

It is, perhaps, of no great consequence to the general reader or to the medical man if the sponges are defined as "characterised by many incurrent openings and only one excurrent opening. Axially symmetric. Sexually reproductive," but this diagnosis is so strikingly inadequate, and to some extent even incorrect, that it might just as well have been omitted, as might that of the arthropods, which are simply defined as "jointed animals." Moreover, it is always possible that the book may find its way into the hands of a student preparing for examination.

In the chapter on the origin of life the author suggests (or borrows the suggestion, it is not quite clear which) that the power of reproduction may be "only characteristic of such forms as shall have already evolved to a certain point." The possibility of organic evolution without reproduction is, we must confess, a new idea to us, and one upon which we do not think, with the author, that "it may not be unprofitable to speculate."

We can only hope that the more especially medical chapters, dealing with blood relationship, infection and immunity, will be found less open to criticism at the hands of medical readers. A. D.

GEOLOGICAL ESSAYS.

Outlines of Geologic History, with especial reference to North America. A Series of Essays involving a Discussion on Geologic Correlation presented before Section E of the American Association for the Advancement of Science, in Baltimore, December, 1908. Symposium organised by B. Willis; compilation edited by R. D. Salisbury. Pp. viii+306. (Chicago: University of Chicago Press; London: Cambridge University Press, n.d.) Price 6*s*. net.

SOME of the best qualified geological writers and workers in America, including Dr. F. D. Adams from the Dominion of Canada, have here brought together their views on the correlation of stratified deposits. The series of essays was originally published in the *Journal of Geology*, and forms a text-book of North American stratigraphy, embodying results up to December, 1908. It is illustrated by Mr. Bailey Willis's "paleogeographic maps" of North America, which are a little difficult to read in their black and white shaded form. Our ignorance of what lies beneath the oceans probably gives a false impression of fixity to the continental boundaries in many cases.

The terminology used has been left to the various authors, so that we may welcome Mr. Willis's retention of "Cambrian" as against Mr. Grabau's "Cambric." Prof. Salisbury, as editor, points a warning finger towards Mr. Grabau's preferences on p. 44; but he is unable to save us from the "Beekmantownian" representative of the "Lower Ordovicic." Should not, by the by, the correct translation of the French "Plaisancien" be, not Prof. Osborn's "Plaisancian" (pp. 216 and 262), but either "Placentian" or "Piacenzan"?

We have the benefit of the views both of Dr. Adams and Prof. Van Hise as to pre-Cambrian classification. The former urges that the break between the Middle and Upper Huronian in America is at least

as important as that between the Keewatin and the Lower Huronian. Hence he is forced to oppose the division of the pre-Cambrian rocks into Archæan and Algonkian only. The early Palæozoic faunas fall naturally to the care of Dr. C. D. Walcott, who interestingly describes the oldest known Cambrian beds, those of south-western Nevada and eastern California (p. 31). In *Nevadia weeksi*, referred at first to Holmia, he recognises a form of trilobite "more primitive than such forms as *Olenellus thompsoni* (Hall) and *Holmia bröggeri* (Walcott.)" This phrase reminds us of the dangers that lie in wait for the palæontologist. Seeing that Olenellus was once regarded as expressing the decadence of the Paradoxides type, may not this suggestion of primitiveness arise from the fact that the Olenellus fauna occurs in California 5000 feet above these interesting strata?

Mr. Grabau carries on the correlation to "Devonic time," in a paper involving considerable labour. In Mr. Girty's essay on the Pennsylvanian, we notice (p. 125) one of the special points provided for us by America, viz., the occurrence of beds with *Productus giganteus* in California, which can be correlated more easily with the Carboniferous Limestone series of Europe than with the eastern Mississippian (Lower Carboniferous) series of America. Mr. Girty believes that none of the Upper Carboniferous faunas of North America are truly of fresh-water origin. Even the Appalachian facies (p. 128) with Naiadites, containing as it also does Lingula and "Aviculipecten," must at any rate imply brackish water.

It is hardly profitable to indicate isolated passages of interest in a book so full of condensed and well-ordered information. As examples, we may mention in conclusion Mr. White's sketch of the rise of the Devonian flora (p. 140), with its hint of Archæopteris prevalent in the upper series throughout the world; Mr. Williston's account of the faunal relations of early vertebrates; and Prof. Osborn's "correlation of the Cenozoic through its mammalian life." Though primarily intended for the specialist, these essays will do much to bring new life into the teaching and writing of British geologists who are willing to look beyond the seas. G. A. J. C.

THE ANALYSIS OF SYNTHETICAL DYES.

Tests for Coal-Tar Colours in Aniline Lakes: A Review of the Coal-Tar Colouring Matters generally used in the Lake Industry, and their Behaviour with Distinct Chemical Reagents. By G. Zerr. Authorised English edition by Dr. C. Mayer. Pp. xii+230. (London: C. Griffin and Co., Ltd., 1910.) Price 10*s.* 6*d.* net.

THE complex nature, as well as their ever-increasing number, render the analysis of synthetical dyes no easy matter. The work before us endeavours to fill a vacant gap in analytical literature, dealing as it does with the detection of a large number of these compounds in aniline lakes.

The book is divided into two parts.

Part i. takes account of the lakes which may be prepared from more than three hundred coal-tar colours. The author's experimental results obtained by a study of the action of selected chemical reagents (caustic soda, sulphuric acid, and stannous chloride in hydrochloric acid), and also of solvents (hot water, alcohol, and acetic acid) on these lakes, are arranged in columns, thus forming a series of tables, which comprise the greater part of the book. More than four hundred lakes are considered, and their behaviour towards sunlight, turpentine oil, and varnish is also mentioned in these lists.

Part ii. indicates the methods of recognising the various coal-tar colours in the lakes. Here also we have a number of tables which are really analytical schemes deduced from the results obtained in Part i., and containing sufficient details to explain their use. We have repeated some of the experiments mentioned in Part i. and have found them satisfactory. The author himself in Part ii. gives us three detailed examples of analysis, which may well serve as models in the investigation of lakes containing one or more colouring matters. The book will no doubt prove a trustworthy guide to those engaged in the analysis of lakes, and also to others who wish to enlarge their experience in the identification of synthetical dyes. Its utility, however, may be enhanced by the addition of a standard colour chart, which will more definitely explain column iv. of Part i., and by a supplementary column (in Part i.), which may include, whenever possible, the constitutional formulæ and systematic names of the various coal-tar colours mentioned by the author, together with any references relating to patents. The translator has done his part well, bringing the work up to date.

It is to be regretted that the translator, before issuing the book, had not worked out a similar table of tests for the coal-tar colours which are manufactured by English firms, as in its present form it distinctly tends to encourage the use of coal-tar colours made abroad as against those made by our own manufacturers.

DOMESTICATED ANIMALS.

Domestic Animals and Plants: A Brief Treatise upon the Origin and Development of Domesticated Races, with special Reference to the Methods of Improvement. By Prof. E. Davenport. Pp. xiv+321. (Boston, New York, Chicago, and London: Ginn and Co., n.d.) Price 5*s.* 6*d.*

THIS volume, we are told in the preface, is intended primarily for high and normal schools in the United States, and also appeals more specifically to the general student. Consequently, it is of the utmost importance that the information it contains should be thoroughly trustworthy. A survey of the sections devoted to groups of animals with which I happen to be more particularly acquainted shows, however, that this is very far, indeed, from being the case.

Take, for example, the statement on p. 96 that all the varieties of domesticated pigeons "have been bred within historic times from the single primitive form, the wild or passenger pigeon." That, in this astounding statement, the author has not by accident written passenger pigeon in place of blue rock, is manifest by the fact that a figure of the former bird is given on

p. 93, with a legend to the effect that it is the parent form. Apparently Prof. Davenport is unaware that the passenger pigeon belongs to a genus apart from the one including the blue rock and domesticated breeds.

The author's want of knowledge is, perhaps, still more conspicuous in the section on cattle and sheep (pp. 219–30), where blunders occur in profusion. In the legend to the figure of an Indian buffalo, on p. 218, we are told, for instance, that this is the only kind of buffalo, but that the name is often applied to the European (as well as to the American) bison. The gayal is stated on p. 221 to be "an intermediate between the domesticated and the wild cattle of the Indian type"; but even that statement is outdone on p. 223, where we are told that if the domesticated cattle of Africa and Asia were to die out, there would be no difficulty in replacing them from wild stocks! Where the author proposes to find a wild ox in Africa, I do not know; but he apparently does not realise the difference between a buffalo and an ox. After this it is not surprising to find the revival of the theory that white park cattle (which are stated to occur "at Chillingham in southern Scotland, and Chartley and Cadzow in southern England") represent the ancestral colour of the wild ox. Neither is it startling to find it stated (p. 228) that the Armenian wild sheep inhabits the islands of the Mediterranean, that the Cyprian wild sheep has more than two horns (p. 230), and that "the musk-ox stands between the cattle and the sheep" (p. 229).

With these and other blunders in a couple of sections, Prof. Davenport's volume can scarcely be recommended as a trustworthy guide to youth in search of information. R. L.

POPULAR SCIENCE.

The Autobiography of an Electron; wherein the Scientific Ideas of the Present Time are explained in an Interesting and Novel Fashion. By C. R. Gibson. Pp. 216. (London: Seeley and Co., Ltd., 1911.) Price 3*s.* 6*d.* net.

A BOOK with so strange a title may well excite our curiosity, for it is not unnatural to expect in such an autobiography interesting speculations as to the nature and functions of electrons going beyond the limits of certain knowledge, and putting forward ideas suggestive of possible future advances in scientific thought. But though the electron is made to give an account of its experiences in different natural phenomena and experiments, it discreetly declines to tell us anything beyond what we know to be facts or what we are accustomed to regard as accepted physical theories. What, then, is the object of this story of the electron—or, more correctly, this series of stories about the experience of the electron in the different experiments described in each chapter? To use the author's own phrase, it is to present to his readers "a book which they may read with the same ease as an interesting novel."

Now it must be admitted that this desire to present to the scentifically untrained reader the established facts and theories of modern science, in a simple and pleasant form, is much to be commended; for the lack of interest taken by the general public in such matters is certainly deplorable. The author is right in thinking that there are many who would take an intelligent interest in scientific progress, but do not care to go into details, and no doubt men of science are largely at fault for not providing such readers with suitable literature. But it is difficult to see what is gained by the somewhat childish device of making the electron speak for itself, and describing the phenomena in the first person rather than in the more usual third person; besides, the contents of each chapter is preceded by a short synopsis called the "scribe's note," and the subsequent text takes one very little further than this note.

Although the particular form of the book seems to have no special advantage, the facts dealt with and their explanations are set forth quite clearly, and with accuracy, so far as is possible, in an elementary way; but there are disadvantages in the method of presentation which are worthy of mention. Whereas when dealing with certain fundamental conceptions of electricity it may be useful to introduce the idea of electrons, to do so seems to add nothing to the understanding of our methods of employing electricity for telegraphy, lighting, traction, and so forth. The principles involved in such technical application can be described without any reference to the ultimate nature of electric currents, without any sacrifice of precision; in fact, the consideration of the motion of the electrons only serves to detract attention from the more essential points. Again, the method of making the electron tell its own story leads the author into rather dogmatic statements on doubtful points. Thus it is found necessary to take up a definite attitude with regard to the nature of X-rays, which are described as æther-pulses, whereas of late considerable doubt has been thrown upon the validity of this conception of the radiation. Taken as a whole, however, this little book is quite a good and interesting popular account of some of the more important ideas of modern physics.

OUR BOOK SHELF.

Cat's Cradles from many Lands. By Kathleen Haddon. Pp. xvi+95. (London: Longmans, Green and Co., 1911.) Price 2*s.* 6*d.* net.

THE problem of the origin and diffusion of games is now generally recognised to be of some ethnographical importance, and Miss Haddon, in her careful account of the mysteries of cat's cradle, has done something to increase our knowledge. Like all pioneers in a new field of inquiry, she has to lament the scantiness of her material. Here and there persons interested in the subject have picked up various forms of the game among American Indians and Eskimo, the people of Central and South Africa, in the Caroline and Andaman Islands, in Oceania and Australia. But large regions, like India, from which only a couple of examples come, still remain practically unworked; and until the search for the game is more widely extended there will be no certain means of deciding whether it originated in one or many centres, and by what routes and agency it was diffused.

It is not surprising, as Miss Haddon remarks, that some of the plainer forms should have a wider dis-

tribution, because, given a simple loop of string, they would soon present themselves to the mind of the ingenious savage. But it is much more difficult to account for the presence of one of the most complicated forms in the Andaman Islands, Torres Straits, Australia, and Central Africa. In some cases doubtless this is the result of direct transmission, as when the puzzled folk-lorist finds "Cinderella" in the Cannibal Islands, he may reasonably suspect that she came with the Berlin-wool work and the hideous forms of dress popular in mission schools. But until more materials become available it is useless to speculate in this way.

This is some evidence, again, that certain forms of the game may be derived from magic of the sympathetic or mimetic kind; and inquirers interested in the subject would do well to ascertain if it is ever accompanied by magic formulæ or songs.

Meanwhile, Miss Haddon has given us a useful little book which may lead to the popularisation of the game in the kindergarten as a means of training eye and finger, or as a pleasant mode of wasting time for those who are no longer children.

A Course of Practical Physics. By Prof. E. P. Harrison. Pp. x+194. (London: Longmans, Green and Co., 1910.) Price 4*s.* 6*d.* net.

THIS book is based on the syllabus of practical physics for the B.Sc. degree of the University of Calcutta, and contains upwards of seventy experiments of an advanced nature. The author states in his preface that laboratory manuscripts have been used in its compilation, and this is far too evident in the result produced. Such instruction forms very often suffer from vagueness and looseness of expression, and although this may not be of much importance in the laboratory, where further explanations can be given by a demonstrator, yet in a published text-book care should be taken to eliminate such blemishes and make the descriptions more general and concise. To cite an example:—The determination of the thermal conductivity of copper on p. 130; the method is that of Searle; one is told to set up the apparatus as in the figure. The copper bar is not lagged, nor is there any mention in the text of the necessity of such lagging. Again, on p. 21—the determination of the period of vibration of a pendulum—it is not clear that the period needs correction (1) for size of amplitude, (2) for damping, but the corrections are merged into one causing ambiguity.

The author describes the measurement of galvanometer resistance on p. 156 (Thomson's method), and begins by telling us that one of 100 ohms resistance is convenient.

In some places the statements are inaccurate, *e.g.* on p. 175, the "neutral temperature" of a thermo-electric couple is defined as that temperature of the hot junction for which the electromotive force vanishes when the cold junction is maintained at 0° C. On p. 144, we have "Plot a B-H curve as in Fig. 101 (hysteresis loop shown). Determine the hysteresis in ergs per c.c. per cycle by measuring the area of the curve."

There is no doubt much in the book that will prove useful to students preparing for a pass degree examination, but its value would have been enhanced by the bestowal of more care in editing.

How to Colour Photographs and Lantern Slides by Aniline Dyes, Water and Oil Colours, Crystoleum, and other Processes. By R. Penlake. Pp. 77. (London: G. Routledge and Sons, Ltd.; Dawbarn and Ward, Ltd.; n.d.) Price 1*s.* net.

ALTHOUGH in the greater number of cases the less handwork there is on a photograph the better, it is often possible to apply colour to photographs and lantern slides in such a manner as not to interfere in any way with their value as impersonal records, and at the same time to increase considerably their value for demonstration purposes, and, in certain circumstances, to enhance their beauty. Experience has shown that the most suitable results are obtained by special methods, without the knowledge of which even the most skilful worker suffers a great disadvantage. It is the technicalities of these special methods that the author describes, dealing first with transparencies and colouring or tinting photographs on the face of them, and in the second part with the art of applying colours on their backs. He gives full instructions as to tools, colours, and processes without wasting any space in "artistic" platitudes.

Fables and Fairy Tales for Little Folk; or, Uncle Remus in Hausaland. By Mary and Newman Tremearne. First series. Pp. iv+135. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1910.) Price 2*s.* 6*d.* net.

THIS is a popularised version of a series of folk-tales collected by Captain A. J. N. Tremearne, and published, with much useful information on the ethnology and customs of the Hausas, in the Proceedings of various societies. The tales add little to our knowledge of the manners of the people. Nearly all of them are based upon the theme of the transformation of men into animals and *vice-versa*, and there is little of the fairy element. The hero of many of the tales is Spider, who, like the fox of European and Chinese folk-lore and the jackal in India, is the type of the successful rogue. He is appointed king of the beasts, and in various ways swindles the elephant, rhinoceros, and hyæna. He marries a Hausa girl and has children, whom he shelters and dresses with his webs. His rival is the billy-goat, who plays tricks on the lion. In its present form, without notes or references from other folklore sources, the book is of little scientific value; but its quaint and humorous incidents of animal life will doubtless be fully appreciated in the nursery.

Early Britain. Roman Britain. By Edward Conybeare. Second edition, revised. Pp. 275. (London: Society for Promoting Christian Knowledge, 1911.) Price 3*s.* 6*d.*

THIS history of Britain, which extends to the year 455 A.D., begins with a treatment of the period shading on one hand into geology, and on the other into written history. The reader gets a glimpse of what the geologist has pieced together about the life of the inhabitants of this country in Palæolithic and Neolithic times, and an interesting account of the less ancient Britons. A very readable description is given of Britains under the Romans, in which the broad facts stand out clearly.

The Green Book of London Society. Edited by Douglas Sladen and W. Wigmore. Pp. xxii+524. (London: J. Whitaker and Sons, Ltd., 1911.)

THIS is the second issue of a comprehensive work of reference, the scope of which may be gathered from its sub-title:—"A Directory of the Court, of Society, and of the Political and Official World; including Celebrities in Art, Literature, Science, and Sport, with many other subjects of current interest." Science appears to be given about a page and a half, and the information includes a list of "eminent men of science who appear in London," the names of seven leading engineers, a list of twenty-four important scientific periodicals, and brief particulars of twenty-three scientific societies.

LETTERS TO THE EDITOR.

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

The Flow of Thin Liquid Films.

WHILST observing the "Brownian" movement of particles of gamboge in water with the aid of a microscope (magnification, about 360 diams.), it occurred to me to press gently on the cover-glass of the slide, so as to cause a movement of the water containing the suspended matter, and to note the paths of these in the vicinity of some larger stationary masses, as one would then be approaching the condition set forth by the late Sir G. G. Stokes, namely, that liquids in thin films behave as frictionless fluids. The results fully confirmed the behaviour of such thin films of liquid. The moving particles, as they rushed by the stationary masses, showed no trace of eddy currents, passing along the edges of the obstacle and leaving it without any swirls, as shown in Fig. 1. The moving particles next to the obstacle had a high velocity, and were in greater numbers per unit area, than those further removed; the obstacle had no effect upon distantly removed portions of the liquid—they moved in straight lines. For very low velocities the course of the particles was exceedingly in accordance with the motion of a frictionless fluid. With high velocities, a cone of slow-moving liquid formed both in front and behind the obstacle, as shown in Fig. 2. When two masses are in the same line of flow, it is difficult to prevent a certain number of particles, mapping out a stream-line, from crossing over from one side to the other between the obstacles, as shown in Fig. 3. We have here a hydrodynamical analogy to the circuit of a Wheatstone bridge

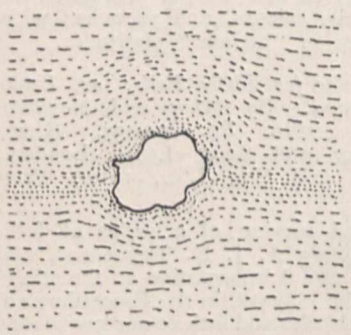


FIG. 1.

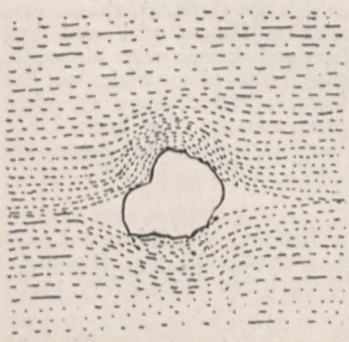


FIG. 2.

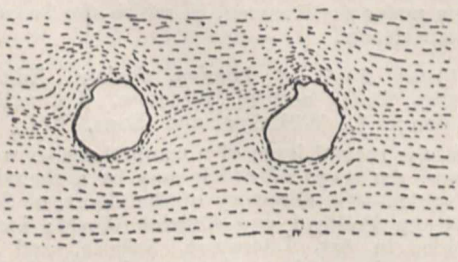


FIG. 3.

when determining the value of an unknown resistance. The liquid represents the metallic circuit, the particles of gamboge the current—or the corpuscles if preferred, the two obstacles the insulation between R_1, R_2 and R_3, R_4, and the fluid between them the galvanometer circuit. When equilibrium is established, no current flows through the galvanometer: no fluid passes across the intervening space between the two obstacles. Vary any one of the resistances, and equilibrium is upset, causing a current to flow through the galvanometer; cause an unbalanced pressure on one side or the other of the line joining the two obstacles, and a current of fluid flows from the place of greater to that of lesser pressure.

Very interesting effects are produced by introducing air bubbles into the liquid instead of solid obstacles. On pressing the cover-glass, the bubble appears to increase in size, while at the same time a rush of liquid passing it is noticed; on releasing the pressure, the bubble contracts, the liquid moving in the opposite direction. One of the most striking effects is seen when a bubble moves of its own accord through the liquid. The effect is difficult to produce, but well repays the effort. As before, gamboge is used to define the course of the surrounding fluid. As the bubble moves forward, the fluid next it is seen to be moving along its edge in the *same direction*, while at a little distance it is moving in the opposite direction to that in which the sphere moves. This effect is shown by the arrows in Fig. 4, the heavy arrow denoting the direction in which the sphere is moving. At the pole *c* the fluid seems to appear, passes with a high velocity to the pole *d* *via* the surface of the bubble, and disappears. The effect of the moving bubble on the surrounding liquid extends for a great distance compared with the case when the liquid is in motion and the obstacle stationary (*vide* ante).

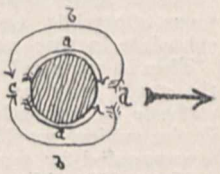


FIG. 4.

W. G. ROYAL-DAWSON.

4 Montague Street, London, W.C., March 6.

Water-Vapour on Mars.

I NOTE in NATURE of February 9 (p. 486) an account of a recent unsuccessful attempt to verify the existence of water-vapour on Mars, already demonstrated by means of other methods by Dr. Slipher and myself (see *The Astrophysical Journal*, vol. xxviii., p. 397, December, 1908, and Lowell Observatory Bulletins, Nos. 36, 43, and 49). Will you allow me to point out that the method employed by Director Campbell was proposed several years ago by Dr. Percival Lowell, and was actually tested by Dr. Slipher at the Lowell Observatory in 1905, with a result similar to that which Director Campbell has now obtained in his repetition of the experiment? The details may be found in Lowell Observatory Bulletin No. 17.

The reason for the failure perhaps lies in the insensitiveness of the method. The spectrum of a body no brighter than Mars cannot be obtained with the utmost fineness of detail under a high dispersion, because a relatively wide slit has to be used, or else a very long exposure must be given to the photographic plate, either of which is fatal to sharp definition of fine spectral lines. In these circumstances it is not easy to distinguish between the terrestrial and planetary components of a fine absorption line with the high dispersion which is absolutely necessary to the success of the experiment.

It still seems to me that the best method of measuring the Martian aqueous vapour which is at present available consists in the observation of the little *a* band with a spectrograph of low dispersion, which gives the band as a shading in which individual lines cannot be discriminated, but the integrated intensity of which can be measured photometrically. The method is also applicable to those diffuse bands discovered by Abney and Festing in nearly saturated aqueous vapour, which apparently are not composed of fine lines, but which are sometimes much more intense than the linear groups.

FRANK W. VERY.

Astrophysical Observatory, Westwood,
Massachusetts, March 6.

The Fox and the Fleas.

I HAVE just been told a very interesting story by Mr. James Day of this town. Many years ago he and his father, both then engaged in agriculture, were sitting with their backs to the straw-covered hurdles which had

been put up to protect some sheep and lambs from the wind, when they noticed a fox come searching along the hedgerows. They kept perfectly still and watched, and, when he got nearer, they saw that he was collecting the sheep's wool caught on the thorns and brambles. When he had gathered a large bunch he went down to a pool at the junction of two streams, and, turning round, backed slowly brush first into the water, until he was all submerged except his nose and the bunch of wool, which he held in his mouth. He remained thus for a short time, and then let go of the wool, which floated away; then he came out, shook himself, and ran off.

Much astonished at this strange proceeding, they took a shepherd's crook, went down to the water's edge, and pulled the wool out. They found that it was full of fleas, which, to save themselves from drowning, had crept up and up the fox's brush and body and head and into the wool, and that thus the wily fox had got rid of them.

Cambridge, March 20. T. MCKENNY HUGHES.

THE CIRCULATION OF AIR IN THE SOUTHERN HEMISPHERE.[1]

IN this investigation of the circulation of the atmosphere in the southern hemisphere, the author has taken a new course. Instead of proceeding in the usual way from tables of wind-direction and force, he has taken as the groundwork of his researches the atmospheric whirls themselves. He does not deal with cyclonic systems, as one might at first suppose, but with the anticyclonic, the travelling high-pressure systems. The reason of this is plainly due to his previous work, "A Discussion of Australian Meteorology" (London, 1909). After a four-year period in the variations of air-pressure over India, South Africa, and South America, and their relations to the four-year cycle in the solar variations had been successfully demonstrated, it was necessary to investigate the weather conditions in Australia with that object. In the subtropical continents of the southern hemisphere weather conditions are chiefly influenced by barometric maxima almost constantly travelling from west to east. This was first shown to be so for Australia by the astronomer H. C. Russell, of Sydney, to whom the meteorology of that continent is so much indebted.

Russell already held the opinion that these travelling barometric maxima (with the V-shaped depressions accompanying them on their south side) do not originate on the continent itself, but approach from the South Indian Ocean. In Dr. Lockyer's extensive work, above quoted, it was shown more conclusively that in the Australian area, in latitudes 20° to 40° S., anticyclonic systems travel with great velocity from west to east, and that this also holds good for South America, South Africa, and Mauritius, in the same belt of latitude. In all probability, what holds good for 130° of longitude would also obtain for the rest of the earth's circumference. A proof of this would be of great importance for the weather prediction of these southern continents. The inquiry was therefore extended over the whole southern hemisphere, in order to obtain at the same time a more secure basis for the determination of the effects of the solar variations on the circulation of the air of the southern hemisphere.

The collection of the materials for this widely extended investigation naturally gave the author much trouble and difficulty. The determination of the amplitudes of the waves of atmospheric pressure over the whole of the district in question formed the preliminary part of the work in view. The author rightly confined himself to the southern winter half-year (April to September). It is quite clear that in calculating the mean height of the pressure waves, all waves, including even the smallest, cannot be taken into account, but only those of a certain magnitude. The author finds the amplitude of the pressure wave (Schwellenwerth) for these by selecting the three greatest wave heights for each station and takes one-fifth of the mean as the lower limit. This value (Schwellenwerth) is naturally different for different places in the various latitudes.

Dr. Lockyer calculates in this way the mean heights of the waves of air-pressure for fifty-five places in the southern hemisphere, between the equator and the Antarctic continent, and enters the values in the chart. That leads further to the drawing of lines of equal wave heights of oscillations of air-pressure. The author denotes these lines by the somewhat mysteriously sounding Greek compound "Isanakatabars": lines of equal up and down movements of air-pressure. The mean amplitudes of the waves of air-pressure naturally increase from the tropics towards higher latitudes. In latitude 0° to 12° S. they reach 1 to 2 mm.; from 12° S. they increase very rapidly and attain a maximum of 18 to 19 mm. in 53° to 60° S., and then decrease again to 14 to 15 mm. in South Victoria Land. The Isanakatabar of 16 mm. occasionally fringes the Antarctic continent. The increase of the wave heights towards the south is explained by the fact that from the belt of the travelling barometric maxima, with still relatively small amplitudes, we first enter the region of V-shaped depressions which accompany them, and then, finally, that of the large cyclones of higher latitudes, the mean tracks of which may probably be taken as between 55° and 60° S. At the southern limit of these, towards the permanent Antarctic anticyclone, the amplitudes again decrease. But, generally speaking, the Isanakatabars run fairly parallel to the parallels of latitude. They exhibit, however, the peculiarity that on the mountain ranges of the west sides of South Africa and South America they trend downwards in higher latitudes, but leave the east coasts in lower latitudes. This may be ascribed to the westerly ranges of mountains in these continents.

These Isanakatabars form the starting point of further very interesting deductions by the author.

It may here be remarked that Kämtz, in his "Lehrbuch der Meteorologie" (vol. ii., p. 339), has endeavoured to draw lines of equal non-periodical oscillations of air-pressure. He calculated for numerous stations of the northern hemisphere the mean value of the *monthly variation* of air-pressure, and called his lines based thereon somewhat improperly "isobarometric" lines. It is certainly noteworthy that lines of equal barometric variation were drawn (1832) long before it was thought of constructing lines of equal air-pressure (isobars). These were first drawn by Renou (1864), and then particularly by Buchan (1869). Kämtz also remarked that his lines did not run wholly with the parallels of latitude, but that, *e.g.* the line of 8 par. lines = 18 mm., is met with on the east coast of the United States in 36° N. latitude, but in western Europe in 42°. At a much later period Fehlberg and Köppen again investigated the variations of air-pressure on a much broader basis, but also for the interval of a month (*Aus dem Archiv d. Deutschen Seewarte*, 1878, and *Meteorologische Zeitschrift*, 1883). These *monthly* barometer variations are naturally a much rougher measure of the irregular variations of pressure than the mean height of the individual pressure waves calculated by Dr. Lockyer. Köppen has already remarked that the lines of equal variations of air-pressure should be in relation with the direction of the tracks of the barometer minima.

[1] Solar Physics Committee. Southern Hemisphere Surface-air Circulation: Being a Study of the Mean Monthly Pressure Amplitudes, the Tracks of the Anticyclones and Cyclones, and the Meteorological Records of several Antarctic Expeditions. By Dr. W. J. S. Lockyer, under the direction of Sir Norman Lockyer, K.C.B., F.R.S. Pp. ix+111+xv plates. (London: H.M.S.O., Wyman and Sons, Ltd. Edinburgh: Oliver and Boyd. Dublin: E. Ponsonby, Ltd., 1910.) Price 6s.

Lockyer shows that, *e.g.* the Isanakatabar of 10 mm. in Australia coincides with the average track of the barometer maxima in that continent.

The next question was: with what velocity do these pressure waves progress from west to east.

By superposing the air-pressure curves of stations of different longitudes (first in Australia) and by shifting the time scale until the crests and troughs of the waves coincide, the difference of time of their occurrence at different places is indicated at once. In this way Lockyer obtains for the continent of Australia a daily velocity of progression of the barometric maxima from west to east of 11·5° of longitude, for South Africa, 12°, for South America, 11·1°, giving a mean of about 11·5°. The velocity over the oceans is naturally much more difficult to determine; Port Durban—Perth, gives for the South Indian Ocean about 9·5° a day; Adelaide—Rikitea, for the Pacific, 9·3°. Still more uncertain is the determination for the South Atlantic, which gives about 9·2°. Over the oceans therefore the barometric waves progress with less velocity. Lockyer gives 9·2° a day as the mean value (the Antarctic Ocean comes out as 9° to 10°). So we may adopt a general mean of 10·7°, whence it would follow that anticyclones travel round the earth in about 33·6 days. The author in no wise assumes therefrom that the anticyclones remain constant in form and intensity during their progression; on the contrary, they are subject to continual changes. He estimates their length of life on the oceans to be about six to seven days.

The wind and temperature observations, also, of all Antarctic expeditions, including the most recent one by Shackleton, are discussed in detail with reference to the problems of atmospheric circulation at present in question; series of barometric minima progressing from west to east are also shown. In longitude 30° to 90° W. the paths of the barometric minima appear from these observations (*Belgica* and *Scotia*) to lie more to the south than in the easterly longitudes. This seems to show that the centre of the Antarctic anticyclone is not at the pole itself, but in easterly longitudes, far therefrom, at the farthest, perhaps, in 130° E.

A coloured frontispiece, a chart of the southern hemisphere on the polar projection, gives a good schematic representation of the barometric minima and maxima that encircle the pole, and of the warm and cold air-currents proceeding from them. In the rear of the minima the permanent Antarctic anticyclone sends cold currents to lower latitudes, while, in front of them, warm air spreads to the Antarctic regions. These formations of the warm and cold currents gear into each other like toothed wheels, while they are constantly rotating round the pole.

With reference to the apparently permanent barometric maxima over the subtropical oceans, which lie nearer to the west than to the east coast of the continents in all oceans, Lockyer develops entirely new ideas which are very interesting and worthy of further examination.

The subtropical barometric maxima lie in the belt of anticyclones constantly travelling from west to east between lat. 20° to 40°. They are not fixed forms, and form no barriers to atmospheric circulation, but indicate only the spaces where the anticyclones which are actually travelling are mostly reinforced. Over warm land-surfaces anticyclones are weakened and partially effaced; over the cool sea-surfaces they are strengthened.[1] *They therefore arrive on the west coasts of the continents with greater intensity than that with which they left the east coasts of the same.*

This very interesting view could only originate in the study of the circulation of the air over the southern hemisphere, for in the northern, the conditions are usually too complicated and disturbed by the land-surfaces.

The author deals only with the air-currents at the earth's surface. Nor does he go into the question of the nature and origin of anticyclones and cyclones, He rightly confines himself to establishing facts, which must certainly precede theories.

Dr. Lockyer's investigation, the contents of which I have briefly sketched, is a very valuable contribution to our knowledge of atmospheric circulation. Objections will probably be raised to many points, but it is pure gain to the science if occasion is given for further discussion. For the simple reason that the author does not follow the ordinary beaten tracks but presents entirely new views for examination, his work will have a very stimulating and useful effect.

J. HANN.

[1] Perhaps I may here correct a slight error which has been taken from Buchan's "Meteorology." The specific heat of water is to that of firm land not as 4 to 1, but only 2 to 1. The question here is the "volume capacity," the specific heat for equal volumes. For dry ground this is 0·5 (for damp, about 0·6), compared to water. The ratio of specific heat for equal weights is only as 0·2 to 1·0.

THE INSTITUTE OF HUMAN PALÆONTOLOGY.

ATTENTION was recently directed in NATURE (January 26, p. 412) to the establishment by the Prince of Monaco of an institute of human palæontology in Paris. The council of administration has now been appointed; it consists of his Highness the Prince as president; MM. Dislère and E. Mayer, conseillers d'état; MM. Boule and Verneau, professors of palæontology and anthropology in the Muséum d'histoire naturelle in Paris; M. Salomon Reinach, member of the Institut and Conservateur of the Musée des antiquités nationales; and M. Louis Mayer, conseiller intime of the Prince. On account of his great services to archæology and his administrative experience, Prof. M. Boule will be the director of the institute. Two collaborators have been appointed: l'Abbé H. Breuil, professor of prehistory and ethnography of the University of Fribourg, who will occupy the chair of prehistoric ethnography, and Dr. H. Obermaier, privat-docent in prehistory at the University of Vienna, who will be professor of geology in its relation to prehistory.

We have frequently directed attention to the numerous and excellent researches of Prof. H. Breuil upon the pictorial and glyptic art of Palæolithic man. Dr. H. Obermaier has been associated with Hoernes and Penck in Germany, and Boule, Cartailhac, Breuil, and Capitan in France; he has made a special study of glacial problems, and has investigated the Pyrenean region from this point of view. He has also published important papers on the form and stratigraphy of the older stone implements.

The professors will direct the explorations and excavations undertaken by the institute, personally or with the aid of other specialists. The results will be published as monographs, in addition to shorter articles. During the dead-season they will give assistance and instruction to students who desire to make a serious study of fossil man. Lectures on the work of the institute will be given to the general public from time to time.

The institute will eventually possess an adequate library, specimens, and instruments; and not only will it bring to a focus all existing information on the subject of human palæontology, but it will be the main centre of all future researches. The stimulation and direction which the institute will afford will soon make itself felt, and in the near future we may look forward to a considerable increase in our knowledge of the early history of mankind.

THE ETHNOLOGY OF YORUBA AND BENIN.[1]

ANYTHING which Mr. Dennett writes in connection with the Black man is bound to be of interest and importance to ethnologists; for even if they disagree with his ultimate theories and deductions they are ready to acknowledge the truth, and often the novelty, of the facts and observations he places on record. In many respects the book under review, which deals mainly with the Yoruba people of the western part of southern Nigeria, is superior to any he has as yet written, in that it contains more undoubted facts and accurate observations than deductions which set one's teeth on edge (as in "At the Back of the Black Man's Mind"), because they are based on insufficient evidence or lack of comparative study of other African races or languages. In fact, it may be said at once without too many qualifications that this work of Mr. Dennett on the Yoruba people is a remarkable book of permanent value to the ethnologist and to the student of Africa. It is, indeed, a special insight into the religious ideas of this highly developed negro people, from whom undoubtedly sprang the closely related art and civilisation of Benin, and most of the religious ideas to be found throughout southern Nigeria from Dahome to the Cameroons.

Yorubaland seems to have been invaded at a relatively early date by northern influence coming from Bornu, Hausaland, and the Fula and Songhai countries of the Upper Niger. We know from the interesting researches of Clapperton and Lander that in the early part of the nineteenth century the country of Borgu, which borders Yorubaland on the north, possessed amongst other evidences of northern influence a corrupted version of Christianity of some ancientness, said traditionally to have been brought there by Tuaregs or Berbers from the Sahara Desert. Similar traditions (accompanied by good collateral evidence) derived from Bornu or northern Hausaland most of the old dynasties of Borgu and other countries bordering the Lower Niger. It is, therefore, no difficulty to go a step farther and believe with Prof. von Luschan and other authorities that European influence penetrated far south into the Niger basin and the Cameroons before the times of Islam and the Roman Empire. Von Luschan can indicate in the Ethnographical Museum of Berlin very marked parallels between the art and the religious emblems of the Benue, Lower Niger, and Camerons regions, and those of Crete and ancient Greece. This analogy, again, quite independently, is pointed out by Mr. Talbot in the December number (1910) of the *Geographical Journal* ("The Land of the Ekoi"). Similarly, in reading Mr. Dennett's extraordinarily interesting description of Yoruba religious ceremonials and traditions, one is reminded of those of the Mediterranean peoples two thousand years ago and more. On p. 163 Mr. Dennett gives in Latin the exact text of the erotic songs declaimed by the women at a religious festival, which must have been very similar to the mysteries of Cybele and other similar phallic- and nature-worship manifestations of religion among the Greek and Latin peoples.

All that Mr. Dennett writes on the subject of marriage and totems (beginning on p. 176) is of great interest, and so far as the reviewer's knowledge goes, quite accurate. In connection with this, allusions are made from time to time in the book to the question of polygamy *versus* monogamy, and Dr. E. W. Blyden is quoted in defence of polygamy as being the system best suited to the negro race. With these opinions the reviewer differs. In his own books—especially that which dealt with the researches of George Grenfell on the Congo—he has given evidence to show that there is a greater proportional increase amongst negroes who practise monogamy—namely, cohabit with only one spouse, at any rate ostensibly—than amongst those who avowedly practise polygamy. The very conditions under which polygamy is practised in Africa limit to very few the number of children which each woman produces, nor does it follow necessarily that these few children are any healthier or better brought up than those which are the outcome of a monogamous union. In any case, this is almost indisputable: that the civilised negroes of the New World who profess to be monogamous—and are so, nearly as much as are the white people of the same region—are increasing at a faster rate than the polygamous peoples of Africa; are produc-

Tree planted over Grave which thus becomes sacred. From "Nigerian Studies."

[1] "Nigerian Studies," or the Religious and Political System of the Yoruba. By R. E. Dennett. Pp. xv+235. (London: Macmillan and Co., Ltd., 1910.) Price 8*s*. 6*d*. net.

ing children quite as vigorous in physique and much better endowed mentally than the average native of Africa.

An interesting allusion is made in this book to the origin of fire, interesting because the native tradition quoted by Mr. Dennett is in accord with the observations and theories of several African explorers. On p. 216 he quotes the Yoruba legend that before man knew how to make fire, bush fires used nevertheless to occur almost yearly at the end of the dry season "when natural combustion took place." In Africa, at any rate, this was how fire became an agent of man. I have seen myself lightning set fire to a dead tree or to the dry grass near a tree, and thus start a bush fire in the dry season. Bush fires are very detrimental, in reality, to civilised agriculture in Africa. Nevertheless, in regions where the natives appreciate this fact and do not set fire to the grass or brushwood, bush fires occur from time to time in the dry season, and the natives assert that they are due to some natural cause, more especially to lightning, but also, it has been suggested, to some action of the sun, possibly of "a burning-glass" character acting through silica or some other mineral substance which concentrated the rays on to tinder. But lightning frequently starts a fire in Africa—as witness the cathedrals, barracks, hospitals, &c., which are burnt to the ground from this cause. The spread of the bush fire proved to be of enormous benefit to early man, since when he followed behind its ravages he was presented by nature with a variety of cooked or half-cooked beasts, birds, and reptiles. In this way he learnt the charms of cooked food and the usefulness of fire, and no doubt began to count on the annual opportunities offered to him in the dry season for the renewal of his household fire before he learnt to produce a flame artificially.

The chapter dealing with totems (p. 175 *et seq.*) is particularly interesting, and useful information is given on the laws and customs of land tenure.

H. H. JOHNSTON.

HIGH-FREQUENCY GENERATOR FOR WIRELESS TELEGRAPHY.

IT is announced in the daily Press that Dr. Goldschmidt has recently succeeded in sending wireless messages from Berlin to the South-Western frontier of Germany using his new high-frequency alternator to generate the electric oscillations. The production of undamped waves by means of high-frequency alternators has been the aim of numbers of inventors, as it is hoped that by producing a suitable generator it may be possible to avoid the defects of working that are associated with the usual arc and spark methods.

A number of alternators have been built, but owing to various reasons none of them have as yet come into extended use. Their design on the usual lines is very difficult, as even if the rotating parts are made to revolve at the highest speeds permissible from mechanical considerations, the number of poles required to produce the high frequencies necessary for wireless telegraphy is so great as to leave very little room for the windings, and the consequent cramping of the windings and great leakage between the closely spaced poles give rise to considerable drop of voltage when load is put on the machine.

Most of the machines that have been constructed hitherto have been of the inductor type, consisting of fixed windings placed under the influence of rapidly rotating armatures of iron containing a large number of projections or teeth, but the Goldschmidt machine is built on a quite different principle.

It is a phenomenon well known to those who have to work with single-phase alternators that when load is put on such machines the armature reaction causes double-frequency currents to flow in the field winding, and that these double-frequency currents cause triple-frequency currents to flow in the armature winding, and so on. This may be explained by the consideration that a stationary alternating flux can be regarded as being composed of two equal and constant fluxes rotating with equal speeds in opposite directions, the speed of the two fluxes being such that one complete revolution is made by them in the time of one period of the alternating flux.

Applying this to the case of an alternator with stationary alternating-current winding and rotating field system, it will be seen that if the rotating field produces alternating currents of a frequency f in the stator, the component rotating fields produced by the stator currents will rotate at the same speed as the field system, one in the same direction as the field winding, and therefore having no inductive effect on it, and the other in the opposite direction, and therefore inducing a current of a frequency $2f$ in it. A continuation of this process would cause currents of frequencies $2f$, $4f$, $6f$, &c., to appear in the field winding, and currents of frequencies $3f$, $5f$, $7f$, &c., to appear in the stator winding. The production of the higher frequency currents in ordinary alternators is limited by the fact that the amplitudes of the series of harmonics decrease rapidly owing to the great impedance opposed to their flow in the windings, but the triple-frequency harmonic superposed on the fundamental is often sufficiently marked to cause undesirable distortion of the wave-shape of the electromotive force of the machine.

Dr. Goldschmidt has constructed a machine in which the effect referred to is utilised to produce currents of very high frequencies, although the fundamental frequency of the machine is comparatively low. In order to prevent the damping out of the higher harmonics, he connects in parallel with the stator windings a series of capacity-inductance shunts tuned to resonance with the odd multiples of the fundamental frequency of the machine, and in parallel with the field winding a series of such shunts tuned to resonance with the even multiples of the fundamental frequency. Owing to the presence of these shunts the high-frequency currents are able to attain considerable magnitudes, and the electrical energy is reflected backwards and forwards between the stator and rotor of the machine a great number of times, the frequency of the oscillations being increased at each reflection until a frequency corresponding to the free period of the radiating circuit is reached.

In Dr. Goldschmidt's machine, oscillations of 120,000 cycles a second are produced, and the rated output is 12 kilowatts.

Practical experience of working will be necessary before it is possible to say to what extent machines of this type are likely to replace the present oscillation generators, but it seems not unlikely that difficulties will arise in keeping the frequency of the oscillations constant enough to enable clear signals to be received. It would appear that any small variation of the speed of the generator would cause each successive harmonic to depart to an increasing extent from its proper frequency, so that the final frequency reached might be so far removed from its proper value that signals would no longer be able to be received; added to this the amplitudes of the harmonics might be expected to be greatly diminished by the fact that a change of the speed of the machine would put all the capacity-inductance shunts out of tune with the harmonics for which they are adjusted, and a considerable weakening of the signals emitted by the aërial would result.

A. J. MAKOWER.

RECONSTRUCTION OF THE UNIVERSITY OF LONDON.[1]

THE period covered by Part ii. of Sir William Allchin's account of the reconstruction of the University of London[1] is comparatively short—three years, but it was an important period, that included attempts and failures that should afford valuable information to the Commission now sitting for the purpose of offering advice towards the further progress of reconstruction. The portion of Sir William Allchin's account now before us occupies, with the appendices, upwards of 500 pages; it presents the advantages, as well, perhaps, as the disadvantages, of a compendious Blue-book, containing numerous quotations from original documents, together with a detailed account from the point of view of a highly qualified witness of events in the order in which they developed, while, as indicated by the author himself, the account is substantially a compilation of actual documents; and although the period dealt with is very short, the compendious character of some of these documents is such that Part ii. by itself contains a reasonably intelligible, as well as a very authoritative, account of the process of reconstruction up to the date of the Selborne Commission of 1888. Although in some respects the difficulties of reconstruction have altered since 1891, the nature of the problem to be solved by the Commissioners remains the same, while the conditions to be fulfilled have become more apparent.

It is as clear to-day as it was twenty years ago that a real university is required in London; a university in which examination is not divorced from teaching, in which the teacher who has been the examiner of his pupils during their whole curriculum shall, with the cooperation and consent of an independent authority, "brand his own herrings." It is equally clear from the extension and development imposed by the force of circumstances upon the University of London—the examining body—when it was separated from University College—the teaching body—that upon the university of the metropolis devolves the duty of holding up to the British Empire the standard of excellence. There must be a university belonging to the great province of London, as there is a University of Manchester and a University of Liverpool, and there must be a university in London belonging, not only to London, but also to York or Toronto or Melbourne, and there must be in London, not two universities, but one university. On its metropolitan side, by force of geographical circumstance, it must include many colleges variously situated but under one common government. On its Imperial side it must say, "*Come and be tested,*" not only to the student at the end of his first few years of pupilage, but to the perpetual student, to the professor who has succeeded in learning something from Nature at first hand.

It is as true now as it was in 1888 to say that "it would be a mistake to constitute a local teaching university in London as a mere branch of a great examining body," and it would be an advantage now, as in 1888, if the title "London" were held by the teaching university, whilst the existing University of London should be styled "Imperial" (p. 32); and while it is probable that the new University of London would feed the old university, it is hardly less probable that the Imperial University of London would play its natural part in the intellectual commerce of the Empire.

[1] "An Account of the Reconstruction of the University of London." Compiled by Sir W. H. Allchin. Part ii. From the Appointment of the First Royal Commission to the Rejection of the Scheme of the Senate by Convocation, 1888 to 1891. Pp. vii+449+c. (London: H.M.S.O., Wyman and Sons, Ltd.; Edinburgh: Oliver and Boyd; Dublin: E. Ponsonby, Ltd., n.d.) Price 5*s*.

No one is better qualified than Sir William Allchin to present us with a clear account of the complication of causes to which the gradually progressive depletion of the London medical schools was attributable, and to the share in that depletion for which the University of London was responsible by reason of its high standards (p. 89). But recent history, and especially the comparative failure of the movement for the concentration of preliminary and intermediate medical studies, do not fall within the period dealt with.

Much water has, indeed, flowed under the bridges since 1891, and the final failure of the two teaching colleges on the one hand, and of the two royal colleges on the other, to produce, either separately or conjointly, any generally acceptable scheme of university organisation, are now matters of ancient history. Reconstruction has taken place under the advice of the Cowper Commission of 1892–4, and of the Statutory Commission of 1898, and the university reconstructed by the Commissioners appointed under the University of London Act, 1898, is now eleven years old; but it may be doubted whether the present structure can be regarded as possessing its definite and permanent form. The doubt expressed by the academic moiety of the Selborne Commissioners as to the possibility "of effectually combining the functions of an examining body, and of a teaching as well as an examining body, in the University of London," appears to have been verified by the progress of events, and advantage has been taken of the new fact of the foundation of the Imperial College of Science and Technology to bring the whole question of university reorganisation in London under the scrutiny of yet another Royal Commission.

The report in 1906 of the Departmental Committee on the Royal College of Science, suggesting that a Royal Commission should be appointed to consider what changes should be made in the character and constitution of the university, which would make it desirable to amalgamate an imperial college with the university, succeeded in the following year by the foundation of the "Imperial College of Science and Technology," and a year later by the request that a Royal Commission should be appointed for this purpose—have led to the appointment of the Commission of 1908, with terms of reference which have set before it a task of far greater scope and complexity than was allotted to either of the two previous University Commissions. Lord Selborne's Commission was instructed

> to inquire whether any, and what, kind of new university or powers are required for the advancement of higher education in London.

The terms of reference to Mr. Haldane's Commission, now sitting, are as follows:—

> To inquire into the working of the present organisation of the University of London, and into other facilities for advanced education (general, professional, and technical), existing in London for persons of either sex above secondary-school age; to consider what provisions should exist in the metropolis for university teaching and research; to make recommendations as to the relations which should in consequence subsist between the University of London, its incorporated colleges, the Imperial College of Science and Technology, the other schools of the University, and the various public institutions and bodies concerned; and, further, to recommend as to any changes of constitution and organisation which appear desirable. In considering these matters, regard should also be had to the facilities for education and research which the metropolis should afford for specialist and advanced students in connection with the provision existing in other parts of the United Kingdom and of his Majesty's Dominions beyond the Seas.

The dual character of the problem set before the Commissioners is clear enough in these instructions, but the duality is no longer restricted to the academic field of teaching and examination. The conflicting views of the teacher and of the examiner are but a small part of that problem, the "dualities" of internal and external interests, or of incorporated and non-incorporated colleges, or of academic and technological ideals, are dominated by the still more cogent duality of Metropolitan and Imperial.

The accidental development of an Imperial University under the Metropolitan name can be remedied and utilised in one way alone. The University of London is *de facto* the rough sketch of an Imperial University that should be distinguished by the name "Imperial." The Incorporated Colleges are *de facto* the nucleus of a Metropolitan University that should be distinguished by the name "London."

THE FUR-SEALS OF BERING SEA.

WE learn from *The Times* of March 17 that Russia has accepted an invitation from the United States Government to take part in a new Seal Fishing Conference at Washington a few months hence, probably in the spring of 1912, and Sir Edward Grey has announced in the House of Commons that an official invitation addressed to this country is now upon its way. It is generally understood that this invitation will be accepted, and that the Home Government, together with Canada, will take part in a friendly discussion upon this once difficult and contentious subject.

It is now eighteen years ago since the Paris Tribune of Arbitration gave its ruling, the gist of which was that, while the United States had no rights of property in the seals outside the ordinary three-mile limit, yet that in the special circumstances of the case it was desirable that that legal limit should be set aside and a wider boundary fixed; and as a matter of fact a close time was appointed, and a zone of sixty miles around the Pribyloff Islands was preserved against the operations of the "pelagic sealer." Three years later the question was again raised by a celebrated letter addressed to our Ambassador by Mr. John Sherman; but after inspection of the seal-rookeries by British experts, and a re-discussion of the whole circumstances of the case at Washington, no sufficient reason was found for disturbing the decision of the Tribunal, and the case has since remained *in statu quo*.

During the thirteen or fourteen years that have elapsed since the Washington conference no inspection of the rookeries has taken place by British agents, and but little news concerning their condition has reached this country; but there can be no doubt at all that the herds have greatly deteriorated during these recent years. The American agents declare that the seals are now only one-fourth as many as at the time of the arbitration, when already the diminution had gone far. At the same time, the Canadian sealing fleet has dwindled almost to nothing, and accordingly the responsibility for the recent depletion of the herds must lie on other shoulders than our countrymen's.

It appears that it is now the Japanese who are mainly responsible. As Japan was no party to the Paris Arbitration, the sixty-mile limit has never applied to them, and the Japanese sealers accordingly ply this trade around both the Russian and American islands right up to the three-mile limit, and (if report says truly), even sometimes to the very shore. During the years of the Russo-Japanese war it is said that the Commander Islands were freely pillaged, and it is certain that nowadays the Japanese fleet—non-existent a dozen years ago—is both large and active. In 1908, it is said by the United States agents that the Japanese fleet consisted of no fewer than thirty schooners, some with as many as sixteen boats, and rumour has it that our own countrymen in British Columbia have attempted to put their vessels under the Japanese flag, so as to evade exclusion from the sixty-mile zone. It is believed that Japan has agreed to take part in the impending conference if Great Britain likewise agrees to participate, and there is thus every reason to hope that an arrangement may be come to by which the destruction shall be arrested, and the herds gradually restored.

PROF. JAKOB MAARTEN VAN BEMMELEN.

IN the death of Prof. van Bemmelen, which took place on March 13, there passes away the oldest member of that singularly distinguished band of chemists and physicists which has had its home at the University of Leyden.

Born on November 3rd, 1830, at Almelo, where his father was head of the Grammar School, Prof. van Bemmelen was in his eighty-first year at the time of his death. His father died in 1830, and the widow moved to Leyden, where her son attended the High School, until he entered the University in 1847. He studied chemistry under the then professor of chemistry and pharmacology, van der Boon Mesch. Van Bemmelen has himself left on record a description of the very primitive laboratory—a single room with wide old-fashioned hearth in the great St. Catherine Inn in Breedestraat, serving as lecture-room and laboratory. There, as he notes, chemical instruction could go no further than the simplest quantitative experiments!

In 1852 van Bemmelen became assistant to Prof. van Kerchoff at Groningen, and it is owing to the fact that the students were mostly interested in pharmacology that his earliest papers were purely pharmacological in character.

Van Bemmelen's life work, his investigation of the colloidal state, came to him when he left Kerchoff to become teacher in the School of Agriculture at Groningen. There he began his analysis of soils, and there also, in 1864, he began to experiment on the "absorption processes in mould," the results of which were not published until 1877, thirteen years later. This delay was due to pressure of other work, largely alien to the young chemist's tastes. In 1858 he had married the daughter of the Rev. Jan Boeke, Baptist minister at Amsterdam, a lady whom the writer remembers as a gracious and kindly hostess at Leyden ten years ago, and the necessity for providing for his home led him to accept with much misgiving the position of director of the High School at Groningen when it was offered in 1864. There he stayed for five years, with little time or opportunity for laboratory work, and, as he himself has recorded in the Gedenkboek of the school, much distressed at the slow progress he could make in his studies of absorption. In 1869 he was moved to the High School at Arnheim, where he remained until the final move to Leyden in 1873.

Though the chief work scarcely progressed at all during these years of school administration, they were not wholly barren of scientific work. More than twenty papers were published, all on problems of agricultural chemistry. To this period also belongs what van Bemmelen himself very characteristically called his greatest contribution to chemistry—the discovery of Bakhuis Roozeboom, who came to assist him in soil analysis.

In 1873, the chair of chemistry at Leyden becoming vacant owing to the retirement of van der Boon Mesch, Dr. van Bemmelen was elected into it, and Bakhuis Roozeboom became his assistant. The first ten years of the professorship were almost exclusively devoted to the chemistry of soils, and the results place van Bemmelen in the front rank of agricultural chemists. Thenceforward, from 1880 onwards, the rest of his long and active life was devoted to elucidation of absorption as a phenomenon of the colloidal state.

In this region van Bemmelen ranks as a pioneer, and his fame rests now, and must always rest, on his classical researches on the relations between the components in the hydrogels of various colloidal oxides.

The work is in the main experimental and descriptive. It embodies an enormous amount of exact observation which has not yet been fully assimilated into the general body of knowledge. In one marked respect van Bemmelen stands apart from the Dutch school of chemists. With the exception of an address on the application of thermodynamics to chemistry which he delivered when rector of the university of Leyden in 1889, van Bemmelen's work is non-mathematical. His colloidal work is the application of the old-fashioned descriptive and experimental methods to a new region. His first assistant, Roozeboom, and his second assistant, Schreinemakers, on the other hand, were purely of the thermodynamic school.

Van Bemmelen possessed great personal charm. No picture which the present writer has seen does justice to features which were singularly delicate and refined. As the descendant of an old Dutch family, he was somewhat of an aristocrat in altogether the best sense of the word. Although his devotion to science was intuitive and instinctive, it left space for many interests amid the "humanities." As his life-long friend and colleague in the professoriate, Prof. Tiele said of him:—"Although an assiduous investigator in special fields of learning, van Bemmelen always bore in mind those greater questions the answering of which is the aim of us all."

W. B. H.

DR. JOHN ATTFIELD, F.R.S.

ON Saturday, March 18, Dr. John Attfield passed to his rest, and scientific pharmacy lost one who had devoted much of his life and work to its advancement.

Born in 1835, Attfield, after the completion of his school education, became a student in the School of Pharmacy of the Pharmaceutical Society, and subsequently demonstrator of chemistry at St. Bartholomew's Hospital, a position which he occupied for eight years. In 1862 he graduated at the University of Tübingen. In the same year he was appointed director of the laboratory of the Pharmaceutical Society, and soon afterwards professor of practical chemistry, a chair which he filled for thirty-four years. During this long period Attfield devoted himself, with marked success, to the advancement of pharmacy and particularly of chemistry as applied to pharmacy. His industry and ability in this respect is attested by the long series, some seventy in number, of original articles that appeared under his name in the *Pharmaceutical Journal* and other journals, an industry and ability that was soon to be rewarded by the blue ribbon of science, the Fellowship of the Royal Society. Of his publications the most important, and that which undoubtedly had the most far-reaching influence, was his "Handbook of Practical Chemistry," a work which was quickly accepted, both in this country and abroad, as an ideal text-book for students of pharmacy.

But it was not by his scientific labours alone that Attfield accomplished so much for pharmacy. Himself an admirable organiser and possessing extraordinarily methodical habits, he took an active part in founding the British Pharmaceutical Conference, an association that has proved itself of inestimable value to pharmacy, and later the Institute of Chemistry. To the subject of pharmaceutical education he devoted much time and attention, and no more strenuous advocate could be found of the advantages that would accrue to pharmacy through the raising of the standard of education amongst its members. Further scope for Attfield's scientific ability and inclination presented itself in the editorship of the "British Pharmacopœia" and of two of its addenda. The pages of these works bear abundant testimony to the care and skill that was bestowed upon them.

To his students Attfield was a genial, kindly teacher, ready at all times to sympathise with them, to assist them in their difficulties, to encourage them by becoming a student himself, and to stimulate them by holding up to them an ideal towards which they should strive. Much as he accomplished directly, it was little compared with what he accomplished indirectly by organising others and directing their efforts. During the thirty-four years of his teaching career many hundreds of students passed through his hands; there is not one that does not owe a debt of gratitude to John Attfield.

HENRY G. GREENISH.

NOTES.

THE annual meeting of the British Science Guild will be held at the Mansion House on Friday, April 7, at 4 p.m. The Lord Mayor will preside, and the president (Mr. Haldane) and others will address the meeting.

MR. F. J. BRIDGMAN, demonstrator in zoology and curator of the zoological museum of the Imperial College of Science and Technology, South Kensington, has been appointed naturalist on the staff of the Plymouth Laboratory of the Marine Biological Association.

ALTHOUGH attacked by a destructive epidemic some two or three years ago, wood-pigeons have of late increased to such an extent that measures are being taken to diminish their numbers. Some letters have appeared in the public Press directing attention to pigeon diphtheria and its risk to man. Pigeon diphtheria, however, has nothing to do with human diphtheria; the micro-organism is quite different, and is probably very minute and a "filter passer."

AN influential deputation from the Royal Institute of Public Health waited on the Presidents of the Local Government Board and Board of Agriculture and Fisheries on March 16 to urge the necessity for appointing a Royal Commission for the purpose of inquiring into (1) the increase of vermin and the steps to be taken for their destruction; (2) the question of what creatures are or are not harmful to man and his industries; and (3) the safety and efficiency of the various viruses on the market and other means advocated for such destruction. Mr. Burns acknowledged the influential nature of the deputation and the importance of their representations, and promised consideration of the matters brought before him.

The Popular Science Monthly for March contains an interesting article, by Dr. Fielding Garrison, on Ehrlich's work on specific therapeutics and on "salvarsan" in

particular. This drug, introduced under the name of "606," is an organic arsenic compound (dioxy-diamino-arsenobenzol), and has an almost specific curative effect on diseases caused by spirillar micro-organisms, such as relapsing fever and syphilis. For the latter a single dose often suffices to cure, whereas the ordinary mercurial treatment must be continued for months.

IN a presidential address delivered before the Society of American Bacteriologists, Prof. Veranus Moore pleads for the inclusion of bacteriology in the curriculum of the schools for the masses. He argues that information concerning the cause of fermentations, the storing of nitrogen in the soil, the causes of the changes in food-stuffs, and the etiology of the common infectious diseases, is as important, or the acquisition of such knowledge of as much disciplinary value, as the study of the life-history of the denizens of the deep as now required in many, if not in most, biological courses.

WE record with regret the death of Lord Airedale, on March 16, at seventy-five years of age. Lord Airedale, who was perhaps better known under his earlier name as Sir James Kitson, devoted himself to the construction of locomotives suited to the characteristics of the countries for which they were required. He was president of the Iron and Steel Institute from 1888 to 1890. In 1904 he was awarded the Bessemer gold medal "for distinguished services to the iron and steel industries of Great Britain." The University of Leeds conferred upon him the degree of Doctor of Science.

THE necessity of a systematic investigation of the prehistoric antiquities in the Balkan Peninsula has been impressed upon English scholars by the important results which have already followed the partial examination of a few of the more promising sites. It is now recognised that this region holds the key to many problems beginning from the early age of Greece and extending to the period of the Byzantine and Bulgarian kingdoms. A new phase of Neolithic culture independent of that of Crete has been identified in Thessaly, and on the Adriatic coast the relationship between the Balkan peoples and those of southern Italy, which is indicated by recent discoveries, needs clearer definition. With the object of exploring these regions, an influential committee of Oxford and Cambridge scholars has been formed, with Dr. A. J. Evans as chairman, Prof. J. L. Myres as secretary, and Mr. Vincent Yorke, The Farringdon Works, Shoe Lane, London, E.C., as treasurer, who invite contributions to a project which is sure to command the approval of all who are interested in the prehistoric culture of the Ægean area.

THE annual awards of the Royal Geographical Society have been made as follows. The two Royal medals have been awarded to Colonel P. K. Kozloff, who receives the Founder's for his explorations in Central Asia since 1883, and to Dr. J. Charcot, who receives the Patron's for his expeditions to the Antarctic continent, first in 1903–5, and second in 1909–10. The Victoria research medal has been awarded to Captain H. G. Lyons, F.R.S., who was for many years the Director-General of the Egyptian Survey Department. During his tenure of office he carried through the cadastral survey of Egypt. Captain Lyons is at present lecturer in geography at the University of Glasgow. The Murchison bequest has been awarded to Dr. Wilfred Grenfell for his many years' work in Labrador. The Gill memorial goes to Captain G. E. Leachman, of the Royal Sussex Regiment, for the journey he made last year in north-eastern Arabia. The Back bequest goes to Dr. Arthur Neve, who has resided in Kashmir for many years, and devoted himself to the investigation of the Himalayas. The Cuthbert Peek fund has been awarded to Mr. R. L. Reid, who, during his six years' residence in the northern portion of the Congo State, carefully mapped the whole of the Mobangi River.

WE regret to record the death of Dr. Otto Puchstein, secretary of the Imperial Institute of Archæology in Berlin, and one of the leading authorities on classical archæology, especially in its relations to Western Asiatic culture. Dr. Puchstein, who was born in 1856, studied archæology in Strassburg, and it was while he was still at the University that he undertook a careful examination of the Greek inscriptions which had been brought back by Lepsius from Egypt, his resulting dissertation obtaining him his doctor's degree in 1880. His first journey in Kurdistan, which largely determined the trend of his later studies, took place two years later, when he was commissioned by the Berlin Academy to report on the tombs recently discovered by Herr Sester, the engineer. The direct result of this report was the organisation by the Academy of a more important expedition to Asia Minor, on which Puchstein accompanied Prof. Carl Humann and Prof. von Luschan. The work recording the results of the expedition, entitled "Reise in Kleinasien," and illustrated as it is from most successful photographs, is still our principal authority for the remains of Hittite art. In his brochure "Pseudo-hettitische Kunst," and his suggestive studies of the origin of the Ionic column, he made full use of his wide acquaintance with eastern archæology. Of his other works, the most important were his monograph, in two volumes, on the sculptures of Pergamon, and the work, produced in collaboration with Dr. Robert Koldewey, on the remains of south Italian and Sicilian temples. Since 1885, in addition to other duties, he had held the post of assistant director of the Royal Museum in Berlin.

IN *The Fortnightly Review* for March, Mr. W. S. Sparrow attempts to solve the problem how the primitive round house became square and oblong. He traces this transition from the period of the long barrows through the bee-hive houses on the island of Skellig Michael in Kerry. The necessity, as agriculture developed, of forming a winter shelter for cattle, led to the adoption of the oblong shed, the ends of which were supported by the forked tree known as gavel or crutch. This form of shed architecture came gradually to be extended to the round family hut as the needs of social life gave rise to the demand for larger roofed structures, which could not be provided in the circular building, and as the growth of the power of the chief made it necessary for him to sit on a dais at some distance from his retainers. The adoption of the crutch as a roof support naturally led to the practice of doing away with the curved spaces at the sides of the house by flattening the outer wall, which, as in the lake village of Glastonbury, then came to be made of long hurdles.

SOME of the papers in ser. 3, vol. xiii., of the *Anales del Museo Nacional de Buenos Aires* (of which we have just received a complete copy), having been already noticed in NATURE as they were separately issued, it will suffice to refer to an article on totemism, by Prof. L. M. Torres, which forms the concluding portion of the volume. This contains a long review and collation of the various theories and opinions as to the origin, signification, and effects of the totem cult, together with the author's own views and conclusions.

IN the course of a note on the local seals in *The Irish Naturalist* for March, Dr. R. F. Scharff states that a seal which lived for some time in the Dublin Zoological

Gardens, and was taken in Galway Bay in 1895, turns out to be *Phoca foetida*, a species of which there appear to be extremely few previous British records. Dr. Scharff refers to certain dental characters by which the ringed seal may be distinguished from *P. vitulina*, but omits to mention a much more important difference between the two. In the common seal the two branches of the lower jaw form a very short union in front, but in adult specimens of the ringed seal the symphysis is of great length, almost recalling, in miniature, that of a sperm-whale. So great is the difference in this respect between the two species, that it affords considerable justification for Gray's generic separation of the ringed seal.

Two papers on armoured dinosaurs have recently appeared in *The American Journal of Science*. In the first (December, 1910) Mr. R. S. Lull describes the skeleton, or rather the compound skeleton, for it is made up of two individuals, of *Stegosaurus ungulatus*, recently mounted in the Peabody Museum of Yale University. This is claimed to be the first reconstructed specimen with the bones in their proper position, and with the dorsal plates in two parallel rows. A restoration of the external form of this strange reptile is also attempted. In the second paper (February, 1911) Mr. G. R. Wieland suggests that even Mr. Lull's restoration is incomplete, for he claims to have evidence of the existence of a series of low pleural keels in addition to the large dorsal plates. In this communication Mr. Wieland furnishes additional particulars with regard to the dermal plates and other remains described under the name of *Hierosaurus sternbergeri*. These, it is stated, indicate a reptile of about 5 metres in length, and therefore about half the size of Stegosaurus. Possibly they may prove generically inseparable from the previously named Stegopelta.

WE have received a copy, bearing the date of May, 1910, of an important memoir, by Dr. O. Abel, on the early Tertiary rhinoceroses of Europe, published as part iii. of vol. xx. of *Abhandlungen der k.k. Geologischen Reichsanstalt*, Vienna. The author adopts the view that the rhinoceros group should be divided into three families, namely, Hyracodontidæ (including Hyrachyus as well as Hyracodon), Amynodontidæ, and Rhinocerotidæ, each of which has undergone divergent development. No fewer than four new generic terms are proposed for the European early Tertiary representatives of the latter, the first two of these being based, respectively, on Cuvier's *Rhinoceros minutus* and Filhol's *Aceratherium minus*, while the other two are established as new species, one from the lignite of Monte Bolca and the other from the Oligocene of Krain. Special classificatory importance is attached to the fourth upper premolar, of which the oldest type is found in Hyrachyus, where the two cross-crests converge on the inner side to form a U-like loop. From this we find a gradual transition in the early Tertiary European forms to the modern Rhinoceros type, in which the last molar has become molariform with sundered and parallel cross-crests. Progressive increase in the complexity of the upper molars is likewise noticeable. The proposed emendation of the name *Prohyracodon orientalis* to *P. orientale* is uncalled for.

THE fourth volume (185 pp.) of Papers from the Tortugas Laboratory of the Carnegie Institution of Washington contains three contributions:—(1) An account, with text figures, by Prof. H. S. Pratt, of the anatomy of *Monocotyle floridana*, a new monogenetic trematode from the gills of the whip-ray (*Myliobatis freminvillei*). (2) A systematic survey of the trematodes of the Dry Tortugas, by Prof. E. Linton, in which are described, and figured on twenty-eight plates, thirty new genera and eleven new species of previously known genera. The author, while disposed to regard the generic limits proposed by modern helminthologists as being too narrow, is not prepared to suggest, at present, any change in the conception of what should constitute a generic character in the Trematoda; he has chosen to make this large number of new genera, all of which, except three, are represented by a single species, rather than to extend the limits of those already known. (3) Dr. Wayland Vaughan's contribution to the geological history of the Floridian Plateau, which he traces from Lower Oligocene time to the present, includes detailed studies on the geology, topography, bottom deposits, and on the transporting agents and their effects. The account is illustrated with maps, figures, and photographs.

THE March issue of *The Naturalist* contains a revised check list of British earthworms, by the Rev. Hilderic Friend. It is nearly twenty years since the previous list was issued, and in the meantime a dozen new species have been discovered by the compiler, and several important varieties. The additions to the former list include *Aporrectodea similis*, Fr., found at Kew last year, and described in *The Gardeners' Chronicle* of August 6, 1910; also *Dendrobaena submontana*, Vej., *Octolasion intermedium*, Fr., from Oxford, *Eophila icterica*, Sav., from Cambridge and Chelsea, *Allolobophora alpina*, Rosa, and *Allurus hercynius*, Mich., from Scotland, and the two interesting worms *Allolobophora hermanni*, Mich., and *Helodrilus oculatus*, Hoffm., which Michaelsen in his "Tierreich" regards as one and the same species. The list contains thirty-five species, besides several varieties, chiefly under the heading of *Eisenia veneta*, Rosa. One entirely new name also appears, but it is at present doubtful whether *Helodrilus elongatus*, Fr., found last year in Cornwall, may not have to be relegated to another group. It may possibly be a Sparganophilus. The author has overlooked the fact that *Bimastus beddardi*, Mich., was found by himself in Ireland, but described as a variety of *B. constricta*, Rosa. As he is preparing a monograph of British earth- and water-worms for the Ray Society, he appeals for help to make his researches complete.

UNDER the title "The Native Camphor Trees (Cinnamons) of Australia," a paper was read by Mr. R. T. Baker, curator of the Technological Museum, Sydney, before the biological section of the Australasian Association for the Advancement of Science, held in Sydney in January last. In this paper the author endeavours to show that the Australian species hitherto recorded are all endemic, and makes use of anatomical and chemical characters as auxiliary to the morphological characters usually relied upon in discriminating between the species. The appearance of the paper itself will be looked for with considerable interest.

WE have received copies of *The American Review of Tropical Agriculture*, a monthly journal, still in its first year of issue, devoted to the agriculture of those tropical countries in which America is particularly interested. It is published in Mexico under the editorship of Dr. Pehr Olsson-Seffer at the price of 15 c., and is intended for scientific and technical communications rather than mere newspaper items. Nos. 5, 6, and 7, which have already come to hand, contain articles on rubber and on the desert rubber-bearing plant, guayule (Parthenium).

THREE bulletins received from the Bureau of Entomology of the U.S. Department of Agriculture deal with insect pests of fruit trees. Mr. Hammar describes the life-

history of the codling moth, *Carpocapsa pomonella*, in north-western Pennsylvania. In Bulletin No. 80, part vii., are given details that must be observed in spraying for this moth and for the plum curculio. The details for spraying with paraffin oil and other washes against the scale insects are set out in Bulletin 80, part viii. In another Bulletin (No. 82) are notes on the cucumber beetles, Diabrotica sp. Circular 122 describes the work done in combating the cotton-boll weevil, perhaps the most expensive insect in the States.

We learn from the Journal of the National Poultry Organisation Society, No. 1, vol. v., that considerable progress has been made during the last twelve months in organising the industry. Indeed, Mr. Brown estimates that we now produce 5,000,000*l.* per annum more eggs and poultry than fifteen years ago. In Ireland particularly great advances have been made, and at the present time the production is considered to be *pro rata* greater than in any other country. Wales and Scotland are, however, only now awakening to the possibilities in this direction. The supply of cheap foreign eggs apparently cannot be relied upon to continue indefinitely, and increased home production is considered necessary if an egg famine is to be avoided.

The possibility of growing sugar beets in South Africa is discussed by Dr. Juritz in *The Agricultural Journal of the Cape of Good Hope* (No. 5, vol. xxxvii.). As the soils of Cape Colony are better supplied with potash than with other plant foods, in particular, lime, it seemed *a priori* probable that crops rich in sugar could be obtained, and this expectation has been realised. Beets have been grown containing 15 to 16 per cent. of sugar, and comparing very favourably with crops obtained in Germany and the United States. There still remain, however, a number of details to settle before definite steps can be taken to grow the crop on a large scale. All experience indicates that sugar beet is somewhat expensive to produce by reason of the labour and manure required.

The reduction of timber supply through the destructive action of insect pests forms the subject of recent circulars (Nos. 127, 128, and 129) issued by the United States Department of Agriculture Bureau of Entomology. The annual loss is estimated at about 62,500,000 dollars, but part of this, at any rate, could be saved by utilising damaged timber as early as possible. Indeed, it is considered that the removal of insect-infested timber would do more than anything else to reduce the number of insects and strengthen the control. In Circular No. 125 some of the insects are described, and methods of control are suggested. Bulletin 94 deals with the injury done to chestnut telephone and telegraph poles by wood-boring insects, especially *Parandra brunnea*, Fab., the life-history of which is described in detail. The oak pruner, *Elaphidion villosum*, Fab., is described in Circular 130. It cuts off twigs and small branches, and sometimes even fells young trees.

On looking through Indian forestry publications and records, it is evident that experience and opinions vary considerably with regard to the best methods for regeneration of forest trees from seed. Considering the great variety of trees and the diversity in soil and climate this is natural, and therefore actual records of observation and experimental seedling plantations are much needed. In the Indian Forest Records (vol. ii., part iii.), Mr. D. O. Witt discusses the sylviculture of *Hardwickia binata*, "anjan," with special reference to the Nimar district of the Central Provinces, and Mr. M. Rama Rao presents a note on the germination and growth of sandal seedlings. Mr. Witt adduces evidence for the contention that successful growth of anjan seedlings depends primarily on a sufficient water supply combined with shade during the hot weather; in addition, preservation is required from grazing, and fire protection is desirable. The paper also contains information with regard to localities, composition, and regeneration of anjan forests.

The new interpretation, preferred by Prof. E. C. Jeffery, of the structure of certain coals, notably of bogheads, is elaborated, with evidence derived from microscopic sections, in the Proceedings of the American Academy of Arts and Sciences (vol. xlvi., No. 12). On the authority of the two famous French palæontologists Prof. C. E. Bertrand and Mr. B. Renault, the explanation has been accepted that boghead coals are largely composed of colonies of gelatinous algæ, to which the name *Pila bibractensis* has been assigned. This explanation is disputed by Prof. Jeffery, who asserts that the thinner microscopic sections prepared by improved methods reveal the presence, not of algæ, but of spores of vascular cryptogams. It is significant that the spore structure is more pronounced in American and Scotch boghead coals than in the bituminous schists originally investigated by Bertrand and Renault. Prof. Jeffery's interpretation has a wider bearing, inasmuch as it undermines the algal hypothesis of the origin of petroleum.

In *The Times* of February 28 is a description of the falls of the Mayo Kebi river, furnished by Mr. P. Talbot, whose party are apparently the first Europeans to visit them. Rising in French Equatorial Africa a little south of the tenth parallel, this river plunges down cliffs some 60 feet high, and flows on to join the Benue river on its way to the Atlantic. These cliffs and the gorge below are of granite, and form part of the ridge which here separates the Niger-Benue basin from that of the Shari flowing to Lake Chad.

As a contribution to the hydrography of the basin of the Seine, M. E. Clouzot gives in *La Géographie*, xxiii., 2, an account of the inundations of Paris in the past due to high levels in the Seine. From the sixth century the banks have been submerged from time to time, but it was only in the middle of the seventeenth century that the question of adopting means for mitigating the results of these occurrences was actively discussed, largely owing to the damage wrought by the great floods of 1649, 1651, and 1658

Dr Groll in the *Zeitschrift der Gessellschaft für Erdkunde* for February discusses the imperfect representation of the ocean floor in the light of the comparatively few soundings which are available when the area for investigation is considered. Difficulties in accurately locating points of observation enter into the question also, but even so, if areas are selected where the most detailed surveys have been carried out, the material is sufficient to show that much of the uniformity shown in physical maps arises from over-generalisation or imperfect information.

Mr. W. Goodfellow, who had to return from the British Ornithological Expedition in New Guinea on account of ill-health, communicated a short summary of his experiences to *The Times* of March 3. He describes the extreme difficulties met with in cutting a way through the dense forest in the low country near the Mimika river. Starting from this river, and pushing inland, it was found eventually that it would have been better to have followed a river lying farther to the eastward, since on reaching the head of the Mimika the expedition had to cut its way eastwards through the forest, a task which

was still in hand when Mr. Goodfellow left. The snow-capped mountain range rose steeply from the country at its foot, and is inaccessible at most points. The heavy rainfall in this range causes the rivers to rise rapidly in flood, by which parties of the expedition were held up for days unable to move. In spite of such obstacles, and the flooded condition of much of the forest region, much careful mapping, both of the Mimika and other rivers, and of a part of the mountain range, has been effected. Collections of birds, mammals, and ethnological objects have arrived in England for study, but a large part of the material obtained has yet to be received, including the reptilian and entomological specimens.

THE Board of Agriculture and Fisheries has just published a memoir of the Geological Survey on the water supply of Sussex (supplement). The memoir contains much new information which has accumulated since 1899, when the original memoir was published. The subject is dealt with under the headings of rainfall, springs, and risks of contamination. Details are given of a large number of wells and borings, together with analyses of waters. A general index, covering the original memoir as well as this supplement, is included. Copies may be obtained, price 2*s*. 6*d*., from any agents for the sale of Ordnance Survey maps, through any bookseller, or from Mr. T. Fisher Unwin, 1 Adelphi Terrace, London, W.C., who is the wholesale agent for the sale of Geological Survey memoirs in the United Kingdom (except in the County of London).

THE "Instructions to the Marine Meteorological Observers of the U.S. Weather Bureau" (third edition), a copy of which has reached us, are very complete, and contain much useful information for general readers interested in meteorology. Some photographs of types of fog in the vicinity of San Francisco are very noteworthy. Instead of several sets of observations required daily by the former log-book, only one observation daily (except in the case of storms) is now asked for, to be taken at Greenwich mean noon. This large reduction in the number of observations required has resulted, as was hoped, in a great increase in the number of observers, which now amounts to about 3000. These daily simultaneous observations taken over the entire sea are first plotted on charts for the study of weather changes as they actually occur; afterwards they are tabulated, according to months, in 5° squares of latitude and longitude, and published in the monthly meteorological charts issued by the Bureau and in the Pilot Charts issued by the Navy Department.

MR. G. W. PIERCE, author of "Principles of Wireless Telegraphy," goes into the question of the best arrangement of the circuits at a wireless receiving station in a paper which appeared in the January number of the Proceedings of the American Academy of Arts and Sciences. The distributed capacity of the antennæ is treated as localised to simplify the calculations, and the results obtained will be sharper and more definite than can be expected in actual practice. The author finds that best resonance may be obtained with two values of the wave-length of the receiving circuits either above or below that of the incident waves. He points out the advantage of a low-resistance detector circuit on account of the superior sharpness of the resonance effect obtained, and considers that what is now required is a low-resistance detector with a high efficiency which shall convert rapid into slow alternate or into direct currents.

The Electrician for March 3 contains an abstract of a paper, presented to the Franklin Institute at Philadelphia by Mr. Carl Hering, in which it is claimed that a conductor carrying an electric current is subjected to a stretching force. In support of this statement, the author describes some of the well-known experiments, or modifications of them, in which a circuit carrying an electric current increases its area if any portion of the circuit is movable. The trough experiment of Ampère, in which a floating conducting bridge connecting two parallel troughs of mercury moves away from the ends of the troughs at which the current enters and leaves, respectively, may be cited as an example. The "pinch" effect, that is, the tendency of a liquid conductor carrying a current to contract in section, which was discovered by Mr. Hering, is given as a further proof of the stretching to which the conductor is subjected. In our opinion, the view taken by *The Electrician* in its leading article on the subject is the more natural one, namely, that the whole of the movements are explained by the repulsion by each other of the magnetic lines of force of the various parts of the circuits.

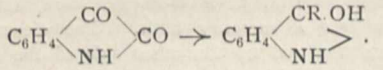
IN connection with the resistance-thermometer method of demonstrating the existence of the Peltier and Kelvin thermoelectric effects described by Mr. Starling in our issue of February 16, Prof. W. König, of Giessen, has directed our attention to two recent papers of his in the *Physikalische Zeitschrift* and in the *Archives* of the Swiss Société de Physique, in which he describes a very simple optical means of demonstrating the existence of the Kelvin effect. The material is a **U**-shaped wire, the bend of which dips into a mercury bath. The electric current passes down one and up the other side of the **U**, and its magnitude is so adjusted that the wire becomes red hot for a short portion of its length. The two red patches are found to be displaced upwards or downwards with respect to each other, according to the sign of the Kelvin effect in the material of the wire. Owing to the complicated nature of the heat losses from such a wire, Prof. König has not been able to make the method quantitative.

WE have received from Messrs. E. Leitz, of Wetzlar, and Oxford Street, London, copies of their catalogues of projection and photomicrographic apparatus. It is an indication of the importance at the present time of such appliances in scientific and educational work that these complete catalogues are compiled and issued separately. Until comparatively recent times such descriptions would have been included in a general catalogue; in fact, even now it seems to be reserved to foreign manufacturers to treat such matters with that thoroughness of which this is a typical example. The apparatus described is, in many cases, designed and constructed on established lines, but in others, particularly in the application of photography to micro-metallurgical work, the arrangements are both novel and ingenious. The ordinary worker is particularly indebted to Messrs. Leitz for introducing a small type of arc lamp, which is of great efficiency considering its small current consumption, may be used on any house supply without special wiring or fitting, and yet gives sufficient light for even the highest power photomicrographic work. Both optically and mechanically the products of the firm now take a high place, and an inspection of the apparatus referred to is sufficient to demonstrate that it is well thought out by those who have practical experience of the requirements of the worker in each particular branch.

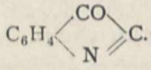
SOLID ammonium nitrite was isolated a year ago by Rây, who showed that small quantities of the salt sublime with decomposition when a dilute solution (0·7 to 2·0 per cent.), prepared by the interaction of silver nitrite

with ammonium chloride or of barium nitrite with ammonium sulphate, is gently heated in a vacuum. It has now been shown by Messrs. Neogi and Adhicāry, of the Rajshahi College, Bengal (Journ. Chem. Soc., February), that the salt may be obtained in fairly large quantities by evaporating and subliming in a vacuum a very concentrated solution of ammonium chloride mixed with sodium or potassium nitrite. The evaporation is carried out in an exhausted distilling flask connected with a condenser and heated by means of a paraffin bath at 50°–60° C., the Geryk pump being worked constantly when the critical moment is reached at which solidification begins. The temperature is then raised gradually to 80°, when the solid nitrite begins to sublime, and forms a thick crust in the upper part of the flask. The salt, which was analysed by a variety of methods, is extremely hygroscopic, but may be kept undecomposed in an ordinary desiccator or in sealed tubes; in a vacuum desiccator the salt is decomposed by the action of the acid on its vapour. Ammonium nitrite is volatile with steam, and does not explode when reheated; vapour-density determinations at 100° showed that the salt had decomposed completely into nitrogen and steam.

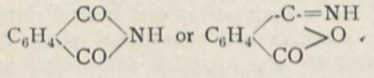
An interesting contribution to the chemistry of the indigo-group is described in the *Sitzungsberichte* of the Vienna Academy by Prof. M. Kohn, who has acted upon isatin with the Grignard reagent in various forms and obtained a series of aryl-derivatives of dioxindol,



The action is remarkable in that only one of the carbonyl groups is attacked, a result that is perhaps due to the fact that isatin is more correctly represented by the formula



In this connection, it is noteworthy that a similar limitation is found in the case of phthalimide, a closely related substance, which may also be formulated in two ways as



An article on air-resistance to plane surfaces is contributed to *Engineering* for March 10 by Mr. A. W. Johns. The pressure on plates placed normal to the direction of relative motion has alone been considered. Values of K in the formula $P=KAV^2$, where P is the pressure, A is the area, and V is the speed, have been tabulated in the article from the results obtained by many experimenters. Square, rectangular, and circular plates are included. Mr. Johns compares the various results, and arrives at the following conclusions:—(1) The value of the coefficient K for the same plate decreases as the speed increases. (2) For rectangular plates, the value of K for the same speed and area increases as the ratio between the lengths of the sides increases, and this increase is generally in accordance with Hagen's formula, viz.

$$P=AV^2(0{\cdot}003+0{\cdot}00004q),$$

where q is the ratio of the sides of the plate. (3) For similarly shaped plates the values of K are the same at "corresponding speeds"; that is, the "law of similitude" can be applied to the motion of plates through the air. This law asserts that for exactly similar bodies the dimensions of which have a ratio L, exactly similar phenomena attend the motions if the speeds have a ratio $\sqrt{L}$. For example, Dines' result for a 12-inch square plate at 40 miles per hour is K=0·0029. For a 60-inch square plate the "corresponding speed" would be $40\sqrt{\frac{12}{60}}=90$ miles per hour, at which speed K would have the same value, viz. 0·0029. Stanton's result for a 60-inch square plate is K=0·0032 for speeds between 0 and 25 miles per hour.

Bulletin No. 44 of the University of Illinois gives account of an investigation of built-up columns under load, carried out by Messrs. A. N. Talbot and H. F. Moore at the University of Illinois Engineering Experiment Station. In the laboratory tests, the amount and distribution of the stress over the cross-section and throughout the length of the channels or other component parts of steel and wrought-iron built-up columns were investigated. The stresses in the lattice bars were also determined. Deformation of the channel members was measured by means of Ames test-gauges mounted on suitable frames. These instruments magnify change of length by means of clockwork operating a hand rotating over a dial. They read directly to 0·001 inch, and by estimation to 0·0001 inch. The deformation of the lattice bars of one of the columns was measured by Ewing's well-known extensometer. The stress distribution both with axial and with eccentric loading was examined. Similar tests were conducted on the columns of a railroad bridge under the load of a locomotive and cars. It was found that considerable local flexural action exists in the channel or angle members of columns. Marked changes in the stress distribution were found at cross-sections short distances apart. Stresses 40 to 50 per cent. in excess of the average stress were measured. The distribution of stress among the various lattice bars was very irregular. The results show the futility of attempting to determine the stresses in the lacing of a centrally loaded column from theoretical considerations. No relation was found between the stresses observed and the stresses computed by any of the usual column formulas. Copies of this bulletin may be obtained gratis upon application to W. T. M. Goss, University of Illinois, Urbana, Illinois.

The Aëronautical Society of Great Britain will publish immediately, as No. 6 of the Aëronautical Classics, "The Flight of Birds," by G. A. Borelli, which first appeared in 1680. This study of bird-flight has been translated from the original Latin for the first time into English by the editors, Mr. T. O'B. Hubbard and Mr. J. H. Ledeboer, and includes a biographical notice and reproduction of the original diagrams and illustrations. The six "Classics," including Cayley, Wenham, Walker, Lana, Pilcher and Stringfellow, and Borelli, can be obtained separately in paper covers at 1*s.* net, or in one bound volume, with a specially designed cover, at 7*s.* 6*d.* net.

Messrs. Witherby and Co. have in the press an illustrated volume entitled "Photography for Bird-lovers," by Mr. Bentley Beetham. The book will be a practical guide to the pursuit of bird-photography in all its branches.

OUR ASTRONOMICAL COLUMN.

The Sydney Observatory.—From an extract from the Sydney *Morning Herald*, reprinted in the March number of *The Observatory* (No. 433, pp. 117–8), we regret to learn that the State Government does not intend to act on the recommendation made by the Public Service Board, two years ago, that the Sydney Observatory should be removed to a more suitable site and properly reorganised. This observatory was founded half a century ago on a site which was then suitable, but which is now enwrapped by the dust and smoke of a great city, and its possibilities otherwise vitiated by the thick haze overhanging Darling Harbour. The instruments are obsolete, and Mr. Raymond, the officer in charge, has to perform his various

duties under great difficulties, and without the status, the authority, or the salary of a Government astronomer. The Public Service Board recommended the removal of the observatory to a more suitable locality, on an eminence not too far from the capital; the appointment of an astronomer with high scientific attainments at a suitable salary (800*l.* per annum and a residence); the re-equipment with modern instruments, including a large telescope of not less than 15 inches diameter; and that steps be taken to affiliate the observatory and the university. Whilst the latter recommendation has given rise to some difference of opinion, there is no dissension on the question of the necessity and advisability of re-establishing the observatory on a proper basis, so that New South Wales shall not be behind other States and countries in the prosecution of astronomical research. But the minds of the Ministers responsible are occupied with "important" matters!

THE SPECTRA OF SPIRAL NEBULÆ AND GLOBULAR STAR CLUSTERS.—On May 20, 1909 (vol. lxxx., p. 354) we directed attention in these columns to some interesting results, obtained by Mr. Fath at the Lick Observatory, concerning the probable structure of spiral nebulæ and globular clusters as indicated by their several spectra. A second paper by the same author appears in No. 1, vol. xxxiii., of *The Astrophysical Journal*, as a contribution (No. 49) from the Mount Wilson Solar Observatory.

For this later research Mr. Fath employed a spectrograph attached to the 60-inch reflector, and obtained spectra that are but little longer than 3 mm. between λλ 3700 and 5000; despite their small scale, these spectra afford further evidence as to the probable structure of the objects under consideration.

The spectrum of the spiral nebula N.G.C. 650–651 shows seven bright lines, at 373, 387, 397, 434, 486, 496, and 501 $\mu\mu$, corresponding to lines usually found in the spectra of gaseous nebulæ. N.G.C. 4725 gave a spectrum of the solar type with lines at F, G, H, and K, and a spectrum of N.G.C. 4736 is similar, with lines at F, G, 425 $\mu\mu$, 410 $\mu\mu$, H, K, and 387 $\mu\mu$. It is, however, a curious fact that the last-named spectrum differs considerably from one of the same object secured in the earlier research; the Mount Hamilton plate gave what was assumed to be a bright band at 406 $\mu\mu$, and absorption lines at 387 and 400 $\mu\mu$, but as it was not in good focus other plates will be taken with a new specially designed spectrograph which, it is hoped, will be constructed shortly.

Whilst recognising that the evidence is, as yet, slight, Mr. Fath suggests that these results point to a progressive change in the spectra of nebulæ with change of form. Starting with irregular nebulæ, like that in Orion, giving bright-line spectra, we pass to probable spiral nebulæ such as N.G.C. 650–1, where the spectrum shows bright lines and little or no continuous background, thence to planetary nebulæ, such as N.G.C. 6543, giving the bright lines and considerable continuous spectrum. In the fourth type the spiral form is well developed, *e.g.* N.G.C. 1068, and the spectrum, while still showing bright lines, has also a strong continuous spectrum, and contains absorption lines. The last type, exemplified by the Andromeda nebula, gives spectra of the solar type, and the nebula has condensed, at least partially, to stars. This progression indicates star-clusters as the final product.

The spectra of eight globular clusters are almost identical, of approximately the F type, in which the hydrogen series predominates, but, where the spectrum extends far enough, H and K are also found; a line, or band, near 419 $\mu\mu$ is also a common feature. In the Mount Hamilton plates, the Hercules cluster, N.G.C. 6205, gave evidence of the inclusion of more than one type of spectrum, but the more recent work does not support this; more plates with the slit crossing different parts of the cluster must be obtained.

THE DARK BORDERS OF THE MARTIAN SNOWCAPS.—In No. 4472 of the *Astronomische Nachrichten*, M. Antoniadi reverts to the question of the objective reality of the dark bands which appear to encircle the Martian polar caps. In a previous communication he maintained that, if real, they should show on photographs, but Prof. Lowell and others suggested that the brightness of the caps was so intense that the non-appearance of the dark areas might be accounted for by the photographic halation from the brilliant caps. This suggestion was supported by the statement that the photographs taken in America in 1909 showed the caps to be far more brilliant than the "continents." M. Antoniadi now brings independent testimony countering the statement, and maintains that the dark areas are not obliterated by photographic "spreading." In opposition to M. Jonckheere's contention that the dark bands exhibit the perspective they should do, if real, he states that he has never seen it, and reproduces a drawing made by Schiaparelli in 1884 in which the dark band is shown of equal breadth at the middle and at the ends of its major axis.

DOUBLE-STAR OBSERVATIONS.—Nos. 4479–80 of the *Astronomische Nachrichten* contain a large number of double-star observations made by Dr. Doberck at Sutton, Surrey. Most of the observations were made in 1910, and since 1910·13 the Elizabeth Thompson micrometer has been employed. In determining the scale value, corrections have been applied for aberration, refraction, and proper motion, and the final value obtained is $19{\cdot}342'' \pm 0{\cdot}002''$.

No. 6, vol. iv., of the Journal of the Royal Astronomical Society of Canada contains a number of double-star measures made by Mr. Motherwell with the 15-inch refractor of the Dominion Observatory. The work was commenced in 1907, the programme being to measure such pairs in Burnham's General Catalogue as are otherwise neglected or of which the motion seems uncertain.

THE "ANUARIO" OF THE MADRID OBSERVATORY.—The annual almanac published by the Madrid Observatory contains the usual tables and ephemerides for the sun, moon, and planets, and a number of extra tables, in which information as to the aspect of the sky, the azimuth of the pole star, and the passages of certain stars, &c., at given hours, is incorporated. Extensive tables for the calculation of latitude from observations of the pole star are also given, and the volume (1911) concludes with records of the solar and meteorological observations made during 1909.

THE NATIONAL PHYSICAL LABORATORY DURING 1910.

THE General Board of the National Physical Laboratory held its annual meeting at the laboratory on Friday last, March 17, when the report of the executive committee for the year 1910 was formally presented. As usual, a large number of visitors were invited, and were received by Sir Archibald Geikie, president of the Royal Society and chairman of the General Board of the laboratory, and by Lord Rayleigh, the chairman of the executive committee.

The reception this year took place in the buildings of the National Experimental Tank, where the equipment for the experiments to be undertaken on models of ships is now almost complete. The models, 20 feet in length, are cast in clay moulds, and shaped to the correct form by a special machine, which cuts in them a series of horizontal grooves, the operator guiding a tracing point over a corresponding sectional drawing. The wax is then trimmed down by hand to a smooth surface, leaving only the finest trace of the grooves as a guarantee of accuracy. The model is finally measured up on a special measuring table.

The carriage by which the model is towed along the tank weighs some 15 tons, and is driven by four motors designed to enable a speed of 17 miles an hour to be reached for the steady portion of the run. As is well known, the "model" law requires that the speed shall be proportional to the square root of the linear dimensions, and the speed indicated is therefore more than sufficient for the purposes of the tests.

The first report of the advisory committee for the tank appears in the report of the laboratory for the year 1910, and gives some interesting details of the construction, and, in an appendix, of the movements of the walls due to filling. A more complete account of the tank and its equipment, by the superintendent, Mr. G. S. Baker, will be presented to the Institution of Naval Architects at their meeting next month.

The visitors to the laboratory were also able to see the progress which has been made with the new buildings for metallurgy, for which the laboratory is indebted to the generosity of Sir Julius Wernher. In these ample accom-

modation will be provided in the near future for this important and increasing branch of the laboratory's work.

In the physics department, several interesting items of the year's work call for mention. The erection of the Lorenz apparatus, presented by the Drapers' Company as a memorial of Prof. Viriamu Jones, and constructed, by the kindness and generosity of Sir Andrew Noble, at the Elswick works of Sir W. G. Armstrong, Whitworth and Co., is now nearly completed. So far the running has been very satisfactory, the speed remaining constant within 5 parts in 100,000, without regulation, for fifteen minutes. Only the marble cylinders on which the coils are wound now require to be put into place.

In April and May, 1910, Mr. F. E. Smith visited Washington, as the representative of the laboratory, to take part in an international research on the silver voltameter and the Weston normal cell. A full report on the work will shortly be presented to the International Committee on Electrical Standards, which was constituted at the London conference of 1908. The immediate result of the work has been the adoption of the value 1·0183 international volts, in place of 1·0184, as the electromotive force of the Weston normal cell (see NATURE, February 16, p. 508).

The valuable researches on the construction and accurate measurement of inductances, which have now extended over several years, have been continued; an interesting feature of the recent work has been the construction of a resistance box of constant and almost negligible inductance. A comparison of magnetic tests, for total loss, on steel sheet is in progress, in cooperation with the Bureau of Standards at Washington and the Physikalisch-Technische Reichsanstalt.

The electrotechnics division has made investigations into the effect of travelling on supply meters, the heating of lamp sockets, the electric strength of micanite, and into the deterioration, and possible means of protection, of ebonite surfaces, which all present matter of considerable practical value. Tests on the heating of cables have been carried out for the Wiring Rules Committee of the Institution of Electrical Engineers. In photometry, the establishment of metallic filament sub-standard lamps has required an investigation which has presented numerous difficulties, and furnished results of much theoretical and practical interest. An important comparison of life tests of glow-lamps was carried out between the laboratory and the Electrical Testing Laboratories of New York, and showed that agreement within 5 per cent. could be expected in such tests.

In the work on the fundamental high-temperature scale, difficulties have been met with in the construction of the reservoirs and tubes of refractory rare-earth materials, which for the time have delayed progress. Valuable work has been done for the International Commission which is dealing with the methods and apparatus for petroleum testing. It is well known that different forms of flash-point apparatus give different values for the flash-point of an oil. Careful exploration of the temperatures below and at the oil surface, and in the vapour, up to the time of flash, has indicated a probable cause of these discrepancies. Some interesting tests have been carried out on the Siemens' calorimetric water pyrometer.

In the metrology division, Mr. J. E. Sears has taken over the charge of the work from Mr. H. H. Jeffcott, who was appointed early in 1910 to the professorship of engineering in the Royal College of Science, Dublin. An interesting feature of the year's work has been the study of the thermal expansion and hysteresis of fused silica, in connection with the new silica standard of length. An account of this work, and of a method employed for counting the rulings of a diffraction grating, has been prepared by Dr. Kaye, and published in the *Philosophical Magazine*.

In the optics division, a tilting table of special design has been installed for tests on clinometers and levels, and metal prisms to serve as standards of angle have been made for use with it, their angles being measured by optical means to a high degree of accuracy.

In the engineering department, a large number of researches have been further advanced, among which may be mentioned specially the investigation into the strength and efficiency of welded joints, the work on alternating stresses of high frequency, shock tests on different forms of screw threads, and the research on the heat transmission and friction of air currents in pipes. In the aëronautics section much interesting work has also been done. The investigations in the air and water channels have dealt with the resistance, stability, and fin area of dirigibles, the lift and drift and centre of pressure of curved surfaces for use as rudders or for other purposes, the resistance of wires, stationary and vibrating, and of ropes, as well as of radiators, model gondolas, &c. The propeller test results have been improved by a careful investigation of the motion set up in the air of the whirling-table shed due to the motion of the whirling arm. The tests of motors entered for the Alexander prize, together with the construction of the necessary testing plant, also formed an important feature of the year's work. The report on these tests was published in November last.

The chief metallurgical research concluded during the year 1910 was that on the aluminium-copper-manganese alloys, which formed the subject of the ninth report to the Alloys Research Committeee of the Institution of Mechanical Engineers. Work on the alloys of aluminium and zinc has since been in progress, and an interesting paper on the theoretical results of this research has recently been communicated to the Royal Society. The investigations into the eutectic alloys, and into the effect of strain on steel at high temperatures, have also made good progress. The planning of the new metallurgical laboratories has, of course, constituted an important part of the year's work.

The section of the report which deals with the work of the observatory department gives details as to the tests of instruments during 1910, and also some particulars of the growth of the Kew verification work between 1880 and 1910. The number of "clinicals" tested in 1881 was about 4000, in 1909 nearly 26,000. The total number of instruments tested since 1880 is more than 673,000. In July last the meteorological work of Kew was transferred to the Meteorological Office, of which Kew will in future be the central observatory.

The complete scheme of reorganisation of the Kew work involves the transference to Teddington of the instrument testing, but for this increased accommodation at Teddington is necessary. The great growth of the work of the laboratory renders also imperative the provision of a building for office and administration purposes. The plans for these additional buildings are already well advanced, and it is earnestly to be hoped that lack of funds will not be allowed to hamper and to curtail the natural development of the important work which the laboratory is called upon to undertake. Figures published in the laboratory report for 1910 show that, out of a total capital expenditure of about 103,000*l*., 49,000*l*. is due to Government grants, while 54,000*l*. has been received from private sources and as payment for work done; and in view of these figures the committee urge that the request for funds for the much needed extension is one which deserves most favourable consideration from the Treasury.

The preceding paragraph is based on the report of the executive committee of the laboratory to the general board. We understand it was stated at the meeting that an intimation has just been received from the Treasury that the sum of 5000*l*. will be placed on the Estimates for 1911–12 towards the cost of the new buildings proposed. The recognition thus afforded of the importance of the work which the laboratory is doing is valuable, but the sum is clearly insufficient to enable the scheme which has been prepared, the estimated expense of which is about 20,000*l*., to go forward immediately. It is, of course, possible that some other generous donor may be found ready to assist the laboratory in its national work; the electrotechnics building was provided by a gift of 5000*l*. from Sir John Brunner, Mr. A. F. Yarrow has enabled the national experimental tank to be constructed at a cost of 20,000*l*., and, as already stated, Sir Julius Wernher has recently given 10,000*l*. for the erection of the metallurgy building, while others have given large sums towards the equipment of the laboratory. It is to be hoped that the Royal Society and the governing board of the laboratory may find means which will enable them to provide, without unnecessary delay, the additional buildings and accommodation rendered necessary by the rapid development of the work.

VELOCITY OF EARTH MOVEMENTS CAUSED BY THE MESSINA EARTHQUAKE.

TO the *Reale Accademia delle Scienze di Torino* (1909–10, p. 355) Prof. G. B. Rizzo has contributed an interesting paper on the velocity with which earth movements occasioned by the earthquake which ruined Messina on December 28, 1908, were propagated to different parts of the world. First he gives in detail the observations made with various types of seismographs at 110 stations. These he sums up in tables, which show for the preliminary tremors or P_1, their followers or P_2, and the large waves or P_3, the time taken by them to travel from their origin to these various stations, their average superficial velocity, and the velocities with which the two first types of movement may have passed along paths corresponding to chords. The first results are also shown as curves drawn on squared paper, the two ordinates, respectively, referring to time and distance. The greatest distance considered is 10,000 kilometres, or 90 degrees, although the tables give results to distances exceeding 18,000 kilometres, or 163 degrees. Dr. Rizzo remarks that none of these curves show the flexure near the epicentrum which Schmidt, like Seebach, has used to determine the depth of the hypocentre. The absence of this is taken by Dr. Rizzo to indicate that the origin of the Messina earthquake was very shallow, a conclusion which I do not think will be shared by all seismologists. Many seismologists will, however, agree with him when he bases the idea of a shallow origin upon the comparatively small area of destructivity.

Up to a distance of 1500 kilometres from the epicentre the velocity of all three phases of movements is constant. The inference from this is that up to such a distance the movements are propagated within the crust of the earth, which is estimated as having a thickness of 44 kilometres. From this distance there is a marked increase in the velocity of the first phase, which, however, is not shown by the succeeding phases. The third or large-wave phase he divides into three parts, which he calls L_1, L_2, and L_3. L_1 appears to correspond with the commencement of maximum motion, whilst L_2 is the maximum movement itself. L_3 is the phase which travels the slowest, but if this is to be accepted as a definite and a recognisable phase in a seismogram, there seems to be no reason why we should not also accept very many other phases, which might be indicated by the letters L_4, L_5, L_6, &c.

Of late years, very many hodographs of the character of the one now presented to us by Prof. Rizzo have been constructed. Prof. H. F. Reid has given us an excellent set of time curves relating to the San Francisco earthquake of 1906. Up to a distance of about 55 degrees from the origin these indicate velocities somewhat higher than those given by Prof. Rizzo, but beyond that distance they are very similar. This kind of difference which we find in the work by different seismologists may be due to differences in the manner in which they have interpretated seismograms, but it is much more likely to arise from the non-recognition of all the elements which should be considered when carrying out these particular investigations. J. MILNE.

THE EBRO OBSERVATORY OF COSMICAL PHYSICS.

EL OBSERVATORIO DEL EBRO is situated in Roquetas, near Tortosa, on the river Ebro, Spain. It is in latitude 40° 19′ 14″ N. and longitude oh. 1m. 58·5° E. Its altitude is 51 m. Originally of private origin, it was inaugurated in September, 1904, in connection with the Collège d'Etudes Superieures de la Compagnie de Jesus, Tortosa, with the assistance of many private individuals. In October, 1904, it was recognised by the Spanish Government as an establishment of public utility, and, following this, the Government in 1907 made a grant in aid, which is used to defray the cost of the publication of memoirs and bulletins.

The observatory consists of eight separate buildings, and observations are made in meteorology, solar physics, terrestrial magnetism, electricity, and seismology. An account of the observatory, and also of the observations of the total solar eclipse of 1905, is contained in the first memoir, written by the director, Padre R. Cirera, S.J. The second, third, and fourth memoirs are entitled, respectively, "La Observacion Solar," "La Seccion Magnética," and "La Seccion Electrica."

In the solar section, daily photographs of the sun are taken both in integrated light by photoheliograph and in "K" by the spectroheliograph, which is of the Evershed type. This instrument gives a disc of 62 mm. diameter, the primary image being formed by an objective of 150 mm. aperture and 2 m. focal length.

The areas and positions of spots, on the heliograph pictures, and of the flocculi, on the spectroheliograph negatives, are measured and published in the monthly bulletins.

In the meteorological section, all the usual observations of pressure, temperature, rainfall, winds, and clouds are made with well-known standard instruments three times a day, viz. at 7h., 14h., and 21h.

The observations of atmospheric potential, ionisation, &c., are undertaken by the meteorological department. In the department of geophysics, the observations of magnetic values and variations are made, and hourly values are tabulated. A microseismograph "Vincentini" and a "Grablovitz" pendulum are used in the seismological section. The results of all these observations, both tabular and curves, are published in monthly bulletins.

The first bulletin is for January, 1910, and those for February, March, and April have also been published. The January bulletin contains a short account of the observatory, and accounts also of the methods used in making and reducing the observations.

Having regard to the amount of work which each bulletin represents, and noting the convenience of having all the different elements registered in one volume, the director, Padre R. Cirera, S.J., is to be congratulated on having been able to issue them so shortly after the making of the observations. M.

EMOTION AND MORALS.

ON Saturday afternoon, March 11, a meeting of the British Psychological Society was held at King's College, London, Mr. A. F. Shand in the chair, when Dr. William Brown read a paper on "Emotions and Morals." After a brief survey of the views of earlier writers on the nature and classification of the emotions and their relation to ethics, in which, however, the doctrines of Aristotle and Adam Smith ("Theory of Moral Sentiments") were treated at some length, the author proceeded to discuss the meaning of the terms "passion," "emotion," and "sentiment" in relation to the theories of Ribot, Shand, and McDougall. According to ordinary uses of the term, and also to its etymology, passion would seem to indicate an uncontrollable state of mind, in the form either of an actual emotion or a system of emotional tendencies. Although Shand's employment of the term sentiment to express the conception of "a system of emotional dispositions centred about the idea of some object" would theoretically cover the latter of these two uses, passion seems to be a more appropriate and expressive word to indicate those systems which are uncontrollable by the rest of the mind, and issue, under appropriate conditions, in uncontrollable emotions, *e.g.* "a passion for politics," "a passion for the stage."

The word sentiment, as used in literature, has acquired associations of weakness or placidity which constitutes a slight drawback to its use in scientific psychology to cover all cases included in the technical definition of Shand above-mentioned. "Tender emotion," identified by Ribot and McDougall with the parental instinct, seems to have a wider connotation, and receives more adequate treatment from Shand. In particular, the element of tenderness or pathos present in many æsthetic emotions has little connection with the parental instinct.

The question of "emotions and art" was treated at some length, with special reference to music and the drama. Neither the sensationalistic nor the formalistic theory is adequate as an explanation of music. The ancient Greeks were right in regarding music as "the proper language of the emotions," but it is important to realise that the emotions of music are not, strictly speaking, identical with the emotions of everyday life. They

are analogous to the latter, and this explains the appropriateness of the music to the words in opera, but they really belong to a world of their own and possess a meaning of their own. This is why the music of an opera, even when entirely appropriate to the words, may transcend them in such a way that elements of grossness in the story entirely lose their real "work-a-day" significance in the total presentation. The "Salome" of Strauss is a striking illustration of this.

As regards the psychology of acting, the important statistical investigation carried out by Mr. William Archer, the dramatic critic, more than twenty years ago, is the only work of definite scientific value hitherto produced. Mr. Archer's chief purpose was to test the paradoxical view of Diderot, accepted by Coquelin, but rejected by Sir Henry Irving, that stage emotion should not be real, and that the really first-class actor should be a man of little or no "sensibility." The results showed that in almost all cases of first-class acting in England, not only did the principal signs of real emotion—real tears, blushing, pallor, &c.—occur, but the artists experienced genuine emotion, and often found real emotion from their private lives help them on the stage by mingling with and intensifying their feigned emotion. A state of dual consciousness while acting was found to be common, but not universal.

Mr. Archer adds many further comments of considerable psychological value, and predicts that the subject will be taken up some day by trained psychologists and subjected to an exhaustive discussion.

As an illustration of many of the points raised by Mr. Archer, a letter very kindly written by Miss Ethel Irving as a reply to a query as to her state of mind when playing intense emotional parts, was quoted and discussed, and a general theory of stage-emotion was sketched out and illustrated by a brief description of Miss Irving's recent emotional acting, especially in Henry Bataille's play, "Dame Nature."

GREEK LANDS AND THEIR PEOPLE.[1]

THE establishment by the University of Oxford, from resources supplied by New College, of a new chair for the exploration of ancient history obviously requires, in view of the facilities which already exist for the study of the subject, the justification which is supplied in the inaugural address delivered by Dr. J. L. Myres, the first occupant of the Wykeham professorship.

Dr. Myres justly remarks that, up to the present, the historical course has been too largely devoted to the centuries adjoining the fifth; that it has too jealously confined its researches to the ascertained results of earlier inquiries; that it has discouraged novel methods of investigation; that, in short, its work has become stereotyped and unenterprising. In pointing out a more excellent programme of research, he directs special attention to what may be termed the economic geography and biology of the peoples of the Eastern Ægean. Much has already been done on these lines of research, as in the cartography of Curtius and Kaupert, the examination of battlefields by experts in the art of war, M. Berard's application of sea-lore to Homeric geography, the study of the influence of malaria on the decay of nations, and, lastly, Mr. Huntingdon's investigations of historic meteorology. But much still remains to be done towards exploring the effects of environmental control on the course of history.

The modern Greek race, it is admitted, is largely intermixed with Albanian, Vlach, and Levantine elements. But this fusion of peoples has been continuous from primitive times, so that the history of the Mediterranean area is, as a whole, a history of its invasions, the earliest sea-borne settlers being of the "Mediterranean" reinforced by "Alpine" and "Armenoid" types. But amidst these racial movements, the mountains, the sea, the climate, the flora, have been there from the beginning, and the ethnological situation now depends not so much upon race as upon the prepotent influence of the environment. "No type of non-Mediterranean invader has ever learnt so quickly how to live under Mediterranean conditions as to escape extinction in the process"; the "external environment modifies breed in Man by offering the alternatives of extinction or conformity."

This environment falls into at least three types. First, the prevalence of scrub-lands results in the smallness and discontinuity of the Mediterranean populations; there is little produce from this area, and so "the Greek world is in general a jamless world"; there is little sport except in the mountain region; the cow and the horse are "oasis animals, fed almost by hand." In the forest region the conditions are more propitious, the olive, grape, orange, and lemon providing considerable sources of revenue, while the goat furnishes the milk supply, and the pig is as important as it was in the household of Ulysses. On the other hand, the ubiquitous, restless goatherd is a constant source of political confusion, while the almost exclusive employment of women and children in the collection of forest produce tends towards the growth of the matriarchate.

Secondly come the grasslands, and the relation of the pastoral races to Ægean culture, leading on to the third type, that of the agriculturist, of which the leading characteristic is the crowding into the season between March and July of processes which in more northern lands extend to October, thus leaving one of the busiest seasons of the English year to idle hands "devoted to the devil's work of seasonal war."

The programme of the new chair thus promises an attempt towards the solution of the ethnical problems of the Ægean on new and scientific lines; and though the address of Prof. Myres is not free from certain characteristic foibles of the Oxford school, anthropologists will readily admit that no more competent and imaginative scholar could have been selected to hold the Wykeham professorship.

[1] "Greek Lands and the Greek People." An Inaugural Lecture delivered before the University of Oxford, November 11, 1910, by Prof. J. L. Myres, Pp. 32. (Oxford: Clarendon Press, 1910.) Price 1s. 6d. net.

A DESTRUCTIVE DISEASE OF POTATOES.

A VERY interesting and valuable report on "Wart Disease of Potatoes" has been issued by the Harper Adams Agricultural College. As in the case of previous reports on the same subject, the cost of publication, and also expenses connected with garden trials, have been borne by Mr. Beville Stanier, M.P.

The present report brings together a number of facts which, taken together, show the magnitude of the danger now threatening potato-growing in Great Britain. The comparatively new and most destructive fungous disease known as "Wart Disease" was first reported in Shropshire in 1901 in the Woore district; by 1908 it had assumed alarming proportions in this and other counties—facts which are here emphasised by some admirable maps. The extent to which the disease has now spread in Great Britain is shown by one of these maps, in which a continuous belt of affected counties stretches down the west side of Great Britain from Perth to Glamorgan—no fewer than thirty counties being affected. In the majority of these counties the disease is confined, as yet, to gardens and allotments (the soil of which in some cases has become so contaminated that it is impossible to grow potatoes profitably), but the authors of the report very rightly lay stress on the fact that the risk of the disease spreading from these centres of infection to the fields of farmers is very great. A perusal of this report, indeed, must convince the reader that this disease—which the Vice-president of the Irish Department of Agriculture referred to last year in the House of Commons as "that terrible disease known as 'Black Scab'"—must now actually be spreading to farm-lands in many counties in England and Scotland, as has already happened in Lancashire and Cheshire.

An instance is given of a consignment of seed potatoes (obtained from a county where the disease is very prevalent) which, distributed for use as "seed," gave rise to a number of outbreaks extending over a five-mile radius. The disease is spread also by animals; cases are here recorded where trespassing pigs and poultry have carried the fungus to clean ground and caused outbreaks of the disease. The use of manure from animals (especially pigs) fed on raw "warty" potatoes is a common means of

distribution of the disease with regard to cottage gardens. Workmen who have used spades in digging in infected soil have, when planting potatoes in clean ground, carried the disease on these tools.

Trials of a large number of fungicides have failed to discover any of value. With regard to the behaviour of different varieties of potatoes to the disease, it has been found that all the best and more generally grown varieties, such as Up to Date, British Queen, and allied sorts, are very susceptible. In the "variety tests," however, marked resistance to the disease has been shown by a number of other varieties (Langworthy, Golden Wonder, What's Wanted, &c.).

A clear account of the life-history of the fungus is given, and the new fact reported that the development of warts continues during winter months in stored potatoes. The various plates published with this report are unusually good. E. S. S.

PROFESSORS AND PRACTICAL MEN.[1]

AFTER allusions to a boyhood spent among practical men, to subsequent university life in Great Britain and Germany, and to the tendency of English men of science with such experience to extol the German system and recommend its adoption, Prof. Smithell's proceeded as follows :—

I am sure that, among the class to which I belong, there is a danger of underestimating the deep-seated powers of Englishmen, of neglecting the true genius of our countrymen, and, in short, of falling into a narrow-mindedness which tends to put us out of sympathy with the people we desire to serve. I think that no one who has studied the history of our industrial development, or has moved observantly among our industrial community, can have failed to be impressed by the great native capacity of the Englishman for practical affairs. The quality is one exceedingly difficult to define. It is very elusive; but it is there—this power of doing things—a power compounded of energy, shrewdness, enterprise, determination, sense of the fitness of things, and knowledge of the intuitive kind. Who does not know the man who, somehow or other, can get hold of the right thing; knows a good thing when he sees it; has an unerring sense of a wrong thing; knows when and where to buy a thing, when and where to sell a thing—who, in short, does not know a good craftsman; and where in the world will you find a better than in England? I honestly believe —nowhere. And yet it may be said that a man who is this, and no more than this, is but a "serviceable savage." I do not agree. He is a man who has developed one set of faculties; but it is a set by no means to be disparaged, by no neglect to be allowed to rust. I honour the man in his workshop who can tell by the look, the feel, the sense of a thing, what it is good for, as well as I can tell by the light of science from the intellectual eminence of a university, for I know that if he is really first-rate in his way, he can assess the value of things for which my science has yet no touchstone. It will be, I dare say, many a long day before an epicure can choose his vintage by chemical analysis; it will certainly be long before science can fully supplant the finely cultivated instinct of the true practical man.

I trust, therefore, gentlemen, that if I, a mere man of science, take upon myself to talk to you about education in relation to your own pursuits, I do not neglect that vastly important element, of education, that development of "mother wit," which comes to man as he fulfils his appointed task of wrestling in the world with men and things for his survival among the fittest. I am not going to emulate the action of a learned acquaintance of mine, who has recently taken upon himself to lecture the pioneers of aviation because they have not delayed their heroic enterprise until the mathematicians have discovered the true theory of stability. Scientific men of this kind, if they had their way, seem to be most likely to achieve the true practice of stagnation. I do not bid you cease to lay mains, to erect gas-holders, or to make gas-fires until we in the august seclusion of our learned halls have worked out the whole true science of heating and illumination.

It is, however, man's prerogative, and it should be his delight, to possess, to use, and to extend the faculty of reason; to increase his power over the forces of nature, and constrain them to his service by a deliberate, a carefully organised, and an unceasing cultivation of the human mind. The true barbarian is the man who is content to do, and does not want to know; and yet how many men are there not, whom no one could call barbarians, who look upon our system of education with a degree of distrust that increases in intensity as their survey passes upwards from the elementary school to the university? This, in my judgment, is a most serious question of the day.

I have long held the opinion that education in England is afflicted from top to bottom with an utterly exaggerated fear of what is called useful knowledge. In that fear, much of a vital kind has been left undone, and much has been given in the name of education which helps its possessor neither to truer wisdom, better work, nobler conduct, nor to greater happiness. The world cries out for educational bread, and it receives only too often an academic stone.

I do not know that I am behind other men in the delight I feel in abstract studies, and I can honestly say it is but rarely I envy another man his larger share of loaves and fishes; but knowledge gathered for what is sometimes called its own sake, and treasured for its own sake, seems to me in great danger of unwholesomeness, and a learned man, who is merely a man of erudition, to be as likely to prove a mischief as he is certain to be a bore.

At the head of our educational system stand the universities. A university is, or should be, in essence a mine and a mart for the highest learning. It was in its origin an adjunct to those callings which made the greatest demand upon the powers of thought. You may put it more picturesquely, no doubt, but it suits my purpose best to use homely terms, for I believe too little stress has been placed upon the real beginning and the original purpose of universities as institutions standing in direct relationship to definite callings. It is, I believe, because our university system has not kept pace with the great changes that have taken place in the character of human occupations, that universities have failed to secure or to retain the sympathy of a large section of the community. The great delay in the development of research and instruction in natural science in the universities led to a corresponding delay in the dissemination of elementary scientific knowledge through our schools, and in consequence we find to-day in the older generation of our more educated citizens, to say nothing of those less educated, a whole legion of men whose knowledge of science would not correspond in terms of their grammar to knowing the difference between a noun and an adjective, in their geography the difference between latitude and longitude, and in their Latin to that between Cicero and Cæsar.

Now I lay great stress upon this lack of the general dissemination of scientific knowledge, because people sometimes say to me that, after all, we have surely had many distinguished men of science in our universities for generations past. It is true; but they were not preparing a market for their wares; they were elaborating in their seclusion something which was utterly mysterious to the average man. Even to-day people come occasionally into my laboratory with the air of men entering a hall of mystery or a chamber of horrors, fearful of what may befall them. Again, people say to me, surely the industrial fruits of scientific knowledge have long been recognised. True again, most palpably true; but how the fruit is related to the knowledge, how the seed is sown, how it is tended, what should be done to nurture the plant, that is not known. It is not known because your educational system did not achieve this one thing for the community—it did not put its victims for a single occasion in their lives in the position of asking a simple scientific question and of faithfully finding the answer by experiment.

Now the portion of knowledge which most completely and vitally interpenetrates our manufactures is natural science, and it has been, I think, an incalculable dis-

[1] Presidential Address to the Society of British Gas Industries, delivered at the annual meeting held in Leeds on March 3, by Prof. Arthur Smithells, F.R.S.

advantage that, whilst these manufactures were advancing by leaps and bounds during the century succeeding the industrial revolution (which I suppose may be dated about 1760) there was no movement in the educational world for a general dissemination of scientific knowledge and skill. During that period several misconceptions took deep root in the English mind. The achievements of Arkwright the barber, Hargreaves the weaver, Crompton the farmer, Watt the instrument maker, Cartwright the clergyman, Stephenson the fireman, Murdock the millwright, and of all that illustrious group—their great and fundamental achievements created an overwhelming belief that the self-taught inventor was destined to be the only important pioneer in industrial discovery, and to this day a young man brought up on a diet of grammar and Samuel Smiles might well despair of contributing anything of moment to the service of industry, unless, indeed, he happened to be exceptionally poor and to have attended no more showy a place of education than a night-school.

If the universities had set themselves to send a current of science through our schools at the time when the direct utility of scientific knowledge and of scientific method was becoming demonstrable in the industrial world, we should, I think, be in a very different position to-day, and our universities would hold a very different place in the esteem of our countrymen. It is this historical retrospect, and the experience of the frantic and wasteful struggles in my own lifetime on the part of the worker to come to terms with the thinker, that have made me realise the dangers that attend academic seclusion, and have left me well content that my lot as a university teacher is cast within earshot of the throb and hum of busy workshops.

Of all that we have lost in the course of the events I have described, nothing is more difficult to retrieve than confidence in the practical usefulness of university science. We are suspected at every turn of trying to elude the practical man, and to betake ourselves to studies and impart information the glory of which lies in its detachment from all things mundane and remunerative. We have engendered the suspicion that we are intellectually exclusive, and that we do not understand, or sympathise with, the practical point of view. A better understanding between us is, I think, a matter of the greatest national importance, and it has seemed to me that if a better understanding is to be attained, it is incumbent on the universities to go out so far as ever they can to meet the legitimate claims of the industrial community, and to bring their studies deliberately into the closest possible relationship with the industrial arts.

I think I may claim that in this university we have shown no lack of courage in doing so. In spite of a good deal of academic apprehension and distrust, not always kindly expressed, from outside critics, we have established departments of work for the explicit purpose of furthering the special pursuits of industry, much in the same way and in the same spirit as schools of law, medicine, and theology were established in bygone days.

Another thing, on which I would lay the greatest stress, is that we have secured in the direction of our university as a whole, and of these special departments in particular, the active cooperation of men of business and of representatives of the particular industries concerned. I do not look upon these steps as a gracious concession, still less as a sordid opportunism. I believe they secure the best interests of thought as surely as I hope they will serve the most immediate needs of work.

No one who has studied the history of science can be ignorant of the fact that science has its roots and has gained its greatest impulse in the practical avocations of mankind. Chemistry was born in foundries and pharmacies, and nearly every great advance can be traced to some industrial impulse. I suppose the greatest achievements in chemistry were those of Lavoisier. How did they arise? I believe I am not wrong in saying that it was in the preparation of his prize essay on the best mode of lighting the streets of Paris. Beginning with a consideration of the best form of lamp, the most effective form of reflectors, the most suitable shape of oil-containers, Lavoisier passed to the study of combustion, and finding organic things like oil and tallow too complex to reveal the fundamental nature of the process, he betook himself to simpler things like phosphorus and zinc, and so was led to the train of discoveries which constitute the foundations of modern chemistry. "It was," as M. le Chatelier has said, "this constant preoccupation with practical questions that enabled Lavoisier to escape without effort from the fictions and conventions amid which contemporary chemists were merely marking time."

I have given you but one of innumerable examples to illustrate a truth that we who profess science should never be permitted to forget, and to assure you that I regard the close association of universities with the business world as of enormous advantage to the universities. We have in this, I believe, the true corrective of academic excesses, the best stay for academic frailties; and I believe the good understanding and mutual respect which we may hope to bring about between the leaders in the spheres of labour and of learning will be extended rapidly through the rank and file.

I hope you will find in what I have said so far, the evidence of a desire to acknowledge some of the shortcomings of the academic world. But I might well be suspected of having had my head turned by the dignity you have conferred upon me if I left you under the impression that I thought the faults were wholly on one side. In what remains of the time at my disposal I wish to confide in you some of the difficulties of the situation which arise from the other side.

I believe that a very large number of business men go wrong when they enter upon the consideration or criticism of educational affairs by attempting to apply methods and standards and principles borrowed from their own callings, which, however excellent in their proper place, do not apply, or at least do not apply in the same way, to education. Let me remind you, in the very first place, that you can, for example, prepare no balance-sheet of a university. You know how much money comes into the university chest and how much is paid out, but how much a university costs or how much it earns no man can discover. Suppose, for example, in my zeal to find employment for a student, I send you a young chemist who, by his unrestrained ardour or incompetence, misleads you into all kinds of futile extravagance, surely you would debit that to the university. I do not doubt you would. Every care is taken that such things are brought home to us. Suppose, on the other hand, I send you someone, like a former student I met last week, who, by what he had learned here, increased the output of his employer's business by 33 per cent. Should that not be credited to the university if by someone's indiscretion you happened to hear of it? I think so. In a business like ours it transcends the powers of any accountant to effect an audit; you would need a whole secret service of educated spies. You, individually, may give us a thousand pounds in the hope of a return, but you, individually, may get nothing in return—at least in this world—or you may get a return that you cannot trace to its source. No; the essence of university finance is collective investment. It is, to some considerable extent, selective for a locality, and may be made equally so for a single group of interests or industries; but, looking at a university as a whole, it is national, or even international, in its financial ramifications.

If I and many of my colleagues in this and other universities are of some value to this country, I would have you remember that the cost of our education has to a quite considerable extent fallen upon the German taxpayer.

If I say that the students who have gone from our chemical department are collectively earning half a million a year for the firms who employ them, no one can contradict me; and I am tempted to affirm it positively as a counterblast to those hasty financiers who look at our accounts and raise their voice in lamentation over the capital we lay down, without stopping to think of the unrecorded dividends that accrue.

I will take another thing. I think a good business man, whilst anxious to progress and branch out, whilst ready to take risks and go somewhat afield for promising expedients or appliances, is usually very careful not to lose sight of the main current of his affairs, expecting to profit by deliberate methodical plans rather than by totally unexpected accidents.

The same is doubtless true within the pursuit of science

itself, where the object is simply to elucidate a given problem. But when it comes to the contact between science and industry, an entirely new factor appears.

The discovery of the atmospheric burner was not an accident. It arose from the desire of Bunsen to have a gas flame that would not smoke his flasks, and it was contrived by a stroke of genius. But what an accident for you that a man of genius should want a smokeless flame! When I was a student in Bunsen's laboratory there came to it Carl Auer von Welsbach, in the spirit of an unalloyed philosopher, eager to solve some problems about the group of chemical elements that seemed, of all, the most remote from any daily human needs. He noticed the remarkable glow of the mixed oxides when a flame impinged upon them, and so begat the mantle. Again, I say, no accident for him; but, again, what an accident for you, that a man of genius should want to investigate the mystery of rare earths!

I need not ask you where the gas industries would be to-day without these windfalls from the tree of scientific knowledge, the scientific branches of which, be it remembered, wave most vigorously in the upper air. By what definite planning are you to get discoveries of this kind made? The answer is, I think, by treasuring your men of genius and letting them work in the light of their genius. Surely the time has gone by to wonder whether true scientific work, carried on in the spirit of a philosopher by a man of genius with his feet upon the earth, subserves the material needs of humanity. Who is there that will dare to set his finger on any patch of new natural knowledge and say: "This may be edifying, but it is nothing to us"?

When, therefore, you seek to bring science into your service, beware of unduly fettering the minds and discriminating the topics. This seems to be the hardest lesson of all for the Englishman to learn. His very straightforwardness and stern common sense, his business-like ways, may all conspire to make him unbusinesslike in matters of education and research, to which, believe me, a man must serve a long apprenticeship before he becomes a master craftsman. I will listen eagerly to a business man whilst he tells me what he wants; I will eagerly seek the real knowledge that he has to give; I will eagerly lean upon him in the manifold business of administration; I will eagerly take his money; but when he wants to tell me that I shall teach this and not teach that, that this is useful, the other useless, above all, when he talks as if a well-constituted university should give proficiency in the practice of trades and render apprenticeship superfluous—well, I do not listen to him very patiently, and I say to myself, "Alas, that this man should think himself practical!"

If we on our side come to take a more sympathetic and direct part in bringing science to your service, I plead that you on yours shall show a larger measure of faith, of hope, and, I might almost say, of charity. Do not try to constrain us in our own proper business; do not be impatient of returns. They are sure to come; history has abundantly proved it; but you must freely cast your bread upon the waters.

I have chosen in this address to take what may be called a materialistic view of education, and I am not ashamed. I do not forget that education has many purposes to serve, and that man does not live by bread alone. But without bread man becomes a shadowy or a rebellious being, an ascetic or an anarchist. He must have bread, and he must get it by the sweat of his brow. Englishmen collectively must have work, the nation must have industries, and I take it as no degradation of education to contrive that it shall minister directly to their preservation, their progress, and their prosperity. Rather would I say this—that thereby you dignify labour, refresh the toiler with the fruits of knowledge, and infuse into his daily work the delight of seeing beneath its grime and dust a play of stupendous forces within majestic laws.

Of all the men whom I have known, I could point to no one who, more completely than George Livesey, embodied the finest native strength of the English industrialist. He was one of those men to whom I referred at the beginning of this address, and was bound to succeed independently of all that we call formal education. But you know that he never breathed any such vulgar boast. On the contrary, he believed with all his heart in the worth of all things intellectual. He was eager to draw to his aid all the resources of modern science; he took the broadest, most sympathetic, view of scientific research, and I can, as I have said before, imagine no memorial more acceptable to him than the one which, to our great honour, you have set up in this University. In the inspiring address which he delivered to you from this chair three years ago, he lifted your thoughts to the ethical side of industrial life, and preached to you the chivalry which you knew he had practised in his life. Honest dealing, confidence between man and man, care for the workman, national before personal interests—in short, a large-hearted humanity—these were his topics as they were his qualities. I am not without hope that in the universities, old and new, where knowledge should be cultivated, whatever it may pertain to, in the worship of truth, where young men should see visions, we may help to maintain the fine flower of British industry of which George Livesey was so splendid an example.

VISUAL SENSATIONS FROM THE ALTERNATING MAGNETIC FIELD.

FOLLOWING on the experiments reported by Prof. Silvanus P. Thompson in the Proceedings of the Royal Society, B, 82 (557), pp. 396 ff., it is interesting to note the further research in this subject pursued by Mr. Knight Dunlap, an account of which appeared in *Science* of January 13.

Prof. Thompson subjected the head to the influence of an alternating magnetic field, which was obtained by means of a coil of thirty-two turns of stranded copper conductor having an internal diameter of 9 inches and a length of 8 inches. The coil was supplied with a current the maximum value of which was 180 amperes at a frequency of fifty cycles per second.

On inserting the head in the coil under these conditions, a flickering light sensation was obtained, the sensation being more clearly defined in the peripheral part of the field of vision.

The object of the further experiments by Mr. Dunlap was to ascertain whether or not these sensations were due to idio-retinal light, under the suggestion of the hum of the coil caused by the alternating current.

A coil was constructed which gave a field of approximately the same density as that obtained by Prof. Thompson, and identical results were observed.

In order to ascertain whether the effects are due to idio-retinal light and suggestion, some experiments were carried out in which suggestion was eliminated to the fullest extent.

In these tests the transformer was placed near the coil, so that the hum of the coil was completely drowned by the noise of the transformer. Arrangements were made whereby the current could be switched from the coil on to a resistance, the strength being maintained constant.

The subject's ears were plugged up, and a telephone receiver connected to the transformer was hung on the coil.

Under these conditions it was absolutely impossible to tell by the sound whether the current was on or off the coil; each of the observers was able, however, to identify the flicker with absolute precision when the current was switched on to the coil.

With a field alternating at a lower (twenty-five cycles per second) frequency, it was found that sensation was much more pronounced and intensely disagreeable, the whole visual field quivering as if illuminated by a rapidly intermittent light.

The effect was at all times very intense when the side of the head was presented to the coil, but on looking into the coil it practically disappears. From this Mr. Dunlap infers that the sensation is due to currents induced in the optic pathway; he states that whether these currents excite the occipital cortex directly, or excite the retina primarily, is a matter for conjecture; the fact that the flicker is produced by alterations faster than the fastest flicker from normal light stimulation being, it is stated, no evidence for the non-retinal character of the flicker in question.

It is stated that there was no evidence to show that

there was a definite arousal of visual sensation by the alternating field; the effect appeared more like an alternate intensification and inhibition of whatever sensory process was already in progress. That is to say, the idio-retinal light which is present before the current is turned on is increased and decreased alternately.

A KINETIC THEORY OF GRAVITATION.[1]

EVER since Sir Isaac Newton enunciated the law of universal gravitation, more than two hundred years ago, philosophers have speculated on the nature of that mysterious agency which links every atom of matter in the universe with every other atom. Newton found himself unable to offer any adequate explanation.

Since Newton's time several theories of gravitation have been proposed; but all, of which I am aware, are open to strong objections, and are not considered even promising by physicists.

Study of the nature of gravitation is beset with unusual difficulties, because gravitation is ever with us and about us; it is the one universal phenomenon, and we cannot escape from its influence—cannot obtain any outside point of view.

Gravitation is often described as a feeble force; and so it is, from one point of view. It is difficult to measure, or even to detect, attraction between two small bodies. But when the bodies are of planetary size the aggregate attraction of their molecules is enormous. It is easy to calculate that the attraction between the earth and the moon, which is just sufficient to retain the latter in its orbit, would, if replaced by a steel cable, require that the cable be about five hundred miles in diameter in order to withstand the strain. Between the earth and sun, the cable would have to be nearly as large in diameter as the earth; and attraction between the components of some double stars is millions of times greater than between the earth and sun (Lodge). So tremendous a phenomenon as gravitation, a phenomenon compared with which all others seem trivial, must have a mighty origin.

That gravitation is a phenomenon of the all-pervading æther is beyond reasonable doubt. This is so generally conceded that it need not be argued. But how does the gravitative influence originate? How is it transmitted and maintained? What is the *mechanism* of gravitation? It is the purpose of this paper to attempt an answer to these questions.

Let us consider what happens to a falling body. We know that it gathers kinetic energy from some source, as evidenced by its acceleration; that this energy may do external work or develop heat; that the amount of energy gathered is measured directly by the distance fallen through (within the limits of uniform gravitation), irrespective of the time or rate of falling. When the distance fallen through is of inter-planetary magnitude, and the attracting body large, the gathered energy is enormous, sufficient, if converted into heat, to vapourise the most refractory falling body.

We are here confronted with the question, Whence comes the energy acquired by a falling body? Certainly it was not inherent in the body before the fall, as evidenced by the fact that during unimpeded fall none of the physical or chemical attributes of the body, aside from the acquired motion, changes in the slightest degree.

We have been taught that before the fall the body was endowed with "potential energy of position," which is converted into kinetic energy during the fall. I think "energy of position" is an unfortunate term, because it is so very inadequate. To me it explains nothing. The case is not like that of a flexed spring, where there is internal molecular strain or displacement.

Let us imagine a pound-weight of iron, for instance, raised from the surface of the earth to a point near the moon in a line joining the centres of the two bodies, the point so chosen that the opposing attraction of the earth and the moon shall exactly balance each other, leaving orbital motion out of consideration.

On the surface of the earth the pound-weight had some so-called "potential energy of position," because it was capable of falling into a pit; but in its new position near the moon, this potential energy not only has not been augmented, but has disappeared entirely; the pound-weight, left free to move, remains stationary; and yet we must have expended more than twenty million foot-pounds of energy in overcoming the attraction of the earth and lifting the weight to its new position. This amount of energy would be sufficient to impart to the weight a velocity more than ten times greater than that of the swiftest cannon-ball, or, if converted into heat, would be many times more than sufficient to raise the iron weight to dazzling incandescence and then vapourise it. Now, in lifting the weight, this large amount of energy has disappeared utterly. We cannot believe that the whole or any part of it has been annihilated; it must, in some form, be resident somewhere. I think no one will contend that this energy is resident, in any form, in the cold, motionless pound-weight. I believe it was absorbed by, and is now resident in, the æther through which the weight was raised. Conversely, if this be true, a falling body must acquire its energy from the æther through which it falls. This is a fundamental idea to which I invite attention. Faraday glimpsed it long ago, and others have appreciated it more clearly since his time. But, so far as I am aware, no one has realised its significance.

This view of gravitation implies that the æther is endowed with very great intrinsic energy in some form. Many men of science now hold that the æther is so endowed, and that the amount of this intrinsic energy is enormous. Sir Oliver Lodge ("The Ether of Space") appears to regard this energy as potential in form, and estimates the intrinsic energy of a single cubic millimetre of the æther to be almost inconceivably vast. He says, "All potential energy exists in the ether." Sir J. J. Thomson says, "All kinetic energy is kinetic energy of the ether."

I conceive the æthereal energy involved in gravitation to be kinetic rather than potential, the latter involving strain or stress. Newton, and later Maxwell, assumed that bodies produce a stress in the æther about them of such nature as to account for gravitation, but they were unable to imagine any physical cause for the stress.

All the past theories of gravitation of which I am aware, except the corpuscular theory of La Sage, appear to regard gravitating matter as the seat of the gravitative influence, the surrounding æther, by induced stress or otherwise, acting simply as the medium of transmission. I cannot see that any of these theories accounts for the energy acquired by a falling body.

My own view of gravitation differs from these radically. I believe that kinetic energy of the æther is the fundamental cause of gravitation, and that a gravitating body plays a secondary *rôle* only in disturbing the normally uniform distribution of the æther's energy, in a manner I shall endeavour to explain later.

Let us assume, then, that the æther is endowed with very great kinetic energy normally uniform in distribution.

Kinetic energy implies motion of something possessed of inertia. Now, inertia is a fundamental attribute of the æther. Sir J. J. Thomson holds that all inertia is inertia of the æther. The æther is highly elastic also, which, with its inertia, enables it to possess kinetic energy in wave form, as exemplified in radiation. By the term wave, I mean progressive motion locally periodic; doubtless the æther as a whole is stationary. Hence we may consider the kinetic energy of the æther as consisting in æther waves of some kind.

These waves, vast in aggregate energy, eternal in persistence, without finite source or destination, are imagined as being propagated in straight lines in every conceivable direction. This isotropic distribution of kinetic energy, essential to my theory of gravitation, was, for me, a difficult conception until I reflected that isotropic radiant energy is approximately realised in the interior of any furnace with uniformly heated walls.

Any kind of waves capable of exerting motive action on the atoms or molecules of matter will fulfil the requirements; but I shall first consider the transverse, electromagnetic waves of radiation, because these are the kind of æther waves we are familiar with.

Of course, intrinsic æther waves, if of the radiation kind, cannot be of any frequency at present known to us as radiation, because then all bodies would become heated.

[1] Paper read before the American Association for the Advancement of Science, December, 1910, by Mr. Charles F. Brush.

But we can easily imagine them of such extremely low frequency that the molecules or atoms of matter cannot respond to them—cannot vibrate in unison with them—molecular resonance cannot be established; hence no conversion of the æther's energy *directly* into heat in the ordinary way can take place.

We are familiar with the dissipation or degeneration of the higher forms of energy into heat, and the continual degradation of heat to lower degree; that is to say, less violent molecular vibration and more general distribution. As is well known, it is only through this degradation or running down of natural energy that we are enabled to utilise some of it. Lord Kelvin called this function of energy "motivity" (we now call it entropy), and said the motivity of the universe tends to zero.

We know that ordinary radiation waves in the æther persist indefinitely and without change of frequency or direction until they encounter matter, when they are absorbed and converted into heat, only to be radiated again, usually in longer waves, to some colder body. This degradation of wave frequency continues until we can no longer follow it. I beg to suggest that the ultimate destination of this wave energy is that vast reservoir of kinetic energy intrinsic to the æther. We may liken the waves of radiant energy, which we apprehend as light and heat, to wind ripples on the surface of water, which continually degenerate in wave frequency until they are absorbed into and become a part of the mighty swell of the ocean.

Thus we may, perhaps, regard the æther's intrinsic energy as energy in its lowest form—Kelvin's zero of "motivity." But fortunately we may, and do, get some of this energy back in available form in several ways, as, for instance, when a falling body is arrested and develops heat; some of our wind ripples are then returned to us.

When two gigantic astronomical bodies collide under the influence of gravitation, as sometimes happens, we witness in far distant space the birth of a nebula. The inconceivably vast amount of heat developed by the collision converts both bodies into luminous vapour, which expands with incredible rapidity into the nebulous cloud. This heat energy must in course of time degenerate back into the æther whence it came, though billions of years may be required; and during all this time the energy has "motivity." We may picture the stupendous result of the collision as only a local splash in the æther's mighty ocean of energy.

Having postulated that the æther is endowed with very great intrinsic kinetic energy in wave form of some kind, that the waves are propagated in straight lines in every conceivable direction, *i.e.* the wave energy is isotropic, and that this energy is distributed uniformly throughout the universe except in so far as the distribution is disturbed by the presence of matter, I shall endeavour to explain my conception of the mechanism of gravitation.

For illustration in terms of the known, let us imagine a closed space having uniformly luminous walls of such character that every point on their surface radiates light in all internal directions. The enclosed space may be of any shape, but for the sake of simplicity let it be spherical or cubical, and large, say as large as a lecture-room. The space will be filled with isotropic radiant energy uniformly distributed—any cubic centimetre of space containing as much energy as any other.

Next let us picture a small opaque body suspended anywhere in our luminous space. The body may be of any shape we may imagine an atom or molecule to have; but, again for simplicity, let it be spherical—say a small grain of shot, and let it be located near the centre of the space.

The small body will absorb the light which falls upon it, and will cast a spherical shadow, the depth or intensity of which will vary inversely with the square of the distance from the centre of the body; and the shadow will extend to the confines of the enclosure, however large the latter may be. We cannot perceive the shadow, but we know it is there. It is true that the body will soon acquire the temperature of its surroundings, and radiate as much energy as it receives; but for the purpose of this illustration let us consider only the high-frequency light energy.

As is well known, the æther waves of light will exert a slight pressure on the body. But in the case supposed the pressure will be equal on all sides, and no effort toward translation can result.

Now let us introduce a second small body, similar to the first, and some distance from it. This also will cast a spherical shadow like the first. The two shadows will intersect, and each body will lie within the shadow of the other. In other words, each body will be partially shielded by the other from the æther waves coming from that direction. Hence the light pressure will be less on that side of each body which faces toward the other than on the side which is turned away, and the bodies will be urged toward each other by the excess of light pressure on the side turned away. This excess of pressure will vary with the inverse square of the distance between the centres of the bodies so long as the ratio of distance to diameters remains large.

The æther waves concerned in gravitation cannot, however, be like the light waves I have just used for illustration, because light waves heat bodies on which they fall; and their pressure is almost wholly superficial, it does not reach molecules much below the surface, and hence bears little relation to mass.

But let us substitute for the short and feeble waves of light powerful waves, still of the radiant kind, but of such great length and slow frequency that, as before explained, they do not excite the molecular vibrations which we appreciate as heat, and hence are not absorbed by matter; they pass freely through all bodies, bathing the interior molecules as effectually as those on the surface.

Under these conditions each molecule or atom or unit of a gravitating body will have its own spherical shadow or field of influence, and the gravitative force acting on the body will vary directly with the sum of its units, *i.e.* with its mass.

The spherical shadow which I have pictured as the field of influence of each atom or material unit implies that the atom has caused, principally in its immediate neighbourhood, a diminution of the æther's energy. Let us further imagine this subtracted energy resident in the atom as kinetic energy of translation in many paths, almost infinitesimally short and in every direction, but without collisions, because neighbouring atoms follow *very* nearly parallel paths. We may then picture the collective atoms or molecules of matter buffeted about in every direction by the æther waves in which they are entangled, like a suspended precipitate in turbulent water.

Each atom or molecule may be regarded as a centre of activity due to its kinetic energy of translation, with continual absorption and restitution of the æther's energy, normally equal in amount. The manner in which this molecular activity maintains, in effect, the supposed spherical shadow, requires explanation, which I shall attempt in a future paper.

Of the several components into which the composite motion of each atom can be resolved, that one lying in the direction of an attracting body will be the greatest, because the waves from that direction, being partially intercepted by the attracting body, are weakest, and the atom will be *pushed* in that direction by the superior waves behind it. If free to fall, the atom will continually absorb more energy from the stronger waves behind it than it restores to the weaker waves in front, and will thus acquire additional kinetic energy of translation in the line of fall, measured directly by the number of waves involved, *i.e.* by the distance moved. Conversely, if the atom be forced away from the attracting body, restitution of energy will exceed absorption, and the energy expended in moving the atom against attraction will be transferred to the æther.

It will be seen that gravitation is a *push* toward the attracting body, and not a pull. It is clear, also, that the velocity which a falling body can acquire tends asymptotically to a limit, which is the velocity of the æther waves which push it—the velocity of light, if transverse waves are involved.

I have already intimated that any kind of æther waves capable of imparting motion (not internal vibration) to the atoms of matter will fulfil the requirements of my theory, but have thus far discussed only transverse waves.

Let us now consider longitudinal waves—waves of compression and rarefaction, like sound waves in air and in

elastic liquids and solids. The "spherical shadow" conception which I have employed in connection with transverse waves applies equally well here.

So far as I am aware, longitudinal waves in the æther are unknown, but that such waves have not been observed is not convincing argument that they do not exist.

Assuming, then, that some, or perhaps much, of the intrinsic energy of the æther is embodied in longitudinal waves, we have only to find some motive action of such waves on atoms of matter to account for gravitation. Adequate motive connection may perhaps be effected by the locally alternating flow and ebb—acceleration and retardation of the æther in which the atoms are enmeshed, incident to its wave motion. We have ample reason for believing that the æther does obtain a grip of some sort on the atoms of an accelerating (falling) body and a retarding (rising) body, from which it follows that accelerating and retarding æther, as in a wave of compression, must grip a comparatively stationary atom.

Certain facts of astronomy apparently require that gravitational attraction between bodies, however distant from each other, must, in effect, be instantaneous; that is to say, the line of apparent attraction between them is a straight line joining their centres. I believe my theory meets this condition, but shall reserve discussion of the point for a future paper.

I feel much diffidence in presenting the foregoing rough draft of a theory of gravitation, but I cannot avoid the belief that it contains some germs of truth, perhaps the real key to the great mystery, though, if this be true, I have no doubt used the key clumsily and imperfectly.

If the æther-wave theory of gravitation is, in the main, the true one, it offers some hope of experimental verification. Provided the waves are of one principal frequency, or even of several, we may find something, doubtless of molecular magnitude only, which will oscillate in unison with them so that resonance can occasionally be established and a cumulative effect be obtained sufficient to manifest itself as heat.

In searching for some natural phenomenon of this nature, I thought of the thermal condition of the upper atmosphere as a possible case. The mean molecular velocity of a gas at some temperature, in connection with the mean free path of its molecules at some particular pressure or pressures, may possibly afford the necessary conditions for fortuitous resonance, with development of some slight amount of heat by the increased violence of inter-molecular collisions. I have done much experimental work on these lines during the past year, but, notwithstanding refinement of method and manipulation, the results have thus far been unsatisfactory. The work is still in progress, however, and investigation of other phenomena is contemplated.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. R. C. B. Gardner has been appointed assistant to the superintendent of the Museum of Zoology, and the appointment has received the consent of the Vice-Chancellor.

The special board for biology and geology has nominated Mr. J. F. Gaskell to use the University table at Naples for three months, and Mr. W. O. R. King to occupy the University table at the laboratory of the Marine Biological Association at Plymouth.

On Thursday, April 27, a Grace will be brought before the Senate suggesting that the laboratory of experimental psychology syndicate be authorised to obtain tenders for the erection of a building for the psychological laboratory in accordance with Mr. Jackson's plans, and that the Vice-Chancellor be authorised to sign the contract for the work provided that the total cost does not exceed 4250*l*.

IT is announced in the *Revue scientifique* that Mr. Arthur Krupp has given 50,000 crowns to the Vienna School of Arts and Crafts towards the establishment of an aviation laboratory.

IN connection with the celebration of the centenary of the University of Breslau, Dr. P. Schottlaender has given the University 250,000 marks, the interest of which, says the *Revue scientifique*, is to be devoted to the provision of travelling exhibitions or to the purposes of research.

AT a meeting of the London branch of the Association of Teachers in Technical Institutions, to be held on Saturday, March 25, at the South-Western Polytechnic, Chelsea, S.W., a conference on the organisation of technical instruction, especially in connection with the higher branches, will be opened by Dr. R. T. Glazebrook, F.R.S., director of the National Physical Laboratory.

THE London Inter-collegiate Scholarships Board announces that an examination will be held on May 9 for eighteen entrance scholarships and exhibitions, of an aggregate total value of about 1500*l*., open to men and women, and tenable in the faculties of arts, science, and engineering of University College, King's College, and the East London College. Particulars and entry forms may be obtained from the secretary of the Board, Mr. A. E. G. Attoe, University College, Gower Street, W.C.

MR. ALEXANDER SIEMENS, president of the Institution of Civil Engineers, speaking at the annual dinner of the institution on March 17, said that the institution proposes to inaugurate a conference on engineering education during the summer with the object of making clear the proper way of preparing young men for the profession of engineering. The passing of examinations is part of what is needed, he pointed out, but not all. The great thing is practical training, so that young men may know how to employ their theoretical knowledge and be prepared to take up any branch of engineering which fate may drive them to. Mr. Siemens hopes that the institution will have an opportunity at the forthcoming Imperial Conference to represent to the Colonies the desirability of recognising the qualifications of its members and of according them uniform treatment throughout the Empire.

THE Home Secretary has appointed a committee to inquire into the constitution, management, discipline, and education of reformatory and industrial schools in England and Wales. The inquiry will include a consideration of the relation of the schools to education committees and other authorities, and the qualifications of superintendents and other officers; variation in the types of schools, and whether further provision is necessary for the proper grading of boys and girls; the suitability of ships for use as schools; the preparation given boys for entry into industrial or other careers, and the training and disposal of girls; the care of boys and girls after leaving the schools and the relation of the schools in this connection to existing institutions for the welfare of young persons. The committee appointed is representative in character, and Mr. C. F. G. Masterman, M.P., is the chairman. Mr. A. Maxwell, of the Home Office, will act as secretary.

THE Board of Education has found it impossible to complete the preparation of the new grant regulations for technical schools, schools of art, and other forms of provision of further education in England and Wales, at as early a date as was suggested in the prefatory memorandum to the regulations issued last August. This being so, the Board feels that to bring new regulations into force by August 1 next would allow insufficient time to education authorities for accommodating their arrangements to the requirements of the new regulations. The grant regulations for 1910 are, therefore, to be continued in force during the educational year 1911–12, and the Board hopes in the course of the coming summer to issue the new regulations, which will not, however, become operative until the educational year 1912–13. The new regulations may thus be in the hands of education authorities a year before they come into force. The Board announces, however, that it will not be necessary similarly to defer the issue or the operation of the new regulations for university institutions. The Board contemplates issuing separate provisions in respect of the educational year 1911–12 for the payment of grant in aid of approved courses provided by university institutions. Any courses so aided will cease to be eligible for recognition under the Board's regulations for technical schools. New regulations for the science and art examinations, the National competition, and the various forms of scholarships and exhibitions given and aided by the Board are under consideration, and it is hoped that

some of the changes involved may be announced in the course of this summer, and may become operative in the summer of 1912.

IN the issue of *Science* for March 3, Prof. Rudolf Tombo, jun., analyses the registration returns for November 1, 1910, of twenty-seven of the leading universities in the United States. Four of the universities show a decrease in their total enrolment of students, viz. Harvard, Iowa, Indiana, and Virginia, as against four in 1909, two in 1908, and five in 1907. If the returns of the number of students for 1910 be compared with those of 1909, we note that Chicago and Michigan have passed Harvard, that Pennsylvania has changed places with Cornell, that Illinois has been passed by Minnesota, California, and Wisconsin, that North-western has passed Yale, and that Johns Hopkins and Virginia have changed places. For the first time in the annals of American universities the 7000 mark has been passed, Columbia having a grand total of 7411 students. Pennsylvania is the sixth university in the States to pass the 5000 mark; Cornell passed it in 1909, Chicago and Michigan in 1908, Columbia in 1907, and Harvard somewhat earlier. The number of students of science in American universities is decidedly smaller than in 1909, and more than half these institutions showed a loss of students in these departments as compared with the previous year. The chief gains were made by Illinois, Yale, and Columbia in the order given. Cornell, Michigan, Illinois, and Yale each enrolled more than a thousand students of engineering. It is noteworthy that the number of undergraduate women students shows a decrease at the majority of the institutions. All the schools of agriculture continue to show an increase in the number of students, and that in connection with the University of Minnesota is still at the head of the list.

SIR ALFRED KEOGH, rector of the Imperial College of Science and Technology, distributed the prizes and certificates to the students of the South-Western Polytechnic Institute, Chelsea, on March 10. In the course of his address he pointed out the deplorable lack of system which exists in the methods of technological education in London. He advocated the creation of a central institution of university rank to which the other institutions might send their most promising students. He also suggested the formation of technological boards of studies composed of the various teachers of technology in London. The annual report of the institute stated that the progress of the work is satisfactory, particularly in the higher branches of science. During the last session twenty-four students attained the London B.Sc. degree, of whom fourteen graduated in honours. Two old evening students obtained the D.Sc. degree. In the Board of Education examinations fourteen obtained honours certificates. A considerable amount of research was completed during the year and contributed to various scientific societies and periodicals. Mr. Hayes Fisher, M.P., chairman of the governing body, alluded sympathetically to the recent loss sustained by the death of Mr. R. C. Antrobus, who for nearly twenty-five years was closely associated with the work of the institute, including ten years' service as chairman of the governing body. Mr. Fisher also stated that they would be shortly in a position to start upon the new buildings, which will furnish accommodation for natural science laboratories and class-rooms, a new physical laboratory, and new and efficient social rooms. After the meeting, the laboratories, workshops, and other rooms were thrown open for inspection. About 1500 visitors availed themselves of this opportunity to inspect the buildings and apparatus.

REPLYING to a deputation from the Trade Union Congress Parliamentary Committee on March 16, Mr. Runciman, President of the Board of Education, dealt with the question of "half-time" pupils in elementary schools. He said the Board of Education has been at work for some time on schemes for linking up continuation classes, and compulsory attendance at continuation classes, with other educational reforms. The Departmental Committee which inquired into the question of "half time" came to the conclusion that the time had arrived for the raising of the half-time age. A Bill will be introduced very shortly into the House of Commons to carry out some of the recommendations of that committee. Continuation-class work ought not, he said, to end at the age of fourteen, but be carried through that period of adolescence in which the boy has lost his habit of learning and has not acquired the proper taste of learning. The Board wishes to keep alive what are called "humanities" as well as technicalities. In trade schools the Board already gives assistance, and it is revising its educational regulation to assist the schools still further. The deputation asked for an inquiry into the question of endowments, but Mr. Runciman, though he has the subject under consideration, said he was unable to promise the appointment of a Royal Commission on the subject. According to *The Times*, the Bill which Mr. Runciman will introduce to deal with half-time attendance will follow the recommendations made by the Inter-Departmental Committee on Partial Exemption from School Attendance, which reported in August, 1909. In reporting against the continuance of the system, the committee recommended that total exemption under the age of thirteen be abolished; that the attendance certificate for total exemption be abolished; that total exemption at the age of thirteen be granted only for the purposes of beneficial or necessary employment; that the ordinary condition for total exemption be due attendance at a continuation class, but that, subject to the approval of the Board of Education, an authority may adopt as an alternative condition the passing of a standard not lower than Standard VI. The committee anticipated that the abolition of partial exemption, coupled with the raising of the minimum age for exemption to thirteen, would necessitate provision being made in the day schools for the instruction of about 22,550 additional whole-time scholars, and would result in an increased cost to the Exchequer to the amount of 22,540*l*.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 16.—Sir Archibald Geikie, K.C.B., president, in the chair.—L. **Doncaster**: Gametogenesis of the gall-fly (*Neuroterus lenticularis*). Part ii. This paper is a continuation of the paper on the same subject published in the Proc. Roy. Soc., B, vol. lxxxii., 1910, p. 88. The previous part dealt with the spermatogenesis and maturation of the eggs of the summer (bisexual) generation. The present part describes the maturation of the eggs in the spring (parthenogenetic) generation. It is found that there are two types of eggs, laid by different females. In one there is a double polar division, by which the somatic number of chromosomes (20) is reduced to 10, and, since the eggs are unfertilised, 10 chromosomes appear in the segmentation divisions. In eggs laid by other females no maturation division occurs; the egg nucleus, after moving to the edge of the egg as if preparing for maturation, sinks in again, and immediately undergoes the first segmentation division. In eggs of this type 20 chromosomes are found in the segmentation spindles, and polar nuclei are absent. Since experiment shows that some females lay only male-producing eggs, others only female-producing, and since male larvæ show the reduced chromosome number (10) in the germ-cells and nervous system, while female larvæ have 20, it is concluded that the parthenogenetic eggs which undergo reduction yield males, those which do not, females.—Sir Thomas R. **Fraser** and Dr. J. A. **Gunn**: The action of the venom of *Echis carinatus*. The minimum lethal dose of Echis venom by subcutaneous injection per kilogram was found to be:—for the frog, 0·009 gram; for the rabbit, 0·0009 gram; for the rat, 0·00075 gram; for the cat, 0·008 gram; and for the pigeon, 0·004 gram. The frog and the cat, therefore, show a relatively high resistance to this venom, the minimum lethal dose for these animals being about ten times that for the rabbit or rat. In the case of Sepedon venom, which may be taken as a typical Colubrine venom, a different ratio of lethality has been found by us for those animals, the cat showing a relatively even higher resistance, but the frog no increased resistance, as compared with the rabbit or rat. This of itself points to an intrinsic difference between the actions of Viperine and Colubrine venoms. The chief effects produced by Echis venom in the animals investigated are hæmorrhages occurring

locally and distally, alterations in the coagulability of the blood, and secondary effects upon the respiration, heart, and central nervous system. The symptoms of experimental poisoning thus very closely resemble those which have been described in cases of Echis bite in man. Echis venom differs from Colubrine venoms in having little or no direct action on the central nervous system or on the nerve terminals in voluntary muscle. It has a direct action in lowering the blood-pressure in mammals by slowing and weakening the heart's contractions; lethal doses also produce a fall of temperature in mammals. The chief toxins in Echis venom, in the order of their potency, are a hæmorrhagin, a substance which alters the coagulability of the blood, and a hæmolysin.—Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie** (Sleeping Sickness Commission of the Royal Society, Uganda, 1908–10). Further researches on the development of *Trypanosoma gambiense* in *Glossina palpalis*. (1) In the course of the development of *Trypanosoma gambiense* in *Glossina palpalis*, the proboscis does not become involved, as in the case of some other species. (2) A few days after an infective feed the trypanosomes disappear out of the great majority of the flies, but in a small percentage this initial disappearance is followed by a renewed development. (3) After a very short time the flies which have fed on an infected animal become incapable of conveying the infection by their bites, and this non-infectivity lasts for some twenty-eight days, when a renewed or late infectivity takes place. (4) A fly in which this renewed or late infectivity occurs can remain infective for at least ninety-six days. (5) An invasion of the salivary glands occurs at the same time as this renewal of infectivity, and without this invasion of the salivary glands there can be no infectivity. (6) The type of trypanosome found in the salivary glands when the fly becomes infective is similar to the short, stumpy form found in vertebrate blood, and it is believed that this reversion to the blood type is a *sine qua non* in the infective process.—Dr. M. **Haaland**: Spontaneous cancer in mice. The observations recorded have been made upon 300 mice in which cancer had developed spontaneously. The tumours originally observed numbered 350. Many of the mice presented multiple growths. It is important that forty-two tumours had a structure distinct from that of the well-known mammary tumours of the mouse. Spontaneous healing is recorded of undoubted malignant new growths. The reasons have been sought for that preponderance of mammary tumours which is characteristic for the mouse. The physiological demands made upon the mamma by repeated pregnancy and lactation can be excluded, since many of the mice which had been under observation since birth had never littered, and twenty had been completely isolated from possibility of association with a male. The histological examination of the mamma of a large number of old mice, cancerous and non-cancerous, showed the frequency of chronic inflammation combined with hypertrophic and other changes in the epithelium. The latter pass through all stages to definite tumours. The only explanation found for the chronic inflammatory and other changes was the presence of nematodes. Numerous experiments of diverse kind were made to define the parts played by local causes, such as those described above, and by constitutional conditions. All the evidence points to the importance of local causes, *e.g.* chronic irritation, and to the absence of general constitutional changes favourable for the growth of cancer. The part played by the irritant is a mediate one, so that it produces the altered conditions under which either the first departure of the cells from the normal takes place, or permits spontaneously occurring sports of cells to multiply and adapt themselves to a new mode of life as observed in propagated tumours.

Geological Society, March 8.—Prof. W. W. Watts, president, in the chair.—Contributions to the geology of Cyrenaica, by Prof. J. W. Gregory and others. (1) Prof. J. W. **Gregory**: The geology of Cyrenaica. According to the evidence available in 1908 regarding Cyrenaica, the country might be interpreted as a fragment of a mountain-loop, or as a plateau of Miocene rocks. In a journey across the country, the author found that it was a plateau of Lower Kainozoic limestones. These limestones must have been deposited in a clear sea, at depths down to 1000 fathoms. Intervals of shallow sea are indicated by limestone-conglomerates and coral-reef limestone. The country was uplifted in later Miocene times, and was then part of a wide land which included Crete and occupied the site of the Ægean Sea. This land was broken up by great subsidences, which left Cyrenaica as a horst bounded by fault-scarps on the north and west. Cyrenaica may be regarded as part of the western limb of the geosyncline of western Egypt.—(2) R. B. **Newton**: Notes on the Kainozoic Mollusca. A number of Mollusca are recognised as belonging to members of the Kainozoic system. The most abundant of the post-Pliocene series is *Cerastoderma edule*. Among the Helvetian-Tortonian forms are *Alectryonia* cf. *virleti* and *Strombus* cf. *coronatus*. The Aquitanian shells present a relationship to the "Schioschichten" fauna of northern Italy. Foraminiferal organisms occur in these beds, but no nummulites. *Lepidocyclina elephantina*, a good Aquitanian species, is found with *Oopecten rotundatus* from Birlibah. The most characteristic of the Priabonian Mollusca is *Pecten arcuatus*. A new species of Æquipecten is described. Nummulites abound in these rocks. So far as the Mollusca are concerned, nothing older than Lutetian has been observed.—(3) F. **Chapman**: Foraminifera, Ostracoda, and parasitic fungi from the Kainozoic limestones of Cyrenaica. The Foraminifera are mainly from the Middle Eocene; others belong to the Upper Eocene and to the Aquitanian or Stampian. The most abundant foraminifer is *Nummulites gizehensis*. At a higher horizon is a nummulitic limestone containing *N. gizehensis*, var. *lyelli*. Some limestones at Wadi Umzigga contain *Lepidocyclina elephantina*, and are referred to the Aquitanian or Stampian. The boring fungus *Palaechyla perforans* occurs perforating Lepidocyclina.—(4) Prof. J. W. **Gregory**: The fossil Echinoidea of Cyrenaica. The Echinoidea are referred to ten species, of which two are new, and one is a new variety. The echinoids come from four horizons; the oldest fauna belongs to the Middle Eocene; the Upper Eocene is represented by an unusually early species of Amphiope, and by an Echinolampas. Some echinoids from the Cyrene limestones are of Aquitanian affinities, and others seen in the limestone east of Benghazi are Miocene. The echinoid faunas show that the Eocene rocks containing them were, as a whole, deposited in a sea of moderate depth.—(5) D. P. **MacDonald**: The foraminiferal limestones of Cyrenaica. The microscopic examination of the limestones shows that they are mainly composed of organic material, and are free from detrital material. Some of them have been partly dolomitised. Some of the limestones are oolitic.—G. E. **Dibley**: The teeth of the genus Ptychodus, and their distribution in the English Chalk. This paper is an attempt to define the species of the fossil fish genus Ptychodus. Hitherto, our information as regards Ptychodus has been derived from associated sets of *P. decurrens* in place and isolated teeth of this and other species. The variation in teeth of one individual is often so marked that, when found separately, they have given rise to the formation of new species. It can now be proved that these teeth belong to already known species, and merely represent a phase in variation in the development of certain teeth of one species. Special attention has been given to the extreme variation in *P. decurrens*, as well as in the equally variable species *P. polygyrus*, and one new species has been added.

Zoological Society, March 7.—Dr. A. Smith-Woodward, F.R.S., vice-president, in the chair.—Dr. Karl **Jordan** and the Hon. N. Charles **Rothschild**: Some Siphonaptera from northern China. This collection of fleas had been made by Mr. M. P. Anderson, the Duke of Bedford's collector, in the province of Shen-si, and contained altogether seventeen species, of which no fewer than thirteen were new. Some of these were possibly only geographical developments, but others represented distinct types not very nearly allied to any known species.—F. E. **Beddard**: Certain points in the anatomy of the frog *Megalophrys* (*Leptobrachium*) *feae*, based on specimens exhibited in the society's gardens.—F. E. **Beddard**: The spermatophores in earthworms of the genus Pheretima (=Perichæta). These structures had been found in two species, one of which would be described as new, contained in a collection of terrestrial Oligochæta from the

Philippine Islands, which had been submitted to him for examination by the director of the Scientific Bureau of the Philippines.—R. **Lydekker**: (1) A rare beaked whale; (2) age phases of the rorqual.—Dr. P. Chalmers **Mitchell**: Longevity and relative viability in mammals and birds, with a note on the theory of longevity. The work was based on a study of the records of the duration of life in the society's gardens of more than 20,000 individual mammals and birds. These were arranged systematically so as to make possible a comparison of the average duration with the maximum duration and what was known or could be inferred as to the potential longevity. Such a method gave a measure of the effect of the conditions of captivity on the duration of life. The memoir discussed some of the results obtained by such a comparison, particularly with regard to the provision of artificial heat. In the note on the theory of longevity, the author briefly reviewed the contributions of Ray Lankester, Weismann, and Metchnikoff, and stated his conclusion that potential longevity was due to constitutional causes, that the constitution was adapted to the average specific longevity, and that the correlation between longevity and reproduction was the reverse of what had been suggested by Weismann.

DUBLIN.

Royal Dublin Society, February 28.—Prof. T. Johnson in the chair.—W. J. **Lyons**: The determination of density, thermal expansion, and volume-change on fusion of waxes. The author described a simple but effective apparatus for the exact determination of the density of liquid and solid fats and waxes at any temperature. The method can be applied to examine the continuous change in volume on change of temperature, and the abnormal volume change on fusion. Some interesting results were shown for beeswax and other waxes.—R. J. **Moss**: A simple form of apparatus for drying substances *in vacuo* at the temperature of boiling water. Finely powdered selenite lost 93·4 per cent. of the total water of crystallisation in one hour by this method, whereas when dried for five hours in the water oven in the ordinary way the loss was only 72·7 per cent.

PARIS.

Academy of Sciences, March 13.—M. Armand Gautier in the chair.—H. **Le Chatelier**: The alterability of aluminium. After some months' use, a marked alteration in the surface of some aluminium utensils was noticed. Photomicrographs are reproduced in the paper showing the nature of the change. The metal developed a crystalline structure, and the crystals tended to become isolated from each other. Some laboratory experiments made with a view to imitate this cellular structure, and to obtain a separation of the grains, have shown that aluminium containing small quantities of calcium lends itself more easily to the reproduction of this structure.—Gaston **Bonnier**, Louis **Matruchot**, and Raoul **Combes**: Researches on the determination of microscopic germs in the atmosphere. Previous researches on this subject have been chiefly directed to the determination of bacteria, and very few have considered the question of the fungi. The apparatus used in this work is described in detail, and a preliminary account of the results is given. The work includes the influence of the culture medium on the development of the organisms, the influence of the surrounding vegetation on the dissemination of the germs, and the influence of the altitude. Amongst other results, the presence of numerous colonies of moulds has been proved in a sample of snow taken on the Pic du Midi at an altitude of 2860 metres. As regards the effect of altitude, the fact already known that the proportion of bacteria diminishes rapidly with the altitude has been confirmed, but, so far as the moulds are concerned, this diminution is less marked, as even at high altitudes numerous mould spores are still found.—A. **Chauveau**: The battle of the visual fields in the stereoscope. A continuation of the work described in an earlier communication (February 27). The results are summarised in ten conclusions, too lengthy for reproduction.—Pierre **Termier**: The age of the green rocks of the Belledonne chain. The green rocks at Tabor are not metamorphosed from the Lias nor from the Trias, and are, indeed, much earlier than the latter.—Paul **Sabatier** and A. **Mailhe**: The catalytic splitting up of esters by certain metallic oxides. Esters may split up catalytically in several directions, forming ketone and carbon dioxide; ethylenic hydrocarbon and water; ketone, carbon dioxide, hydrocarbon and alcohol; acid and hydrocarbon. Examples are given of all these cases, and it is shown that the nature of the acid, the temperature, and the nature of the metallic oxide all have an influence on the course of the reaction.—M. Pavlov was elected a correspondant in the section of medicine and surgery in the place of the late M. Herrgott, and S. Arrhenius a correspondant in the section of physics in the place of the late M. Hittorf.—M. **Nicolau**: The variation in the motion of the moon.—Zoárd **de Geöcze**: Contribution to the quadrature of curved surfaces.—Henri **Villat**: The problem of Dirichlet relating to a circular corona.—Gustave **Dumas**: The resolution of the singularities of surfaces.—C. **Tissot**: The exact determination of the periods of electrical oscillations. A discussion of the limitations of the method described in a previous paper.—C. **Gutton**: A comparison of the velocities of propagation of light and of electromagnetic waves along a wire. The comparison of the velocities of light and electromagnetic waves has hitherto been obtained by the determination of each magnitude separately. By utilising the electrical double refraction of carbon bisulphide, the author makes a direct comparison of the two velocities without measuring either separately. The two velocities were found to be equal within 1 per cent., or within the limits of accuracy of the experimental method employed.—Pierre **Weiss**: Magneton in solid paramagnetic bodies.—Ch. **Moureu** and A. **Lepape**: A spectrophotometric method for the estimation of krypton, especially of the yellow line 5871·12 and the green line 5570·50, and the regular increase in the intensity of the yellow line in a mixture of argon and krypton. This line is in the region of the spectrum in which the eye has a maximum sensitiveness. The results are based on the proportion of krypton in atmospheric argon as found by Sir William Ramsay, but experiments are in progress to make up standard mixtures of pure krypton in pure argon. The minimum amount of krypton that it has been found possible to estimate is about 0·001 cubic millimetre in 4 four cubic centimetres of the krypton-argon mixture.—A. **Lafay**: The utilisation of the acetylene method for the measurement of the velocity of the wind and the study of the aërodynamic field. Comparison of the velocities measured by the vane anemometer and the Pitot tube, respectively, frequently give very discordant results. The method proposed by the author is based on the high refractive index of acetylene. A jet of acetylene is cut off periodically at known intervals of time, and the regularly spaced nebulosities photographed. The results obtained agree better with the indications of the vane anemometer than with those of the Pitot tube.—M. **de Broglie**: The lowering of the differences of the contact potential apparent between metals caused by the removal of the adherent layers of moisture.—M. **Dussaud**: New applications of low voltage bulbs. Some applications of the intense light obtained by tungsten wires in a high vacuum carrying 1 ampere at 15 volts. This lamp, using only 15 watts, may replace for some purposes an arc using 3000 watts.—Maurice **Joly**: Static frequency transformers.—André **Kling**: The influence of catalytic substances in the determination of vapour density. Different results are obtained in a Victor Meyer vapour density tube according to the presence or absence of a layer of calcined sand at the bottom of the tube. The sand in some cases causes a catalytic decomposition of the substance vapourised, and the vapour density is thus found too low. The replacement of the sand by other metallic oxides known to possess catalytic properties has been studied.—M. **Hanriot**: The nature of adhesivity.—Jean **Meunier**: The modification of the mechanism of flame by convergent combustion.—Mlle. E. **Feytis**: The magnetism of some complex salts.—W. Œchsner **de Coninck**: An attempt at the determination of the molecular weight of uranyl. Five determinations are given of the reduction of uranyl chloride, UO_2Cl_2, in hydrogen at a dull heat, the residual UO_2 being weighed.—V. **Auger**: The oxidation of iodine by hydrogen peroxide. In dilute solution and in presence of a trace of chloride, iodine is quantitatively oxidised to iodic acid by hydrogen peroxide. The iodic acid is recovered in a pure state by simple evaporation.—A. G. **Vournasos**: Some definite bismuthides.—E.

Fleurent and Lucien **Lévi**: A method for the exact determination of the ash in the analysis of vegetable and animal materials.—MM. **Taffanel** and **Durr**: The comparative study of combustible dusts from the point of view of their inflammability.—Const. A. **Ktenas**: An acid eruption at the centre of the *massif* of the Cyclades.—L. **Gain**: A new species of Monostroma coming from the South American Antarctic region.—MM. **Doyon**, A. **Morel**, and A. **Policard**: The direct extraction of hepatic antirhombine. The case of the rabbit refractory to the action of the peptone.—L. **Grimbert**: The separation of urobiline with its chromogen.—J. **Wolff** and E. **de Stœcklin**: A new mode of preparation of the catalase of the blood and on its properties.—W. **Nicati**: The capacity

$$VC = 0{\cdot}1(11 - V),$$

inverse decimal function of the visual angle.—J. P. **Bounhiol**: A hydrodynamic theory of the pseudo-migrations of the tunny fish (*Thynnus vulgaris*) in the Mediterranean.—J. **Deprat**: The classification of fusiline limestones in China.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part vi. for 1910, contains the following memoirs communicated to the society:—

May 2.—D. **Hilbert**: Outlines of a general theory of integral equations.

October 29.—O. **Wallach**: Researches from the Göttingen University chemical laboratory, xxiv.: (1) Reduction of unsaturated cyclic alcohols; (2) reduction of unsaturated ketones.

November 26.—W. **Voigt**: Changes in concentration of the solution of a magnetisable salt in a non-homogeneous magnetic field.

December 10.—P. **Furtwangler**: Researches on the last of Fermat's theorems and the division of the circle.—J. **Yoshikawa**: Boundary-value problems with three parameters.—J. **Yoshikawa**: A theorem in oscillations with two parameters.—E. **Hecke**: Real quadratic groups and automorphic functions.

DIARY OF SOCIETIES.

THURSDAY, MARCH 23.

ROYAL SOCIETY, at 4.30.—A Theory of Asymptotic Series: G. N. Watson.—The Ionization of Heavy Gases by X-rays: R. T. Beatty.—The Variation of the Ionization with Velocity for the β-Particles: W. Wilson.—The Causes of Absorption of Oxygen by the Lungs in Man: C. G. Douglas and Dr. J. S. Haldane, F.R.S.—The Influence of Planets on the Formation of Sun-spots: Dr. A. Schuster, F.R.S.

ROYAL INSTITUTION, at 3.—Giants and Pygmies: Prof. A. Keith.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electricity Meters with Notes on Meter Testing: H. A. Ratcliff and A. E. Moore.

FRIDAY, MARCH 24.

ROYAL INSTITUTION, at 9.—The Sidereal Universe: Sir David Gill, K.C.B., F.R.S.

PHYSICAL SOCIETY, at 5.—(1) A Sensitive Thermo Regulator; (2) Experiments on the Measurement of Electrolytic Resistances using Alternating Currents: Dr. H. F. Haworth.—(1) Oscillatory Currents in Coupled Circuits; (2) Some Radio-telegraphic Apparatus in Use at the City and Guilds (Engineering) College: Prof. G. W. O. Howe.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Uses of Chemistry in Engineering: James Swinburne, F.R.S.

SATURDAY, MARCH 25.

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

MONDAY, MARCH 27.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The New Geography: its Aims and Methods: H. J. Mackinder, M.P.

ROYAL SOCIETY OF ARTS, at 8.—Applications of Electric Heating: Prof. J. A. Fleming, F.R.S.

INSTITUTE OF ACTUARIES, at 5.—State Insurance against Invalidity and Old Age—the Actuarial Basis of the Austrian Method: G. W. Richmond.

TUESDAY, MARCH 28.

ROYAL INSTITUTION, at 3.—Explorations of Ancient Desert Sites in Central Asia: Dr. M. A. Stein.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Electrification of a Portion of the Suburban System of the London, Brighton and South Coast Railway: P. Dawson.—*Probable Papers*: 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, MARCH 29.

ROYAL SOCIETY OF ARTS, at 8.—Art Education in Jewellery, Goldsmithing, and Allied Trades: G. B. Heming.

BRITISH ASTRONOMICAL ASSOCIATION, at 5.

THURSDAY, MARCH 30.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Chemical Dynamics of Serum Reactions: Captain A. G. McKendrick.—Preliminary Note on a Method of Measuring Colour Sensations by Intermittent Light, with Description of an Unfinished Apparatus for the Purpose: Dr. G. J. Burch, F.R.S.—On Variation and Adaptation in Bacteria, illustrated by Observations upon Streptococci; with special reference to the Value of Fermentation Tests as applied to these Organisms: E. W. A. Walker.—On the Inter-relations of Genetic Factors: W. Bateson, F.R.S., and Prof. R. C. Punnett.—A Case of Gametic Coupling in Pisum: P. de Vilmorin and W. Bateson, F.R.S.—On Gametic Coupling and Repulsion in *Primula sinensis*: R. P. Gregory.

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

FRIDAY, MARCH 31.

ROYAL INSTITUTION, at 9.—Travelling at High Speeds on the Surface of the Earth and above it: Prof. H. S. Hele-Shaw, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Uses of Chemistry in Engineering: J. Swinburne, F.R.S.

SATURDAY, APRIL 1.

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

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