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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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INDEX.

Reviews and Our Bookshelf.

LITERARY SUPPLEMENT.

INDEX TO LITERARY SUPPLEMENT.

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NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

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THURSDAY, MAY 4, 1905.

SCIENTIFIC WORTHIES.

XXXV.—EDUARD SUESS.

AMONG the living leaders of geology none is more widely known and more highly honoured than Eduard Suess. The amount and value of his original contributions to science, the broad, philosophic grasp he has displayed of every department of research on which he has entered, the vivid, imaginative insight which has enabled him to marshal a multiplicity of scattered facts into connected order and sequence, the unwearied industry with which he has made himself acquainted with the geological literature of almost every country on the face of the globe, and the noble march of the literary style in which he has clothed not a little of his reasoning and speculation, have combined to give him a place apart, like that of one of the great masters in the heroic age of geology. Full of years and honours, and president of the Academy of Sciences, he still moves as the centre of the scientific life of Vienna, still enriches the world with his impressive pictures of the structure and history of the earth, and still manifests an ardent interest and enthusiasm in all that concerns the advancement of natural knowledge.

But for a wave of change in the world of commerce we might have claimed Suess as an Englishman, and his achievements might have added their lustre to the scientific fame of this country instead of Austria, for he was born in London and spent here the earliest years of his childhood. His father, who was a native of Saxony, had settled here as a German merchant, importing wool from Bohemia, and it was during the residence of the family in London that the eldest son and future geologist was born on August 20, 1831. When wool began to arrive in abundance from the vast sheep-runs of the Australian colonies, the trade in the Bohemian product declined so much that at last, in November, 1834, the Suess family left England for Prague. The father in 1845 became a partner in a great industrial establishment in Vienna, and that city was thenceforth the family home. It had been at first intended that the son should enter the same business, and accordingly at the end of the usual school training he was placed in the polytechnic school. But it soon became apparent that his natural bent did not lie in the commercial direction, but wholly towards natural history studies. As early as the year 1850, when he was only nineteen years of age, he ventured upon his first publication—a short sketch of the geology of Carlsbad and its mineral waters, specially prepared for the use of foreigners. So completely had his tastes now decided his future life that in the following year he was appointed an assistant in the Imperial Museum of Vienna, and thus made his formal entry into the official ranks of science. From that day until now the long intervening half-century, though uneventful in personal experiences, has been with him a time of ceaseless industry and fruitful research. A few more specially notable epochs in his career may here be noticed.

In the vast palæontological collections of the Vienna Museum Suess found a wide domain for the exercise of his powers of observation and comparison. He at first specially devoted himself to the study of the brachiopods of the Palæozoic and Mesozoic formations, and for some ten years continued to publish the results of his researches among these interesting and important fossils, but with incursions into other departments of the animal kingdom, which displayed a general enthusiasm for biological inquiry from the geological point of view. His zeal and ability were soon recognised by his being appointed in 1857, at the age of twenty-six, professor in the university. In 1862 he relinquished his post in the museum and devoted himself thenceforth to the duties of his chair. It was in this early part of his life that he entered upon those studies in palæogeography on which his scientific renown

now largely rests. As far back as 1863 he published a brief statement of the results to which his inquiries had led him as to the former connection of northern Africa with southern Europe. In 1855 he married the daughter of Dr. Strauss, a distinguished physician in Prague, and then entered on a life of great domestic happiness, which largely contributed to the success of a strenuous career wherein science and politics came to be strangely blended.

From his youthful days, when he described the Carlsbad springs, he had been interested in underground waters, and among the inquiries which he pursued while attached to the museum was one that embraced the relations of the soil and water supply of Vienna to the life of its inhabitants. In 1862 he published a small volume on this subject,[1] in which he gave a comprehensive account of the economic geology of the district. At that time the city was suffering from an impure water supply and consequent typhoid fever. The luminous essay of the young professor at once attracted attention. He was the same year elected into the town council, that he might give the benefit of his advice in the steps to be taken towards the attainment of better sanitary arrangements. He boldly advocated a scheme for bringing the abundant pure water of the Alps into Vienna by means of an aqueduct 110 kilometres in length. This project, eventually adopted, was brought to a successful termination in 1873. So grateful were his fellow-citizens for the signal service thus conferred on them that they bestowed on him their highest civic distinction by electing him an honorary burgess. By this time he had made his mark in the town council as one of its most useful and able members, so that it was not surprising that he should have been chosen as one of the parliamentary representatives. For more than thirty years he sat in the Austrian Parliament as a powerful leader of the Liberal party, only retiring in 1896, when advancing age made the strain of the two-fold life as a politician and man of science too great to be longer borne. When the political history of the country during the last half of the nineteenth century comes to be written, a prominent place in it will be given to Eduard Suess.

But it is his scientific work that has to be chiefly dwelt upon here. As an enthusiastic and able teacher he has exerted a notable influence on the successive generations of students at the university, until after forty-four years he resigned his professorship in the summer of 1901. Throughout his career he has shown a keen interest in those branches of geology which more especially deal with the evolution of the earth's surface features. The problems of mountain-building were suggested to him by his excursions among the eastern Alps, and in 1875 his views were so far matured that he published a little volume entitled "Die Entstehung der Alpen." This work contains the germ of those later contributions to science which have placed him on so conspicuous an eminence among the geologists of the day. It sketches the general principles of mountain-architecture, especially revealed by a study of the Alpine chain. But he did not confine his view to the particular area with which he was himself personally familiar. Already his eye looked out on the wider effects of the unequal contraction of the terrestrial crust, and swept across the European continent eastwards into Asia, and westwards across the Atlantic into America. He still held the general belief in the upheaval and depression of continental areas, and dwelt on the evidence of these movements in Scandinavia, which he has since rejected with much elaboration of argument. To thoughtful students of the science this treatise, in its firm hold of detail combined with singularly vivid powers of generalisation, was full of suggestiveness. But the interest and importance of its subject did not obtain general recognition until it was followed ten years afterwards (1885) by the first volume of the great "Antlitz der Erde"—the work which has chiefly given Suess his place among his contemporaries, and by which his name will be handed down to future time.

In its striking arrangement of subjects, in its masterly grouping of details which, notwithstanding their almost bewildering multiplicity, are all linked with each other in leading to broad and impressive conclusions, and in the measured cadence of its finer passages, the "Antlitz" may be regarded as a noble philosophical poem in which the story of the continents and the oceans is told by a seer gifted with rare powers of insight into the past. The order of treatment is not that of a systematic text-book. On the contrary, the casual reader who looks over the contents of the chapters might suppose them to consist of a series of desultory essays with no very clear sequence of thought. Yet a more leisurely study soon shows him how closely interwoven is the texture of the whole composition. He is astonished at the almost incredible range of literature which the author must have consulted, and he finds himself borne onward page after page by the luminous array of facts and the brilliant conclusions drawn from them. From the ancient traditions of the Deluge he is led through other human records, and made to see by what combination of physical conditions changes are worked on the surface of the earth. Upheaval and subsidence, volcanic eruptions, the elevation of mountain-chains, the depression of sea-basins, the structure and disposition of continents, the formation and boundaries of the different oceans in the past as well as at the present day, the successive plications that in the course of geological time have produced the land areas and mountain-ranges of the globe—in short, the gradual evolution of the existing topography of the surface of the globe—this vast theme is here treated with a fulness of knowledge and a breadth of view which are to be found in no other author.

The work at once commanded attention among the geologists of every country, and the influence of its

[1] "Der Boden der Stadt Wien nach seiner Bildungsweise, Beschaffenheit, und seinen Beziehungen zum Bürgerlichen Leben." (Vienna, 1862.)

teaching before long became apparent in geological literature. It was first translated into French in an edition which, thanks to the singular erudition of its editor, M. E. de Margerie, has been so enriched with footnotes as to become an invaluable work of reference for published papers in every department of the wide range of subjects whereof it treats. Within the last few months the first volume of an English translation by Miss Hertha Sollas, under the direction of her father, Prof. Sollas, of Oxford, has been issued by the Clarendon Press. The labours of Prof. Suess are thus placed within the reach of all English-speaking geologists in a version which reads more like an original treatise in our language than as the translation of a German work.

That in covering so wide a field as that of the "Antlitz" the author has necessarily had to rely on recorded observations of unequal value, and that consequently the deductions he has drawn may need to be corrected from subsequently obtained fuller and more accurate data, will doubtless be admitted by no one more frankly than by himself. But even in regard to questions which have long been discussed, and regarding which abundant facts have long been known, there is room for different interpretations from those which the professor has adopted. Thus the phenomena of submergence and emergence of land in Sweden and the basin of the Baltic are treated by him in great fulness and with much ingenuity, but he arrives at conclusions strongly opposed to those to which prolonged study has led the northern geologists. This problem is one of fundamental importance in regard to our conceptions of the nature of the movements to which the surface of the globe is subject, and it is much to be desired that some general agreement in regard to it should be attained.

Nevertheless, apart from differences of opinion, which are inseparable from the growth of such a science as geology, and even where one may be most disposed to dissent from the views of Prof. Suess, the transcendent value of his life-long labours is none the less vividly realised now by all who have studied his writings. Their importance in the history of science will assuredly be no less fully acknowledged by the future generations who will gain from them inspiration and enlightenment. Meanwhile, he has the satisfaction of abundant recognition from all civilised countries. The learned societies of Europe have vied with each other in doing him honour, and not the least prominent among them has been our own Royal Society, which ten years ago elected him as one of its foreign members, and in the year 1903 awarded him the Copley medal—the highest distinction which it has to bestow. The "Antlitz" is not yet completed, but the second part of the third volume is far advanced. Let us trust that years of rest and quiet work are in store for the illustrious geologist, and that he may live to finish his work amidst the hearty congratulations of the many fellow-workers who look up to him as their master. ARCH. GEIKIE.

THE RUDIMENTS OF BEHAVIOUR.

Contributions to the Study of the Behaviour of Lower Organisms. By Prof. Herbert S. Jennings. Pp. 256. (Washington: Carnegie Institution, 1904.)

THE author has been for about ten years a careful observer of the rudiments of behaviour which are exhibited by unicellular and other relatively simple animals, and we have read with interest several of his previous studies on the reactions of infusorians and the like to various sets of stimuli. The general impression conveyed was that infusorians and the like gave evidence of an exceedingly simple and stereotyped mode of behaviour—a mere reaction method. When effectively stimulated by agents of almost any kind, the animalcule moves backwards and turns to a structurally defined side of its minute body, while at the same time it may continue to revolve on its long axis. In relation to all sorts of stimuli, the behaviour seemed exceedingly simple and machine-like. But Prof. Jennings has been gradually discovering that the simple reaction-formula does not cover all the facts, and he now gives us news which seems almost too good to be true.

He finds that even among unicellulars "the behaviour is not as a rule on the tropism plan—a set, forced method of reacting to each particular agent—but takes place in a much more flexible, less directly machine-like way, by the method of trial and error." This is a momentous conclusion, notably in relation to comparative psychology. The data are foundation-stones for the science of animal behaviour, and the author is to be congratulated on his demonstration that the ways of even very simple creatures are more than series of "tropisms."

In his "Introduction to Comparative Psychology" (1894), Dr. Lloyd Morgan told the story of his dog's attempts to bring a hooked walking stick through a narrow gap in a fence. The dog "tried" all possible methods of pulling the stick through the fence. Most of the attempts showed themselves to be "error." But the dog tried again and again, until he finally succeeded. He worked by the method of trial and error; and so, Prof. Jennings now assures us, do the infusorians.

"This method of trial and error involves many of the fundamental qualities which we find in the behaviour of higher animals, yet with the simplest possible basis in ways of action; a great portion of the behaviour consisting often of but one or two definite movements, movements that are stereotyped when considered by themselves, but not stereotyped in their relation to the environment. This method leads upward, offering at every point opportunity for development, and showing even in the unicellular organisms what must be considered the beginnings of intelligence and of many other qualities found in higher animals. Tropic action doubtless occurs, but the main basis of behaviour is in these organisms the method of trial and error."

This is not the first time that the dawning of intelligence has been discovered in the Protozoa, but on previous occasions the discovery has been reported by casual observers or by investigators unacquainted with the tropisms. Prof. Jennings has made a special

study of the tropisms, and we find him declaring that it is almost impossible to describe the behaviour of the unicellulars intelligibly without using terms like "perception," "discrimination," and "intelligence." Of course these are used in an "objective sense," and "when their objective significance is kept in mind there is no theoretical objection to them, and they have the advantage that they bring out the identity of the objective factors in the behaviour of animals with the objective factors in the behaviour of man."

From our point of view, Prof. Jennings does not strengthen his position by using these pre-occupied psychological terms; "'perception' of a stimulus," he says, "means merely that the organism reacts to it in some way; 'discrimination' of two stimuli means that the organism reacts differently to them; 'intelligence' is defined by the objective manifestations mentioned in the text." But this does not seem to us the sound line of progress; it leads back to saying that the lucifer match perceives the sandpaper on the box. It seems safer, in the meantime, to say that infusorians alter their behaviour, and alter it effectively, in respect to their experience.

"Stentor does not continue reacting strongly to a stimulus that is not injurious, but after a time, when such stimulus is repeated, it ceases to react, or reacts in some less pronounced way than at first. To an injurious stimulus, on the other hand, it does continue to react, but not throughout in the same manner. When such stimulus is repeated, Stentor tries various different ways of reacting to it. If the result of reacting by bending to one side is not success, it tries reversing the ciliary current, then contracting into its tube, then leaving its tube, &c. This is clearly the method of trial and error passing into the method of intelligence, but the intelligence lasts only very short periods."

With such difficult subjects any evidence of the registration of experience was not to be expected, and the author is to be congratulated on having discovered considerable evidence in support of the thesis that the behaviour of unicellulars is largely a method of trial and error, one reaction by trial and error becoming the basis for a succeeding reaction. This is surely a pathway leading to the high-road of intelligence.

It is easy to make an inanimate system—a little potassium pill on a basin of water, or a tiny wound-up engine on a smooth table—which, once set a-going, will charge against an obstacle, will fail to overcome this, will recoil passively and charge again, and some observers have thought that, *mutatis mutandis*, the animalcule did little more. But Prof. Jennings has shown that the infusorian, in relation to its experience of "error," changes its little tactics, and changes them again, until it succeeds. In a word, it profits by experience. The very essence of vitality, as Spencer pointed out, is in effective response to environment; but when we find an infusorian "trying" one response after another, abandoning those that spell "error," we cannot but feel that vitality has been raised to a second power; it is just beginning to be intelligent. The infusorian is more than a tropic automaton, it is playing a little game of tactics; perhaps if we could educate one it would develop the rudiments of strategy. It is, of course, extremely difficult to keep to a scrupulous objective record of what occurs, but we incline to think that Prof. Jennings has supplied what comparative psychologists have been waiting for, namely, quite trustworthy accounts of the beginnings of selective or controlled behaviour.

"The method of trial and error involves some way of distinguishing error, and also, in some cases at least, some method of distinguishing success. The problem as to how this is done is the same for man and for the infusorian. We are compelled to postulate throughout the series certain physiological states to account for the negative reactions under error, and the positive reactions under success. In man these physiological states are those conditioning pain and pleasure. The 'method of trial and error' is evidently the same as reaction by 'selection of over-produced movements,' which plays so large a part in the theories of Spencer and Bain, and especially in the recent discussions of behaviour by J. Mark Baldwin. The method of trial and error, which forms the most essential feature of the behaviour of these lower organisms, is in complete contrast with the tropism schema, which has long been supposed to express the essential characteristics of their behaviour."

Instead of referring in detail to the author's studies—(1) reactions to heat and cold in the ciliate infusorians; (2) reactions to light in ciliates and flagellates; (3) reactions to stimuli in certain rotifers; (4) the theory of tropisms; (5) physiological states as determining factors in the behaviour of lower organisms; and (6) the movements and reactions of amœbæ—we have sought to explain the chief result of his studies in the infant school of life, and to emphasise its importance in relation to the general theory of animal behaviour. Prof. Jennings has rescued the animalculæ from the bonds of automatism too hurriedly thrust on them, and has afforded a secure basis for the study of the evolution of intelligence.

J. A. T.

MECHANISM.

Mechanism. By Prof. S. Dunkerley. Pp. vi+408. (London: Longmans, Green and Co., 1905.) Price 9*s.* net.

WRITERS of text-books on mechanism have, of late years, been much influenced by the views of Realeaux on the classification of mechanisms, and the present work shows clearly the impress of these views; but the author has not hesitated to depart from the order in which Realeaux presented his theory of machines in order to suit the needs of beginners, who are apt to find the elaboration of the systematic theory somewhat dry if not accompanied by a wealth of illustration drawn from actual machines, even if these contain elements the properties of which have not been fully explained.

The author, as appears from his preface, is fully alive to the difficulties which the logical treatment of the subject presents, and he expressly states that his work is not intended to be a philosophical treatise on the subject.

From this standpoint the arrangement of the sub-

ject-matter appears to be quite a proper one, for at the present time almost everyone is familiar with the elementary properties of gear-wheels, clutches, the mechanism of steam engines and the like, because of their increasing use in everyday life, and more especially of late, owing to their applications to self-propelled vehicles. On the other hand their less obvious, although not less important, properties are possibly not so well understood; thus, to take a single instance, the conditions to be satisfied in order to produce true rolling motion by gear wheels require a knowledge of the properties of various curves, and this latter subject may well be left to a later stage, as is done in the present work, although it need not prevent a study of machines containing gear wheels when this knowledge is not absolutely necessary for the purpose. The author has therefore described many machines using higher pairing quite early in the book, and has left the more detailed examination of some of the elements for later chapters; this adds very much to the general interest of the reader, while its drawbacks are small. The work opens with an introductory chapter in which the usual definitions occur relating to machines, kinematic chains, lower and higher pairs, and the like, and this is followed by a chapter which is exceedingly interesting on simple machines and machine tools.

Chapters iii. and iv. deal chiefly with mechanisms of the quadric crank and double slider crank chain forms, all those possessing important geometrical properties being grouped together. Naturally the pantograph finds an important place here, and to amplify this section there are descriptions of the copying lathe and also a machine on the same principle for drilling square and hexagon holes. In a future edition it might be worth while to insert, in a suitable place, an account of the epicyclic trains which form an essential part of some machines for turning nuts and bolts to a practically perfect square or hexagon section.

The next two chapters deal with velocity and acceleration diagrams, and we are sure that all students of mechanism will feel greatly indebted to the author for the clear manner in which he has presented this part of the subject. The remainder of the book deals with gear wheels, non-circular wheels and cams, and these are discussed on the usual lines. There is also a section devoted to gear-cutting machinery, which gives an interesting account of this special branch of machine tool work.

It is somewhat remarkable that no place is found in the book for the consideration of so fundamental a subject as the degrees of freedom possessed by a body and the applications which follow from a recognition of these principles in geometrical slides and clamps, such as are described in Thomson and Tait's "Natural Philosophy." Ignorance of these fundamental principles has been one of the most fruitful causes of bad design in mechanism.

The illustrations are mainly line drawings, exceedingly well adapted for descriptive purposes, and with a few exceptions the photographs of machinery are clear and distinct. A series of numerical examples at the end of the book will be of much value to students.

The author has succeeded in writing a valuable text-book on mechanism which will repay a careful study by engineers and others who wish to obtain a knowledge of something more than the elements of this branch of science. E. G. C.

PRACTICAL ELECTROCHEMISTRY.

Practical Methods of Electrochemistry. By F. Mollwo Perkin. Pp. x+322. (London: Longmans and Co., 1905.) Price 6*s.* net.

ELECTROCHEMICAL methods, both of analysis and preparation, have in recent years undergone such rapid development, and have reached such a degree of importance, that systematic instruction in their employment has become an indispensable part of the training of the modern student of chemistry. This book, therefore, forms a welcome addition to the ordinary laboratory manuals.

After a general account of electrical magnitudes and units, measuring instruments, and electrolytic apparatus, the author gives practical instructions for electrochemical analysis. The conditions for the quantitative electrodeposition of the individual metals are first discussed; then follows a section on quantitative oxidation and reduction at the electrodes, and, finally, directions are given for the separation of metals from mixed solutions of their salts. The last and longest section of the book deals with preparative electrochemistry. The primary subdivision of the subject is into the preparation of inorganic and of organic compounds, the latter section being treated in three chapters on organic electrolysis, reduction of organic compounds, and oxidation of organic compounds respectively.

The practical instructions are on the whole adequate and accurate, so that the student could acquire with little assistance a sufficient acquaintance with the working methods of electrochemistry. Whilst the book is satisfactory in this, the most important, feature, it shows in other respects many signs of hasty composition, which greatly detract from its value. For example, there are frequent evidences of haste in the treatment of electrical units. In the table on p. 9 the heading of the last column but one is "electrochemical equivalent per coulomb in mg. per sec."; the words "per sec." are not only superfluous but misleading. On p. 29 we find "1 kilowatt=101·93 kilogrammeters," and "1 horse-power is 75 kilogrammeters," where the words "per second" should have been added in both cases. Nothing is more detrimental to clear thinking on the part of the student than slipshod statements of this kind. Again, in the table of "useful data" on p. 286 we find "1 kilowatt=1000 watt-hours," and "volt × amperes=watts." Such data are the reverse of useful. A curious batch of mistakes is to be found on pp. 231–232. It is stated on p. 231 that the electrolyte for the preparation of diethyl succinate is "*acid* potassium or sodium malonate" instead of "*ethyl* potassium or sodium malonate." On the same page we twice find "*diethyl adipic acid*" instead of *diethyl adipate*, and on the succeeding pages a similar error

is repeated. On pp. 226–227 it is surely wrong to ascribe the formation of the trace of ethylene found during the electrolysis of an acetate to the same cause as that which produces the plentiful yield of ethylene during the electrolysis of a propionate. The fact that equation v. is divisible by 2, and that equation iv. is not so divisible, is almost in itself sufficient evidence that the actions are of essentially different character. It is somewhat surprising to find that the kathodic reduction of nitrites, nitrates, and arsenical compounds finds treatment under the heading "Metals deposited as Oxides at the Anode" (pp. 145–150). These and similar slips are minor blemishes; but it is to be hoped that the author will subject his book to a thorough revision for their removal when a second edition is called for.

The references to original papers are numerous, and a convenient table of five-figure logarithms, with instructions for its use, is contained in an appendix. The value of the table might be still further augmented by the inclusion of instructions for the use of the decadic complements of logarithms, a device of which the chemical student is almost invariably ignorant.

OUR BOOK SHELF.

Das Alter der wirtschaftlichen Kultur der Menschheit, ein Rückblick und ein Ausblick. By Ed. Hahn. Pp. xvi + 256. (Heidelberg: Carl Winter, 1905.) Price 6.40 marks.

In the opinion of Dr. Hahn, well known as the inquirer who revolutionised our ideas on the so-called "three stages"—hunting, pastoral pursuits, agriculture—the mass of the reading public will not change its traditional views on pre-history and primitive culture unless the specialist is prepared to do more for it than issue specialist literature. With the object of making propaganda for his views on the domestication of animals, the forms of cultivation, the transition from hoe-cultivation to plough-cultivation, the invention of the plough, the use of the ox as draught-animal, the share of woman in primitive culture, and especially the development of personal property, Dr. Hahn has written the present work, and his object in so doing is commendable. Even specialist literature, however, is not above all considerations of form and logical sequence of ideas; in an *oeuvre de vulgarisation* it is *a fortiori* necessary that there should be an orderly development of facts and of the conclusions to be drawn from them; and this, unfortunately, Dr. Hahn has not given us. Not only is the book in places indigestibly full of facts the connection of which with the main argument is not always made clear, but too much is attempted; to the list of subjects given above must be added the description of the economic conditions and interrelations of China, Babylonia, India, and Egypt, a discussion of the origin of the wheel and the waggon, much polemical matter, dealing with criticisms which the public has never read, and finally excursuses on the fiscal question, socialism, and other subjects unconnected with his immediate purpose. It would be unfair to deny that the book is interesting and stimulating, but it is rather a *causerie* than an exposition of the author's theories. This is the more unfortunate because his views on the domestication of animals, the forms of cultivation, and the stages of economic evolution are largely accepted. From mere lack of literary skill Dr. Hahn will leave his readers comparatively unmoved. As an example of the deficiencies of the book we may mention that the process of domestication of cattle is dismissed with a mention. Many of the author's theories are improbable; it is unnecessary to suppose that the curved horns imitating the shape of the crescent moon first led to the sacro-sanctity of cattle; there are animal cults everywhere. Personal property, even in vegetable food, was known before domesticated plants; the Australian natives store up *bunya-bunya* nuts. We do not need to look to the apparent motion of the stars for the explanation of the origin of Babylonian god-processions, which are a natural method of disseminating the holy influence. The connection of sexual ideas with agriculture may be secondary; syncretism is disregarded in this and other instances. It may not be out of place to say that a few maps of culture areas would have been very helpful, and not to the general reader only.

N. W. T.

Infantile Mortality and Infants' Milk Depôts. By G. F. McCleary, M.D., D.P.H. Pp. xiv+135. (London: P. S. King and Son.) Price 6*s*. net.

The publication of the evidence before the Inter-Departmental Committee on Physical Deterioration has directed general attention to such subjects as infant feeding. The decreasing birth rate and the appallingly high death rate among infants are dealt with by the author in the earlier chapters of his book.

An increasing number of mothers are unable to nurse their children, so that some method of artificial feeding has to be adopted. The death rate in 1904 among children under one year was 146 per 1000 births, and even these figures by no means represent the total evil, for many of the survivors must be seriously affected. How can this fearful waste of life be stopped? Dr. McCleary deals with one solution, viz. the establishment of depôts worked by the municipality and partially rate-supported. It is generally agreed that cow's milk is the best substitute for human milk. Various opinions are held as to the degree of modification that may be necessary, but pure cow's milk is the *basis* from which to work.

Even if a pure milk were on the market the poor could not afford to buy it. The question of State assistance arises. Dr. McCleary leaves the moral question as to whether it is for the ultimate good of a people to relieve them of their parental duties. Within the compass of 130 pages he wisely restricts himself to the practical working of the depôts, and as he speaks with knowledge of the Battersea depôt his testimony is of interest. In France the milk depôt system is carried out to a considerable extent, unmodified sterilised milk usually being supplied (Budin's method). In America the tendency is to follow Rotch in giving modified unsterilised milk.

The author repeats the necessary warning that a dirty milk is not made clean by sterilisation, and from this it follows that no depôt is on a satisfactory basis unless it has absolute control of its own milk supply. Dr. McCleary advocates much more stringent supervision of the general milk supply, and the establishment of municipal depôts on the lines of that at Rochester, U.S.A.

The book is well illustrated.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Parts i. to v. Pp. iv+146. (Sydney: W. A. Gullick, 1903–4.)

The classification of the Australian eucalypts presents similar difficulties to those which confront the botanist who undertakes the arrangement of the Hieracia or Rubi of our native flora, with the additional disadvantages that the eucalypts are trees or shrubs, and their distribution is more extensive. In the cir-

cumstances it is natural that monographers should have expressed diverse opinions as to the limits of the species, and that different characters and parts of the plant should have been taken as a basis for classification. Bentham grouped the species according to the shape and mode of dehiscence of the anthers, and von Mueller followed his lead. Prof. Tate has proposed a system based upon the structure of the fruit, whilst of vegetative characters, the cotyledons, leaf-veins, stomata, gums, and timber have all been tested in the hope of finding satisfactory criteria. Mr. Maiden attaches considerable importance to the bark and timber for the guidance of the forester, but recognises that the anthers and fruit are the best characters for the systematist.

In the present monograph the object of the author has been to include, with a description of the important characters, the substance of all recorded observations and investigations which might assist in determining the position and value of species or varieties. Synonyms are considered in detail, with the original description of each where it has been proposed as a species, and the range of each species is noted; finally, the author's views are crystallised in a discussion of the affinities of allied species. These views are based not only on the examination of specimens from important herbaria, but also upon much careful study of the growing trees in their native localities. Whilst recognising the desire of the author to render the work as comprehensive as possible, it must be said that its practical value would be increased by a considerable reduction in the amount of material, in the size of print and in the spacing. The five parts issued amount to 145 pages, and contain twenty-four plates for eight species, so that the complete work will be bulky and exclusive as to price. It may be suggested that a supplement to this treatise in the shape of a compendium suitable for foresters and students generally would be most useful.

Hymenopteren-Studien. By W. A. Schulz. Pp. 147. (Leipzig: Engelmann; London: Williams and Norgate, 1905.) Price 4*s.* net.

THE present work consists of three essays, the first relating to African Hymenoptera (chiefly Vespidæ and Fossores), the second describing new genera and species of Trigonalidæ, and the third discussing Vespidæ and Apidæ from the Amazons. The work is chiefly descriptive, and will hardly appeal to any but specialists, who must of course consult it when working at the faunas and groups which are discussed in it.

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 High-frequency Electrical Treatment.

THE inquest on a lady who died in the Charing Cross Hospital on April 11 must be of interest to those who employ the high-frequency electrical treatment. The report of the case in the *Standard* of April 17 is as follows:—"On April 11 she (the deceased) was under treatment, lying on the electrical couch. Suddenly witness observed the perspiration break out on her face, and immediately stopped the current. He watched her for a while, and as she seemed to be in a collapsed state he administered a spoonful of sal volatile. Then he recognised symptoms which pointed to 'a serious state of affairs,' and sent for Dr. Bailey. The lady was removed to another ward and died in the evening. Death was caused by hemorrhage of the brain, following a rupture of an artery. This was not a consequence of the electrical treatment; she would probably have died just the same if she had been sitting in the waiting-room, instead of on the electrical couch. It was a mere coincidence. Dr. Bailey and Dr. Freyberger gave evidence supporting this view of the case." The treatment was that of the high-frequency electrical current.

Now that high-frequency electrical discharges are much employed in medical work, being the newest and most up-to-date method of treatment for many diseases, it is somewhat important that even "mere coincidences," such as that cited, should not be overlooked or treated lightly; it is only by collecting evidence on such points that any real knowledge respecting the action of the treatment can be obtained. Shortly after the experiments of N. Tesla on electrical discharges, I carried on many experiments on the subject, and from somewhat painful experience I have learned that one source of trouble may be overlooked by many, since it is a secondary action, so that while the utmost attention may be given to the behaviour of the discharge itself, but little may be given to the action of the air which has been subjected to an electrical discharge. The danger of breathing such air was pointed out by me long ago (NATURE, 1896), and by many other workers with electrical discharges since then. Air which had been acted on by the high-frequency discharge, when breathed, caused irritation to the throat and lungs, and a feeling of suffocation, in some cases very severe. This is rather to be expected, since ozone and ozonised air act on blood, albumen, and organic substances readily. Profs. Roscoe and Schorlemmer write thus in their treatise on "Chemistry," p. 243, vol. i. (subject, ozone):—"Whilst blood is completely decolorised, the albumen being entirely, and the other organic matters being nearly all destroyed.")

The trouble mentioned was removed to a considerable extent by inducing a strong draught of warm air across the chamber where the apparatus was used. I feel that I am taking a great liberty in suggesting anything to the high-frequency specialist, who will give me at once the reason why self-induction is expressed as "a length," and why a rapidly varying electromagnetic field causes flashes of light to be seen when the head is placed in such a field. I would suggest that in connection with the method of treatment with the high-frequency discharge, all evidence of new phenomena should be collected and sifted in a scientific spirit, whether it be for or against it.

Operators now take every possible precaution to guard themselves against the evil effects of the X-ray, which at first was treated as quite innocuous. May not the high-frequency discharge in a modified form have a somewhat similar kind of action, and should it not be treated with as much, or at least some, caution?

F. J. JERVIS-SMITH.

The Critical Temperature and Pressure of Living Substances.

IT is well known that living substance is in a labile state, its constructive or destructive metabolism being determined by minute changes, sometimes of temperature or pressure, sometimes of other dynamic conditions. But Mr. Geoffrey Martin's suggestion (NATURE, April 27, p. 609) that the lability is due to the great number of atoms in the molecules of living substance, or to the complex "carbon compounds" present, gives only a partial explanation.

The decomposition of a chemical compound under raised temperature, diminished pressure, &c., depends not only on the size and complexity of the molecules, but also on the tendency of the atoms to re-arrange themselves and form more stable compounds, generally with dissipation of energy. For instance, the paraffins with large molecules are fairly stable, the products of their decomposition being hydrocarbons still. Fatty acids with equally large molecules are less stable, for there is a tendency to split off substances of higher oxidation, leaving a hydrocarbon residue. This tendency increases with the increase of oxygen in compounds, and so the small molecule of glucose is less stable than the large molecule of fatty acid. The presence of nitrogen is often a cause of instability, especially when the nitrogen forms a link between elements (or groups) of opposite polarity; and the instability is most marked when the nitrogen is combined with oxygen on the

one hand, and with carbon and hydrogen on the other, as in the explosives, *e.g.* nitroglycerine.

Living substance has apparently all the above mentioned sources of instability, and perhaps not the least important is that it has for its pivot nitrogen, the element which above all others is remarkable for the lability of its compounds. I have elsewhere [1] indicated the probability that the active molecule of living substance consists of an enormous complex of proteids, carbohydrates, &c., linked together by means of the nitrogen atoms, and that the oxygen store is more or less combined with the nitrogen. At the death of the molecule its constituent groups (proteids, &c.) are released, and the store of oxygen passes from the nitrogen into other and more stable forms of combination.

F. J. ALLEN.

Cambridge.

Chalk Masses in the Cliffs near Cromer.

AT the present time the cliffs near Cromer exhibit some interesting chalk masses in the Glacial drifts. Between East and West Runton Gaps are several of great size and remarkable in position. One, a very long slab-like mass, is bent from being nearly horizontal until it is almost vertical, and thus comes to within a short distance of the top of the cliff. The masses near Trimingham will now repay a close study, for they have changed greatly during the last five years. Both my friend, the Rev. E. Hill, and I have made notes and rough sketches, with the intention of sending to the *Geological Magazine* a short account of what can now be seen; but we earnestly hope that some geologists who are adepts at photography will visit both localities at the earliest possible opportunity, in order to secure a permanent and accurate record of these exceptionally interesting sections.

T. G. BONNEY.

The Rigidity of the Earth's Interior.

THE letter of Dr. T. J. J. See (NATURE, April 13, p. 559) deals with a subject of profound interest to students of the larger problems connected with physical geology. But it appears that, in Dr. See's treatment of the subject, he has overlooked an important point, which I dealt with in a paper read before Section C of the British Association at Birmingham in 1886. Therein I directed attention to the fact that "gravitation" is only a special instance of the law of universal attraction, and as a corollary to this, at any considerable depth within the sphere of the earth, an appreciable factor of what I may call negative gravity must be allowed for, owing to the counter-attraction of the mass of matter situated nearer the surface of the sphere; so that a body placed at the centre of gravity of the earth, whatever its mass or density, would have no weight at all.

I am glad to see that the consideration of "critical temperatures" of *quasi*-solids (the importance of which was emphasised in my little work on metamorphism some fifteen years ago) is receiving serious attention, and I may also point out that the idea of a potentially liquid (or even gaseous) condition of a mass at depths in a practically rigid state is not new; it was treated in a masterly way by Prof. Albert Heim, of Zürich, some twenty years ago, in his magnificent work "Ueber den Mechanismus der Gebirgsbildung." "Ueberlastet" is the word used by Heim to express such conditions, where the pressure is so far "hydrostatic" as to consist of compression acting equally (for the time being) in all directions. Any disturbance in a given portion of the lithosphere of the equilibrium thus existing must result in *shearing movement* if the disturbance be small, and in *flow* in a given direction if the relief in that direction from pressure is great and rapid enough. In the former case we should get "metataxic change," in the latter schistosity; for I still challenge the statement, made recently by a high authority, that "it is only a question of degree between the cleavage of a slate and the foliation of a crystalline schist or gneiss."

Questions relating to tidal action in the rotating lithosphere, and even Lord Kelvin's oft-repeated objection on that ground to the impossibility of any considerable portion of the lithosphere being fluid, because the earth does not undergo the deformation which the physicist would expect owing to the tidal action which should be set up within it, might possibly be seen in a fresh light on taking into account the remarkable facts demonstrated by Prof. John Perry in his lecture on spinning tops, which he gave to an audience of working men on the occasion of the meeting of the British Association at Leeds in 1890. As a "working man" in a real sense of the word, I considered myself privileged to attend that lecture, and was rewarded by finding in my own mind a great difficulty cleared up by Prof. Perry's masterly demonstrations of the practically rigid condition of non-rigid bodies, if only made to rotate with sufficient rapidity, as the equatorial regions of the earth do—something like 1000 miles an hour.

Bishop's Stortford, April 17.

A. IRVING.

[1] Report Brit. Assoc., 1896, p. 983; and *Proc. Birmingham Nat. Hist. and Philos. Soc.*, 1899.

Rival Parents.

A CURIOUS example of the rival claims of a pair of thrushes and a pair of blackbirds for the parentage of a young blackbird is being observed in my garden.

A pair of blackbirds built a nest in a small thick laurel, and in another shrub, some 4 feet off, a pair of thrushes also built a nest. The young in both nests were hatched out at the same time, and were successfully reared until they were some eight or nine days old, when a cat attacked the nests (Monday, April 17), killing all the young thrushes and all the blackbirds except one, which was found hidden under the shrubs. It was continually visited after the tragedy by both the old thrushes and old blackbirds, and two or three hours later was removed in some way not observed to a shrubbery twenty or thirty yards away. There for the last five days it has been fed and looked after by both pairs of birds, who mob with exceptional vigour any intruding cat or dog. The young bird seems to have thriven mightily under the attentions of its true and foster parents, who appear in no way to be jealous of one another.

KENNEDY J. P. ORTON.

University College of North Wales, Bangor, April 21.

The Measurement of Mass.

IN the notice of my little book, "Radium Explained," on April 6, twenty-nine lines are devoted to showing that I have reached a wrong conclusion through not knowing that mass is measured by inertia, and I am corrected in these words:—"how is the quantity of matter to be ascertained? The choice practically lies between defining mass by inertia at a given speed or by gravity. . . . As, however, gravity depends on local circumstances, while inertia (at given velocity) does not, the latter property is preferred for the definition of mass, as being more fundamental." So far from rejecting this principle, I state it, in almost the same terms, on p. 84 of my book:—"Mass, or quantity of matter, is usually ascertained by weighing. But weight is merely the force with which the earth attracts, and this varies with our position on its surface. To get an absolute test of mass, which would be independent of position, we may measure the force required to move or stop a body at a certain speed." And nowhere in the book have I supported any argument by the repudiation of the principle here clearly stated. This is a question of fact; the other objection taken is equally ill-founded, but, being on a controversial point, it cannot be dealt with so briefly.

W. HAMPSON.

West Ealing, May 1.

Properties of Rotating Bodies.

PROF. W. H. PICKERING, in NATURE of April 27 (p. 608), refers to the property which a rotating body possesses of assimilating, in certain circumstances, its axis of rotation to a secondary axis of rotation or revolution impressed upon it, and he mentions the fact that this property is rarely described.

It was fully discussed in an elementary lecture given by Prof. Perry at the Royal Institution about fifteen years ago, and afterwards published in the Romance of Science Series under the title "Spinning Tops."

E. W. ROWNTREE.

20 Queen Square, W.C., May 1.

RECENT SPECTROHELIOGRAPH RESULTS.

IN a previous number of this Journal (vol. lxix. p. 609, 1904), under the heading of "A New Epoch in Solar Physics," I gave an account of the magnificent work that Prof. Hale had recently been accomplishing at the Yerkes Observatory with his latest form of spectroheliograph, the instrument being worked in conjunction with the great 42-inch Yerkes refractor, which forms an image of the sun seven inches in diameter.

In the present article it is proposed to give a brief description of another instrument based on the same principle, an account of which was published by M. Janssen, and to indicate some of the results which have been obtained with it. This instrument has been at work at the Solar Physics Observatory during the past year, and in a recent communication to the Royal Astronomical Society I gave a more full account of it, to which reference can be made for more detailed information than is here given.

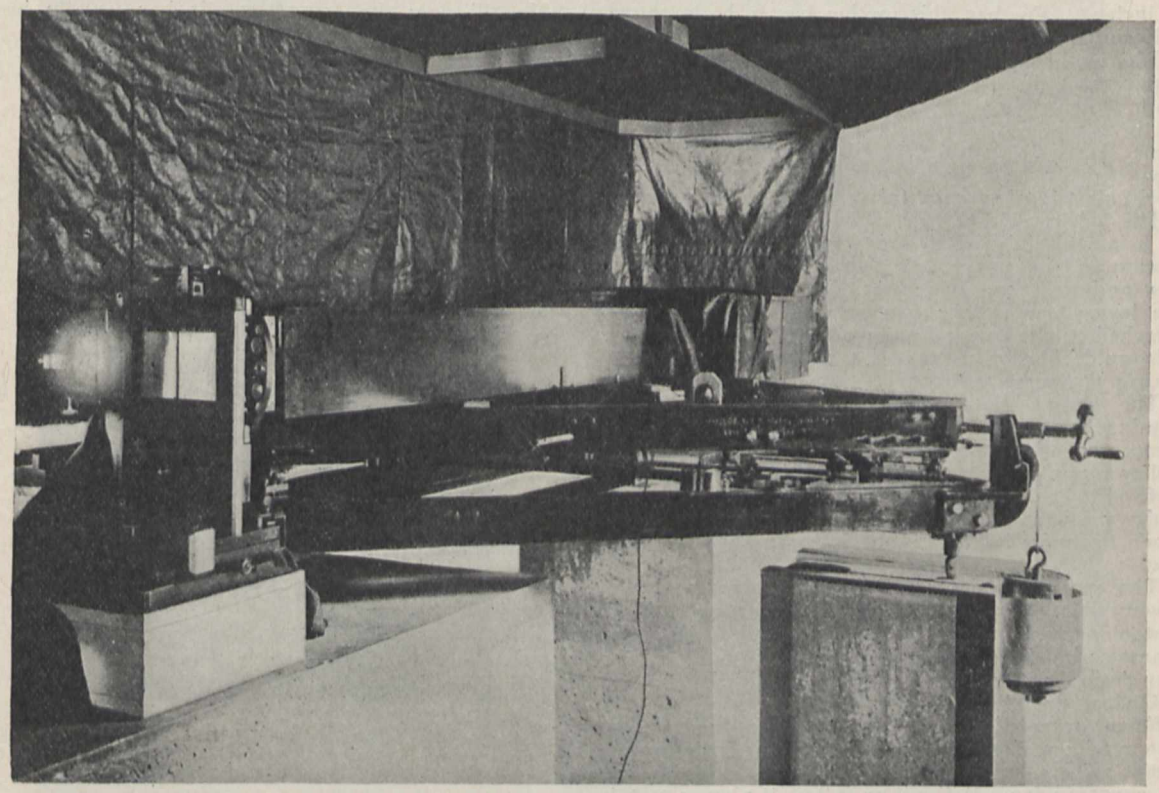

FIG. 1.—The spectroheliograph, showing the general arrangement of the two slits, the collimating and camera tubes, the moving (upper) and fixed (lower) triangular frameworks.

It is not necessary in this place to refer at any length to the principle which underlies the construction of a spectroheliograph, since this was referred to in the article above mentioned. It will suffice here to say, therefore, that the pictures produced by this new method of solar research give us photographs of the sun in monochromatic light, or in rays of any particular wave-length that is desired. Thus if we require to study the distribution of hydrogen on or around the solar disc we employ a line in the spectrum of hydrogen, if calcium a calcium line, or iron an iron line.

There are, however, several methods of using the spectroheliograph. This instrument may either be employed in conjunction with a large equatorial, in which the solar image is moved across the primary slit by means of the declination motor which moves at the same time and rate the photographic plate; or the primary slit, and with it the whole spectroheliograph, may be moved across the image formed at the focus of the equatorial. The first method is that adopted at the Yerkes Observatory, and the second that at Potsdam.

There is a further method in which a stationary solar image is formed by means of a siderostat and lens, and the spectroheliograph is mounted horizontally and moved in an east and west direction across this fixed image. Such a mode of procedure is that employed at South Kensington.

The advantage of the last mentioned arrangement is that there is no limit to the size or weight of the spectroheliograph; the uniform motion required can be easily and efficiently secured, and lastly, this motion does not in any way affect the steadiness of the solar image under examination.

The South Kensington instrument was erected in the year 1903, but it was not until last year that satisfactory photographs were secured and routine work begun. This success was due to the use of a larger lens (12-inch) for throwing the solar image on the primary slit, the previous lens of 6 inches aperture not giving a sufficiently bright image.

In this curtailed description of the instrument reference of any length need only be made to the spectroheliograph proper. There is nothing particularly novel about the siderostat, except, perhaps, its more than usual size, the large mirror of 18 inches diameter, the two small motors for operating the slow motions in right ascension and declination, and a modified form of Russell control for regulating the speed of the driving clock. This instrument is

placed in a separate house the upper portion of which can be rolled back towards the north. Some distance due south of this, in another building, is the 12-inch Taylor photo-visual lens mounted on a concrete pillar, and still further south, and in the same building, is the spectroheliograph, also mounted on concrete pillars.

Wtih this arrangement the solar beam is thrown by the siderostat mirror continuously due south and in a horizontal direction; this beam then falls on the 12-inch lens, and the solar image in the focus of this lens is thrown on the primary slit plate of the spectroheliograph.

In order to analyse the solar image by allowing each portion of it to fall successively on the primary slit, the latter, and consequently the whole of the spectroheliograph, has to be moved horizontally in an east and west direction, a distance a little more than the diameter of the solar image (in this case 2¼ inches). Further, this motion has to be extremely uniform.

The method adopted to accomplish both of these requirements is as follows:—A triangular iron framework (Fig. 1) is supported on three levelling screws on three concrete pillars. A second framework of the same size and material is placed on the first, but separated by steel balls free to roll between small steel plates fixed to each framework near the corners.

The longer side of this isosceles triangle is placed in a north and south direction. The direction of motion of the upper framework is restricted to an east and west line by means of a guide bar fixed to the lower framework; two small levers with rollers attached to the upper framework are pressed against this guide bar by means of small weights, thus ensuring the correct direction.

The actual motion of the upper framework is obtained by weights attached to one end of a steel strap the other end of which, after passing over a pulley mounted on an arm on the lower framework, is fixed to the western corner of the upper framework. This weight always tends to pull the upper framework towards the west, that is towards the right in Fig. 1.

The motion is controlled by a plunger projecting downwards from the upper framework operating a piston in a cylinder full of oil attached to the lower framework. The outlet valve can be so adjusted that any desired rate of motion can be obtained.

Owing to changes of temperature of the oil, different rates of movement can be obtained for any one reading of the micrometer head regulating the outlet valve. It is necessary, therefore, when making an exposure for a "disc" or "limb" picture to take the temperature of the oil into account. This is accomplished by employing a table, made from previous "runs," in which the valve setting can be directly read off from the temperature reading and the required length of exposure.

It is on the upper framework that the optical parts of the spectroheliograph are placed. These consist of a double tube carrying the two slits (Fig. 2) at the northern or siderostat end and the two lenses (4-inch) of equal focal length at the southern end. The dispersion is produced by a single prism of 60°, and a reflector is inserted in the system in order to make the total deviation of the beam 180°. Thus the part of the solar image which passes through the primary slit falls on the collimating lens, is reflected by the 6-inch mirror on to the prism, traverses the latter, and finally, after passing through the camera lens, is brought to a focus in the plane of the secondary slit in the form of a spectrum. By isolating any particular line in this spectrum by means of the secondary slit (Fig. 2) the solar image can be analysed in this wave-length.

For photographing the whole disc of the sun or its immediate surroundings with one exposure the lengths of the slits must be greater than the diameter of the solar image (2¼ inches); in the present case they are 3 inches long. Further, owing to the fact that the lines in the spectrum are curved, the secondary slit jaws are curved to the same radius; this necessitates very accurate adjustment of the secondary slit on the line, and means are provided to facilitate such requirements.

In order to obtain a photographic record of the sun in monochromatic light, a fixed photographic plate is held by means of a wooden support as close to the secondary slit as possible (Fig. 2). In this way, as the primary slit moves over the stationary solar image, so the secondary slit traverses with equal speed the stationary photographic plate.

Up till now the secondary slit has usually been

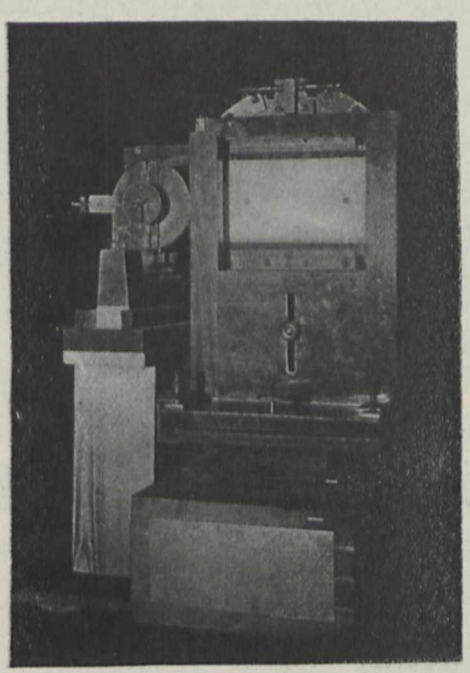

FIG. 2.—The primary slit is on the left and the secondary behind the plate carrier is seen on the right. This illustration shows also the metal disc in position for a "limb" exposure.

adjusted on the "K" line of calcium by eye estimation aided by a small watchmaker's lens, a check being made by taking a photograph of the spectrum, if possible with a sun-spot region, on the primary slit. On bright days this setting can be made with little difficulty, but during the late autumn, with a low sun, the "K" region of the spectrum is not easy to see, and the setting is in consequence very uncertain. A new method just brought into operation entirely eliminates this difficulty, for at a constant distance on the red side of the "K" line a small glass plate has been set with a cross engraved on its surface which can be adjusted on a known line in the more visible region of the spectrum. By bisecting a particular line with the cross the "K" line is adjusted on the slit jaw simultaneously.

The photographs taken during the past year have been of two kinds, the first to investigate the distribution and area of the calcium clouds, or flocculi as Prof. Hale has termed them, on the sun's disc, and

the second the distribution and forms of prominences round the limb. To obtain the latter, a metal disc just a little smaller than the solar image is placed close up to the primary slit plate (Fig. 2), and retained there by a metal wire fixed to a firm base; this disc is so adjusted that it is concentric with the solar image. While in use it becomes extremely hot, and it is therefore necessary that it be made of metal and riveted to the wire which supports it. These limb pictures, an example of which is given in Fig. 3, are

Without entering into too minute details, the following brief summary of the more salient facts derived from a general survey of the photographs taken during the past year may be given.

Dealing with the "disc" pictures in the first instance, all of them show a "mottling" of very definite character extending from the equator to the poles. Nearer the equatorial regions this mottling seems to become exaggerated in size in patches, some of the interspaces becoming filled up, giving rise to

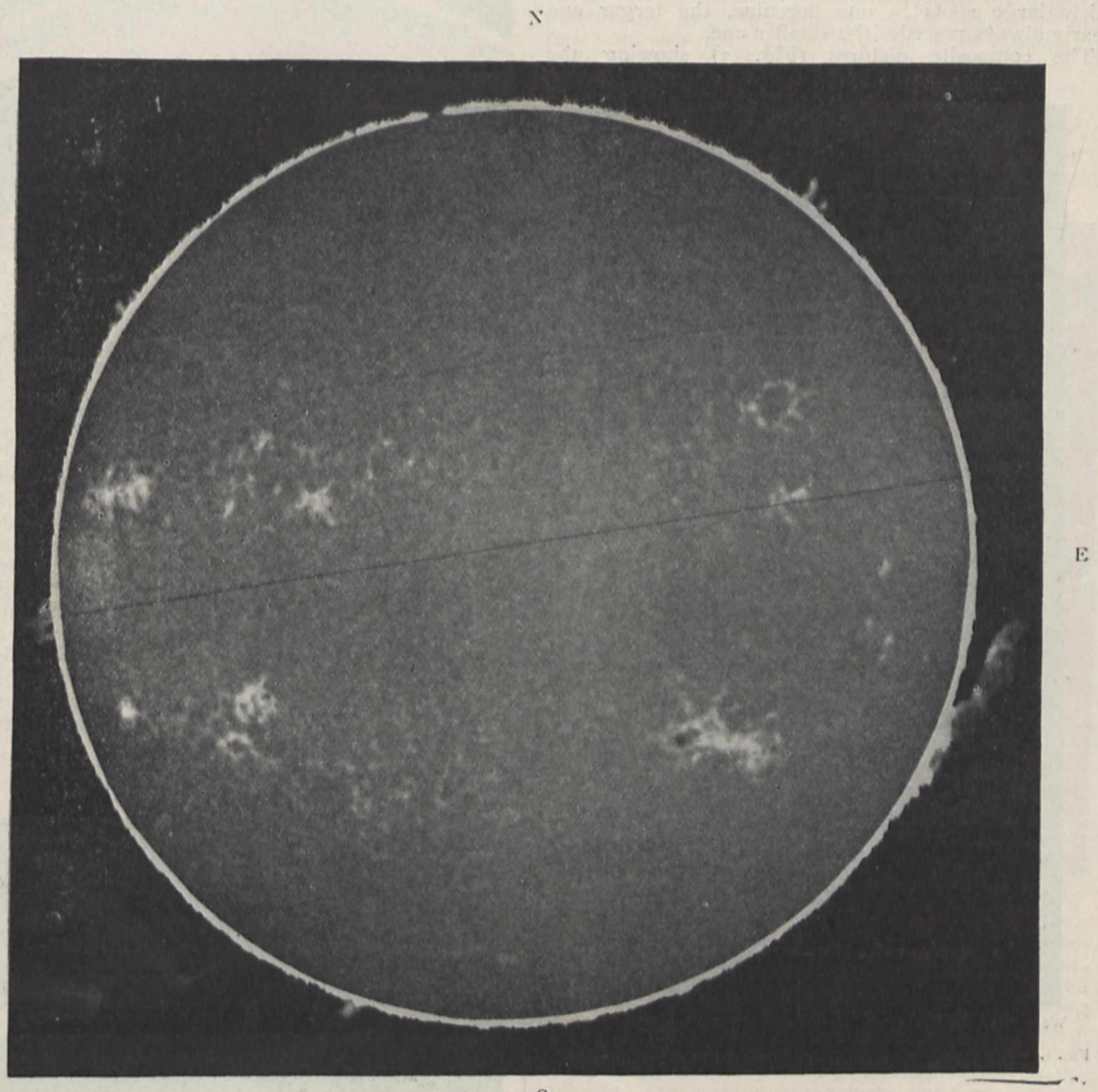

FIG. 3.—Limb and disc of sun in "K" light, July 19 Limb exposed from 11h. 36m. to 11h. 52m. (interval 16 m.); Disc exposed from 11h. 53m. 30s. to 11h. 53m. 48s. (interval 18 s.). Enlarged nearly 2½ times.

of a composite nature in that after the exposure of the limb has been made the metal disc is removed from the primary slit, and a "disc" exposure is made on the same plate. It has been found by experience that a "limb" exposure requires about sixty times the time that is necessary for a "disc" exposure. Under very favourable conditions fifteen seconds is necessary for the latter and fifteen minutes for the former.

the prominent flocculi, many of which clearly indicate the mode of structure. Fig. 3 gives an idea of their appearance in the photographs. It will be seen that there are frequently long streaky bright portions springing apparently from a central nucleus and having subsidiary ramifications. A three-legged formation is a very common type of structure in many of the photographs.

These flocculi, in the first instance, exist alone, but

in some of them spots appear at a later stage. No spot has been photographed unaccompanied by a flocculus; in fact, the duration of a spot is only a brief interval in the life-history of a flocculus.

Another interesting subject of inquiry is the position of a spot in relation to the flocculus. Spots more generally make their appearance near the head of, or, in other words, precede the apparently trailing masses of the calcium clouds with respect to the solar rotation, which is from east to west. Some examples of these are given in Fig. 4. When there are two fairly large spots in one flocculus, the larger one nearly always precedes the smaller one.

The composite pictures (Fig. 3) showing the

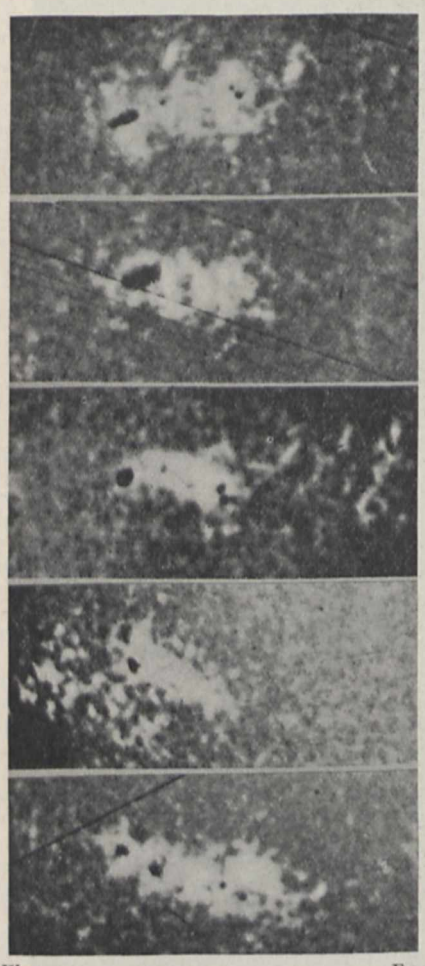

FIG. 4.—Typical cases of spots situated in the front portions of flocculi.

"limb" and "disc" have also brought to light many interesting points which call for further inquiry. In the first place prominences both near the solar poles and equator give strong images in calcium light. Secondly, prominences, which occur nearer the solar poles than the flocculi, do not appear to disturb the regular mottling on the disc in these high latitudes.

Again, an intense flocculus, when on the limb, is not always accompanied by a large prominence. These two last mentioned facts seem to indicate that flocculi and prominences are not always interdependent phenomena.

On continuous fine days, when several photographs of the limb are secured, an opportunity is afforded of studying the changes in the form of large prominences after intervals of a few hours. Two examples of such changes are here illustrated and briefly described. In Fig. 5 we have two photographs (only the portions of the limb indicating the particular region of the sun in question are shown) which were taken on July 14, 1904, at 11h. 8m. a.m. and 12h. 8m. p.m. respectively. It will be noticed that during this interval of about one hour a startling change has occurred to the largest prominence; not only has its height been considerably increased, but its form has entirely changed. The material radiating the calcium light seems to have been ejected from the chromosphere and then to have apparently met a strong current moving polewards (that is, from left to right in the figure) which has thrown this material in that particular direction. The change of height from about 50,000 miles to 60,000 miles in this interval corresponds to a velocity of nearly three miles a second.

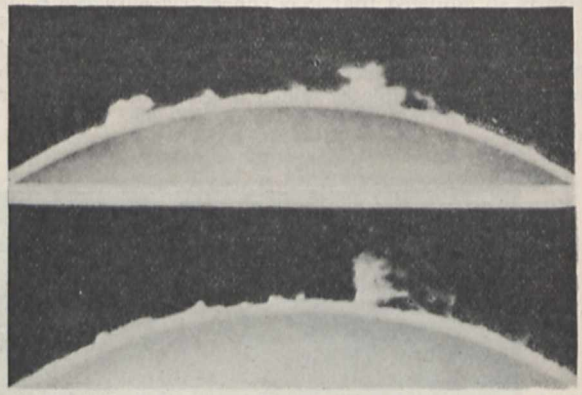

FIG. 5.—Showing changes in prominences after an interval of one hour. (Lower picture taken last.)

Not less interesting is the apparent disappearance of the second large prominence in the figure situated on the left.

Another example of a change of form of an enormous prominence photographed on July 19 at 11h. 45m. a.m. and 3h. 59m. p.m. respectively is that shown in Fig. 6. This prominence was situated in the south-east quadrant. The approximate dimensions

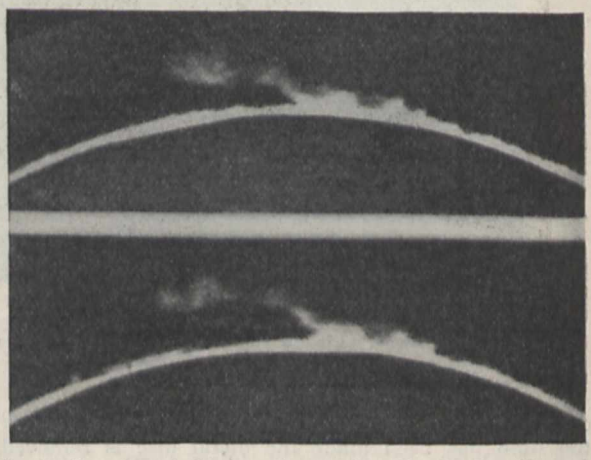

FIG. 6.—Two views of a large prominence taken with a four hours' interval between them. (Lower picture taken last.)

as deduced from measurements of the photographs were as follows:—

Time h. m.		Length in miles		Height in miles
11 45	...	192,000	...	55,000
3 59	...	216,000	...	60,000

When it is mentioned that our earth has a diameter a little less than 8000 miles, an idea of the magnitude of this solar disturbance can be roughly grasped.

An interesting point to notice further in the original is the apparent falling towards the limb of the material forming the highest part of the prominence in the lower picture.

Enough, perhaps, has now been written to give the reader an idea of the instrument at work, and a few deductions from the photographs obtained during the summer months of the past year.

When it is considered that the results described, and others of which no mention has been made, only apply to the photographs secured with the "K" line of calcium, and that other lines in the solar spectrum, such as hydrogen, iron, magnesium, &c., still remain to be examined, some notion of the vast field of work open to investigators becomes apparent.

To avoid too much duplication of work beyond what is absolutely necessary, steps should be taken as soon as possible to subdivide the labour. The past year has seen the formation of a representative body to undertake such a scheme, and it is hoped that more instruments will soon be erected and at work to cope with the large demand of facts relating to our sun rendered now possible by the pioneer work of Prof. Hale and M. Deslandres.

WILLIAM J. S. LOCKYER.

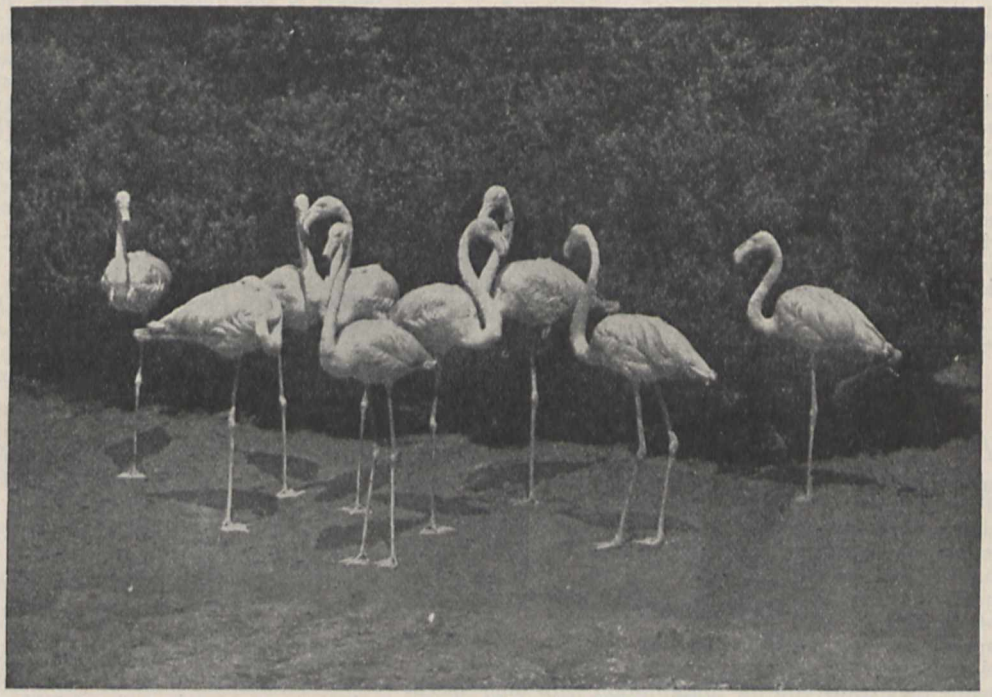

FIG. 1.—Flamingoes in the Regent's Park. From Beddard's "Natural History in Zoological Gardens."

THE TEACHING VALUE OF MENAGERIES.[1]

SO far as the general public is concerned, there is always a very considerable danger lest menageries should be regarded merely as places of amusement and curiosity, and that their great value as teachers of zoology should be more or less completely ignored. The main object of the volume before us appears to be to emphasise the teaching value of institutions of this nature, and to show what admirable schools for acquiring the rudiments of practical zoology lie ready to our hand, if only we will take advantage of our opportunities; in other words, we have nature-teaching of a unique description awaiting our attention. Mr. Beddard treats, indeed, his subject almost exclusively from this point of view, so that his volume forms, in great degree, a sketchy kind of text-book of vertebrate zoology, illustrated by a number of first-class photographs and drawings of the animals under discussion. Such a mode of treatment necessarily prevents the inclusion of any great amount of matter that is really new in his work, and from one point of view it is a matter for regret that the author, with his long experience of the establishment in the Regent's Park, has not seen his way to give us more information with regard to the behaviour and life-history of animals in menageries. One point in this connection on which information is sadly lacking is the duration of life of animals in menageries, and the periods during which individuals of long-lived species have survived in captivity. So far as we have seen, information on this latter point is given only in two cases, namely, in that of the polar bear and that of the pelican. Possibly, however, the author may have in view a companion volume, in which these phases will form the leading theme; and if so, we feel sure that it will supply a marked want.

Restricting, and very wisely so, his volume to the vertebrata, the author commences with a general sketch of the leading features of that group, and then takes in systematic order the various representatives selected for description. Mammals accordingly come first; and it is not out of place to mention that Mr. Beddard directs attention to the fact that a good popular name for this group is still a desideratum. In the case of both mammals and birds, the species taken as examples of different types are in the main well selected, and in nearly every instance the illustrations are almost everything that can be desired. As one of the best, among those reproduced from photographs, we have chosen the group of flamingoes, taken in the gardens, to set before our readers.

[1] "Natural History in Zoological Gardens; being some Account of Vertebrated Animals, with Special Reference to those usually seen in the Zoological Society's Gardens in London and Similar Institutions." By F. E. Beddard. Pp. x+310; illustrated. (London: Archibald Constable and Co., Ltd., 1905.) Price 6s. net.

Typographical errors appear to be comparatively few. The meaning of the last sentence on p. 22 is, however, obscured by the misplacing of the word "much"; while on p. 125 we have *Suiae* for *Suidae*, and on p. 149 Australia for Australian. As regards other matters for criticism, it may be pointed out that the author admits that the term aurochs properly belongs to the extinct wild ox, and it is therefore not easy to see why he applies it to the bison in the plate of that animal. In the section on the wild ass (p. 60), the non-scientific reader will probably find it difficult to ascertain the proper name and the number of races of the Asiatic representative of that group; while the sportsman will gasp with astonishment when told (p. 63) that this animal may be ridden down by an expert horseman after a run of five-and-twenty miles (or does the author mean minutes?). On p. 139 the Tasmanian devil, under the synonym of the ursine dasyure, is made to do duty for two species. Finally, the palæontologist is likely to be staggered by the suggestion (p. 185) that the horn of the American birds commonly known as screamers is a direct inheritance from a dinosaurian ancestor.

Throughout, Mr. Beddard has made his book readable and mildly interesting; and it is especially satisfactory to find that he is conservative as regards the scientific names of the animals he discusses, and is, moreover, sparing in the use of such of these names as he selects to designate the various species. The book should form a valuable companion during a visit to the gardens in the Regent's Park, and likewise an excellent work of reference to those who really desire to learn something from visits of this nature.

R. L.

SCIENCE AT THE ROYAL ACADEMY BANQUET.

AMONG the guests of the Royal Academy of Arts, at the anniversary banquet on Saturday last, were eminent representatives of many branches of science. The president of the Academy, Sir E. J. Poynter, presided; and the Prince of Wales responded to the loyal toast proposed by the chairman. Sir E. Seymour having replied for the Navy and the Duke of Connaught for the Army, the president proposed the toast of "Science," the domain of which, he remarked, appeals to innumerable interests from its utilitarian side, and in its higher aspects deals with matters which, while they transcend the imagination with their speculative possibilities, require for their verification the utmost capacity of the intellect for exactitude and minuteness of research. Sir William Huggins, president of the Royal Society, replied to the toast in the following speech, which we take from the *Times* report of the banquet:—

I rise, as representing the Royal Society, to acknowledge the toast of science, so cordially honoured by her younger sister, the Royal Academy. I say sister, because art and science have in common the same object of worship and study—nature, in her varying moods and aspects; art "to exalt the forms of nature," science "to enlarge her powers." More than this, for to be accepted of nature, to be true artists or true men of science, both must possess an intuitive and profound insight into nature. The fine paintings which surround us are not mere transcripts of nature, but created visions of nature, revealing to the common eye the cryptic poetry and prose visible only to the second sight of the true artist—

". . . a painter gazing at a face
Divinely through all hindrance finds the man behind it."

As truly, the man of science must be a seer, endowed with the open eye and power of imagination. At this point the sisters part company. The muse of art fixes on the canvas a momentary aspect of nature, or of the human face divine. The muse of science strains her eyes to see what is behind the outward show, her quest is for the why and wherefore of nature's changes. But science is more than a presiding muse; she is in very deed a great beneficent power imminent in the lives of her votaries, a power such as was feebly foreshadowed in the tales of folk-lore by the Queen of the Good Fairies, richly rewarding by enchantment with all good things those who made her their friend. The seven-league boots and the magic steeds were but poor anticipations of the gifts of science—the railway, the motor, and the turbine-driven vessel. The enchantment of gold, jewels, feasts, and palaces are more than realised by the boundless resources which science places at man's disposal. Science, indeed, brings back the age of Methuselah. Even literally life is prolonged by increased power over disease. True life is not measured by the passing of the suns, but by the sum of our activities; not by the falling sands of the hour-glass, but by the living pulses of the mind. The flying train, the flashing of intelligence, night turned into day, and the thousand and one appliances of machinery crowd into one year a fulness of life which was possible to our fathers only, if at all, in many years. How great, then, would be the gifts of science to the nation in return for full national recognition—by placing science on an equality with the humanities in our universities and public schools, and by the endowment of laboratories worthy of the nation! With science nationally honoured, our armies and our ships could know no defeat, our machinery and our manufactures no rivalry in the world's markets, our every undertaking must prosper. Shall we then remain in deadly apathy and take no steps to have it so?

NOTES.

ON Sunday, the President of the French Republic entertained the King at the Elysée at a dinner party, at which 120 guests were present. The guests included distinguished authors, artists, musicians, and other representatives of intellectual activity, almost exclusively members of the Institute of France. By inviting leaders of literature, art, and science to meet the King, graceful recognition was given of the high place occupied by the muses in the polity of the Republic. In the days when sheer muscular force was the mainstay of a nation, bodily strength and prowess were rightly regarded as recommendations for Court favours; but now that brain-power instead of muscle determines the rate of national progress, the State that desires to advance must foster all the intellectual forces it possesses. This principle is well understood in France, and is also clearly recognised in Germany, where every man who makes notable contributions to knowledge of any kind, assists industrial progress, or creates works of distinguished merit, whatever they may be, is sure to receive personal encouragement from the Emperor. The presence of these leaders of thought is a striking characteristic of the German Court; while, on the other hand, their absence, and the overpowering influence of military interests, are distinguishing features of Russian, and, let us add, of British Court functions.

ON many occasions reference has been made in these columns to the excellent object lesson of the intimate connection between a scientifically organised system of education and national prosperity afforded by the success which has in recent years attended Japanese enterprise. It is gratifying to find that this insistence on our part is, in view of affairs in the Far East, now being echoed by our contemporaries. Commenting upon the account of its Tokio correspondent of the battle of Mukden, the *Times*, in a leader in the issue of April 25, remarked:—"We have before us evidence of national education in its highest and most complete manifestation—education such as we in this country have hardly begun to conceive. We have co-

ordinated intelligence at its best, fortified by an invincible *moral*, and employing a physical education capable of carrying out all its behests. We see these things not merely producing a small *corps d'élite* insignificant in comparison with the mass of the nation, but turning out half a million of men with brain power adequate for their direction." When it is remembered that Japan has established and perfected its system of education in the years since the passing of our first Elementary Education Act in 1870, it is easy to appreciate how profound and speedy can be the effect of an earnest and sustained effort on the part of the Government of a nation to develop its educational resources. There is hope that now our great newspapers are advocating the paramount claims of higher education and science we may see both more generously treated by the Government of this country.

THE inactivity shown by our statesmen in matters concerning the preservation of our ancient monuments compares very unfavourably with the measures taken in other countries to cherish their structures of antiquity. A timely article in the April number of the *Quarterly Review* directs attention to several cases of vandalism to show the precarious tenure on which this country holds so many of its artistic and historical treasures. Here we are almost devoid of the official and semi-official machinery which is actively engaged abroad. France and Austria have State-appointed commissions which exercise a general supervision over historical and artistic monuments, and see to their preservation and proper repair. The French list of structures regarded as of unmistakable national value contains about 2200 monuments, of which 318 are prehistoric in the form of dolmens or cromlechs. The care of monuments in all the German States is in the hands of official custodians or monument commissions, who are responsible to the Ministers of Public Instruction or of the Interior. The minor States of Europe exhibit a similar official interest in historical monuments. In our own country, however, only tentative efforts have been made at arrangements which on the Continent are in full working order. So far as any expenditure is concerned, the Ancient Monuments Acts are almost a dead letter. The indifference of the Government to the whole matter is sufficiently indicated by the fact that since the death of the inspector of ancient monuments, General Pitt-Rivers, in 1900, no successor has been appointed to the post, although no emoluments are attached to it. It seems impossible to get our so-called statesmen to see that unless the State shows active interest in the preservation of our ancient monuments, many of our national assets of the highest historical value are doomed to destruction. The public and public bodies would soon learn to prize such monuments if the Government would take steps to show that these structures are of national importance.

MR. E. T. NEWTON, F.R.S., palæontologist to the Geological Survey, retired on May 4 after a distinguished service extending over forty years. In 1865 he joined the Geological Survey as assistant naturalist under Prof. Huxley, while Murchison was director-general; and when Huxley severed his connection with the Museum of Practical Geology, he worked under the late Robert Etheridge until 1881. On Mr. Etheridge's transfer to the British Museum, Mr. George Sharman and Mr. E. T. Newton were appointed joint palæontologists to the Geological Survey, and on Mr. Sharman's retirement in 1897 Mr. Newton remained as chief of the palæontological department. The loss of his great experience and knowledge on all branches of palæontology, to say nothing of the personal loss, will be widely felt in the museum at Jermyn Street by the officers and by the visitors who come for assistance in the study of fossils. It is satisfactory to learn that Dr. F. L. Kitchin has been appointed to succeed Mr. Newton; he received his palæontological training under Zittel, and joined the staff of the Geological Survey in 1898. He has published important monographs on fossil Invertebrata in the "Palæontologia Indica."

MR. JOHN GAVEY, C.B., engineer-in-chief to the Post Office, has been nominated for election as president for 1905–6 of the Institution of Electrical Engineers.

NEWS has just reached this country that Dr. J. E. Dutton died at Kosongo, in the Congo, on February 27, while actively engaged in the investigation of trypanosomiasis and tick fever.

THE Paris Natural History Museum has accepted a bequest made by M. Emmanuel Drake del Castillo consisting of a herbarium, a botanical library, and a sum of 25,000 francs.

PROF. HANS MEYER, of the University of Vienna, we learn from *Science*, has accepted the invitation to deliver the Herter lectures at Johns Hopkins University on October 5 and 6. His subject will be "The Physiological Results of Pharmacological Research."

IT is announced that the New Mexico legislature has passed a law authorising a geological survey of the State; the sum of 1200*l.* has been voted for the purpose, and is to be expended under the direction of the New Mexico School of Mines at Socorro.

PROF. W. KÖNIG, of Greifswald, has been appointed ordinary professor and director of the physical laboratory at Giessen; Prof. M. Disteli, of Strassburg, professor of mathematics at Dresden; and Dr. Ernest Orloch professor at the National Physical Laboratory at Charlottenburg.

PROF. H. M. HOWE, professor of metallurgy at Columbia University, Bessemer medallist of the Iron and Steel Institute, has been elected foreign correspondent of the Paris Society for the Encouragement of Industry to succeed Sir Lowthian Bell. The other four recipients of this honour are Cannizzaro, Mendeléeff, Solvay, and Sir Henry Roscoe.

MR. J. H. HAMMOND has given 1000*l.* to establish a mining and metallurgical library at San Francisco. The State Mining Bureau already possesses an extensive library, but, for want of funds, it has not been possible to add new books during the past ten years. The new library is to be placed in the rooms of the Mining Bureau, but as a separate unit. Three trustees are to select the books.

THE President of the Board of Agriculture and Fisheries has appointed a departmental committee to inquire, by means of experimental investigation and otherwise, into the pathology and etiology of epizootic abortion, and to consider whether any, and, if so, what, preventive and remedial measures may with advantage be adopted with respect to that disease. The chairman of the committee is Prof. J. MacFadyean, principal of the Royal Veterinary College.

THE Baly medal, given every alternate year on the recommendation of the president and council of the Royal College of Physicians of London for distinguished work in the science of physiology, especially during the two years immediately preceding the award, has been awarded to Prof. Pawloff, of St. Petersburg. The Bisset Hawkins

gold medal for 1905, given triennially for work deserving special recognition as advancing sanitary science or promoting public health, has been awarded to Sir Patrick Manson, K.C.M.G.

A DECIDED earthquake shock was felt in the Vale of Llangollen, North Wales, about 1.40 a.m. on May 1. The disturbance lasted about four seconds, and was accompanied by loud rumbling sounds. The river Dee, which runs through the district, rose several feet during the night.

THE Paris correspondent of the *Times* reports that earthquake shocks were experienced at about 2 a.m. on April 29 over the whole of the Jura, the Rhone valley between Lyons and Valence, and the eastern portion of the *Central Massive*. All the shocks appear to have occurred simultaneously, and were accompanied by sudden and violent squalls, as well as by rumblings like distant thunder. An earthquake shock, lasting eight seconds, was recorded also at Chamonix. Subsequently the shocks recurred, though in a mitigated degree. At this place a new spring suddenly gushed from the ground as the result of the seismic disturbance, and the waters of the river Arve were swollen in consequence. The shock was felt at 2.45 a.m. at Turin and Domodossola. The seismographs at the observatories of Pavia, Padua, Ferrara, Modena, Ischia, and other towns also recorded disturbances. At Heidelberg Observatory the seismograph registered a decided earthquake of short duration at 2.49 a.m.

ATTENTION was recently directed in these notes (vol. lxxi. p. 492) to a statement made in the *Times* that the Tower of Galileo on the hill of Arcetri, near Florence, has been practically destroyed in the course of recent building operations. Prof. A. Ricco, having been led by our note to make a special inquiry at Florence, now writes to point out that the so-called Torre del Gallo cannot in any way be considered as associated with the name of Galileo. Such an association was first suggested comparatively recently and purely gratuitously by the late proprietor of the tower, but no evidence in support of it can be traced either in the numerous letters or writings of Galileo. This was clearly pointed out by Gebler in 1878 in an article in the *Deutsche Rundschau*, and the most recent examination of Galileo's writings made on the occasion of the publication of the "national edition" of his works has given support to the same opinion. It may perhaps be surmised that a confusion of names has occurred, Torre del Gallo, literally the Cock's Tower, being wrongly regarded as a corruption of Torre di Galileo.

IN one of his recent articles on Stonehenge (vol. lxxi. p. 391, February 23) Sir Norman Lockyer referred to the interesting fact, pointed out to him by Colonel Johnston, director of the Ordnance Survey, that the solstitial line in 1680 B.C. passes through not only the present centre of Stonehenge, but also through Sidbury Hill to the north-east, and the earthworks at Grovely Castle and Castle Ditches to the south-west. This continuation of the solstitial line from Stonehenge to other ancient structures is of great interest; but an even more remarkable relation found by Colonel Johnston is that Stonehenge, Old Sarum, and Grovely Castle occupy the points of an equilateral triangle each side of which is exactly six miles in length. A very definite connection is thus shown to exist between the various primitive works in the neighbourhood of Stonehenge. We notice that Mr. J. H. Spencer describes these relationships in an article in the April number of the *Antiquary*, but he does not mention that the credit of the discovery of the connecting lines between the various monuments belongs to Colonel Johnston.

WE learn from the *Journal of the Society of Arts* that funds have been placed at the disposal of the council of the Society of Dyers and Colourists for distribution in the form of prizes for the solution of technical problems. The following prizes are now offered:—(1) 20*l*. for a satisfactory systematic tabulation of the reactions of dyestuffs on the fibre, and a comprehensive scheme for their identification on dyed fabrics; (2) 10*l*. for a trustworthy method of distinguishing between unmercerised and mercerised cotton of various qualities, and for the estimation of the degree of mercerisation without reference to lustre; (3) 20*l*. for a full investigation of the causes of the tendering of cotton dyed with sulphide blacks, and the best means of preventing such tendering; (4) 20*l*. for a satisfactory standardisation of the strength and elasticity of cotton yarns of various qualities and twists in the grey and bleached conditions; (5) 20*l*. for a full investigation of the average degree of tendering brought about in cotton yarn of various qualities by—(*a*) cross dyeing with acid colours; (*b*) dyeing aniline black; and (*c*) various other dyeing processes, with the object of fixing standards for the trade. Further information can be obtained from the hon. secretary, Mr. E. T. Holdsworth, Westholme, Great Horton, Bradford.

SATISFACTORY progress and general prosperity form the key-note of the report of the Zoological Gardens at Giza for the past year. The report is illustrated by the reproduction of a most interesting photograph of an aard-vark, or ant-bear, slightly marred by the effect of a shadow by the side of the nose.

IN a communication published in the *Anales of the Buenos Aires Museum* (vol. xii. pp. 1–64), Dr. F. Ameghino gives reasons for concluding that the single facet by which the astragalus of marsupials articulates inferiorly with the calcaneum is a specialised feature, derived from the more common type in which there are two such facets.

THE April issue of the *Proceedings of the Royal Irish Academy* is devoted to a list of Irish Cœlenterata, inclusive of the Ctenophora, by Miss Stephens. The list includes about 250 species, but since the north-west coast of Ireland has not yet been thoroughly worked, it cannot be regarded as complete.

Museum News is the title of a periodical issued by the Brooklyn (N.Y.) Institute of Arts and Sciences to replace the *Children's Museum News*, and intended to deal with matters connected with both the Central and the Children's Museum in that city. Special attention will be devoted to informing the public with regard to new exhibits and additions to the collections.

ACCORDING to its seventy-first report, Bootham School (York) is making a vigorous push in the direction of encouraging the study of natural science, and the natural history club has entered a period of renewed life and vigour. The report is illustrated with reproductions from two excellent photographs, one showing the nest and eggs of a black-headed gull, and the other the same eggs in the process of hatching.

THE seals frequenting Killala Bay and the Moy Estuary, in Mayo, form the subject of an article by Mr. R. Warren in the April *Zoologist*. Both the common and the grey seal frequent and breed in this district, the young being apparently born in most cases in caverns difficult of access.

The largest grey seal ever killed weighed 560 lb., but specimens scaling 740 lb. and 770 lb. are recorded from the Farne Islands, on the Northumberland coast.

"DIE SOGENNANTEN RIECHSTÄBCHEN DER CLADOCEREN" is the title of a paper in vol. xii. of *Ploner Forschungsberichte*, in which the author, Mr. D. J. Scourfield, of Leytonstone, discusses the function of the so-called olfactory setæ in this group of minute crustaceans. From the stronger and more numerous development of these bristles in the males, it is inferred that their sensory functions are more acute in this sex than in the females. As regards their probable function, the author is of opinion that while they are largely concerned in the perception of taste, yet that they may also serve in the recognition of other senses which may be as far removed from taste as is the latter from hearing.

THE *Journal of Hygiene* for April (v., No. 2) contains a number of interesting and important papers. Dr. Petrie discusses the relationship of the pseudo-diphtheria and diphtheria bacilli, and Dr. Boycott the relative seasonal prevalence of these two organisms. Dr. Petrie also describes trypanosomes observed in rabbits, moles, and certain birds. Dr. Savage, as the result of experiments made to ascertain the degree of sewage pollution of tidal waters, considers that mud samples yield more trustworthy evidence of the degree of contamination than either water or oyster samples. Other papers are by Dr. Hamilton Wright on preventive measures against beri-beri, Drs. Newsholme and Stevenson, and Dr. Hayward on statistical methods applied to birth-rates and life tables, and Dr. Mackie on a handy method of determining the amount of carbonic acid in air.

PART i. of the reports of the commission appointed for the investigation of Mediterranean fever under the supervision of the advisory committee of the Royal Society has just been issued. The first two reports, by Major Horrocks, R.A.M.C., deal with the problem of the saprophytic existence of the causative organism (the *M. melitensis*) outside the human body. It is found that the organism will retain its vitality in sterilised tap water for thirty-seven days, in dry soil for forty-three days, and in moist soil for seventy-two days. The same observer was able to isolate the micrococcus from the urine, but not from the fæces, sweat or breath of patients. A series of experiments was instituted which showed that the micrococcus is absorbed by, and gives rise to the disease in, monkeys exposed to dust, or given food containing it. Staff-Surgeon Gilmour, R.N., and Dr. Zammit detail experiments on the isolation of the *M. melitensis* from the blood, and Staff-Surgeon Shaw, R.N., writes on the same subject and on experimental work in relation to animals.

AN interesting article on polished stone axes in history until the nineteenth century, by Dr. Marcel Baudouin and Lionel Bonnemère, will be found in the *Bulletin de la Société d'Anthropologie de Paris* (5e. sér., tome v., p. 496). Examples are given of their use at the present day as charms against lightning, storm, and other evils, and also they are credited with therapeutic efficacy. The *βαίτυλος* of the Greeks was a polished stone implement; from classical times onwards these stones were supposed to have fallen from heaven, and at the present day this belief is current from western Europe to Malaysia.

VARIOUS folk-tales and other items of folklore will be found in the *Journal of the Asiatic Society of Bengal*; in vol. lxx., part iii., p. 99, Mr. S. C. Mitra records a new accumulation-droll or cumulative folk-tale from Bihar; in vol. lxxi., part iii., p. 4, in the same *Journal*, Mr. H. P. Shastri describes a form of tree worship at Naihati; a female deity is supposed to reside in a date palm, when clods of earth are thrown at the tree as offerings to her, she at once pacifies children crying at the home of the devotee. Ten years later the author re-visited the spot, and found that sweets were then offered as well, that various other boons were prayed for, and a myth had grown up about the tree. The marriage customs of the Khonds are described by Mr. J. E. F. Pereira, from which it appears that they are gradually Hinduising their customs.

THE ideal forestry college forms the subject of an article in the *Indian Forester* (February); the suggestions made are based upon a selection of the advantages observed at various institutions, all of which, it is hardly necessary to state, lie outside the British Isles. College gardens and forests are mentioned as the most important adjuncts to laboratories and museums, and in these particulars the forestry school at Tharandt, Saxony, is well provided. In the matter of getting wider experience than can be obtained in the college forests, the students of the St. Petersburg Institute have the advantage of inspecting and completing a final course in some of the great forest areas of Russia.

JUDGING from the account by Mr. J. W. White published in vol. xxii., part iv., of the *Transactions and Proceedings of the Botanical Society of Edinburgh*, the Balearic Islands offer many attractions to the botanist who is contemplating a holiday. Not only do the islands lie outside the general track of tourists, but the flora is unusually rich, and a considerable number of the plants are endemic or confined to one of the neighbouring countries. Amongst the rarer curiosities a fragile vetchling, *Vicia bifoliata*, *Lepidium Carrerasii*, and a curious little shrubby *Daphne velloeoides* were obtained in Minorca, and in Majorca *Pimpinella Bicknelli*, which grows in splendid isolation, and a delicate rock-sheltered labiate, *Salvia Vigineuxii*, were discovered.

A RECORD of the progress of the *Albatross* Expedition to the eastern Pacific is given in a letter from Prof. Alexander Agassiz dated January 6 (*Amer. Journ. Science*, April). The influence of the Humboldt current on the marine life west of Callao was investigated. As far as 800 miles from the mainland, it affected both the surface and bottom fauna. Towards Easter Island, the surface fauna first became less abundant, and at a distance of from 1200 to 1400 miles from South America the trawl hauls were absolutely barren. The bottom of the greater part of the line was covered with manganese nodules on which were found attached a few siliceous sponges, an occasional ophiuran, and a few brachiopods and worm-tubes. The pelagic and intermediate fauna from Easter Island to 12° south latitude, in the direction of the Galapagos, was very poor, and indicated that the region was to the westward of the great Humboldt current. Beyond this limit the marine fauna was again rich and abundant, and great changes were noted in the temperature of the water between 50 and 300 fathoms. Soundings made eastward of the Galapagos and Easter Island indicate a gradual deepening of the ocean bed towards the Continent, as observed during the *Challenger* Expedition. On Easter Island some time was spent in examining the prehistoric monuments and the great quarries from which colossal images had been cut. Sculptured rocks were noted, and it was remarked that some of the cyclopean stones used in the ancient buildings exhibited excellent workmanship.

GEOLOGICAL and petrographical researches on the northern Urals have for some years been carried on by Prof. Louis Duparc and Dr. Francis Pearce. Their latest work (*Mém. Soc. de Physique et d'Hist. nat. de Génève*, xxxiv., fasc. v.) embraces a description of the eruptive rocks of the chain of Tilaï-Kanjakowsky-Cérébriansky, in the Government of Perm. This range is composed of basic igneous rocks, of pyroxenites passing into koswites, which form the principal axis of the chain, with bordering gabbros elsewhere prominent; there are diorites, norites which are intercalated locally in both gabbros and pyroxenites, and dunites which are massive in places and also send veins into the gabbros and pyroxenites; and there are other eruptive rocks. All these are described in considerable detail and illustrated. Continuing their observations eastwards, the authors describe the quartzites and crystalline conglomerates of Aslianka and of Tépil, with, in the latter region, Devonian strata and various igneous rocks; and finally they deal with the crystalline schists and intrusive rocks of Koswinsky-Katéchersky-Tilaï. The memoir is illustrated by pictorial views of the topographic features, by longitudinal sections, and by microscopic sections of the rocks.

THE report of the observatory department of the National Physical Laboratory for the year 1904 shows, as usual, a large amount of useful work; it is published separately, as appealing to a different class of workers from that interested in the engineering and physics departments. The work of the observatory deals with magnetic, meteorological, and seismological observations (separately), experiments and researches, verification of instruments and watches (separately), and miscellaneous commissions for inland, colonial, and foreign institutions, &c. It is observed that the electric trams have interfered with part of the magnetic work; the mean declination for the year was 16° 37′·9 W. The tabulations and automatic records of the meteorological observations are sent to the Meteorological Office for publication in detail; the Kew report contains monthly and yearly summaries of the results. The seismological observations are published in the report of the British Association; the largest disturbance recorded during the year took place on April 4, when the maximum amplitude exceeded 17 mm. The verification of instruments, exclusive of watches and chronometers, amounted to 25,797, of which 15,903 were clinical thermometers.

DURING a thunderstorm it has often been noticed that some flashes of lightning appear to "flicker," while others seem to leave a glow in their paths which lasts a second or two before entirely disappearing. In the first case the apparent trembling of the light is due to the fact that the observer is actually watching the passage of more than one flash following the same route. In multiple or intermittent lightning flashes there are sometimes as many as five or six separate flashes in a very brief interval of time, and the impression on the retina is an apparent flickering of a single flash. In the *Comptes rendus* (April 10) M. Em. Touchet directs attention to those particular flashes which leave a glow in their wake, and gives an illustration of a photograph of one he secured with a moving camera on April 12 of last year. The object of the communication is to point out that this glow is attributable to the incandescence of the air; but it seems to us that this is a fact already very well known. In photographing very bright lightning flashes with movable cameras it is a very common occurrence to get trails on the plate of the brighter portions of the flash, and if the plate and lens be very rapid it should be the rule rather than the exception. There are numerous examples of flashes which have been photographed showing this peculiarity, and it is a simple matter to differentiate between those due to multiplicity and those due to the incandescent air resulting from the original flash. Anyone interested in this question will find some typical photographs published by L. Weber (*Sitz. d. k. Preuss. Akad. d. Wiss.*, vol. xxxviii., 1889), Ladislaus von Szalay (*Met. Zeit.*, vol. xxxviii., 1903, p. 341), and B. Walter (*Jahrbuch d. Hamburgischen Wiss. Anstalten*, vol. xx., 1903). As M. Touchet refers to Dr. Hoffert's paper on intermittent lightning-flashes (*Phil. Mag.*, August, 1889), reference is there made to "streaks of light, showing that a very considerable residual illumination remains between the discharges," which indicates that the writer was quite familiar with the incandescence of the air due to the flash and its effect on the photographic film.

AN installation for the production of high-tension electricity, on view at Messrs. Isenthal and Co.'s, 85 Mortimer Street, Cavendish Square, W., has been examined by a representative of NATURE. The original source of the energy is an ordinary uni-directional current, and an important feature of the apparatus is a commutator which does away with the necessity for an interrupter. In the main circuit is a condenser of very large capacity, and the commutator breaks the circuit when the condenser is charged, so that no sparking is produced. The condenser employed is not large, and owes its compactness to the use of thin layers of aluminium oxide, prepared electrolytically, as the dielectric. The commutator has the appearance of a piece of engineering work, and should not require much attention. Oscillatory currents, with a frequency of about a thousand per second, are set up in the primary of an induction coil, and it is claimed that the impulses in the secondary are much stronger in one direction than in the other. The apparatus is also intended for the production of alternating currents, and some very interesting experiments are shown. An alternating current is sent through the coil of an electromagnet, the core being vertical; a sheet of paper is placed over the upper pole, and on the paper is scattered some iron dust (not filings); the dust forms itself into little spiked heaps which move and dance about. When the paper and iron dust are removed, and the forehead is placed near the pole of the magnet, the light of the room appears to fluctuate in intensity.

MESSRS. A. BROWN AND SONS, LTD., will publish during this month a work by Mr. J. R. Mortimer entitled "Forty Years' Researches in British and Saxon Burial Mounds of East Yorkshire, including Romano-British Discoveries and a Description of the Ancient Entrenchments on a Section of the Yorkshire Wolds."

THE report of the council of the Hampstead Scientific Society and the proceedings for 1904 have been received. Fifty-six new members were elected during the year, and the number of members is now 333. The number of meetings held in 1904 was thirty-three, and in addition there were four Christmas lectures to children and a course of six lectures on nature-study. Among lectures delivered at general meetings of the society may be mentioned one by Prof. S. P. Thompson, F.R.S., on Japanese magic mirrors, and one by Prof. W. Boyd Dawkins, F.R.S., on the incoming of the Brythons into Britain.

MESSRS. S. RENTELL AND CO., LTD., have published a fifth edition of "The Telegraphists' Guide to the Departmental and City and Guilds Examinations in Telegraphy," by Messrs. James Bell and S. Wilson. The contents have

been revised thoroughly, the chapters re-arranged, and much fresh matter introduced. The extra pages supply a description of Wheatstone's ABC instrument, a more detailed reference to batteries, single-needle working, duplex and Wheatstone automatic systems, repeaters, test cases, concentrator switch, wireless telegraphy, and other subjects.

No. 5 of the *Central*—the magazine of the Central Technical College—is very good, and may be regarded as even constituting an advance on its predecessors. It contains an account by Mr. R. Freeman of the design and construction of the steel-work of the bridge over the Zambezi at Victoria Falls, a continuation of the series of articles by Prof. Armstrong on the mechanism of combustion, and a description of the Klingenberg carriage switchgear by Mr. J. D. Griffin. The magazine is well and copiously illustrated.

We have received from Mr. Geoffrey Martin a copy of a paper on the theory of solution, published in the *Journal of Physical Chemistry* (vol. ix. p. 149), giving a detailed account of views already briefly stated in a letter to NATURE (vol. lxx. p. 531). An attempt is made to explain the fundamental facts that for all substances there is a limit of solubility in each solvent, that the solubility increases as a rule with the temperature, and that molecules often dissociate on passing into solution.

Among the popular science lectures to be delivered at the Royal Victoria Hall, Waterloo Bridge Road, during May are the following:—May 9, fishes old and new, Dr. Smith Woodward, F.R.S.; May 23, some summits of the lost continent Atlantis, Mr. H. Ling

OUR ASTRONOMICAL COLUMN.

Discovery of a Tenth Satellite to Saturn.—A telegram from the Kiel Centralstelle announces the discovery of a tenth satellite to Saturn by Prof. W. H. Pickering, who, it will be remembered, also discovered Phœbe, the ninth satellite.

The newly discovered satellite is very faint, being reported as three magnitudes fainter than Hyperion, the seventh satellite, which has a magnitude of about 17; its period is given as 21 days, and its orbital motion is direct.

The Alleged Identity of Comets "Brooks 1889" and Lexell.—An abstract of a paper by Dr. Charles L. Poor, wherein he discusses the identity of Brooks's 1889 comet with the object known as Lexell's comet, is given in No. 4, vol. xiii., of *Popular Astronomy*. After mentioning the discovery and subsequent history of each body, he discusses the various perturbations to which each has been subjected, and then gives the results obtained from a re-computation of the orbit of Brooks's comet, using the observational data secured during the re-appearance of 1903. Finally, he arrives at the conclusion that the objects are not identical, although further evidence will be necessary before the question can be settled definitely.

Ancient Drawings of Celestial Phenomena.—Parts xiii. and xiv. of the current volume of *Das Weltall* contain an interesting article by Dr. W. Lehmann, of Berlin, in which the ancient Mexican accounts of solar eclipses, comets, &c., are discussed. The article is freely illustrated by drawings of eclipses, comets, the moon, planets, &c., taken from the old accounts, and these drawings are most interesting as depicting the old Mexican ideas of these phenomena. For instance, the first is a contemporary drawing of the total solar eclipse of 1531 A.D., and shows plainly immense prominences and coronal wings.

Mount Wilson Observatory.—In No. 2, vol. xxi., of the *Astrophysical Journal*, Prof. Hale gives an account of the conditions of solar research at Mount Wilson, California, where he has recently established the Solar Observatory of the Carnegie Institution of Washington. In the first of the two articles he enumerates the requirements of the site of such an observatory, and then discusses in detail the meteorological conditions, the seeing, the transparency of the atmosphere, and the instruments available at Mount Wilson.

In the second article the author describes the foundation, the equipment, and the programme of the observatory, and illustrates his description with photographs and diagrams of the site and of the various instruments and houses already erected or in course of erection.

Anomalous Dispersion and "Flocculi."—In No. 3, vol. xxi., of the *Astrophysical Journal*, Prof. Julius advances the theory of anomalous dispersion to explain the varying appearances of the flocculi on spectroheliograph photographs. The "dark flocculi" of Prof. Hale are explained by the incurvation of the direct rays producing an excess of light in the bright flocculi, and therefore a deficit elsewhere, hence the dark regions naturally ensue.

The differences between the H_2 (calcium) and Hβ (hydrogen) pictures obtained by Prof. Hale are explained by the supposition that the Hβ rays are less strongly incurvated, and therefore rays of more varied refractive indices pass through the secondary slit, thereby producing a less dark and less defined image. On this assumption Prof. Julius states that the hydrogen photographs would show the fine details seen on the K_1 photographs if the dispersion employed were greater, or if the secondary slit were used narrower. Without requiring any other hypothesis, Prof. Julius explains by this theory all the anomalies seen on the spectroheliograms.

In the same journal, the same author also discusses the "dispersion bands" seen in the spectra of δ Orionis and Nova Persei, and, *inter alia*, arrives at the conclusion that the former star is *not* a spectroscopic binary.

Astronomical Society of America.—Abstracts of sixteen of the numerous papers read at the sixth meeting of the Astronomical and Astrophysical Society of America, held at Philadelphia last December, are given in No. 533 of *Science* by Mr. Frank B. Littel. The various titles are too numerous to mention here, but amongst them we may notice "The Constant of Aberration," by Prof. C. L. Doolittle, in which the author obtains the value $20''{\cdot}540 \pm 0{\cdot}0055$ from a series of zenith telescope observations made between December, 1889, and December, 1903; "The Reflex Zenith Tube," by the same author; "Variation of the Bright Hydrogen Lines in Stellar Spectra," by Miss Annie J. Cannon; "Planetary Spectrograms" and "The Canals of Mars," by Mr. Lowell; "The Coordination of Visual and Photographic Magnitudes," by Mr. J. A. Parkhurst; and "Recent Researches of the Henry Draper Memorial," by Prof. E. C. Pickering.

COLOUR IN WASPS OF THE GENUS POLISTES.

In the paper referred to below[1] the author deals very fully with the various colour variations observable in the species of the genus under notice, and a very interesting account is given of the variability in colour-pattern, and of its gradual development in the nymphal and imaginal stages, illustrated by coloured plates i. and ii. A chemical analysis of the nature of the pigments is also given, and illustrations of the layers in which the pigments are located. Coloured plates iii. and iv. give figures of several of the different species of the genus—besides these plates there are excellent maps, showing the distribution of the various forms, and elaborate diagrams are provided, indicating the variations observable. The author has evidently spared no pains to render the treatment of the subject as exhaustive as possible, and as a study of colour variation this treatise seems to leave little to be desired. The problem attacked in this work, viz. "an inquiry into the nature and probable causes of specific differentiation in the genus Polistes," is one which is both difficult and perplexing.

The author commences at once by saying, "apart from differences in size, the characters used to separate the species are based almost exclusively on colour; accordingly, this in-

1 "Coloration in Polistes." By Wilhelmine M. Enteman. Pp. 88 6 plates. (Carnegie Institution of Washington, November, 1904.

vestigation resolves itself into a study of coloration in the genus." The conditions which make for variation in the different species are well indicated, as the author points out that, even where the inmates of a single nest are examined, the following points have to be considered :—First, that two or three females may work together for the good of one community, and may be very differently coloured; secondly, that each may be fertilised by several males, which again may be differently coloured; thirdly, that intruders from other nests may be present as they "are not always so certainly driven away from strange nests as has been affirmed for other social Hymenoptera."

In these circumstances, the attempt to distinguish the species by colour characters seems to be almost hopeless—a point, however, which seems to the present writer to have been overlooked is the possibility of the presence of unobserved plastic characters which might serve as better and more satisfactory guides to classification. That such characters exist among the palæarctic species has been demonstrated by F. F. Kohl in *Ann. K.K. Naturh. Hofmuseum*, Wien, xiii., heft i., pp. 87–90, taf. iii., who shows that five forms of the males can be easily separated by well-defined characters in the form of the clypeus and genæ, the grooves of the face, and the shapes of the subapical joints of the antennæ, and although their respective females and workers have not been satisfactorily identified, it is not improbable that careful investigation may yet disclose characters to associate the sexes of the different species together; as also it is quite probable that all the species would vary in colour in more or less parallel directions—any investigation into the distribution of the species, unless conducted with special reference to these characters of the males, would be very liable to lead to wrong conclusions. One conclusion especially to which one would like to apply the male character test is summed up in the following words :—"It is hardly probable that we have in *P. variatus* a primitive species which has differentiated in two directions, but, as we shall see from the study of the geographical distribution of the species, aurifer and pallipes are two originally distinct species which, from the course of their migration northwards, have come together in the Mississippi valley, and by their commingling produced a species having, in some measure, the characters of both." These remarks are made with no wish to depreciate, even if it were possible, this very careful attempt to investigate a most difficult problem, but merely to point out that there are characters in our Palæarctic species of Polistes which might be well looked for in those of the other hemisphere.

THE CLEAVAGE OF SLATES.

THE memoir described below[1] contains an account of experiments undertaken to test the author's theory, propounded some years ago, of the cause of the cleavage property in slates. Dr. Becker's theory, substantially the same as that put forward earlier by the Rev. O. Fisher, is that cleavage-planes are planes of maximum tangential strain, or in other words shear-planes. This is opposed to the theory of Sharpe (or, as we might say, of Sharpe and Sorby), which makes the cleavage-planes perpendicular to the maximum compression. The author has misunderstood Dr. Sorby's position, having apparently overlooked the earlier papers of that writer. The question whether heterogeneity in the rock is necessary for the production of cleavage seems to be beside the mark, since all rocks (other than glasses) are heterogeneous in this sense. Both Tyndall's wax and Dr. Becker's ceresin, being crystalline bodies, are heterogeneous, and their behaviour must depend on the orientation of the minute component crystals.

The experiments described were carried out with ceresin, a substance of the paraffin series, and some also with clay. These were submitted in one series of tests to simple compression, and in another series to shearing by means of a machine devised for the purpose. In the small masses dealt with the strains developed vary greatly from point to point, and the resulting structure is of a complex kind. We must confess that we are not convinced that the effects observed are such as to be rightly described as cleavage—they have rather the character of fractures, depending on the application of the forces which produce them, as well as on the intimate structure of the material.

It is unfortunate that no attempt is made to collate the results of the experiments with actual examples of cleaved rocks. As the author remarks, the position of the strain-ellipsoid affords a crucial test. On the Sharpe-Sorby theory the principal diametral plane of the ellipsoid must coincide with the cleavage-plane; on Dr. Becker's hypothesis it should be inclined at some angle of less than 45°. Now there are many slates in which the strain-ellipsoid is actually presented in deformed spherical concretions or colour-spots. The "birdseye" slate of Westmorland and the green-spotted purple slates of Llanberis are examples familiar to every English geologist. In every case the orientation of the ellipsoid is that which agrees with the received theory. Moreover, the spots are elliptic in the cleavage-plane itself, being elongated, as Dr. Sorby pointed out fifty years ago, in the line of cleavage-dip. If the cleavage-plane were a plane of shearing, it would correspond with a circular section of the ellipsoid.

We might object further that, since there are two directions of circular section, or of shearing, there should, on Dr. Becker's hypothesis, be always two directions of cleavage, perpendicular to one another with incipient cleavage and making an acute angle in well cleaved slates. Our author endeavours to meet this difficulty in discussing his shearing experiments. One direction of shearing is parallel to a fixed face of the block undergoing deformation, while the other is continually changing, "so that any one set of particles undergoes maximum tangential strain along these planes only for an infinitesimal time." Even assuming such conditions to be realised in nature, which cannot be the general case, we should still suppose that the cleavage-property (as distinguished from fractures set up in the process of deformation) will depend on the actual structure of the rock, not on the manner in which that structure has been arrived at.

It will be apparent from the foregoing criticism that, while recognising the intrinsic value of these experiments and the clear manner in which the author's views are set forth, we do not find in them anything which assails successfully the generally accepted interpretation of the cleavage structure. A. H.

[1] "Experiments on Schistosity and Slaty Cleavage." By George F. Becker. Pp. 34; 7 plates. *Bull.* No. 241 of U.S. Geological Survey. Washington, 1904.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—By direction of the Board of Geographical Studies, part ii. of the examination for the diploma in geography will be held on June 21 and two following days. No person is qualified for admission to part ii. who has not previously passed part i. (or the special examination in geography for the ordinary B.A. degree). The names of intending candidates, together with the subjects they propose to take up, should be notified to the registrary not later than May 24. The fee for admission to the examination is, for members of the university, 3*l.*; for persons not members of the university, 5*l.* The fee must be paid to the registrary not later than June 15. The subjects are regional geography, surveying and mapping, geomorphology, oceanography and climatology, the history of geography and anthropogeography. Copies of the schedules defining the range of examination may be obtained by application at the registry.

The council of the Senate has recommended that the University of Queen's College, Kingston, Ontario, be adopted as an institution affiliated to Cambridge University.

It is understood that the syndicate for considering the studies and examinations of the university, the report of which in favour of the abolition of compulsory Greek in the previous examination was thrown out last term, will continue to meet. It is proposed to add to the syndicate Mr. E. S. Roberts, master of Gonville and Caius College; Dr. Adam, one of the tutors of Emmanuel College; Mr. S. H. Butcher, late professor of Greek at Edinburgh University; and Mr. G. H. Hardy, of Trinity College. These gentlemen were on the "non-placet" side at the

last vote, but it is understood that the majority of them are in favour of some alteration in the present state of things.

A VERBATIM report of the proceedings of the Welsh national conference on the training of teachers and pupil teachers, held at Shrewsbury last November, has just been published. An account of the conference appeared in NATURE of November 17 (p. 66).

THE council of the City and Guilds of London Institute has conferred the fellowship of the institute on Mr. H. Cecil Booth in recognition of the engineering work done by him since he gained his diploma of Associate of the City and Guilds Institute in 1892.

ON Wednesday, June 7, Viscount Goschen, as Chancellor of Oxford University, will lay the foundation-stone of the new buildings of Reading University College, to be erected, at a cost of about 80,000*l.*, upon a site presented by Mr. Alfred Palmer.

AT the recent installation of Dr. Edwin A. Alderman as president of the University of Virginia, it was announced, says *Science*, that in addition to the conditional gift of 100,000*l.* from Mr. Carnegie, Mr. Rockefeller had given 20,000*l.*, Mr. Jefferson Coolidge 10,000*l.*, and alumni and friends 10,000*l.* towards the endowment fund.

MR. CARNEGIE has added another handsome donation to his many princely gifts to higher education. This time he has given 2,000,000*l.* to provide annuities for college professors prevented by old age or other physical disability from continuing to earn salaries. The gift is to be for the benefit of the United States, Canada, and Newfoundland, and applies to all universities, colleges, and technical schools without regard to race, colour, or creed, but excluding State or colonial institutes, and excluding also purely sectarian institutions. The fund is to be vested in trustees, among them Presidents Hadley, of Yale University; Eliot, of Harvard University; Harper, of the University of Chicago; Butler, of Columbia University; Schurman, of Cornell University; and Wilson, of Princeton University, all of whom have accepted. Mr. Carnegie hopes that by this endowment the best men available will be attracted to professorial work, since in view of the retiring pension, which will now be secured, present day salaries will not appear very inadequate in comparison with those of other professional men.

ON his way to Simla for the summer months, Lord Curzon visited Pusa and laid the foundation-stone of the agricultural college there. The Pusa estate comprises some 1280 acres of soil on which almost any crop may be grown. The Government proposes to concentrate there all the agricultural skill, scientific, practical, and educational, to be procured. The buildings will cost 16½ lakhs of rupees, of which amount the laboratory and its fittings will absorb 7½ lakhs. Pusa will provide for agricultural students research in the laboratory, experiment in the field, and instruction in the class-room. After laying the stone Lord Curzon, we learn from the *Times*, referred to the circumstances in which he received from Mr. Henry Phipps, the American millionaire, the munificent bequest which was the origin of the institute. The college, Lord Curzon continued, will form a centre of the application of science to Indian agriculture, and it is hoped that each province of India will in time possess its own staff, its own institute for research and experiment, in fact, a properly organised agricultural department. The Government has no desire to monopolise the field, and will lend every possible advice to great land holders conducting their own experiments, improving their own seed and the breed of their own cattle. Earlier in the day Lord Curzon, replying to an address of welcome from the Behar planters, said that the problem confronting the indigo growers since the synthetic indigo of Germany was perfected some eight years ago is so to combine scientific methods with cheapening of the cost of production as to enable them to produce a natural colour at a price permitting of competition with the artificial product.

WE have received from the Agent-General for New South Wales a copy of a "Statistical Account of Australia and New Zealand, 1903-4," by Mr. T. A. Coghlan. An important section of the volume deals with education, and a prominent place is given in this summary to university and technical education. It appears that the Government endowments to the universities of Sydney, Melbourne, Adelaide, and Tasmania in 1903 were respectively 15,533*l.*, 13,500*l.*, 6611*l.*, and 4000*l.* In addition to the annual endowment, the Adelaide University has received a perpetual endowment of 50,000 acres of land from the Government of South Australia. The University of New Zealand—which is an examining, and not a teaching, body—has a statutory grant of 3000*l.* a year from Government, and of the affiliated colleges Auckland University College is in receipt of a statutory grant of 4000*l.* a year. The University of Otago derives a sum of about 5500*l.* annually from rents of reserves. The Australasian universities are empowered to grant the same degrees as the British universities, with the exception of degrees in theology. Women are admitted to all the universities. As regards technical education, the State expenditure upon it in five of the Commonwealth provinces and New Zealand is as follows:—New South Wales, 26,500*l.*; Victoria, 16,400*l.*; Queensland, 7200*l.*; Western Australia, 5710*l.*; Tasmania, 2500*l.*; and New Zealand, 21,000*l.* In addition to ordinary technical classes throughout New Zealand, there are schools of mines in the chief mining districts, and the Government makes an annual grant of 500*l.* towards the endowment of the chair of mining and metallurgy at the Otago University. Facts such as these show that administrators in Australia and New Zealand are alive to the part which higher education should take in the life of the State, and are willing to supply funds from the public treasury to assist the work of their colleges and universities.

A LETTER from Prof. W. Ridgeway in the *Times* of April 27 contains a number of wise suggestions for the improvement of the education given to boys in secondary schools. Referring to the recent vote on the Greek question, he says, careful inquiries give reason to believe that many voted to make Greek optional simply because they believe that the system of education at present in vogue in public schools is bad, that too much time is given up to Latin and Greek, that, as a rule, science is not taught at all, that the universities are in a large measure responsible for the existing state of things, and that something must be done to improve matters; and accordingly, as somebody must be thrown overboard, Greek was the proper Jonah. Prof. Ridgeway goes on to argue that the mere abolition of compulsory Greek would not have effected any improvement in the method of teaching the older subjects in the schools or have done anything to make the teaching of science general. Moreover, he rightly remarks, there can be no reform worthy of the name which does not ensure that boys whose tastes are literary should learn the methods of science, whilst boys whose bent is to science should get a literary training to give them the power of expressing their ideas with lucidity and to imbue them with a taste for culture. The faulty teaching of the schools, he continues, is due in the main to the specialisation which is required by the open scholarship system, and to the sacrifice of the average boys to those who show greater promise and are likely to win scholarships. The universities are largely responsible for this state of things, for they deliberately encourage premature specialisation in boys of promise by their system of open scholarships, and permit the interests of the average boys to be sacrificed by allowing boys to matriculate before they have passed any examination to show that they have acquired a sufficient modicum of liberal education to serve as a basis for a university training.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 16.—"A Determination of the Amounts of Neon and Helium in Atmospheric Air." By Sir William **Ramsay**, K.C.B., F.R.S.

The author had already attempted to estimate the amounts of krypton and xenon in air by the evaporation of relatively large quantities of liquid air. No doubt much krypton and some xenon evaporated, hence the figures given were necessarily minimum estimates. Dr. Travers

and the author made a rough guess at the proportions of neon and helium in air; the amount of each gas obtained was known, but the quantity from which they were derived could only be guessed at. The figures were:—of helium one or two parts per million, and of neon one or two parts per 100,000.

The ingenious method devised by Sir James Dewar of cooling a dense form of charcoal with liquid air, and using it as an absorbent for gases, made it easy to obtain a nearly correct estimate of the amounts of the more volatile constituents. After oxygen, nitrogen, and argon had been absorbed from about 16,800 c.c. of air by exposure to 100 grams of charcoal cooled with liquid air, the neon and helium were removed with the pump. They were freed from traces of heavier gases by a similar method, and a partial, but fairly complete, separation of the two was effected in the same way. The total quantities were measured by a form of burette, in which the level of the mercury was set to a point, and the differences of pressure read.

The results are:—

	In air 1 vol. in	In crude argon 1 vol. in	Percentage By weight	Percentage By volume
Neon ...	80,790	... 757	... 0·000086	... 0·0000123
Helium..	245,300	... 2300	... 0·00000056	... 0·0000040
Together	61,000	... 571	... —	... —

It was not possible to detect the free hydrogen in this quantity of air; after the crude mixture of neon and helium had been mixed with a trace of oxygen and sparked for a few minutes, no contraction was observed; the volume of the gases was the same before and after sparking.

April 6.—"On Reciprocal Innervation of Antagonistic Muscles.—Seventh Note." By Prof. C. S. **Sherrington**, F.R.S.

If the crossed extension reflex of the limb be examined before and after a prolonged flexion reflex an alteration is evident in it. When a carefully adjusted electrical stimulus is at regular intervals applied to the afferent path of one limb and the resultant extensor reflex of the crossed limb is noted, it is found that if in one of the intervals a flexion reflex of the latter limb is induced and maintained for twenty seconds or more, the extensor reflex becomes altered in consequence. For a period immediately following the flexion reflex the extension reflex is increased. The intensity of the reflex is heightened, its duration is prolonged, and its latent time is reduced. If the testing stimulus be subliminal the threshold value of the stimulus required by the reflex is found to be lowered. In short, the activity of the flexion arcs directly or indirectly induces in the extension arcs a super-excitability as tested by crossed extension just as when tested by the extensor thrust.

But although this after-effect of the activity of the flexion arcs upon the antagonistic arcs, both direct and crossed, is one of increase of activity, the primary effect is, as shown previously, one of depression. In these instances there supervenes on the spinal inhibition a rebound effect of augmentation.[1]

The "spinal induction" is obviously qualified to play a part in linking reflexes together in a coordinate sequence of successive combination. If a reflex arc A during its own activity not only temporarily checks the discharge-action of an opposed reflex arc B, but also as a subsequent result induces in arc B a phase of greater excitability and capacity for discharge, it predisposes the spinal organ for a second reflex opposite in character to its own in immediate succession to itself.

Much of the reflex action of the limb that can be studied in the "spinal" dog bears the character of adaptation to locomotion. "Spinal induction" obviously tends to connect this "extensor thrust" as an after-effect with precurrent flexion of the limb. In the stepping forward of the limb the flexion that raises the foot and carries it forward clear of the ground, though temporarily checking the reflex discharge of the antagonistic arcs of extension, is, as it continues, so to say, sensitising them to respond later in their turn by the supporting and propulsive extension of the limb necessary to progression. In reflex sequences an antecedent reflex would thus not only be the means of bringing about an ensuing stimulus for the next reflex,[1] but in such instances as the above will predispose the arc of the next reflex to react to the stimulus that will arrive.

1 Sherrington, Schäfer's "Text-book of Physiology," vol. ii., p. 841, 1900.

"Further Experiments and Histological Investigations on Intumescences, with some Observations on Nuclear Division in Pathological Tissues." By Miss Elizabeth **Dale**. Communicated by Prof. H. Marshall Ward, F.R.S.

(1) This paper is the third of a series on intumescences, and deals chiefly with two plants, *Solanum tuberosum* and *Populus tremula*. On the potato plant intumescences were obtained experimentally in about twenty-four hours, either on the uninjured plants or on small fragments of leaves. The effect of nutritive solutions on the formation of intumescences was investigated.

(2) Additional anatomical observations were made, and a classification of various types of intumescences has been drawn up. The cell contents were examined and compared.

(3) The occurrence of acids and salts was investigated.

(4) The experiments show that the internal causes of intumescences are *extremely local*, and quite independent of root pressure. The osmotically active substance is probably *oxalic acid*.

The present experiments show the importance of *irritability* and *active powers of assimilation*, as well as of *moist air, heat, light*, and, generally, oxygen.

(5) Finally, the nuclear phenomena were investigated and compared, and were found to be in every respect identical in various intumescences and in wound-callus. Pathological tissues in certain plants and animals are also compared, and a strong resemblance is seen to exist between certain *rapidly* formed outgrowths in plants and animals, caused not by any parasitic organism, but simply by the influence of some stimulus, probably always external, acting upon a plant or animal in such a condition of irritability that it is able to respond. A similar resemblance occurs between regenerative wound tissues in certain plants and animals, the formation of which is in all cases accompanied exclusively by the more rapid form of nuclear division known as amitotic or direct.

Zoological Society, April 18.—Mr. H. Druce, vice-president, in the chair.—The horn-core (with sheath attached) of an Urus (*Bos primigenius*): J. G. **Millais**. The specimen was believed to be the only British example of the actual horn of the Urus in existence. The curious corrugations on the surface of the lower end were similar to those found on the American and European bison, and incidentally supported the view that the white cattle of Chillingham, Chartley, and Cadzow were not descended from this animal.—Photograph of the horns of a Roberts's gazelle (*Gazella grantii robertsi*) obtained by Mr. C. L. Chevalier: O. **Thomas**.—The discovery of the skeleton of *Diplodocus carnegii*, Hatcher: Dr. W. J. **Holland**. Dr. Holland discussed the osteology of Diplodocus, briefly pointing out some of the more interesting structural features of the skeleton, and in this connection animadverted upon certain so-called "restorations" made public in popular magazines. Dr. Holland concluded his account by exhibiting in rapid succession pictures of a few of the more remarkable skeletons which had been recovered by the palæontological staff of the Carnegie Museum from various localities in the region of the Rocky Mountains.—A unique specimen of *Cetiosaurus leedsi*, a sauropodous dinosaur from the Oxford Clay of Peterborough: Dr. Smith **Woodward**. The author described the fore and hind limbs and the tail, and confirmed the observation of the late Prof. O. C. Marsh, that Cetiosaurus was one of the more generalised Sauropoda.—On a young female Nigerian giraffe: Dr. P. C. **Mitchell**. On the evidence afforded by a young female giraffe, obtained by Captain Phillips in the district of Gummel, about 300 miles due west of Lake Chad, and now deposited in the Society's Gardens, the author was inclined to believe in the distinctness of the

1 Loeb's "Ketten-reflexe," discussed in his "Vergleichende Gehirnphysiologie u. Vergleichende Psychologie." Leipzig, 1899. p. 96, and *seq.*; compare also Exner, "Entwurf einer physiologischen Erklärung psychischer Erscheinungen," Vienna, 1894, p. 102, and *seq.*, under "Successive Bewegungscombinationen."

Nigerian giraffe (*Giraffa camelopardalis peralta* of Thomas), which, however, was closely allied to the Nubian form (*G. c. typica*).—The ento-parasites obtained from the Zoological Gardens, London, and elsewhere: A. E. **Shipley.** Thirteen species were enumerated, one of which was described as new.—The muscular and visceral anatomy of a leathery turtle (*Dermatochelys coriacea*): R. H. **Burne.** The animal was a young female about 4 feet long, and was thus considerably larger than the few examples of this rare chelonian that had previously been dissected. It came from Japan. The muscles of the neck, trunk, and limbs were described in detail, and notes were made of numerous hitherto unrecorded or imperfectly described features of the alimentary and other internal organs.—A third collection of mammals made by Mr. C. H. B. Grant for Mr. C. D. Rudd's exploration of South Africa, and presented to the National Museum: O. **Thomas** and H. **Schwann.** The present series was obtained in Zululand, and consisted of 222 specimens, belonging to 49 species, of which several were described as new, besides a number of local subspecies.—Description of a new species of newt from Yunnan: G. A. **Boulenger.**—Hybrid hares between *Lepus timidus*, Linn., and *L. europaeus*, Pall., in southern Sweden: Dr. E. **Lönnberg.** The hybrids had become comparatively common in this part of Sweden owing to the introduction of the latter species for hunting purposes.—Description of the giant eland of the Bahr-el-Ghazal: A. L. **Butler.** Mr. Butler was of opinion that this eland was more nearly allied to the West African form than to that of South Africa, and proposed to distinguish it as *Taurotragus derbianus gigas*. It differed from the typical *T. derbianus* in its much lighter body-colour (a pale *café-au-lait* fawn instead of a rich ruddy brown), in the greyish white of the black-maned dewlap, and in carrying grander horns.

Chemical Society, April 19.—Prof. R. Meldola, F.R.S., president, in the chair.—Complex nitrites of bismuth: W. C. **Ball.** A series of double salts of bismuth nitrite with alkali and ammonium nitrites and nitrates were described. These salts, though unstable, appear to be perfectly definite substances.—Experiments on the synthesis of the terpenes, part ii., synthesis of Δ^3-*p*-menthenol (8), $\Delta^{3:8(9)}$-*p*-menthadiene, *p*-menthanol (8), $\Delta^{8(9)}$-*p*-menthene, and *p*-menthane: W. H. **Perkin,** jun., and S. S. **Pickles.**—Part iii., synthesis of aliphatic compounds similar in constitution to terpineol and dipentene: W. H. **Perkin,** jun., and S. S. **Pickles.**—Part iv., synthesis of Δ^3-normenthenol (8), $\Delta^{3:8(9)}$-normenthadiene, normenthanol (8), and $\Delta^{8(9)}$-normenthene: K. **Matsubara** and W. H. **Perkin,** jun. These three papers described the preparation of terpenes and related substances. The results showed that the lemon-like odour of certain terpenes is associated with the simultaneous occurrence of two ethylenic linkages, one in the ring and the other in the side chain, and that by the disappearance of the ethylenic linkage in the ring terpenes having a peppermint odour are produced. The interesting fact was also observed that when the two ethylenic linkages occupy the so-called Tiemann position with regard to each other only one of them becomes saturated by the addition of halogens, and that consequently the property of forming a tetrabromide is not distinctive of a particular class of terpenes possessing only one double bond, as has frequently been supposed.—*C*-Phenyl-*s*-triazole: G. **Young.** This compound and certain of its derivatives were described.—The resolution of *inactive* glyceric acid by fermentation and by brucine: P. F. **Frankland** and E. **Done.** In view of Neuberg and Silbermann's observations (*Ber.*, 1904, xxxvii., 339), the authors have re-examined the barium salts of *fermentation* glyceric acid and of the synthetic acid deracemised by means of brucine, and have confirmed the results obtained by Frankland and Frew and Frankland and Appleyard, which are at variance with those recorded by the German workers.—Estimation of potassium permanganate in presence of potassium persulphate: J. A. N. **Friend.** Small quantities of potassium permanganate may be estimated iodometrically in presence of potassium persulphate provided that the solution is dilute, only faintly acid, and that the iodide is added only in slight excess of the amount required to reduce the permanganate.

Royal Microscopical Society, April 19.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—A slide of *Bacillus typhosus* and the method adopted in staining and mounting, also photomicrographs of the slide ×2500 and 5000 diameters with flagella well displayed: W. J. **Dibdin.**—On the application of the undulatory theory to optical problems: A. E. **Conrady.**

DUBLIN.

Royal Irish Academy, April 10.—Mr. F. Elrington Ball, vice-president, in the chair.—On the growth of crystals in the contact-zone of granite and amphibolite: Prof. Grenville A. J. **Cole.** Attention is directed to the growth of crystals in amphibolites when these come under the stimulus of an invading mass of granite. Garnet and hornblende may thus appear upon a larger scale than that adopted by them in the original amphibolite. Hornblende especially grows in large prismatic forms in the composite rocks produced along such junction-surfaces, and serves as evidence in these cases that contact-alteration has taken place rather than dynamic metamorphism. Under dynamic influences, the secondary hornblende is of the granular type common in epidiorites. The instances quoted are from both sides of the Gweebarra estuary in Co. Donegal.

PARIS.

Academy of Sciences, April 25.—M. Poincaré in the chair.—Two observations relating to the undergrowth in woods: P. **Fliche.** Certain forms of plants requiring plenty of light for their proper development appear to die out when the undergrowth reaches a certain height. After clearing, however, these plants again re-appear at the same spots, and as an example of the great persistence of such plants the author instances groups of *E. lathyris*, probably planted by the Romans, which are found near Gallo-Roman remains.—On a new clutch: le **Duc de Guiche** and Henri **Gilardoni.**—On the light emitted by crystals of arsenious anhydride: D. **Gernez.** The author has made a careful study of the luminous phenomena produced during the crystallisation of arsenic trioxide, and finds that, contrary to the statements of Rose, the light is not produced at the moment each minute crystal is deposited on the sides of the flask, nor during its growth, but that the least contact between a hard body and a recently formed crystal, or between two crystals, causes a brilliant evolution of light. It is a case of the development of light by the fracture of crystals, many examples of which are known in the field of organic chemistry. This property of arsenic trioxide crystals is not a fugitive one, but is exhibited after a long interval of time.—On the application of the methods of interferential spectroscopy to the solar spectrum: Ch. **Fabry.** A description of a modification of an arrangement given in an earlier paper. It possesses the advantage of allowing a larger number of lines to be studied, and may be of use in determining very small displacements of lines.—On the variations of lustre given by a Crookes's tube: S. **Turchini.** The brightness of the fluorescent screen, when acted upon by a given Crookes's tube, was measured photometrically, each of the constants of the circuit being varied in turn. The luminosity of the screen increased with the equivalent spark up to a spark length of 10 cm. to 12 cm., after which it remained constant. Measurements were also made of the effect of the frequency of the contact breaker, of coils differing in size, and of variations in the self-induction of the coil.—The application of the microscope to the examination of india-rubber: Pierre **Breuil.** It was found that the progress of the vulcanisation of rubber could be followed under the microscope, the absorption of the sulphur being accompanied by changes in the crystalline structure.—The floral diagram of the Cruciferæ: M. **Gerber.** The floral formula of the Cruciferæ is given as

$$S(2_l+2_m).P(4_d).E(2_l+4_d).C(2_{ls}+2_{ms}).$$

—The experimental production of the ascospore apparatus of *Morchella esculenta*: Marin **Molliard.** From the experiments described the best conditions are worked out for the cultivation of this mushroom.—Chlorophyll assimilation in young shoots of plants; applications to the vine: Ed. **Griffon.** Boussingault, in 1807, studied the question

as to whether young shoots, almost colourless, possessed the power of decomposing carbonic acid, his experiments leading to a positive result. The method used was indirect, the assimilation being proved by the evolution of oxygen. The author has taken up this question again, using the method of gaseous exchanges in a confined atmosphere containing from 5 per cent. to 10 per cent. of carbon dioxide. In the cases studied the assimilation was extremely small, and was easily masked by the respiration.

CALCUTTA.

Asiatic Society of Bengal, April 5.—The colouring principle of the flowers of *Nyctanthas arbor tristis*: E. G. **Hill.** The author describes the uses of the flowers of the "Narsinghar" plant in dyeing, and gives an account of the separation and properties of the crystalline yellow colouring matter. A sweet principle, recognised as mannitol, and wax were also extracted from the flowers.—On some forms of the Krīs hilt, with special reference to the Krīs Tādjŏng of the Siamese Malay States: N. **Annandale.** The Krīs is the most characteristic weapon of the Malays, but its origin is probably not very ancient. The hilt takes various forms, all of which, however, have much in common, and can be reduced to one general type. Examination of a series of specimens shows that this type was originally Hindu.—On the occurrence of the fresh-water worm Chætogaster in India, with a diagnosis of a species from Calcutta and notes on its bionomics: N. **Annandale.** The genus Chætogaster does not appear to have been recorded hitherto from India. A species (*Chaetogaster bengalensis*, sp. nov.) common in the Calcutta tanks lives in close association with water-snails, but is not parasitic upon them, feeding on small Crustacea. It progresses by the aid of an anterior and a posterior sucker, and uses its setæ in insinuating itself between the snail and its shell.

DIARY OF SOCIETIES.

THURSDAY, MAY 4.

ROYAL INSTITUTION, at 5.—Flame: Sir James Dewar, F.R.S.

CHEMICAL SOCIETY, at 8.—The Synthesis of Substances Allied to Adrenaline: H. D. Dakin.—Methylation of *p*-Aminobenzoic Acid by Means of Methyl Sulphate: J. Johnston.—Some Notes on Sodium Alum: J. N. Wadmore.—Camphoryl-ψ-semicarbazide: M. O. Forster and H. E. Fierz.

RÖNTGEN SOCIETY, at 5, (1) to Medical Members only. Forty-two Cases of Ureteral Calculus Diagnosis by X-Rays proved by Operation on the Passage of the Calculi; (2) at 8.15 p.m., to the General Meeting, Measurement and Technique in Therapeutic Dosage: Dr. C. Lester Leonard, Philadelphia.

LINNEAN SOCIETY, at 8.—Œcology: its Present Position and Probable Development: A. G. Tansley.—The Flora of Gough Island: R. N. R. Brown.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 7.30.—Annual General Meeting.—At 8.—Card-Indexing and Filing: J. C. Osborne.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Discussion on A. M. Taylor's paper "Standby Charges and Motor Load Development."

FRIDAY, MAY 5.

ROYAL INSTITUTION, at 9.—Problems underlying Nutrition: Prof. H. E. Armstrong, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—Discussion on Dr. Buchanan's paper on The Spread of Smallpox occasioned by Smallpox Hospitals during 1900-1904: Dr. Newsholme.

GEOLOGISTS' ASSOCIATION, at 8.—Explorations for Fossil Bones in Western North America, with Special Reference to the Skeleton of Diplodocus, of which a Plaster Cast is now being Mounted in the British Museum (Natural History): Dr. W. J. Holland.

SATURDAY, MAY 6.

ROYAL INSTITUTION, at 3.—Moulds and Mouldiness: Prof. Marshall Ward, F.R.S.

MONDAY, MAY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Nile Provinces and Western Uganda: Lieut.-Col. C. Delmé-Radcliffe.

TUESDAY, MAY 9.

ROYAL INSTITUTION, at 5.—The Study of Extinct Animals: Prof. L. C. Miall, F.R.S.

WEDNESDAY, MAY 10.

SOCIETY OF ARTS, at 8.—The Native Races of the Unknown Heart of Central Africa: The Viscount Mountmorres.

GEOLOGICAL SOCIETY, at 8.—The Geology of Dunedin (New Zealand): P. Marshall.—The Carboniferous Limestone of the Weston-super-Mare District: F. Sibly.

THURSDAY, MAY 11.

ROYAL SOCIETY, at 4, Election of Fellows.—At 4.30, *Probable Papers*: On the Resemblance existing between the "Plimmer's Bodies" of Malignant Growths and certain Normal Constituents of Reproductive Cells of Animals: Prof. J. B. Farmer, F.R.S., J. E. S. Moore, and C. E. Walker.—The Effect of Plant Growth and of Manures upon the Soil: the retention of Bases by the Soil: A. D. Hall and N. H. J. Miller.—A Study of the Process of Nitrification with Reference to the Purification of Sewage: Miss H. Chick.—Pathological Report on the Histology of Sleeping Sickness and Trypanosomiasis; with a Comparison of the Changes found in Animals infected with *T. gambiense* and other Trypanosomata: Dr. A. Breinl.—(1) The Experimental Treatment of Trypanosomiasis in Animals; (2) Remarks on Mr. Plimmer's Note on the Effects produced in Rats by the Trypanosomata of Gambian Fever and Sleeping Sickness: Dr. H. Wolferstan Thomas.

ROYAL INSTITUTION, at 5.—Flame: Sir James Dewar, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Manufactures of Greater Britain. III. India: H. J. Tozer.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telephone Traffic: H. L. Webb.

SOCIOLOGICAL SOCIETY, at 8.15.—Some Guiding Principles in the Philosophy of History: Dr. J. H. Bridges.

MATHEMATICAL SOCIETY, at 5.30.—On the Intersections of two Conic Sections: J. A. H. Johnston.—On a System of Conics yielding Operators which Annihilate a Cubic and its Bearing on the Reduction of the Cubic to the Sum of four Cubes: H. G. Dawson.

FRIDAY, MAY 12.

ROYAL INSTITUTION, at 9.—The Pressure due to Radiation: Prof. E. F. Nichols.

PHYSICAL SOCIETY, at 8.—A Simple Method of Determining the Radiation Constant; suitable for a Laboratory Experiment: Dr. A. D. Denning.—A Bolometer for the Absolute Measurement of Radiation: Prof. H. L. Callendar, F.R.S.—The Resistance of a Conductor the Measure of the Current flowing through it: W. A. Price.

MALACOLOGICAL SOCIETY, at 8.—Note on *Helix pellita*, Fér., and other Shells from the Pleistocene Cave-deposits of East Crete: Rev. R. Ashington Bullen.—Notes on Recent Spanish Shells from Granada and Carmona: Rev. R. Ashington Bullen.—Description of a new Species of Vitrea from Greece: E. A. Smith.—Descriptions of new Forms of Marginellidæ and Pleurotomidæ: E. R. Sykes.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, MAY 13.

ROYAL INSTITUTION, at 3.—Moulds and Mouldiness: Prof. Marshall Ward, F.R.S.

CONTENTS.