THURSDAY, JULY 18, 1907.

AN INTRODUCTION TO THE COMPARATIVE ANATOMY OF VERTEBRATES.

Einfuhrung in die Vergleichende Anatomie der Wirbeltiere. By Prof. Robert Wiedersheim. Pp. xxii+471; illustrated. (Jena: Gustav Fischer, 1907.) Price 11 marks.

THE fatalities which may overtake standard text-books are numerous and complex in their action, but on the whole, overgrowth, the result of repeated editions, is one of the commonest causes of extinction. With the incorporation of new material in each edition, the scientific merit of a work may rise, but unfortunately its commercial value will certainly decline; from an examination book with a wide circulation amongst students it becomes a reference book, used only by experts. This is a difficulty which faces every author in the preparation of a new edition of a standard text-book; he may do his duty at the expense of circulation, or he may throw overboard older work to make room for the new, and thus maintain or even increase the circulation, or he may do as Prof. Wiedersheim has done—allow the work to increase with the growth of knowledge, and issue another book altogether, into which are condensed the merits and essentials of the older work.

The volume under review is a condensation of Prof. Wiedersheim's well-known text-book on comparative anatomy. It will be widely used, no doubt, by medical and by science students in Germany, but it will also prove of the greatest service to those who wish to obtain a summary of our modern knowledge of this subject. The author has the incomparable advantage of a first-hand knowledge of the whole length and breadth of vertebrate anatomy; as colleagues and advisers in the University of Freiburg he has Gaupp, Keibel, and E. Fischer, each eminent in his own field of work. He possesses a simple, easy diction, a judicious eye for the selection of his facts, and a very open mind. His attitude perhaps is too cautious, too non-committal; difficult and unsettled problems are simply mentioned or brushed aside.

It is a curious fact that no British anatomist has ever produced a systematic treatise on comparative anatomy of the type so common in Germany—the type best represented by the works of Gegenbaur and Wiedersheim. Huxley's classical work on vertebrate comparative anatomy is arranged on quite different lines; there the anatomical facts are so grouped as to throw light on the relationship of one class of animals to another; clearly, in Huxley's opinion, the chief object of the anatomist is to ascertain the evolutionary history of *the animal*, whereas the German anatomist seeks the evolutionary history of *the organ*. English anatomists set their facts under a zoological classification, whereas, in the book under review, the classification is strictly anatomical. Prof. Wiedersheim may make incidental allusions to the bearing of a fact on the position of one group of animals to another—such as the impossibility of deriving the mammalian lung from the reptilian—but such allusions are few and far between. Clearly he has no immediate object in view saving that of bringing together in an orderly arrangement all that is known of the form and variation of each organ. Strictly speaking, the classification adopted in German works on comparative anatomy is essentially physiological; the structures subserving circulation are dealt with in one chapter, those of respiration in another, and it may be at once admitted that this method of classification has an overwhelming advantage over any other. Yet such a treatise is the last one in the world one would consult for physiological information, because the correlationship between function and form has never appealed very strongly to the German anatomist. As knowledge increases, it becomes more and more certain that the key to comparative anatomy is comparative physiology—a subject yet in its infancy.

This statement, however, is less true of Prof. Wiedersheim than of his compeers; one rejoices to see occasional allusion to function in his work; he rightly describes the functional significance of the air sacs attached to the lungs of birds; his allusion to the function of the accessory sexual organs will probably assist the student to understand their structure and relationship; mention is made of the effects of the substance secreted by the suprarenal body in raising the arterial blood-pressure, although nothing is said of its equally important action on the musculature of the alimentary canal. There is a frank, engaging honesty in the manner with which Prof. Wiedersheim deals with structures of obscure meaning. As regards the descent of the testicle, he says it is a "schwer erklärbare Vorgang"; unlike Metschnikoff, he does not conclude that the hymen at the entrance of the vagina has neither function nor meaning, because in the present state of our ignorance regarding sexual organs generally we have not as yet discovered any function or meaning attached to it. He frankly admits that the significance of the abdominal pores is unknown. On the other hand, he concludes that the lobulation of the lung has no physiological significance—an inference which will not be supported by a closer knowledge of the mechanism of respiration.

There are certain minor blemishes in this work. The index is not nearly full enough. For instance, on taking the book up for the first time, the reviewer wished to ascertain what was taught regarding the fate of the cloaca in higher mammals, but found no reference to that structure in the index. But in the text he discovered, from incidental remarks rather than from any special description, that Prof. Wiedersheim regards the anus of the higher mammals as the cloacal orifice, and that the urogenital aperture is a new opening. The research of Dr. F. Wood Jones leads to a diametrically opposite conclusion, namely, that the urogenital orifice is the cloacal orifice, and that the anus is a new opening, and hence the frequent occurrence of *atresia ani* in children. There are other statements, too, with which English anatomists will not agree, such as those regarding the nature of the sternum, the origin and nature of the temporo-maxillary joint, the origin and nature of the diaphragm,

the homology of the muscles of the body wall, and the retrograde nature of the appendix vermiformis. These, however, are all contentious matters, which the author purposely has left undiscussed, preferring evidently to state the older view until the truth of the newer has been more firmly established. A. K.

THE PRINCIPLES AND PRACTICE OF FOOD PRESERVING.

Les Industries de la Conservation des Aliments. By X. Rocques. Pp. xi+506. (Paris: Gauthier-Villars, 1906.) Price 15 francs.

M. ROCQUES'S aim in writing the present work has been to explain, for the benefit of manufacturers and others, the scientific principles upon which the preservation of foodstuffs is based.

At first sight it is somewhat curious that in dealing with the problems of food-preservation no large measure of success should have been met with until comparatively recent times. To retain the fruits of the earth against periods of scarcity must always have been a desirable object. Hence such operations as the garnering of grain and the drying and salting of flesh were practised ages ago; but afterwards there was a gap of many centuries—one might almost say from prehistoric times until yesterday—during which no considerable advance was made in devising means of preventing the progress of decay. It was a question of the infinitely little. Against club or sword of human despoilers a man might match club or sword in defence of his store of foodstuffs, but he was very nearly powerless against the microscopic agents of putrefactive change.

Nevertheless, in a groping, tentative sort of way, some steps were beginning to be made during the eighteenth century. On the theoretical side Van Helmont, Boyle, Becher, Pringle, Macbride, Black, and others studied the allied questions of fermentation and putrefaction, whilst Lavoisier gave the first touches of quantitative exactitude to such inquiries by his experiments upon the alcoholic fermentation of sugar. On the practical side Gaefer and Eisen tested the possibility of preserving vegetables and fruits by desiccation. Then in the early part of last century came Appert, who practised what is essentially the process of sterilisation employed at the present day on an immense scale in the preservation of every sort of comestible. But it was only with the victory of Pasteur in his famous controversy with Liebig that the true nature of fermentative and putrefactive change became clear. It was the micro-organism, and not the air (*per se*), nor spontaneous generation, nor chemical instability, that was responsible for the decay of organic tissues. Henceforward the steps become firm. It is now the aim of all preservative processes to prevent the development of the micro-organism, whether by exclusion of its presence, or by its destruction, or by the inhibition of its growth. Hence it is that either heat or cold may be used for the required purpose: canned peaches are edible because the putrefactive organisms had been destroyed by heating; ice-embedded mastodons, ages after their death, have furnished well-preserved carcasses because the development of micro-organisms has been inhibited by cold.

After touching upon these and other points in an interesting historical sketch, the author deals, shortly but comprehensively, with the phenomena and products of putrefactive change in alimentary substances. He passes then to the consideration of the practical processes employed in preventing these changes. Preservation by means of heat is first described. To give an idea of the general plan of the book we will outline this section. First comes a sketch of the development of the industry, with notes of localities, products, and some statistics of production—not very recent, by the bye—then the general technique is described, including the manufacture of tins and bottles, and the different methods of closing and sterilising these vessels after they are filled. Afterwards the various classes of foods—vegetables, fruits, meat, fish, and milk—are dealt with in detail, the quantity of material, preliminary treatment, and time of sterilisation being given where necessary for each individual article. Numerous illustrations of machinery and operations elucidate the text.

This thorough and practical style of treatment is continued in the remaining sections of the book, dealing respectively with preservation by means of cold, by desiccation, and by the use of antiseptics. M. Rocques laments the fact that France has lagged behind other countries in the use of cold storage, which in the opinion of M. Muntz is the method having the greatest future. In connection with this an interesting parallel may be noted. Just as Lister's antiseptic surgery has been largely replaced by aseptic processes, so in the case of foodstuffs sterilisation by heat is being to a considerable extent obviated by the practical asepsis of refrigeration.

We can cordially endorse the closing words of M. Brouardel's preface: M. Rocques has written a good book and done a good deed at the same time, since in all probability the health of his fellow-men will benefit from using the information he summarises and applying the principles he explains.

C. SIMMONDS.

THE THEORY OF PLANT BREEDING.

Le Transformisme appliqué à l'Agriculture. By Prof. J. Costantin. Pp. 300. (Paris: Alcan, 1906.) Price 6 francs.

BY "transformism" Prof. Costantin understands the passage from one species to another or the creation of new species—Lamarckianism or Darwinism in contradistinction to the older theories of men like Jordan concerning the absolute fixity of species. The book in the main deals with plants, and consists of a general discussion of the meaning of a species and of such phenomena as garden varieties, bud sports, and graft hybrids, the effects of climate and soil on type, together with a summary of the work of de Vries on mutations and of Nilsson and the Svalöf station on the improvement of cereals. It is a difficult and complex country, and as so much of the progress of agriculture must depend on the creation of improved varieties, the importance of a survey of the known

and the unknown cannot be exaggerated. For example, if one may judge from the variation in yield among existing varieties of wheat, an increase of 10 to 20 per cent. in the maximum yield is not beyond the reasonable expectation of the raiser of new varieties. This increase involves the cultivator in no extra expense to speak of, whereas if he obtained it by means of fertilisers or more intensive cultivation, the added cost might easily consume all the extra return for the crop.

In the creation of new varieties of horticultural or agricultural plants the guiding principle in the past has been selection. In many cases this has consisted in the skilled observer picking out "mutations," new forms which have arisen *per saltum* and show some essential and transmissible difference from the type. In other cases a process of slow amelioration has gone on through persistently breeding only from the best. For example, the percentage of sugar in the sugar beet has been doubled in about fifty years by selecting for seed purposes only those roots which were richest in sugar, a little core having previously been bored out for analysis. It is necessary, however, to distinguish here; richness in sugar is a congenital condition of the root, transmissible with variations to its descendants, whereas mere size or other temporary factors due to culture cannot be so passed on and do not in consequence form material for selection. Thus it is probable that an immense amount of work that has been done to improve cereals by sowing only the largest or the heaviest grains, or, again, the grains from the longest ears, has been wasted; there is no evidence of the permanent amelioration of any variety by this method. The advances have all been acquired by "pure culture" methods; a desirable type of ear or grain is seen, and a pure strain is created by propagating from that alone.

It is with these questions of mutation and selection that Prof. Costantin's book mainly deals, but though such methods have had the field very largely to themselves in the past, they are not likely to retain their position in the future. Until recently the raiser of new varieties was rather shy of cross-breeding; he obtained thereby such an extraordinary and unstable set of mixtures that it was only by a lucky accident he could select anything tractable from it. Thanks, however, to the Mendelian hypothesis, we are now able to handle with some precision the varied hybrid forms which result from a cross, and the work of the Cambridge school of biologists, of Bateson among sweet-peas, and of Biffen among wheats, has shown what a remarkable practical tool Mendel has placed in the hands of the plant-breeders. Mendel's work has revolutionised the whole point of view, and in consequence Prof. Costantin's book, which, though dated 1906, contains no mention of Mendel and his theories, is hardly of service to the plant-breeder of to-day. Doubtless we may have to come back to a consideration of many of the facts therein, facts which lie outside the scope of Mendel's hypothesis, but just at present the current is setting so strongly the other way that Prof. Costantin's book will not meet with much acceptance.

SCIENCE FOR ARTISTS.

Modern Painters. By John Ruskin. 5 vols.
The Stones of Venice. By John Ruskin. 3 vols.
Unto this Last, and Other Essays on Art and Political Economy. By John Ruskin. Everyman's Library. (London: J. M. Dent and Co., n.d.) Price 1*s*. net per volume.

A CHEAP edition of Ruskin's works, clearly printed, and with the author's illustrations well reproduced, is a boon which will be keenly appreciated in many directions. The world of art already owes a heavy debt to "The Stones of Venice" and "Modern Painters," but for many years these have been accessible to the young student only through the agency of the public library or some such place. The great critic, whose watchword was "truth," thus failed to see the full fruits of his teaching. Now it is possible for anyone to enjoy the benefit of his writings, and the training of an artist must be regarded as incomplete until he has mastered, at least, the principles of his calling as laid down by Ruskin in "Modern Painters."

It has always, ever since the days of ancient Greece, been fully recognised that no representation of the human form can be even passable unless it is anatomically correct. Every muscle, every sinew, must be in its proper place, and correctly proportioned; even the attitude and expression of each figure must be correctly fitted to the subject, or the result will be unmercifully condemned. But how many a landscape is defaced with impossible clouds, trees which grow nowhere on this earth, and even rocks and mountains such as no eye has ever seen. In truth, nature has an anatomy as real as that of the human body, and the man who knows turns from such parodies with exactly the same feeling of contemptuous disgust as is inspired by a figure with misshapen limbs, or poised in an impossible attitude.

Misrepresentation of nature has been endured by the public from ignorance bred by lack of observation. As Ruskin says, it is not easy to discern the truth. The eye has to be trained to see correctly, and a picture should contain just that amount of fact which would be visible in the circumstances represented, and no more. It is useless for men who would be regarded as scientific Philistines to urge such things upon artists. Only the great ones would listen for a moment, and they are just those who need the advice least of all. They have always known, more or less, how to combine truth of visible detail with those qualities of breath and feeling which are involved in the idea of a "picture." But the rank and file too often palm off on ignorant buyers works which are wrong in drawing, wrong in colour, and ridiculous as representations of nature.

No one can regard Ruskin as a mere man of science, and he should command the attention of all who aspire to be his brother artists. His magnificent chapters on clouds, on plant forms, and on mountain sculpture are admirable alike in conception and execution. They are an excellent beginning. An artist who has studied them with care cannot but go to

nature with an opened eye, and a little correct seeing must surely inspire him with the desire to understand, and to know nature as the sculptor knows the human body. The anatomy of scenery can only be fully grasped by industrious study, and every landscape painter should be put, as a prime essential, through properly devised courses of meteorology, botany, and geology, since they are the only clues to the working of the bones and muscles of the world.

OUR BOOK SHELF.

The Hills and Valleys of Torquay: a Study in Valley-Development and an Explanation of Local Scenery. By A. J. Jukes-Browne. Pp. viii+104. (Torquay: Published by the Author, Floriston, Torquay, 1907.) Price 3*s.* 6*d.*

THIS is a pleasantly written but withal scientific explanation of the sculpturing of the land which forms the Torquay promontory. The natural attractions of the region are great, and Torquay itself is said to spread over eight hills. Among these, Lincombe and Warberry Hills, formed of red Devonian grits, rise from 400 to nearly 500 feet; while the coast scenery is diversified by the limestone crags and cliffs of Torquay and Babbacombe, the slates of Ilsham, the dark igneous rock of Black Head, and the red conglomerates, sandstones, and clays of Watcombe and Livermead.

In describing the various stages and processes that have led to the present scenery, the author has endeavoured to make his work as simple as possible, but the reader who has hitherto paid no attention to geology must give earnest application to the introductory geological chapters in order to understand the subject.

The author shows how the present features were gradually developed after the Bovey Beds of Eocene age had been spread over an eroded surface of older rocks. The rivers then took their courses over soft strata, and cut channels through this covering into the Permian and Devonian rocks beneath. In process of time all traces of Bovey Beds have been removed from the area, and there have been revealed the remnants of old rock-platforms like that of Babbacombe, trenched in places by river action, before the present outlines of the coast were shaped.

The work, which will be of special interest to residents and visitors, is illustrated by a number of excellent pictorial views, and by a series of maps, based on those of the Geological Survey. The student may with advantage colour by hand the different geological formations represented on these maps. The author would have done well to mention the Geological Survey memoir on the country around Torquay by Mr. W. A. E. Ussher, a work which must form the basis of future research in the area.

Ammonia and its Compounds. By Dr. J. Grossmann. Pp. x+151. (London and New York: Harper and Bros., 1906.) Price 2*s.* 6*d.* net.

THIS is the first volume of a series of handbooks on chemical technology which, so the preface informs us, are not intended to be highly elaborated treatises, but are rather to afford a general survey of the subject and to serve as guides to the larger standard works. Although the author of the present volume disclaims either originality in the subject-matter or completeness in the compilation of his materials, the careful reader will soon realise that whatever defects the book may possess, it is written by one who is not only familiar with his subject, but combines a full knowledge with the power of clear and concise exposition. A more comprehensive treatise may possess the advantage of a work of reference for specialists, but a small volume like this will no doubt attract a wider circle of readers, and should find its way to the shelves of the student of general chemistry. We can only express a hope that the succeeding volumes may maintain the high standard of excellence attained by the pioneer volume of the series.

But if the publishers are to be congratulated on their new venture, we must candidly express regret that so admirable a little volume should have been printed on such inferior paper. It may be desirable to buy a good book at a low price, but no one would grudge a small additional cost if it enabled him to decipher the lines of the illustrations. We would specially direct attention to the figure on p. 85, in which, owing to the character and surface of the paper, all the fine lines are obliterated, and the drawing rendered quite worthless as an illustration.

J. B. C.

Ventilation, Heating, and Lighting. By W. H. Maxwell. Pp. vi+151. Second edition, revised and enlarged. (London: The Sanitary Publishing Co., 1907.) Price 3*s.* net.

THE simple principles and practice of ventilation, heating, and lighting are described in this volume from the point of view of the sanitary engineer. It would be to the advantage of the community if every architect and sanitary engineer were not only familiar with the physical laws upon which successful ventilation, heating, and lighting depend, but also based their work upon them. Usually, the provision made to ventilate and heat a building is quite inadequate; and when any means are provided they are constructed according to rule-of-thumb methods, with little consideration for the possibly peculiar nature of the building to which they are adapted. A few new devices and systems are described by Mr. Maxwell, and the views of authorities on requirements and efficiency are freely cited. The student and the practical man will find the book easy to understand, and a useful guide to success in examinations or in building construction.

Practical Physiological Chemistry. By Dr. Philip B. Hawk. Pp. xiv+416; illustrated. (London: J. and A. Churchill, 1907.) Price 16*s.* net.

DR. HAWK'S name is well known as an investigator in the subject of physiological chemistry. The present volume testifies to his ability as a teacher of the subject. Although there is nothing strikingly original in his presentation of the subject, the book he has produced is free from error, is clearly written, is practical, and sufficiently full for most purposes. The recent work published by Fischer and his colleagues on the question of protein cleavage products is given with special fulness; the urine, also, is naturally a subject which occupies considerable space; indeed, nearly half the book is devoted to this important secretion. The volume is admirably illustrated and well printed.

W. D. H.

Résistance des Carènes. By M. Fricker. Pp. 170. (Paris: Gauthier-Villars; Masson et Cie., 1907.)

THIS latest addition to the series of little volumes known as "Encyclopédie scientifique des Aide-Mémoire," to which attention has often been directed in these columns, deals with the propagation of waves and questions of resistance of liquids to motion through them, with particular reference to the motions of ships. The problems considered are treated theoretically and experimentally, and the student of naval architecture with some knowledge of the calculus should find the book useful.

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.]*

Radium Emanation.

IN 1903, it was shown by Mr. Soddy and myself that the spontaneous change of the emanation from radium results in the formation of helium; this observation has been confirmed by Indrikson, by Debierne, by Giesel, by Curie and Dewar, and by Himstedt and G. Meyer. Debierne has shown that actinium chloride and fluoride also develop helium. I have also once detected helium in the gases evolved continuously from a solution of thorium nitrate, and hope soon to confirm this observation.

When the emanation is in contact with, and dissolved in water, the inert gas which is produced by its change consists mainly of neon; only a trace of helium could be detected.

When a saturated solution of copper sulphate is substituted for water, no helium is produced; the main product is argon, possibly containing a trace of neon, for some of the stronger of its lines appeared to be present. The residue, after removal of the copper from this solution, showed the spectra of sodium and of calcium; the red lithium line was also observed, but was very faint. This last observation has been made four times, in two cases with copper sulphate, and in two with copper nitrate; all possible precautions were taken; and similar residues from lead nitrate and from water gave no indication of the presence of lithium; nor was lithium detected in a solution of copper nitrate, similarly treated in every respect except in its not having been in contact with emanation.

These remarkable results appear to indicate the following line of thought:—From its inactivity it is probable that radium emanation belongs to the helium series of elements. During its spontaneous change, it parts with a relatively enormous amount of energy. The direction in which that energy is expended may be modified by circumstances. If the emanation is alone, or in contact with hydrogen and oxygen gases, a portion is "decomposed" or "disintegrated" by the energy given off by the rest. The gaseous substance produced is in this case helium. If, however, the distribution of the energy is modified by the presence of water, that portion of the emanation which is "decomposed" yields neon; if in presence of copper sulphate, argon. Similarly the copper, acted upon by the emanation, is "degraded" to the first member of its group, namely, lithium; it is impossible to prove that sodium or potassium are formed, seeing that they are constituents of the glass vessel in which the solution is contained; but from analogy with the "decomposition-products" of the emanation, they may also be products of the "degradation" of copper.

A full account of this research will shortly be communicated to the Chemical Society. WILLIAM RAMSAY.

July 11.

Effect of Pressure on the Radiation from Radium.

I HAVE, during the last eighteen months, been engaged in an investigation on the effects of pressure on radio-active phenomena. In designing the apparatus necessary for the purpose, it was necessary to consider that if any change in the rate of production of the emanation occurs through pressure, effects would not be noticeable at once, as a new state of equilibrium would only be reached after several days. Similar considerations hold if any of the slowly decaying products is affected. A special pressure pump was therefore constructed according to the designs of Mr. J. E. Petavel, and this pump allowed me to keep up a pressure of about 2000 atmospheres almost indefinitely without sensible leak. The time of the experiments was not, however, extended beyond four or five days. The results have been entirely negative, and I estimate that a change in the activity of one-third per cent. would have been noticed.

During the course of the investigation several fictitious effects made their appearance, and it was the elimination of these which necessitated a gradual improvement in the methods of observation and took up the greater part of the time occupied in the experimental inquiry.

In addition to the help of Mr. Petavel which has already been mentioned, I have had the assistance of Mr. Makower in the early stages of the work. The final experiments were conducted by my assistant, Dr. Hans Geiger.

ARTHUR SCHUSTER.

Victoria Park, Manchester, July 12.

IN order to ascertain if the rates of disintegration of radium and its successive products (the emanation, A, B, and C) are affected by high pressure, we have placed about 1 gram of barium chloride, containing 1·04 mg. of radium, completely sealed beneath lead, in a thick-walled cylinder of nickel steel, and compressed the radium by a tight-fitting chromium tungsten steel piston 1 cm. in diameter. The greatest pressure applied has been $3{\cdot}2 \times 10^5$ lb. to the square inch, which is the estimated pressure at a depth of fifty miles beneath the surface of the earth. The penetrating radiation arising from radium C was observed by two large electroscopes placed on either side of the radium, and at a distance of about 30 cm. from it. The γ rays produced a deflection of about twenty-eight divisions a minute in an electroscope, the natural leak of which was 0·4. The pressure on the radium was gradually increased from zero to that at ten, twenty, thirty, forty miles beneath the earth's surface, and was maintained for four days at about the forty-mile value. The pressure was then taken off, and observations were continued for three days more. During all these variations of pressure, no change was detected in the γ radiation, although a variation of 1 per cent. could have been observed without difficulty.

The pressure was then rapidly carried from zero to the fifty-mile value and back, and also maintained at fifty miles for two hours. Again there was no change, certainly not 1 per cent.

It is therefore clear that the transformation from radium to radium C continues in a normal manner at pressures equal to those at forty to fifty miles beneath the earth's surface; and this important conclusion seems inevitably to follow—that *radium generates heat by disintegration equally at the surface of the earth and at pressures which obtain at depths forty to fifty miles beneath the surface.*

The Hon. R. J. Strutt has proved that the quantity of radium in rocks near the earth's surface is greatly in excess of that required to compensate for the loss of heat by conduction and radiation from the earth's surface. Dr. Bronson has proved that the disintegration of radium is unchanged by wide variation of temperature. It appears from our experiments that the transformations take place in the usual manner even under a pressure of 160 tons to the square inch. If radium were distributed throughout the earth in the same amount as at the surface, a higher temperature gradient than that actually found would be expected. A possible explanation of the paradox has been put forward by Strutt and supported by Milne. He supposes that the constituents of the earth some twenty to forty miles beneath the surface are different in character from those near the earth's surface, and that they do not contain radium, or contain it to a smaller extent. This seems to carry with it the conclusion that igneous rocks, which contain considerable quantities of radium, have their origin nearer the surface of the earth than some geologists have supposed.

A. S. EVE.
FRANK D. ADAMS.

McGill University, Montreal, June 28.

The Æther and Absolute Motion.

THE particular objection to identifying magnetic force with velocity of the æther, which has been discussed recently in the columns of NATURE by Prof. O. W. Richardson, Sir Oliver Lodge and Prof. W. M. Hicks, Dr. C. V. Burton and Mr. E. Cunningham, must depend on some point of view which is foreign to my ways of thinking. Such a hypothesis involves, of course, that the

all-pervading æther shall be at rest under normal conditions; the effect of any local disturbance due to matter must thus be a local effect, and the distant regions of æther will remain unmoved. There can be no question of ascribing a uniform motion to the whole of the æther, extending to the remotest infinity, because there is no conceivable means of producing or altering such a motion. In other words, an infinitely extended æther postulates absolute motion as a fact, in the only real sense of that term, namely, motion relative to the remote quiescent regions of the æther; and once that determination is made, arguments from relativity of motion must lapse.

The interesting point raised by Prof. Richardson, that the steady field of a uniformly moving electron would contain an infinite amount of moment of momentum, requires detailed consideration; but it is not without parallel in more familiar departments of abstract physics. Its scope may be illustrated by the steady motion of a solid sphere in infinitely extended viscous fluid. The sphere, even when in steady motion, experiences resistance, and must be pushed along in order to maintain its motion. This steady push must impart momentum to the fluid, which increases in amount without limit as the time is prolonged; and it is, in fact, well known that the field of flow around the sphere when it has reached its ultimate theoretical steady state contains an infinite amount of linear momentum. But this circumstance does not vitiate the dynamics of fluid resistance. For, in fact, the steady state of motion is very soon set up throughout the neighbourhood of the moving sphere, while the continued supply of momentum simply diffuses away into the distant regions where the velocity is so slight that it does not react sensibly upon the resistance to the sphere. Similar considerations apply to the case of an electron set into steady translatory motion through æther. Here it is rotational momentum that is steadily imparted to the surrounding æther as time goes on, and is carried away into the distant regions by wave-motion. This requires that the æther exerts a torque on the moving electron, the reaction of which on the æther is the source of the angular momentum communicated to that medium. The possibility of permanent adjustment to a torque of this kind is not here anomalous; it is provided for in the fundamental hypothesis of elastic resistance to absolute rotation of the parts of the æther. There is, however, a fundamental difference from the previous illustration of a solid sphere moving through infinite viscous fluid. In that case the force continually does work, leading to continued dissipation of energy into the viscous fluid. But in the electric case the energy in the æther settles down to a steady value, and no further energy is put into it, although a constant stream of angular momentum is put into it so long as the motion of the electron goes on.

The validity of illustrating the nature of magnetic force by velocity of the æther rests on an application of the Principle of Least Action. The power of that principle resides in its allowing dynamical inferences to be drawn without requiring detailed scrutiny of the mechanism through which the forces operate. But the exceptional character of the hypothesis of rotational elasticity, or the possibility of some flaw in the argument, might conceivably have put the application of the principle at fault. It is thus essential, both for verification and for clearness of view, to scrutinise in detail the circumstances of the motion as determined by the Principle of Action, so far as possible. It would appear that, as regards the interesting feature discussed by Dr. Richardson, nothing has gone amiss.

Even in the case of a sphere set in motion in frictionless fluid, it may be said in the same way that when the steady motion has become absolutely established by propagation outward, an infinite amount of momentum has been transferred from front and rear to the sides.

Cambridge, July 8. J. LARMOR.

IN NATURE of July 4, Mr. E. Cunningham discusses my statement of an objection to identifying the magnetic vector with translational velocity of the æther. Mr. Cunningham says:—"If it were definitely stated that the magnetic force in the free æther was proportional to the velocity of the æther relative to the observer the objection would be valid"; and certainly any theory which embodied such a doctrine would stand self-condemned. My argument, however, was not directed against this obviously untenable view.

If, for the free æther, we assume that magnetic force is, within a constant factor, identical with æthereal velocity, then we can determine the velocity of the æther at any point by measuring the magnetic force at that point. For the value of the magnetic force there is a perfectly definite physical criterion, which is independent of any arbitrarily chosen frame of reference, and hence we should have the means of determining *absolutely* the velocity of the æther. Thus, on our assumption, absolute motion attains to a definite physical significance which has no counterpart in the postulates of ordinary dynamics; and, this being so, dynamics must fail to give a true account of electromagnetism.

Accordingly, when we identify the magnetic vector with translational æthereal velocity, and at the same time assume that we are dealing with a dynamical system, we should expect to be led to results inconsistent with known electromagnetic relations. Consider, in fact, the unaccelerated motion of a charged body (or of an electron) through a space where there is no magnetic intensity. Then pass to the case where the space in question is uniformly pervaded by magnetic force in a direction transverse to the motion of the charged body, while at the same time a new component is added to the motion of the body, identical in direction and magnitude with the æther-drift which we assume to constitute our magnetic field. We have thus impressed a uniform velocity on the whole system considered, and if the system is fundamentally a dynamical one, no new acceleration will thus have been introduced: that is, the charged body will move without acceleration across the lines of magnetic force. C. V. BURTON.

Cambridge, July 12.

Root Action and Bacteria.

IN NATURE of June 6 (p. 126), Mr. S. Pickering has a note on "Root Action and Bacteria" in which he concludes that the proper functioning of roots depends on the presence of bacteria.

Experiments I have made here both in the field and in water culture with a large number of varieties of plants do not lead directly to the same conclusion. Water cultures have been made on a fairly large scale, three harvests of ninety plants being taken in a large number of dishes, each containing two litres of water. After the third harvest, the water was allowed to stand and evaporate to half its volume. On attempting to use this water for further water cultures, all the plants sown in it died within two days and some within half an hour, the time varying with the variety of plant that was transplanted into the water, and with the variety that had previously been grown in the water.

Further, boiling this water neither increases nor diminishes its toxicity to plants. It is, moreover, immaterial whether the nutrient solution is such as to become acid or alkaline after use; neutralisation in either case does not make it possible to grow plants in it.

My experiments lead to the conclusion that the roots of all the plants so far tried excrete a substance that is toxic to all plants (including that by which it is excreted), but in different degrees.

Similarly, in the field *Sesanum indicum* will not grow (on stiff black soil) within 2 feet of *Sorghum vulgare*; all the plants tried appear to decrease the yield of neighbouring plants *of the same variety* by about 50 per cent.

The effect of the toxic substance both in the field and in water culture is completely neutralised by tannic and pyrogallic acids, carbon black, and other substances.

It is, of course, possible that bacteria in the soil have a beneficial action by elaborating antitoxins similar to those mentioned.

I have not yet been able to isolate the toxic substance contained in the polluted water of my cultures.

F. FLETCHER.

Poona, June 21.

THE NATURAL HISTORY OF THE CEYLON PEARL BANKS.[1]

PROF. HERDMAN is to be congratulated on the completion of his report on the pearl fisheries and marine biology of Ceylon. It fills five large volumes, which, besides containing much information of direct practical importance in regard to pearls and pearl fishing, form a broad and firm basis for further study of the biology of the Ceylonese region of the Indian Ocean. The report speaks volumes as to Prof. Herdman's genius as a collector—we doubt if any single worker ever made such large collections over the whole field of zoology in so short a time; he has also done his share of the descriptive studies, and he, along with Mr. Hornell, is responsible for the parts that deal directly with the pearl oyster itself.

It is very interesting to find that since Prof. Herdman's expedition there have been four successive fat years of pearl fishing—the most profitable, so far as is known, that have ever been. In 1905, eighty-one and a half millions of oysters were fished, and the revenue brought in was upwards of two and a half millions of rupees; in 1906, more than sixty-seven millions of oysters were fished, and the total proceeds amounted to 1,385,000 rupees. This should surely convince the Philistines that there is something in biology after all! Prof. Herdman predicts a moderate fishery for this year, and a good fishery for 1908, adding that "after 1908 the prospects depend upon further careful scientific inspecting, transplanting and culching, upon the lines which have been laid down in successive sections of the report." As is well known, the fisheries have been leased by the Government to a company, and it is a matter for congratulation that Mr. Hornell is retained on the spot, and that, in terms of the lease, the necessity for a scientific treatment of the pearl banks during the next twenty years has been duly recognised and provided for.

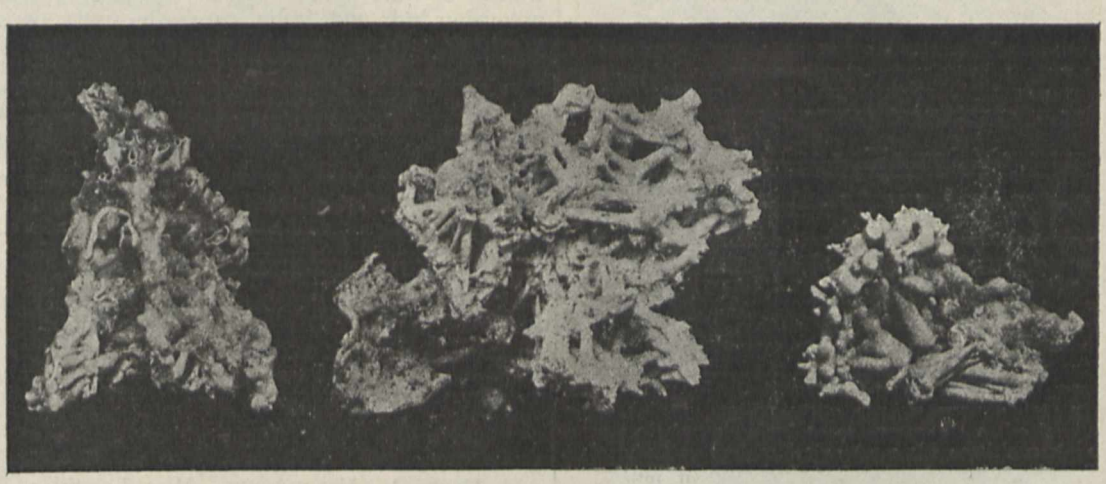

FIG. 1.—*Ramulina herdmani*, Dakin. Natural size.

Vol. v. begins with an interesting essay on pearl production. The authors (Herdman and Hornell) examine the three main theories—(1) that the pearl is the result of a reaction to a grain-of-sand irritation, (2) that the pearl is a pathological secretion, and (3) that the stimulation caused by the presence of a parasitic worm, which acts as a nucleus, results in the deposition of successive layers of pearly material within an epithelial sac. It seems that the grain-of-sand method is occasionally found operative in the causation of true pearls, and it is possible that some of those that appear to have no nuclei may have been deposited around very minute inorganic particles; some pearls not of the finest quality are probably formed as calculus-like growths independently of known parasites; but most and the best pearls are deposited around the larva of a Platyhelminth. In the Ceylonese pearl oysters (*Margaritifera vulgaris*) it seems likely that the parasite is a larval Tetrarhynchus. Apart from pearly excrescences on the interior of the shell, due to the irritation caused by Clione and other boring animals, the authors distinguish (1) ampullar pearls, where the nucleus and resulting pearl lie between the shell and the body, or in an ampulla of the ectoderm projecting into the mantle; (2) muscle pearls, formed around minute calcareous concretions (calcospherules) near the insertions of the muscles; and (3) cyst pearls, formed around encysted parasites. As to the proposal to secure artificial infection of oysters, the authors think that this is probably quite unnecessary on the Ceylon pearl banks. There seem to be plenty of parasites to go round, and every pearl oyster in the Gulf of Manaar, or, for that matter, around the coast of Ceylon, runs a fair chance of becoming infected. It is to be hoped that further investigation will make our knowledge of the pearl parasite and its life-history more precise.

In their report on Cestodes from Ceylonese fishes, Messrs. A. E. Shipley and J. Hornell have some notes on *Tetrarhynchus unionifactor*, which they described in vol. ii. Some of the larval forms entering the oyster arrive in the mantle and other tissues, acquire an ectodermic sac, and there encyst, finding "a costly grave in the developing pearl." Others reach the alimentary canal, and, after growing there, encyst on the outer surface of the intestine. "They are too big for enclosure in a pearl, and they can wait without anxiety for the advent of their second host (*Rhinoptera javanica*), within whose intestine they rapidly become sexually mature."

The late Prof. M. Stossich made notes on a few Nematodes in the collection, and Dr. Max Lühe describes seven new species of Trematodes from fishes. The first part of the volume ends with a very valuable general summary of practical conclusions and recommendations, which we may hope will find application not only in Ceylon but elsewhere. One cannot but

[1] Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar. By W. A. Herdman, D.Sc., F.R.S., P.L.S., with Supplementary Reports on the Marine Biology of Ceylon by Other Naturalists. Part v. Pp. viii+452; 38 plates. (London: Published at the request of the Colonial Government by the Royal Society, 1906.)

admire Prof. Herdman's wide scientific outlook—the true naturalist's point of view—which may be inferred, for instance, from this sentence, "It is impossible, until a careful study has been made of each case, to say which members of the fauna and flora of an oyster bed are of most importance to its prosperity—probably none are wholly without influence for good or evil, so closely interwoven in past history and present function is the web of living nature." If this wise saying were as widely accepted as it is certainly true, biological science would find more generous public support, and we should hear no more of impatient criticisms of scientific investigations which do not yield an increase of rupees so rapidly as Prof. Herdman's study of the Ceylonese oyster beds has done. It is fitting that the practical recommendations should end with a beautiful plate of the life-history of the pearl oyster.

The second half of the volume is occupied with eleven supplementary reports (xxxi–xli). Dr. Nelson Annandale reports on the Cirripedia (11 species); Prof. G. H. Carpenter on a new species of Halobates;

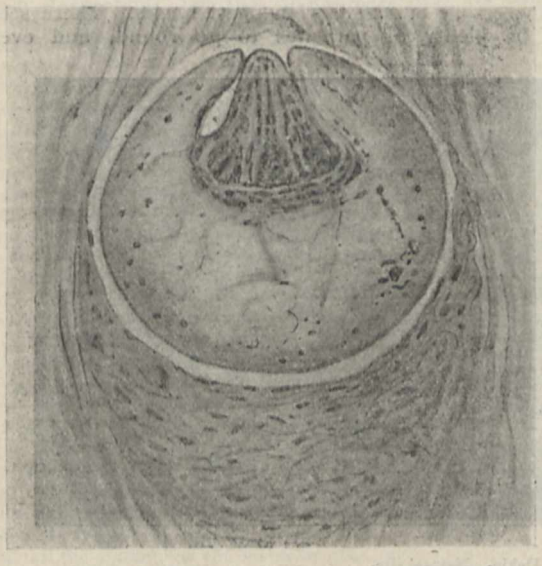

FIG. 2.—Young larval Cestode (Tetrarhynchus, sp.) encysted in connective tissue of pearl oyster.

Mr. W. M. Tattersall on the Leptostraca, Schizopoda, and Stomatopoda; Mr. C. B. Wilson on an interesting series of parasitic Copepods, including two new genera; Mr. T. Southwell on the Anomura (48 species, 2 new); Mr. W. J. Dakin on the Foraminifera (131 species and varieties), which include *Ramulina herdmani*, n.sp., forming masses of calcareous tubules varying in size from a hazel-nut to a small apple; Prof. G. C. Bourne on Jousseaumia, an interesting new genus of Eulamellibranchs commensal with the corals Heterocyathus and Heteropsammia; Messrs. R. Standen and A. Leicester on a large number of Molluscan shells; Prof. Herdman on the Tunicates (64 species); Mr. R. Douglas Laurie on the Brachyura (208 species, 15 new, three of which are referred to new genera).

The volume ends with a general discussion of the faunistic results by Prof. Herdman. His expedition has made known 2615 species of marine animals from the coasts of Ceylon. Of these 575 are described as new to science, and have required the formation of 65 new genera and three new families. About 250 of the Ceylonese species extend into the Malay region and 300 on into the Pacific. At least 240 are known from the Red Sea, and 130 from the Mediterranean. About 280 species extend southwards to the Australian coasts, and a few are found elsewhere in southern latitudes. Finally, 90 Ceylon species are found also in the West Indian region, and may indicate a closer connection by sea in a former period than exists at the present day. Prof. Herdman makes an interesting comparison of his collections with those of the *Investigator*, with those from the Mergui Archipelago and off the coast of Lower Burma, and with those from the Maldive and Laccadive Archipelagoes.

After reviewing his rich collection, Prof. Herdman concludes in the following words:—

"Such are the animate surroundings, including both friends and foes, amid which the pearl oyster habitually lives in the Gulf of Manaar, and seems, if left in comparative peace, able to hold its own in the struggle for existence; but the balance, as we have shown in previous parts of this report, is liable to be seriously disturbed by three all-powerful factors: devastating hordes of voracious fishes which come up from the deeper waters and leave crunched shells and torn byssus in their wake; storms, currents, and overwashes of sand which may sweep away or bury a promising bed; and lastly man, who comes periodically from above on his diving stone and clears the bank of tens of millions of oysters, old and young. The carnivorous fishes and the monsoons cannot be controlled; but to show that much can be done by man to mitigate their influence, and to compensate for the decimation necessarily caused by his own operations, has been the chief object of the present report."

THE DESERT AND THE SOWN.[1]

SOME of the best books of travel nowadays seem to be written by women. We may instance Mrs. Bishop, Miss Durham, and now Miss Lowthian Bell, who, in "The Desert and the Sown," has given us a most delightful description of a wandering undertaken by herself alone with native servants from Jerusalem across Jordan to the Haurân and Jebel Drûz, thence to Damascus and on by Homs, Hama, and Aleppo to Alexandretta. Miss Lowthian Bell's route is, of course, not new. She has seen nothing that has not been seen before, and has contributed nothing new to our archæological knowledge beyond one or two short Arabic inscriptions. But this we do not expect, nor had she any archæological intent in the shaping of her travels beyond the desire to see the famous ruins of Roman Syria. The reason for her journeyings is frankly set forth by her as pure delight in the life of the Near East, and more especially that of the desert. To "travel on where travels above him the Mother of all the clustered stars," deeming "the wild the sweetest of friends," in the words of the Arab poet prefixed by the author to her book ("*yeraya al-waḥshaha al'ansha al-anîsha, wa yahtadî beḥayithu ahtadat Umm ennejumi esh-shawabîkî*"), was her desire, and she has given us a good book describing what she saw in her wandering. As she says at the beginning of the book, "To those bred under an elaborate social order few such moments of exhilaration can come as that which stands at the threshold of wild travel."

Of all wild travel, surely the most exhilarating is that in the Syrian desert. Here the Druze, with his strange religion, descendant of the Old Man of the Mountain and his "Assassins," still reigns in

[1] "The Desert and the Sown." By Gertrude Lowthian Bell. Pp. xv + 347. (London: W. Heinemann, 1907.) Price 16*s*. net.

his "mountain" and lords it over Moslem and Christian alike, despite the suzerainty of the Turk. Here the wild Arabs, 'Anêzeh, Ghiâth, and Shammar, still live as they did in the days of old, rearing their horses and camels, raiding and stealing those of the neighbours, murdering each other, and praising God and his prophet daily. Here is the desert, whether stony waste or bare waste of volcanic débris and lava like the Safa or Ḥarra,[1] or steppe like the Ruhbe and the greater part of the Hammada, or high desert. The yellow Egyptian desert of limestone and sand is not that of Syria. Except in such districts as the Ḥarra, the Syrian desert is not a desert as the Egyptian is, except for the fact that its inhabitants are nomads and have no fixed home in it. Of this steppe its inhabitants know every inch; as one of Miss Bell's guides said to her: "By God" (Wallâh), "the plain is covered with places wherein I rested." "He had struck the note," she goes on; "I looked out beyond him into the night and saw the desert with his eyes, no longer empty but set thicker with human associations than any city. Every line of it took on significance, every stone was like the ghost of a hearth in which the warmth of Arab life was scarcely cold, though the fire might have been extinguished this hundred years."

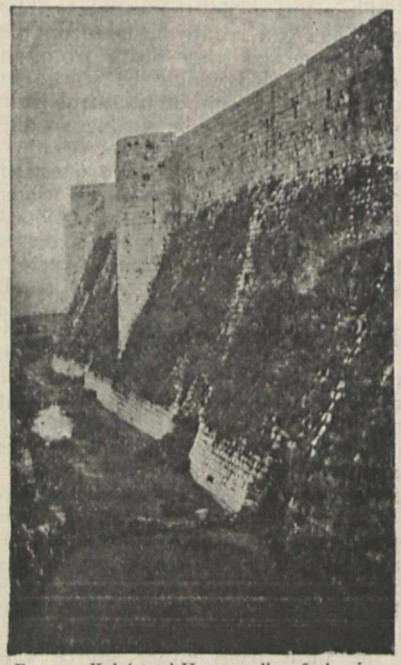

FIG. 1.—Kala'at el-Ḥusn, walls of the inner enceinte. From "The Desert and the Sown."

Out of this waste, tenanted now only by the nomad and his flocks, and knowing now no habitation but the tents of goats' hair, rise the ruins of the great cities of the Ghassanides, like Ḳanawat or Bosra Eski-Sham, in the Haurân, wonderful relics of the civilisation of Syria in the sixth and seventh centuries of our era, in which we see Roman forums with great pillared courts next door to the square towers of the oldest mosques of the Muslim, the last monuments of the "Age of Ignorance" and the oldest of the "Age of Enlightenment" side by side. And apart from the towns we see what are indeed remarkable monuments of Roman civilisation in the Near East, private houses, country-seats of the fifth and sixth centuries, such as the "Sheikh's House at Hayât" (illustrated on p. 103), which is still occupied as a dwelling-house, or the stone houses at el-Bârah and Serjilla (pp. 245, 252), and the "Ḳasr el-Benât" (p. 256), in northern Syria. Miss Bell's photographs of these and other remains of ancient civilisation, including Kala'at el-Beida, Baalbek, Ruwêihâ, the canopied tomb at Dâna (p. 298), are all very good and very interesting.

Miss Bell's route from Jerusalem was taken by way of Jericho and the Jordan ford to es-Salt, in the Belka', where she deliberated as to the way of reaching the Haurân and the Mountain of the Drûz, since the Turkish authorities are by no means friendly to English visitors east of the Jordan, especially to those who wish to visit the Jebel Drûz. However, by avoiding the Turks at 'Ammân and the neighbourhood of the railway, which was crossed north of Mshitta, Miss Bell reached Salkhad in safety. Of Mshitta Miss Bell gives a photograph taken "before the Germans had sliced the carved façade from that wonderful building." It seems regrettable that the "stone lacework" of Mshitta should no longer be seen in its own place under the Syrian sky; now it is cooped up in a dark and low corridor, where it is difficult to see it, in a museum on the banks of the Spree. But with the advent of the railway its removal was perhaps advisable, in view of the possibility of vandalism on the part of some Turkish official.

At the castle of Ṣalkhad the traveller was received with the traditional hospitality of the Drûz, and witnessed an extraordinary scene, very well described on p. 91, a sort of savage war-dance to inaugurate a *ghazu* or raid on the Arabs of the Beni Ṣakhr, as revenge for a previous raid by the latter. This she instances as an "example of the freedom with which the Druzes control their own affairs."

North of Damascus Miss Bell again met with the Drûz, the members of that faith who live in the Lebanon, cheek by jowl with their old enemies the Maronite Christians. And members of the mystical sects of Western Asia, who are half Muslims, half pagans, such as the Nosairis, Meta-

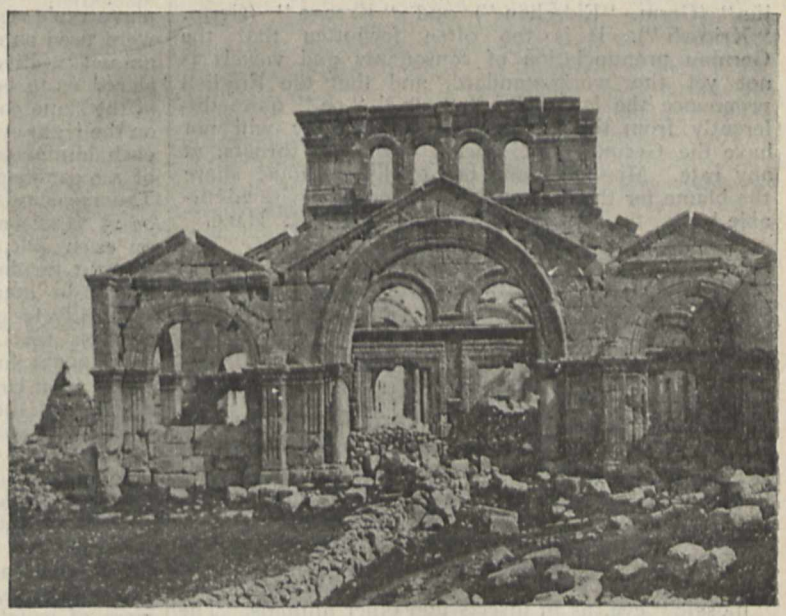

FIG. 2.—Kala'at Sim'ân, the west door. From "The Desert and the Sown."

[1] The vulcanological researches of the late Dr. Alphons Stübel, of Dresden, in the Ḥarra and among the mountains of the Lejâ are well known.

wilehs, Beha'is, and Ismailis, were also encountered by the way.

In northern Syria two of the most interesting places visited by Miss Bell are the castle of Kala'at el-Husn, near Homs, and the church of Kala'at Sim'ân, between Aleppo and the Bailan Pass. Kala'at el-Husn is the northern Kerak, the "Crac des Chevaliers" of Crusading times, and is one of the finest examples of the military architecture of the Crusaders in existence. Fig. 1, a photograph by Miss Bell, gives an idea of the walls with their French round towers and Saracenic sloping walls. The castle belonged to the Hospitallers, and the Grand Master of the Order lived there, until it was taken by the Egyptian Sultan Malek edh-Dhaher. This, then, was the first stronghold of the Order of St. John, to be succeeded by Rhodes, always associated with the name of de l'Isle Adam, and by Malta, the scene of the heroism of la Valette and the cowardice of Hompesch.

Kala'at Sim'ân (Fig. 2), the scene of the fakir-life of St. Simon Stylites on his pillar, is a fine example of a Byzantine church of the sixth century. Kalb Lôzeh (p. 302) is just such another. Many of these splendid specimens of Syrian stone architecture have been studied by the recent archæological expedition of Princeton University.

At beautiful Antioch and Seleucia Miss Bell's Syrian journey ended.

It is a pity that her map is not better than it is. It is based on Kiepert's map in Oppenheim's "Vom Mittelmeer zum Persischen Golf," with additions and Miss Bell's route marked in red. All the German spellings of Arabic names seem to be retained unaltered, with the result that the British reader is confronted with such words as "Meschetta," "'Ijun," "il-Kreje," "Riat," "Dimaschk Ischscham," and so on, which he will hardly recognise as the "Mshitta," "Ayun," "el-Kreyeh," "Ghiath," and Damascus "Esh-Shām" of Miss Bell's text. This is a bad fault, but one often committed when German maps are copied in England. By the average British reader "Ijun" and "Kreje" will be pronounced "Eye-jŭn" (Germ. "Eidschan") and "Kreege" (Germ. "Kridsch"). It is too often forgotten that the German pronunciation of consonants and vowels is not yet the world-standard, and that the English pronounce the letters "j," "sch," "ch," quite differently from the Germans. We certainly will not have the German "j" thrust down our throats, at any rate. Miss Bell and her publishers must share the blame for this serious blot on her otherwise admirable book.

H. R. HALL.

HAVE ALL EYES THE POWER OF FORMING IMAGES?[1]

SOME animals, such as the earthworm, have no eyes, and yet they are phototropic either in a positive or negative sense, according as they move towards or away from light. Others, such as planarians, have remarkably simple eyes, consisting of one or several sense elements, behind which is a pigmented cup, composed of one or more cells. Such eyes cannot form an image, and they have been called "direction eyes" because light from only one direction can affect such an eye at a given time. Higher in the scale we find the "compound" or "mosaic" eye, as in insects and other animals. The question arises, To what extent is an image or images formed by such an eye composed of many ocelli? There can be no doubt that the compound eye forms an image or images. Exner has taken a photograph through the eye of a fire-fly, and Parker has shown that the compound eyes of Astacus form a single image. Lastly, we find in vertebrates the "simple" eye, the optical construction of which leads to the formation of an image on the retina. The image of a distant object can readily be seen on the retina of a fresh eye removed after death from an albino rabbit, and if a lighted candle be placed in front of the isolated eye of a frog, a beautiful little inverted image of the flame may be visible on the sclerotic.

Mr. Leon Cole recently investigated the question as to the formation of images by different kinds of eyes by a new and ingenious method. It is obvious that it would be almost impossible to make a direct observation on the formation of an image by certain kinds of eyes, especially mosaic eyes of very small size. Mr. Cole's "aim has been, rather, to treat the formation of images from the point of view of their relation to the animal as a living organism—to determine in what way the ability to form a more or less perfect image affects the responses of the animal to light, and what relation, if any, this result has to the normal habits of the creature, and to its behaviour under experimental conditions" (p. 337).

For phototropic observations, Mr. Cole devised an arrangement by which two sources of illumination were so placed as to cause one or other to illuminate the eyes. The animal was placed with its long axis at right angles to a line joining the two lights. One light was so much larger than the other that the ratio of the two areas illuminated was as 10,000 to 1. The intensity of the light from either source was about 1·25 candle metres. The qualities of the two lights were also compared and tested, and the differences in the spectral components were so slight as to be negligible. The experimenter wished to ascertain "to what extent complexity in the organisation of eyes is correlated with the reactions to luminous areas of different size but of equal total luminosity" (p. 347). The character and relative percentage of phototropic responses as movements to or from lights were used as measures of the reactions. Suppose an animal positive in its reactions to directive light is so placed as to be midway between two luminous areas of the same shape, size, and intensity, the one acting on the right eye and the other on the left. Assume that each luminous area is 1 cm. square, has an intensity of 100 candle-power, and is 2 metres from the animal. The measure of the light falling on each eye would be 25 candle metres. Thus simultaneously stimulated on each side, the animal might go straight ahead without turning, or it might turn at random towards one light more than the other, and as the animal is positively phototropic it would continue to crawl towards this light. But as the chance of random movements in one direction is as great as in the other, in a large number of trials, we should find the number of times that the animal would go towards each light would be practically equal. Enlarge one of the areas to 100 cm. square, but keep the total amount of light the same. The area being 10,000 times as great, the intensity from 1 sq. cm. is now only 0·01 candle-power. The whole amount of light on each side is still the same, 25 candle metres. If the animal had no light-perceiving organs, the reactions would be the same as when the lights were of equal size; the animal would be indifferent. But if it had cells sensory to light distributed in its skin, as there is no apparatus for concentrating the light, the amount of light received at any point of the skin on either side of the animal would be equal to that received by any other. "This is evident from

[1] "An Experimental Study of the Image-forming Powers of Various Types of Eyes." By Leon J. Cole, Zoological Laboratory of the Museum of Comparative Zoology at Harvard College. (Proc. of American Academy of Arts and Sciences, vol. xlii., No. 16, January, 1907.)

the fact that light from every one of the 10,000 areas (each 1 cm. sq.) which make up the large area falls upon each point of the surface of the animal; the intensity of the light from any single square centimetre of the area is only 0·0025 candle metre, but since there are 10,000 such radiating squares the total intensity is 25 candle metres" (pp. 347–8).

In an animal having eyes that form a good image the case is different. The small light, only 1 cm. square, would form on the retina an image having a very small area (*x*), but the light would have considerable intensity (*y*). On the retina of the other eye there would be an image covering a larger area (10,000 *x*), but each area (*x*) would receive a light intensity of only 1/10,000 *y*. In all probability the difference between a very weak light and no light at all falling on a visual element would be more stimulating than the same or even a greater difference in the amount of the light at higher intensities. If so, we should expect an animal to react more strongly "to that stimulus which fell upon the larger number of visual elements—that an animal normally positive, for example, would be more strongly positive to the large light than to the small, and similarly that a negative animal would tend more often to move away from the larger than from the luminous area" (p. 349).

A large number of experiments was made on several animals, and the results, when discussed by methods now in use in biometrical work, on the whole bear out the line of reasoning just given. With the earthworm (*Allolobophora foetida*) the results showed that the *intensity* of the light is the controlling factor in its movements to right or left. This animal was negatively phototropic. It has no eyes, but it has cells in the skin sensitive to light. No image could possibly be formed. The largest of the land planarians (*Bipalium kewense*) has small *direction* eyes. Numerous experiments showed that animal has, to a slight extent, the power of appreciating differences of area, as it responded by turning away from the larger luminous area more often than from the smaller. It was negatively phototropic. The larva of the mealworm (*Tenebrio molitor*) has two or three ocelli on each side of the head, but nothing of the nature of lenses. It is negatively phototropic. When two lights, of different areas, acted simultaneously on both eyes, the responses right and left were equal in number, showing that "the ability of the eyes to form distinctive images of objects differing considerably in size is wholly lacking" (p. 371). The sow bug (*Oniscus asellus*), an active isopod, has small eyes consisting of a group of about thirty ocelli on the side of the head at the base of the antero-lateral lobe. It is negatively phototropic. The responses to light were of a less definite character than was observed in the larvæ of the mealworm. It has only unilateral illumination, and yet its eyes have greater efficiency for the formation of images than the larvæ of the meal bug. The cockroach (*Periplaneta americana*) has well-developed compound eyes, and it is very active and keenly sensitive to differences of light and shade. It was difficult to handle, and having more of what may be called a restless intelligence than the other animals already mentioned, the results do not seem quite so trustworthy. It reacts negatively to direct light in an excess of about 50 per cent. of its responses, but although it has relatively large eyes, Mr. Cole does not think the evidence bears out what one would have expected, namely, that the eyes were capable of forming better images than those of the animals already mentioned. The mourning-cloak butterfly (*Vanessa antiopa*) creeps and flies towards a source of light. It is positively phototropic for lights varying in intensity from 2 candle-power at 2 metres distance (0·5 candle metre) to 250 candle-power at 2 metres distance (62·5 candle metres). It can discriminate between lights of different area falling with equal intensity on the animal. Other animals, such as the water-scorpion (*Ranatra fusca*), the Pomace fly (*Drosophila ampelophila*), the European garden snail (*Helix pomatia*), the European garden slug (*Limax maximus*), were also examined. In the case of the garden snail, the inference from the experiments was "that the eyes of the snail do not aid greatly, if at all, in the discrimination of two lights differing in area as the two used" (p. 391).

The results with the cricket frog (*Acris gryllus*) are very instructive. It is, on the whole, positively phototropic. With luminous areas of different sizes but equal intensity, it turns in by far the greater number of trials towards the larger of the two areas. The result was the same when the skin was protected and the eyes alone were left uncovered. After section of the optic nerves, but having the skin exposed to the light, the animal is indifferent to the size of the luminous field. Still, even with the optic nerves severed, the frog is positively phototropic. Here light must be perceived by the skin, a result in keeping with the well-known experiments of Lord Lister made many years ago on the pigment cells in the skin of *Rana temporaria*. Similar results were found with the green frog (*Rana clamata*).

Mr. Cole concludes his paper with an interesting general discussion, showing that there is a correlation between the habits of the animals and the conditions under which they live. For example: "those are creeping forms whose movements towards the light take them in the direction of their food or else that other conditions prevent their phototropism from taking them into unfavourable surroundings" (p. 407). The following is very interesting:—"A query which Romanes found among Darwin's manuscript notes shows careful observation and puts the question very clearly. It is as follows: 'Query. Why do moths and certain gnats fly into candles, and why are they not all on their way to the moon—at least when the moon is on the horizon? I formerly observed that they fly very much less at candles on a moon-light night. Let a cloud pass over and they are again attracted to the candle.' Romanes thinks the answer is that 'the moon is a familiar object, the insects regard it as a matter of course, and so have no desire to examine it.'" Parker and Cole give a more reasonable explanation. The moths and gnats react to larger areas of light than to a point of more intense light. They therefore remain near the ground, on account of the bright patches of moonlight, instead of flying towards the moon; but if they come near a candle, the great intensity of the light at a short distance "overcomes the reactions of the moonlit areas," and the insects fly into the flame. Obscure the moonlight by a cloud so as to take away the patches of moonlit earth, and the insects fly more readily into the flame.

Mr. Cole gives at the close of his admirable and suggestive paper the following classification:—

Type A. Response of eyeless forms.—Usually negative; sometimes positive, and then usually to very weak light. Response to *intensity* only (earthworm).

Type B. Response of forms with "direction" eyes.—Usually negative (Bipalium, Periplaneta, Tenebrio larvæ); sometimes positive (larva of wood-borer). Response wholly to *intensity*.

Type C. Response to size of luminous field.—

Animals usually positive; may be temporarily negative, as in the frog.

Type D. Response to definite objects in the visual field.—Not simple reactions; responses involve psychical phenomena. Respond (1) to moving objects; (2) to stationary objects. This form of response usually inhibits ordinary phototropic reactions. JOHN G. MCKENDRICK.

SIR W. H. PERKIN, F.R.S.

WITH deep regret the whole scientific world will hear of the death of Sir William Henry Perkin, F.R.S., the founder of the coal-tar colour industry, and one of the most distinguished of British chemists. Sir William Perkin passed away at his residence, Sudbury, on Sunday, July 14, after four days' illness, the cause of death being double pneumonia and appendicitis. Especially affecting will be the news to his London friends, among whom his bodily vigour and mental energy had, even up to the last, been the envy of many a younger man.

Born on March 12, 1838, William Henry Perkin was educated at the City of London School, and at fifteen commenced his studies under A. W. Hofmann at the Royal College of Chemistry. During the Easter vacation in 1856 he discovered mauve, and, supported by his father and brother, immediately began its manufacture under the name of "Tyrian Purple." The importance of this discovery, which has given birth to the extensive industry of coal-tar colours, was fully recognised at the Jubilee celebrations last year, when Dr. Perkin was presented with congratulatory addresses from all the important chemical societies of the world, and also received the honour of knighthood. Messrs. Perkin and Sons not only introduced the first aniline dye into commerce, but soon began to manufacture alizarin, in itself the first member of an important series of dyestuffs which are still to-day classed among the most valuable colouring matters used by dyers and printers. In 1873 the Greenford Green aniline-dye factory was sold, and the business finally transferred to Silvertown, where the manufacture of alizarin is still being carried on with success.

Perkin now devoted himself to laboratory work, and soon discovered the valuable method of synthesis of unsaturated aromatic acids, such as cinnamic acid, which bears his name. He also effected the synthesis of coumarin, the odorous principle of the Tonka bean. Later, he turned his attention to the magneto-optical properties of organic compounds, and enriched chemistry with a series of researches on this subject, of which the last account appeared in the Journal of the Chemical Society for May of the present year. In all he contributed about ninety original papers, published chiefly in the Journal of the Chemical Society.

The value of Perkin's work was not left unrecognised; the Royal Society made him a Fellow in 1866, he was awarded the Royal medal in 1879, the Davy medal in 1889, the Longstaff medal of the Chemical Society in 1888, the Albert medal of the Society of Arts in 1890, and the Birmingham medal of the Gas Institution in 1892. These were followed by the Hofmann medal of the German Chemical Society and the Lavoisier medal of the French Chemical Society in 1906. He held honorary degrees from Würzburg and Heidelberg (Ph.D.), St. Andrews (LL.D.), Manchester and Leeds (D.Sc.), and Munich (Dr.Ing.).

Sir W. Perkin married, in 1859, a daughter of the late Mr. John Lissett, and, some years after this lady's death, the daughter of Mr. Hermann Mollwo. Few fathers can have had the same happiness as he in seeing his three sons distinguish themselves in his favourite science.

Loved by his neighbours at Sudbury for his philanthropic work, respected and admired by his scientific friends the world through, all were instinctively attracted by Sir William Perkin's equable and amiable temperament, and unite in deploring the loss which they and the nation have sustained. J. C. CAIN.

NOTES.

WE regret to see the announcement of the death of Dr. A. Dupré, F.R.S., on Monday, July 15, at seventy-one years of age.

WE learn with regret of the death, on July 13, of Prof. Heinrich Kreutz, who for many years acted as editor of the *Astronomische Nachrichten*.

THE eleventh International Navigation Congress is to be held at St. Petersburg in May, 1908.

THE American Academy of Arts and Sciences has awarded the Rumford premium to Mr. E. G. Acheson "for the application of heat in the electric furnace to the industrial production of carborundum, graphite and other new and useful substances."

DR. ARTHUR J. EVANS, F.R.S., describes in the *Times* of July 15 some further discoveries made by Dr. Mackenzie and himself, during the past two months, in the great prehistoric Palace of Knossos. The net result of these investigations is to show that an additional area of some three thousand square yards must be added to the palace. At a short distance from the actual "House of Minos," two beehive tombs have been found belonging to a period about 800 B.C., and their contents are of deep interest. If the accurate astronomical orientations have been measured of the structures now revealed, the results will be of great value.

A SMALL exhibition of science apparatus, mostly for chemistry and physics, is being arranged by Mr. R. E. Thwaites, of Wyggeston Grammar School, in connection with the forthcoming meeting of the British Association at Leicester.

THE Recorder of Section I (Physiology) of the British Association informs us that an important change has been made in the provisional programme for the Leicester meeting announced in last week's NATURE. On August 6 there will be no discussion on antitoxins, but instead one on the value of perfusion experiments. This will be opened by Prof. E. A. Schäfer, F.R.S., and will probably be of considerable interest to expert physiologists. To the list of those who will take part in the discussion on the physiological and therapeutical uses of alcohol has now been added the names of Prof. Cushny, and Drs. Dixon, Rivers, and Waller; Prof. Zuntz, Prof. Schäfer, Dr. Reid Hunt, and Prof. Sims Woodhead.

IN connection with the retirement of Prof. G. Lunge from the chair of technical chemistry at Zurich, of which mention was made in last week's issue of NATURE, an interesting farewell meeting was held on July 10 at Zurich Polytechnic. The occasion was the distinguished chemist's last lecture hour, and, in addition to the students, most of his fellow professors and some from the neighbouring university had assembled. On Prof. Lunge's entry into his lecture theatre all rose in silence. After an interval Prof. Treadwell, professor of analytical chemistry, made a short speech in which he eulogised Prof. Lunge's work, and afterwards read an address from the whole of the

teaching staff. An address from the students was also read. Prof. Lunge made a suitable reply, and the whole audience showed by its enthusiasm the high regard in which he is held and the regret felt at his retirement.

THE Paris correspondent of the *Times* states that the French Government has just asked Parliament to grant a fresh credit of 12,000*l.* in order to prepare a new French expedition to the Antarctic. Some four or five months ago the Academy of Sciences declared that a new expedition would be of great scientific utility as well as an act of patriotism which would benefit the whole world; and it appointed a commission to draw up a scientific programme of work. The expense is estimated at 30,000*l.*, of which the State is to provide 24,000*l.* The 12,000*l.* now asked for by the Government will be immediately used for the construction of the special ship necessary for the expedition.

A LONG excursion, extending from August 15 to August 24, has been arranged by the Geologists' Association. The district selected is Appleby and its surroundings, and the party will be under the direction of Dr. J. E. Marr, F.R.S. Interesting observational work has been allocated for each day, and the arrangements which have been made for visitors will ensure comfort at a moderate expense. The party will leave Euston at 11.30 a.m. on August 14, and geologists who wish to avail themselves of the opportunity offered should communicate with Mr. A. C. Young, 17 Vicar's Hill, Lewisham, S.E. The association has arranged an excursion also in connection with the centenary celebrations of the Geological Society in September next. The excursion will be to Reading on September 28, and will be conducted by Messrs. H. W. Monckton, O. A. Shrubsole, and H. J. Osborne White.

THE Mackinnon studentship of the Royal Society in physical science has been awarded for a second year to Mr. W. Geoffrey Duffield, for a research on the influence of pressure on spectra, being conducted at the University of Manchester; and the studentship in biology to Dr. H. M. Woodcock, to aid him in working out the life-history of certain hæmatozoa of birds, an investigation which will be carried on at the Lister Institute of Preventive Medicine. The income of the Gunning fund accrued during the past three years has been placed at the disposal of Dr. F. H. Scott for the continuation of his investigations into the metabolic processes in nerve cells. The election to the Joule studentship of the Royal Society will be made at the end of July.

THE Commission appointed by the Presidents of the Board of Agriculture and Fisheries to inquire into the nature of distemper in dogs in Great Britain and the methods of its infection, and to report whether any, and if so what, preventive or remedial measures, exclusive of ordinary medical treatment, can with advantage be taken with respect to it, has now been fully constituted as follows:—The Duke of Beaufort, Lord Middleton, Lord Leconfield, Sir John McFadyean, Mr. E. Barclay, Mr. S. Stockman (chief veterinary officer to the Board of Agriculture and Fisheries), Mr. W. M. Wroughton, and Mr. E. W. Jaquet (secretary of the Kennel Club). The chairman of the commission will be Lord Middleton, and Mr. James Ralph Jackson (veterinary inspector, Board of Agriculture and Fisheries, 4 Whitehall Place, S.W.) will be secretary.

A DISTINGUISHED experimental physicist has been lost by the recent death of M. André Prosper Paul Crova, formerly professor of physics at Montpellier, and since 1886 a correspondant of the Paris Academy of Sciences. M. Crova was born in 1833 at Perpignan, and after receiving his education there became, at the age of twenty, professor of physics in the local Collège. Six years later he filled the same position in the Lycée at Metz. In 1864, M. Crova went to Montpellier, where, first at the Lycée and after 1870 in the Faculty of Science, he occupied a chair of physics. His most important work was devoted to the study of radiant energy, and included a classical determination of the constant of solar radiation. In addition to his well-known researches in this field he occupied himself very largely with optical and electrical problems of a general character, and published a large number of memoirs. As an experimentalist he possessed great skill and practical ingenuity in carrying out researches of very great difficulty, and to his inventive power are due several valuable instruments, including, besides his actinometer, an optical pyrometer and a spectrophotometer.

THE death of Sir William Broadbent, which occurred on July 10 after a long illness, removes a figure well known in the medical world. Those who saw the active interest he took in the meeting of the British Medical Association at Toronto last August little thought that he would soon be laid low, never to rise again. Born in the early part of 1835, he had completed his seventy-second year. He was educated at Huddersfield College, at Owens College, Manchester, and at the Royal School of Medicine at Manchester, graduated as M.B. in the University of London in 1858, taking the M.D. degree two years later. Early in his medical career he became associated with St. Mary's Hospital, of which he was successively assistant physician, physician, and consulting physician. As a clinician he had few rivals, and his teaching was thorough and painstaking. In 1870 he enunciated the hypothesis, since known as "Broadbent's law," on the association of nerve nuclei, by which he sought to explain the immunity of bilaterally associated muscles from paralysis in hemiplegia. He was also much interested in diseases of the heart, on which and on the pulse he wrote standard text-books and published a number of papers on clinical subjects. During the latter years of his life he took an active part in movements associated with the public health and the good of the profession, notably in the crusade against tuberculosis and in cancer research. He was a Fellow of the Royal Society, had bestowed on him many honorary degrees, and was physician-in-ordinary to His Majesty. He received his Baronetcy on the occasion of the marriage of the present Prince of Wales, and was a Knight Commander of the Victorian Order.

THE report of the Birmingham Natural History Society for 1906 records the incorporation with that body of the Midland Malacological Society, which now forms a malacological section. Another important event in the society's career during the period under review was the transference of the offices and library to Avebury House, Newhall Street, where it has been found possible to arrange all the books in one room.

WE have received from the author, Mr. L. M. Lambe, of the Canadian Geological Survey, copies of two papers published in the *Ottawa Naturalist*. One deals with a tooth of a musk-ox from a Canadian Pleistocene deposit, while the other records the occurrence of a supernumerary upper premolar in a dog. As dogs normally possess the full series of four upper molars, the occurrence of an additional one is more noteworthy than would be the case were three the normal number of these teeth.

THE wide circulation of "Pokorny's Naturgeschichte der Thierreichs" is indicated by the appearance of the twenty-seventh edition not very long subsequent to the issue of its predecessor. This edition, published by G. Freytag, of Leipzig, is edited by Mr. Max Fischer, and illustrated by twenty-four coloured plates, in addition to the woodcuts. A new feature is an appendix, in which the proper care of the human body and its various parts is briefly described. The proper standard of weight, the amount of sleep and food necessary to be taken, and the care of the eyes are some of the subjects discussed in this appendix, which can scarcely fail to be useful.

CONSIDERABLE importance attaches to an account of the skull of the Cretaceous pliosaurian genus Brachauchenius given by Mr. S. W. Williston in No. 1540 (vol. xxxii., pp. 477–489) of the Proceedings of the U.S. National Museum. Brachauchenius, which is known from West Kansas, is regarded by its describer as closely related to Pliosaurus, from which it differs in having single-headed cervical ribs. From other plesiosaurians in which the skull is fully known it differs in that the palatines meet each other in the middle, but this is a feature which the author thinks will be met with in Pliosaurus. The assumed relationship of the plesiosaurs to chelonians is disputed. The latter lack, for instance, epiphyses to the humerus, while such resemblance as exists between the shoulder-girdle in the two groups is due to adaptation. Chelonians are without the parietal foramen of plesiosaurs, and retain the hypocentral mode of articulation of the ribs, whereas in plesiosaurs the ribs are attached to the transverse processes. Sauropterygia are, indeed, probably descended from theriodont ancestors, while Chelonia appear derived from a cotylosaurian type, both being widely sundered from ichthyosaurs and rhynchocephalians.

AMONG fifteen recent issues of the Proceedings of the U.S. National Museum, special reference may be made to three (Nos. 1543, 1547, and 1551) by Mr. A. H. Clark, on new and other crinoids. The most important novelty is *Phrynocrinus nudus*, a new genus and species from Japanese waters, described in No. 1543. In general shape the calyx is acorn-like, and it is further remarkable for the presence of broad spaces between the radial, covered with a leathery skin, showing no external signs of radial plates. In the author's opinion, this crinoid probably indicates a family by itself. The same paper contains the description of a new species of Bathycrinus, also from Japan. *Ptilocrinus pinnatus*, described in No. 1547, is a new genus and species, from the neighbourhood of the Queen Charlotte group, allied to Bathycrinus, but characterised by a peculiar feather-like arrangement of the radials. Japanese crinoids of the genus Eudiocrinus, one of which is regarded as new, form the subject of the third paper (No. 1551). In No. 1548 Mr. P. Bartsch describes a gastropod of the genus Eulima parasitic in the calyx of Ptilocrinus. In three specimens the proboscis was found to be deeply embedded in the calyx of the crinoid; no other Eulima is believed to be parasitic.

MR. M. J. NOWAK communicates to the *Bulletin international de l'Academie des Sciences de Cracovie* (January) a description of fossil plant-leaves found in the Upper Senonian beds at Potylicz, in north Galicia. The leaves are typical of evergreen xerophilous plants, among the genera represented being Gleichenia, Cunninghamia, Quercus, Myrica, Eucalyptus, and Aralia. Mr. W. M. Kudelka presents a paper on the comparative anatomy of the vegetative organs of species of Ribes.

THERE are many difficulties militating against the successful exploitation of new woods from the colonies and foreign States, but with a little care it should be possible to provide fair, representative specimens for show or report. Mr. H. Stone, who has handled numerous collections in recent years, offers some hints on the subject in the Journal of Economic Biology, vol. iii., part i. He attaches special value to cylindrical samples with a dome-shaped top as showing every variation of grain from the radial to the quarter.

THE report of the Midland Reafforesting Association for 1906 announces the formation of three small plantations at Walsall, Bloxwich, and Wolverhampton, the two former on pit waste, the latter on a sand-pit. The three local committees at Old Hill, Walsall, and Wednesbury have been augmented by two new committees for Wolverhampton and Ocker Hill. An arbor-day festival was held in some of the districts to interest the children in the preservation of the trees. The association still lacks the services of a paid secretary owing to insufficiency of funds.

ROYAL assent was given on July 4 to "The Destructive Insects and Pests Act, 1907," and the Board of Agriculture and Fisheries will now be able, under this new law, to issue an order against the American gooseberry mildew. Mr. E. S. Salmon, mycologist to the South-Eastern Agricultural College, Wye, sends us a letter in which he emphasises the necessity for growers to cooperate with the Board to stamp out this new pest. The disease has been allowed seven years' start in Ireland and two or three years' start in England. Now that the Board of Agriculture has acquired the necessary legislative powers to deal with the disease, it behoves all growers and gardeners generally to cooperate heartily with the Board if they wish to see the American gooseberry mildew stamped out and their gooseberry plantations kept healthy. Up to the present, the outbreaks that have occurred in England are as follows:—Kent, on standard gooseberries only in one nursery (disease believed to be now stamped out); Worcestershire, thirty-one outbreaks in gooseberry plantations; Gloucestershire, one outbreak; Wisbech and district, two outbreaks; Warwickshire, one outbreak.

BRILLIANT weather has at length set in over the whole of the British Isles, and the failure of summer, which threatened for so long, has fortunately not been realised. The past records of temperature for London fail to show any previous first fortnight of July as cold as that of the present year. The sheltered thermometer did not touch 70° from July 1 to 14, and the observations since 1841 show no corresponding period without that temperature being reached, and in most years a reading of 80° is shown, whilst in some years the thermometer registers 90°. On July 15 the thermometer in London registered 77°, which is the highest temperature since May 11 and 12. The whole type of weather has changed, and the persistent cyclonic disturbances have at last given place to an anticyclone, which during the present week has embraced practically the whole of England.

THE volume of rainfall observations (*Nedbφriagttagelser*, vol. xii.) published by the Meteorological Institute of Norway for 1906 is a most important contribution to that branch of meteorological science. The institute, under the able superintendence of Prof. H. Mohn, deals with about 430 rainfall stations for the year in question, and includes means from seventy-seven additional stations at which observations have now been discontinued. Daily observations are given for 200 places, and daily statistics relating

to snowfall for some fifty places. The monthly and yearly summaries for the whole 507 stations include means for past years, in some cases going back to 1867. The maps which accompany the volume are very clear, and exhibit the rainfall for the year 1906 by lines showing equal amounts (isohyets); the amounts on the *west coast* between lat. 59° and 62°, the usual track of the Atlantic storms, range from 1200 mm. to 3000 mm. at some few points, while inland the amounts vary from 400 mm. to 800 mm. yearly.

THE Director-General of Indian Observatories has issued a memorandum, dated June 8, on the abnormal features of the weather of the past half-year, with a forecast of the probable character of the south-west monsoon rains of 1907. From the various conditions affecting the question, all of which are clearly stated, the outlook for the total rainfall of India during the period June to September does not appear on the whole to be unfavourable; it seems, however, likely that the effect of the heavy and late snowfall will show itself in north-west India in the delay of the establishment of the monsoon, or in diminished rainfall. An interesting fact in connection with the investigation is mentioned by Dr. Walker, viz., that statistical analysis shows that when estimating the amount of monsoon rainfall corresponding to a given pressure distribution and a given frequency of sun-spots, the influence of solar activity upon Indian rainfall is almost exactly that which corresponds to the disturbance in the pressure distribution caused by the solar activity.

IN the Journal of the Meteorological Society of Japan for April, Dr. T. Okada gives several interesting instances of the occurrence of Föhn winds at Wonsan, one of the seven observatories of the first order established by the Japanese Government in Corea in 1904. The station lies on the eastern coast, in lat. 39° 9′ N., and is surrounded by high mountain ranges, except on the east side. The phenomenon is almost always associated with westerly winds, and causes abnormally high temperature and excessive dryness of the air as compared with that obtaining at other stations. In another article Dr. Okada discusses the effect of snow upon the diurnal variation of temperature in the lower parts of the atmosphere, based on hourly observations at various depths at Hokkaido in February last. The total daily heat exchange in the snow on the ground was found to be approximately 19 gram-calories per square centimetre; the amount of the exchange on clear days was nearly double that on cloudy days. Other articles (in Japanese) deal with periodicity of earthquakes, and density of snow and evaporation from its surface.

PROF. H. POTONIÉ has issued a fourth edition of his pamphlet on the origin of coal (Berlin: Borntraeger Brothers, 1907). In its present form it covers forty-seven pages, and contains twenty-eight admirably reproduced illustrations. The author's views are well known, and we are pleased to note that he intends shortly to publish an exhaustive work on the subject.

THE British standard specification for material used in the construction of railway rolling-stock (Report No. 24 of the Engineering Standards Committee) has been re-published in revised form. Several important alterations have been made. In the specification for steel castings, the number of tensile and bend tests required for waggon-wheel centres has been reduced, as it was considered that the quantity asked for under the existing specification was somewhat in excess of that usually obtaining in general practice. For locomotive-wheel centres cast with heavy balance weights it has been made permissible to reduce the height of the fall in the drop test. In connection with the specification for copper and brass tubes for locomotive boilers, an alternative drifting test has been added to the clause dealing with the bulging test. The principal alterations in the specifications dealing with steel plates for locomotive boilers, locomotive frames, and carriage and waggon frames, are in connection with the new standard iv. diameter test-piece for bars of more than 1 inch diameter. This shorter test-piece has been introduced to reduce the amount of material required for testing and the amount of turning down when such is necessary.

IN the Journal of the Franklin Institute (vol. clxiii., No. 6) there is a lengthy paper by Dr. William Campbell on the changes in structure in iron and steel, in which the changes that take place in the iron-carbon series are considered in the light of recent work. He considers that the cementite-martensite series is the unstable one. Absence of silicon and rapid cooling tend to cause white cast iron to be formed. Grey cast irons are the martensite-graphite series, which occur with much silicon and slow cooling. The formation of graphite is due to the decomposition of cementite by re-heating to temperatures of about 1000° C. Most cast irons are a mixture of white and grey, or cementite, martensite, and graphite. The simultaneous occurrence of cementite and graphite in certain specimens of siliconless irons cannot be explained satisfactorily except by assuming that there are two systems, (*a*) ferrite and graphite, and (*b*) ferrite and cementite. This does away with the necessity of assuming a reaction between graphite and martensite to form cementite at about 1000° C. In this paper the term martensite is used in its old meaning, the solid solution of carbon in iron. Now, however, the solid solution is known as austenite, and martensite is regarded as a transition product.

NOTWITHSTANDING the much improved statistics recently issued by the Lunacy Commissioners, thoroughly satisfactory materials are still wanting for solving the question whether the prevalence of insanity is or is not increasing. The importance of the problem, especially in its bearing on the persistently urged theory of progressive physical deterioration, imparts special interest to a paper by Mr. Noel A. Humphreys on the alleged increase of insanity, published in the Journal of the Royal Statistical Society (vol. lxx., part ii.). This paper shows in a striking manner the value of scientific statistics in checking crude figures. The author expresses a decided opinion that there is no absolute proof of actual increase of occurring insanity in England and Wales, and that the continued increase in the number and proportion of the registered and certified insane is due to changes in the degree and nature of mental unsoundness for which asylum treatment is considered necessary, and to the marked decline in the rate of discharge (including deaths) from asylums.

IN an article entitled "The Measurement of Nerve Force," contributed to the May number of the *Contemporary Review*, Dr. A. T. Schofield describes experiments with an instrument called the "sthenometer," which, it is suggested, provides a means of measuring an unknown "nerve force" emanating from the human organism. The instrument consists essentially of a straw balanced on a needle point and placed under a glass case. When a hand is brought close to the glass, at right angles to the straw and with the tips of the fingers opposite the end of the straw, a motion of the straw toward the hand is obtained. Dr. Schofield concludes from evidence of this

kind that the "movement is produced in the sthenometer by some unknown force emanating from the right and left hands that can move a straw over a very considerable arc." It was shown, however, by Messrs. F. J. M. Stratton and P. Phillips in the Journal of the Society for Psychical Research for December, 1906, that heat radiated from the hand is the cause of the motion of the balanced straw of the sthenometer. Hot objects were observed to produce the same effects, and the extent of the motion was found to increase with the heat radiated from the hand as indicated by a thermopile. With the results of these experiments before us, and also a note by Mr. Stratton in the March number of the Journal of the society, it is difficult to understand why the effect described should be supposed to be produced by an unknown force. Much more substantial evidence will be required than that adduced in the article in the *Contemporary Review* before any firm foundation can be secured for the position taken up by Dr. Schofield.

THE three official articles, on the work done at the Physikalisch-Technische Reichsanstalt during the year 1906, which appeared in the April, May, and June numbers of the *Zeitschrift für Instrumentenkunde*, have now been issued as a separate pamphlet. In addition to statistics showing how the work of the institution is growing, short summaries of the principal conclusions arrived at during the course of the year's work are given, and greatly enhance the interest and value of the publication. As typical examples may be mentioned the paragraphs on the expansion of bodies at very high and at very low temperatures, on the comparison of the various temperature scales at high temperatures, on the self-inductance of lead-covered and other cables, and those on the comparison of the methods of testing magnetic materials. Apart, however, from its scientific value, there is one feature of the report which teaches us an important lesson, that is, the close contact which exists between the institution and the manufacturers of Germany. Almost every official, from the president downwards, has spent some time during the year in visiting the works of clients of the institution, "um persönlich Fühlung mit der Industrie zu nehmen," to quote the words of the report. How long will it take us to learn this lesson?

AN important series of determinations of fundamental atomic weights is described by Prof. T. W. Richards, in conjunction with several of his students, in No. 69 of the Publications of the Carnegie Institution. The atomic weight of potassium was re-determined by ascertaining the ratio of the weight of potassium chloride to that of the silver chloride it produces when precipitated by means of almost exactly the theoretical quantity of silver nitrate. By using a Gooch crucible with a matting of platinum sponge the weight of the silver haloid formed could be determined with a high degree of accuracy, a correction being introduced for the minute quantities of silver chloride retained in the mother liquors. A similar series of determinations was also made with potassium bromide by converting the latter into silver bromide. In both series exactly the same value, 39·114, for the atomic weight of potassium was obtained (Cl=35·473, Br=79·953). Determinations were also made, introducing many new refinements, of the weight of silver nitrate formed from a known weight of silver; the results are of especial interest, inasmuch as they are incompatible with the low value recently advocated for the atomic weight of nitrogen if the atomic weight of silver be taken as 107·93; assuming this value, the atomic weight of nitrogen becomes 14·037. The atomic weight of sulphur was also determined by a new method based on the conversion of silver sulphate in a quartz tube into silver chloride by means of gaseous hydrogen chloride. The change takes place in a manner very favourable to accurate results, and gives a value 32·113 for the atomic weight of sulphur (Ag=107·93), which is considerably higher than that accepted hitherto. An interesting account of the general principles underlying recent determinations of atomic weights was given by Prof. Richards in a lecture delivered before the German Chemical Society, and printed in the current number of the *Berichte*.

THE Board of Agriculture has published colour-printed geological maps of Worms Head (Sheet 246). The map is issued in two editions (price 1*s*. 6*d*. each), on one of which (the solid edition) glacial deposits are omitted, while on the other (the drift edition) such deposits are indicated by colour. The scale is 1 inch to the mile.

THE latest list issued by Messrs. Voigtländer and Son, of 12 Charterhouse Street, E.C., is a handsome production. It contains numerous examples of photographs taken with various types of lenses made by this firm, and is in addition provided with an excellent introduction by Dr. H. Harting on the selection of photographic lenses and cameras.

THE Livingstone College Year-book for 1907 contains the annual report, extracts from letters from old students, hints on diet and hygiene in the tropics, &c. The college gives a training in elementary medicine and surgery to missionaries, and is doing much good work.

DR. M. MOSZKOWSKI has translated into German Prof. T. H. Morgan's work on "Regeneration," and the volume is published by Mr. W. Engelmann, Leipzig, at the price of twelve marks. Prof. Morgan has provided his translator with new material relating to facts and theories of scientific importance published since the first or English edition appeared in 1901, and this has been incorporated in the German edition. At the end of the chapter on the theories of regeneration, Prof. Morgan states the views he now holds concerning some questions of fundamental interest.

OUR ASTRONOMICAL COLUMN.

COMET 1907*d* (DANIEL).—Several observations of this comet are recorded in No. 4188 of the *Astronomische Nachrichten* (p. 207, July 4). Observing at Kremsmünster on June 24, Prof. Fr. Schwab saw a nebulous body of about 2′ diameter with a bright nucleus; the comet disappeared in the dawn simultaneously with stars of the ninth magnitude. Herrn van Biesbroeck, with the 15-inch refractor at Uccle, found the magnitude to be 8·5 for the whole comet, on June 19, this being decidedly brighter than on the previous day. On June 27 Prof. Hartwig saw a bright centrally-placed condensation. On July 4, Dr. Lappa, observing at Rome, found the magnitude of the nucleus to be between 6.0 and 7·0.

This object now rises about midnight, about four hours before the sun, and may be seen with a good field-glass.

COMET 1907*c* (GIACOBINI).—Dr. Strömgren continues his daily ephemeris for comet 1907*c* in No. 4189 (p. 223, July 6) of the *Astronomische Nachrichten*, and carries it forward to July 31. This object is now travelling in a south-easterly direction through the constellation Virgo, and its brightness is only about half that at the time of discovery, its magnitude then being 13·0.

THE ORBIT OF α CENTAURI.—Finding that his second set of elements does not represent the angles measured at periastron passage, and having many more observational results on which to base his calculations, Prof. Doberck has re-investigated the orbit of α Centauri, and publishes

the result in No. 4189 (p. 209, July 6) of the *Astronomische Nachrichten*. In the new set of elements (iv) the eccentricity is given as 0·5057 and the period as 78·81 years. There are still differences between the observed and calculated positions which must be accounted for either by unusually large constant errors in the measures or by the presence of an invisible third body, the effect of which, in this case, would be enhanced on account of the large eccentricity of the orbit; an ephemeris for 1907·5–1936·5 accompanies the paper.

COMPARISON OF THE SPECTRA OF THE LIMB AND CENTRE OF THE SUN.—In No. 5, vol. xxv. (p. 300, June), of the *Astrophysical Journal*, Prof. Hale publishes an important paper showing the results of a comparison of the spectrum of the central parts of the sun's disc with that of the sun's limb. In 1879–80, Prof. Hastings showed that the modifications of the Fraunhofer spectrum at the limb were similar to those which obtain when a spot spectrum is examined, but were much less in degree. Recent work at Mount Wilson confirms this, and shows that the effect is greater than was previously expected.

The differences between centre and limb are plainly shown in three sets of spectra which Prof. Hale reproduces. All winged lines such as H, K, Hγ and the lines of the *b* group lose, to a great extent, their hazy borders, the latter, for example, appearing as comparatively hard, well-defined lines. Other lines, *e.g.* λλ 5156·823, 5219·875, 5426·474, which are intensified in passing from the Fraunhofer to the spot spectrum, are intensified at the limb, whilst still others, generally "spark" lines, are weakened at the limb as they are in spots.

There are, however, as shown by the preliminary examination, important differences in the changes undergone. Perhaps the most striking is in the winged lines the borders of which, at the limb, are universally contracted, whereas in spots the wings on the strong lines in the more refrangible portion of the spectrum are intensified rather than diminished. Another anomaly is that at the limb the lines of V and Ti, certainly the most affected in spots, are not so strongly affected as those of Mg, Fe, Ca, &c. Again, in spots, Hα, like all the other H lines, is thinned, whereas at the limb this line is actually widened and perhaps strengthened.

The thinning of the spark lines is strikingly shown in a table in which the behaviour at the limb of twenty-seven of the more prominent enhanced lines of Fe, Ti, and V, as given by Sir Norman Lockyer, is exhibited. All these lines are considerably weakened in passing from centre to limb, and the majority of them have been observed similarly affected in spots.

A discussion of these results in their bearing on the solar theory is promised in a later paper.

THE ORBIT OF ι ORIONIS.—A note by Mr. Plaskett in No. 3, vol. i. (p. 206, May–June), of the Journal of the R.A.S. (Canada) mentions the preliminary results obtained from the radial-velocity measurements of the spectrum of ι Orionis. These show that the eccentricity of the orbit is 0·75, greater than that of any other yet known spectroscopic binary, and that the period is about 29·12 days.

METEOR AND FIREBALL OBSERVATIONS.—*Astronomische Nachrichten*, No. 4187 (p. 183, June 29), contains an account by Mr. Denning of a first-magnitude Leonid observed on November 17 last. This meteor travelled along a visible path more than ninety-one miles in length at a velocity of thirty miles per second, a considerably lower velocity than that usually attained by Leonids. The height at the beginning of the flight was seventy-seven miles, at the end sixty-six miles, so that the path was very long and nearly horizontal, facts which may account for the low velocity, as the body would thus encounter considerable atmospheric resistance.

A fireball, observed over Yorkshire on November 23, 8h. 5m., was brighter than Venus, and appears to have proceeded from a radiant at 46°+5°, a position near α Ceti. From previous observations there appears to be a shower of long duration, or a succession of showers, from this radiant, Cetids having been observed in September, October, and November, those in November furnishing the most brilliant examples. The mean position of the radiant is 43°+5°.

THE ROYAL SOCIETY OF CANADA.

THE annual sessions of this society, the premier scientific society in Canada, were held, as usual, in the capital city of Ottawa on May 13–16. The society, which was founded twenty-five years ago by the Duke and Duchess of Argyll (the Princess Louise and the then Marquis of Lorne), combines the features of the Royal Society of London and the French Academy. The number of fellows is very limited, and there are four sections, viz. French literature and history, English literature, &c., physics and chemistry, and biology and geology. There was an unusually large attendance from all parts of the vast Canadian dominion, and in Sections iii. and iv. the meetings were regarded as the best ever held.

Dr. Wm. Saunders, C.M.G., president of the society for 1906–7, and head of the Government Experimental Farms, gave his presidential address on the evening of May 14 in the presence of a distinguished audience, including Sir Sandford Fleming, Sir James Grant, Profs. Ramsay Wright, Penhallow, Prince, and Clark Murray, and representatives from most of the universities of Canada. The subject was "The Development of Agricultural Science," and it consisted of a masterly review of the history of farming from classical times to our own day.

The ancient Hebrews and Egyptians were the most proficient tillers of the soil in those distant ages, and the latter race was the first to raise domestic cattle. Amongst the Romans, agriculture was highly esteemed, and when luxury brought demoralisation, the noblest minds reverted to farming. "The earth," said one of these old Romans, "gives back what it receives with usury, and nothing can be more profitable or beautiful than a well-kept farm."

During the Middle Ages, only the wealthy ate wheaten food; the poorer classes used rye, barley, and oats. But in the sixteenth century Raleigh introduced the potato into Ireland. However, when the Queen of England wanted a salad for luncheon, she had still to despatch a messenger to Holland.

Up to the eighteenth century land was sown until exhausted. By that time farmers had learned the alternate crop plan of conserving the strength of the soil, and at the opening of the nineteenth century they understood the value of manure as a fertiliser.

"It is highly probable," declared Dr. Saunders, "that the plant-life will always supply enough food for mankind, and the supposition sometimes advanced, that the rapidly increasing population will not find sufficient nourishment, seems far remote from probability."

Twenty-three years ago farming was in a very depressed condition in Canada. In 1884 a select committee of the Canadian House of Commons investigated the causes of this depression, and found it was due, not to poor soil or idleness, but to a lack of knowledge and skill in the farmers, and the committee recommended the establishment of experimental farms to promote agriculture and instruct the farmers. Accordingly, in 1886 a central farm was started near Ottawa, with four other branch farms in other parts of Canada. In agriculture, Canada is now pre-eminent among the nations, and even Egypt, the ancient farming land, is asking for samples of Canadian products that she may emulate this country in the pursuit of the farming industry.

Prof. Rutherford, F.R.S., was president of Section iii. (Physics), and gave an address on the life-history of radium, and other fellows of the society presented twenty-five original communications, while Prof. Edward E. Prince, Chief Commissioner of Fisheries, delivered an address, as president of Section iv. (Biology and Geology), on marine biology in Canada. Prof. Prince is the head of the three biological stations carried on by the Government on the Atlantic, the Pacific, and the Great Lakes shores, and his account of the progress of zoological research and of the investigations at the stations proved exceptionally interesting. Twenty-seven papers were read and discussed, including one, the first ever presented to the society by a lady, the subject being "The Islets of Langerhans in the Pancreas of Certain Fishes," by Prof. Swale and Mrs. Thompson, of Winnipeg. Prof. Adami, McGill University, gave a paper upon certain curious cases

of vertebrate teratology recently studied by him, and Prof. A. B. Macallum, F.R.S., described some new cells with protruding tail-like processes occurring in the mesoglœa of Aurelia and other Medusæ.

The popular evening lecture, which is always an important feature of the Canadian Royal Society's annual meeting, was delivered to a crowded assembly in the large hall of the Normal School by Prof. Ernest Rutherford. The subject was "Recent Results of Researches on Radium." In a graphic manner, the lecturer explained his famous "disintegration" theory, the transformation of chemical elements, the marvellous phenomena of radiant matter, and illustrated his remarks by striking experiments. He aroused much interest by stating that in Canada there were probably more rocks containing radium than in any other territory on the globe, and he had found, by suspending a wire in the open air in Montreal during a shower of rain, that radium collected on the wire. Many brilliant social functions took place during the meetings, including a large garden party by Dr. and Mrs. Saunders at their official residence; dinners given by the president-elect, Dr. S. E. Dawson; luncheons by Sir James Grant, former president; and other entertainments.

THE ROYAL VISIT TO THE UNIVERSITY COLLEGE OF NORTH WALES.

IN last week's NATURE, a short account was given of the visit of the King and Queen to Bangor to lay the foundation stone of the new buildings of the University College of North Wales. A few particulars relating to the origin and work of the college, and some thoughts suggested by speeches made at last week's ceremony, may be of interest as a supplement to the report that has already appeared.

The University College of North Wales was founded in 1884, and is at present located in the buildings of the former Penrhyn Arms Hotel. It has been enlarged by the addition of laboratories and lecture rooms for the faculty of science, which includes departments of agriculture and electrical engineering. The former was the first institution of its kind in Great Britain, and has been adopted as the model of similar agricultural departments started elsewhere. Its operations have been extended by the foundation in 1904 of a school of forestry under the auspices of the Board of Agriculture, one of two in the United Kingdom. The electrical engineering department is maintained by an annual grant from the Drapers' Company. If its resources in the matter of equipment have not been on a lavish scale, the training it has afforded has been of a high character and has probably possessed advantages which an over-elaborate plant might not afford. Still, much apparatus is badly needed before the condition of maximum efficiency can be reached. Another feature is the fisheries department, which has performed useful work in developing the fishing industry of North Wales, an industry which is capable of being greatly developed by the diffusion of practical scientific knowledge in the fishing districts. Although the present notice necessarily deals primarily with the scientific aspect of the work of the college, allusion must be made to the day training department, the courses in secondary education, and the facilities for kindergarten training afforded by the establishment of a preparatory school under the auspices of the college.

The new college will consist, when finished, of two quadrangles. At present it is only intended to erect the arts and administrative buildings, and it is to be hoped that by the time this has been done the building fund will admit of the science buildings being commenced. The library is very inadequately housed, and when we point out that only about 10*l.* a year is available for the purchase of books in such a subject as pure and applied mathematics combined, physics or chemistry, it will be seen that the present college staff is doing good work under difficulties which would not exist in a similar institution in Germany or America.

At the public luncheon, the Right Hon. D. Lloyd George, M.P., gave some interesting statistics showing the liberality and enthusiasm of the people of North Wales in matters relating to education. The contributions for university and technical education are six times, and to secondary education nine times, as high as in England, and the contributions of the town and suburbs of Bangor to the college alone represent the proportional equivalent of a sum which for a town of the size of Liverpool and its suburbs works out to 1,750,000*l.* In regard to the question of Government assistance, Mr. Lloyd George thought that waiting for Governments was like waiting for sunshine, and that the college afforded a grand opportunity for a millionaire to earn gratitude and fame.

But where is Mr. Lloyd George going to find his millionaire? A country which raises a protective tariff against millionaires in the form of death duties is scarcely a promising field. When we take account of the heavy losses North Wales has sustained by the death of a number of its most influential and prominent landowners during the last decade, the progress of the new college buildings will be found to represent a widespread feeling of munificence and loyalty towards the cause of higher national education far in advance of anything that exists in America. But in the race between British and American universities, Great Britain is heavily handicapped, with the result that, in spite of all the efforts we are putting forward, we are rapidly falling further and further behind. The inevitable result is that the responsibilities which the acquisition of wealth entails will be pressed more and more heavily every year on our Governments, and unless they can supply the extra few rays of sunshine we shall be less and less able every year to raise up the intellectual produce necessary to enable us to compete with the foreign producer.

The problem was solved long ago for Germany by her system of State universities. That Germany owes her national prosperity in no small measure to the principle of *Lehrfreiheit*, which has been adopted as the fundamental law governing the relations of the university professors with the State, is a fact which every German citizen knows well. It is no trifling thing to say that there is probably not a single university college in the United Kingdom the council and senate of which are more thoroughly imbued with the spirit of the German ideal than the University College of North Wales. In the large industrial centres of South Wales there exists an unfortunate conflict of rival factions, and it is sad to notice that many people only associate themselves with university education in order to acquire a cheap reputation by belittling the academic element, making unjustified and vexatious attacks on its representatives, and hampering the progress of the nation whose interests they falsely profess to have at heart. We refer in particular to the state of affairs which culminated some years ago in the premature death of the late Principal Viriamu Jones, and has continued to exist ever since. In North Wales the ardent Welsh nationalist, and the scientific worker who believes that "he is the greatest patriot who has the world for his nation," all realise that they are working together for a common cause.

G. H. BRYAN.

THE ALDROVANDI CELEBRATIONS AT BOLOGNA.

IT is not improbable that some of the delegates appointed to represent foreign universities and learned societies at the tercentenary of the death of Ulisse Aldrovandi (1522–1607) were insufficiently acquainted with the works of this great naturalist to appreciate thoroughly the importance of the occasion. The international gathering at Bologna (June 11–13) has been the means of rescuing from partial obscurity the memory of one of the many pioneers in the study of nature which Italy has produced. Bologna, the birthplace of universities and the *alma mater* of not a few students whose names occupy a prominent place in the history of the natural sciences, is an ideal meeting place of the nations to do homage to one of the fathers of scientific investigation. The numerous coats of arms which decorate the walls of the old university buildings bear witness to the hospitality of Bologna to students from all parts of the world, and the celebration which has now been brought to a successful conclusion testifies to the continuance of a spirit of hospitality after the lapse of centuries.

Aldrovandi's works, including several volumes published after his death, are in themselves a striking monument to his prodigious industry and encyclopædic knowledge; his wealth and long life were given up to an attempt to realise his ideal—"nothing is sweeter than to know all things."

The committee appointed under the patronage of the King to carry out the arrangements for the Aldrovandi celebrations had as honorary presidents the Marchese Tanari (Prosindaco del Commune) and the Rector of the University, Prof. Puntoni. Prof. Capellini, whose geniality is well known to many English friends, filled the office of acting president, and it is mainly to his labours and to those of the general secretary, Sig. Sorbelli, that the success of the meeting is due. On arriving at Bologna delegates were met at the station by members of the reception committee, from whom they received useful literature and information as to the lodgings provided for them. A general meeting was held in the Archiginnasio in the afternoon of June 11, at which Prof. Capellini welcomed the guests and gave an account of the order of procedure; in the evening a conversazione was given by the Marchese Tanari in the municipal buildings. The morning of June 12 was devoted to the most important business of the meeting; the delivery of discourses by Prof. Capellini, the Minister of Public Instruction and Agriculture, Prof. Costa and others, was followed by the presentation of addresses, accompanied by a few remarks by selected delegates. A feature of special interest was a speech by Count Luigi Aldrovandi—connected through fourteen generations with his illustrious ancestor. Prof. Ferguson, of Glasgow, was chosen by the British delegates as their spokesman. Oxford University was represented by Mr. Ashburnèr; Cambridge University, the Royal Society, the Linnean and Geological Societies of London, by Prof. Seward; St. Andrews, by Dr. Steele; and Glasgow University by Prof. Ferguson, who had previously taken part in the celebration of the octocentenary of the Bologna University. Among other delegates who spoke were Prof. Pélissier, of Montpellier; Prof. Schück, of Upsala; Dr. Wieland, of Newhaven; Prof. Entz, of Budapest; Prof. Richter, of Kolozsvar; and Prof. Brusini, of Zagabria (Agram, Croatia). The unveiling of a memorial tablet to Aldrovandi in the courtyard of the Archiginnasio terminated a somewhat lengthy programme.

In the evening delegates were afforded an opportunity of seeing the new Italian Opera—"John the Baptist"—in the Municipal Theatre. A cordial reception was given to the composer, a young priest from Turin, as he appeared before the curtain with those who took the parts of Christ, John the Baptist, Herod, and Salome. On June 13 the delegates were present at the inauguration of the Aldrovandi Museum. This was the most striking event during the meeting. A large collection of well-executed wood-blocks, together with the original specimens, shelves filled with volumes of unpublished manuscripts, a collection of coloured drawings of natural objects, and a series of herbaria formed a most impressive demonstration of the industry and whole-hearted devotion with which Aldrovandi applied himself and his means to the pursuit and organisation of knowledge. The fact that a catalogue of the unpublished manuscripts, specially printed for the celebrations, consists of 300 pages affords some measure of what Aldrovandi accomplished. Each delegate received a bronze medal bearing a bust of Aldrovandi and the following inscription on the reverse:—

Cui natura parens
Quaerenti tota refulsit

Virum post tria saecula meritas et gloria florentem
civitas et universitas
Bononiensis doctorum totius orbis adsensu rite
concelebrant. Prid. id. iun. MDCCCCVII.

In the afternoon a visit was paid to the Istituto Rizzoli at San Michele, in Bosco. Within the building devoted to orthopædic treatment were seen strange machines in motion to which were attached patients in various attitudes. The view from the grounds of the institute of Bologna and the plain beyond could not easily be surpassed.

An enjoyable banquet at the Hotel Brun in the evening brought the celebrations to a conclusion.

The presentation of several specially compiled volumes to those attending the meeting afforded another proof of the pains taken to render the meeting a success, and supplied a permanent interest to a thoroughly enjoyable reunion of nations. The volumes included "Intorno alla vita e alle opere di Ulisse Aldrovandi—Studi di A. Baldacci, E. de Toni, M. Gortani, F. Morini, A. C. Ridolfi, A. Sorbelli"; "Chartulorum Studii Bononiensis"; "Catalogo dei Manoscritti di U. Aldrovandi a Cura di Ludovici Frati con la collaborazione di A. G. e Albano Sorbelli."'

NATIONAL POULTRY CONFERENCE AT READING.

THE second national poultry conference was held at University College, Reading, last week, July 8–12, under the presidency of Sir Walter Palmer, Bart.

In addition to papers and discussions, there was an exhibition of pairs of about 150 breeds of poultry, both English and foreign. Several breeds of the latter had not been seen in this country previously.

Mr. C. C. Hurst read a paper on Mendel's law of heredity and its application to poultry breeding. After briefly alluding to Mendel's work on peas, he went on to describe the Mendelian pairs of characters in fowls, such as rose and single comb, white and coloured plumage, colours of legs, and others. The "law of segregation" was then explained and illustrated by reference to crosses between rose-combed Hamburgh and single-combed Leghorn, and between white Leghorn and black Minorca and other coloured varieties.

The rose-combed are dominant over the single-combed varieties, and the first cross are all rose-combed birds. Bred among themselves they produce on the average three rose-combed chicks to one single-combed bird. The latter mated with a similar one breeds true. The nature of the blue Andalusian fowl was then discussed, and the want of fixity of colour, in spite of more than fifty years of breeding and separation of "rogues," was pointed out. Pedigree "blue" birds produce only one-half blue like the parents, the remainder being black and splashed white birds in equal proportions. The black and white breed true, but when crossed produce all "blue" birds. The necessity of the determination of what characters are Mendelian was emphasised, and the practical value of Mendel's law in enabling breeders to calculate what the results of particular crosses will be was referred to in conclusion.

The next paper in the section dealing with breeding problems was by Dr. J. Llewelyn Thomas, on "Hybridisation Experiments with the Ceylon Jungle-fowl." These experiments were undertaken in 1903–4 with the view of solving the following questions:—(1) Will the Ceylon jungle fowl (*Gallus stanleyii*) breed with the domestic fowl? (2) Will the hybrids breed with the jungle fowl and with the domestic fowl? and (3) will the hybrids breed among themselves? The view that the black-breasted jungle fowl of India (*Gallus bankiva*) is the parent stock of the domestic game fowl is generally accepted, and Darwin, in his "Animals and Plants under Domestication," says that the Ceylon jungle fowl "may in all probability be rejected as one of the primitive stocks of the domestic fowl," a statement which he based on information supplied by a Mr. Mitford that two hybrids raised by the latter proved sterile. It was felt that the evidence just mentioned was not sufficient to establish a conclusion one way or the other, and experiments were undertaken to obtain further information on the matter. Wild Ceylon jungle fowls were obtained after much trouble and placed in specially built runs with domestic fowls in various parts of the island.

The mating of jungle hens with the domestic cock was a complete failure. The jungle cock, however, mated readily with domestic hens! The eggs laid proved fertile, and about thirty chicks were raised from them. The hybrid cock crossed with the domestic hen gave fertile eggs, and the offspring was fertile not only with the domestic parent, but also with the hybrid parent and with one another. No chickens were obtained from the crosses

(1) hybrid cock × jungle hen, (2) hybrid hen × domestic cock, (3) hybrid hen × jungle cock.

From the cross-bred cock × hybrid hen several addled eggs were obtained, four more had chicks dead in the shell, and from two of the eggs live chickens were hatched out. The latter were apparently sturdy and robust enough for a short time, but died on the twelfth and eighteenth day respectively after hatching. The sterility of the hybrids cannot, therefore, be adduced as evidence that the Ceylon jungle fowl is not a parent stock of the domestic fowl. It was pointed out that the Ceylon jungle fowl has a reddish-brown breast, and when reversion occurs among domestic fowls, even those of pure bred black-breasted types, the males usually have red or brown breasts and not black like *Gallus bankiva*.

Mr. F. V. Theobald gave an account of a parasitic liver disease in fowls, specimens of which had been sent to him during the last three or four years. Although previously unrecorded, it is probably quite common, and due to a protozoon *Amoeba maleagridis*, Sm. Diagnosis is somewhat difficult, but the *post-mortem* appearances of the liver with yellow spots along with swollen cæca are characteristic. The life-cycle of the parasite is not yet fully worked out.

Mr. Theobald incidentally referred also to an infectious disease among poultry in South America, produced by a Spirochæte, which passes part of its life-cycle in a fowl tick (*Argas miniatus*). J. P.

HYDROLOGY IN THE UNITED STATES. PURIFICATION OF SEWAGE.

WE have on several previous occasions noticed the papers issued by the United States Geological Department on Water Supply and Irrigation.[1] Recently we have been favoured by the receipt of nineteen further papers bearing on this subject.[2]

The greater part of these, although containing a great deal of information bearing on water supply, are yet chiefly of local interest.

Paper No. 180 of the series now sent deals with the efficiency of turbine water-wheels, and consists of a compilation of data derived from tests and from manufacturers' power tables of American stock sizes, and is intended principally for the use of the hydrological surveyors in cases where the turbine is used for gauging streams.

Paper No. 179 gives an account of investigations carried on for the purpose of discovering means for preventing the pollution of streams by distillery refuse. Paper No. 189 further deals with the disposal of the waste liquors resulting from the manufacture of strawboard, an important problem connected with the prevention of stream pollution in the districts where this industry prevails.

Paper No. 187 deals with the measurement of streams when they are frozen over, and with the modifications of the ordinary methods of gauging these streams when they are covered with ice.

Paper No. 182 describes the various wells in use for municipal or domestic supply in Michigan, and the means adopted for raising the water from these wells.

Paper No. 185, on investigations into the purification of Boston Sewage, with a history of the sewage disposal problem, is of much more general interest, and contains a great deal of information of value to sanitary engineers and chemists engaged in sewage disposal. It therefore deserves a more extended notice in this Journal.

The origin of the paper was as follows:—An anonymous friend of the Massachusetts Institute of Technology, moved by the magnitude and gravity of the sewage disposal problem as it concerns householders and communities, in 1902 presented to the institute a sum equal to 1000*l*. a year for three years, afterwards extended to five years, for the purpose of making experiments on sewage purification and giving the widest possible publicity to means or methods by which the present too often crude and imperfect systems may be improved.

The report now under review, which contains 162 octavo pages, has been drawn up by Messrs. Winslow and Phelps in consonance with the wishes of the donor, and consists of a popular statement of the history of the several methods that have been tried for the purification of sewage, and a record of the results obtained at the laboratory of the Massachusetts Institute. It is claimed by the authors that the paper is written in a popular style and in language so simple that citizens, boards of health, and sewerage commissions may readily avail themselves of the information contained in it.

The sewage experimental station at the institute is situated adjacent to the City of Boston, U.S.A. Within the last few years the whole of the sewage of this city has been collected into two large main outfall sewers, and is discharged into the harbour on the ebb tide. The station is connected with one of these outfall sewers. The sewage is pumped directly from the sewer through 2½-inch galvanised pipes into a series of twenty-five tanks having an area of 24 feet each, the depths varying from 3 feet to 6 feet. In these tanks the sewage is treated by intermittent sand filtration; the septic process; contact filtration through coke, stone, and brick of various diameters; and by trickling filters. The result of the effluent from the different tanks, as obtained by analysis, is given.

Under the conditions of these experiments crude sewage has been successfully filtered through a 2-feet bed of sand with an effective size of 0·14 millimetre at a rate of 0·4 million gallons per acre per day, divided into four doses in the twenty-four hours. The effluents were clear, bright, and well purified.

With single contact beds of stone 1½ inches in diameter, passed at the rate of 1·2 million gallons per acre per day, the effluent of the crude sewage was only partially purified. The beds clogged rapidly, and the surface required much attention.

The double contact system in primary beds of 2-inch material, and secondary beds of ½ inch, yielded a fairly well-purified and stable effluent at the rate, on the combined double system, of about 0·7 million gallons per acre per day with beds 6 feet deep.

The most practical of the methods that have been studied appears to be the treatment of the sewage either sedimented or subjected to a very short period of septic action in double contact beds.

The process of trickling filtration remains to be considered in a further report, but, so far as the present experiments indicate, this method will probably prove superior to any so far tested.

In the report is also given a summary of the history of sewage purification in England, Germany, the United States, and other countries, and the gradual development of the processes at present in operation. Starting from the discharge of the crude sewage into the sea or rivers, broad irrigation or sewage farming is described, and also chemical precipitation, intermittent filtration through sand, septic tanks, contact process in beds of coarse material, and continuous trickling over coarse material.

With regard to the first, it is shown that, although where the conditions are favourable sewage may be discharged into the sea without creating a nuisance, there yet remains to be considered its effect on shell-fish. With regard to the discharge into rivers, the conclusion arrived at by the River Pollution Commission of 1874 is given, that sewage mixed with twenty times its volume of pure

[1] Water Supply and Irrigation in the United States, January 7, 1904; July 28, 1904; November 3, 1904; December 22, 1904; January 26, 1905; December 21, 1905; March 2, 1906; May 24, 1906.

[2] Reports issued by the Department of the United States Geological Survey. Water Supply and Irrigation Papers. (Washington: Government Printing Office, 1906.) No. 185, Purification of Boston Sewage; No. 179, Prevention of Stream Pollution by Distillery Refuse; No. 180, Turbine Water Wheel Tests and Power Tables; No. 159, Summary of Underground Water Resources of Mississippi; No. 161, Quality of Water in the Upper Ohio River Basin; No. 162, Destructive Floods in the United States in 1905; No. 164, Underground Waters of Tennessee and Kentucky; No. 172, Progress of Stream Measurements, Missouri River; No. 174, Progress of Stream Measurements, Western Gulf of Mexico; No. 175, Progress of Stream Measurements, Colorado River; No. 177, Progress of Stream Measurements, California; No. 179, Means of Preventing Pollution of Streams by Distillery Waste; No. 181, Geology and Water Resources of Owens Valley; Nos. 182 and 183, Flowing Wells and Municipal Water Supplies in the Southern Peninsula of Michigan; No. 184, Underflow of South Platte Valley; No. 187, Determination of Stream-flow during the Frozen Season; No. 188, Water Resources of the Rio Grande Valley in New Mexico; No. 189, The Prevention of Stream Pollution by Strawboard Waste.

water would be two-thirds purified in flowing 168 miles at the rate of one mile an hour. With regard to broad irrigation, the conclusion generally arrived at is that sewage farms can never be expected to show a profit if interest on capital is included in the expenditure, and the experience is that there need be no serious danger of the spread of disease from irrigated crops, but that fruits and vegetables so grown should never be eaten without being cooked. With chemical precipitation the great difficulty is the disposal of the sludge, which amounts to twenty to twenty-six tons per million gallons of sewage. The disposal of this sludge generally involves considerable expense, it being found by practice to be of no value as manure. In fact, in some places, after being compressed into cakes, it is burnt or buried in the ground.

The result of the other processes has already been dealt with in the experiments conducted by the Massachusetts Institute.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LIVERPOOL.—The annual exhibition of antiquities arranged by the Institute of Archæology, illustrating excavations in Upper Egypt 1906–7, was inaugurated at Burlington House, London, W., on Tuesday, July 16, and will remain open until July 30. The exhibits include scarabs, ornaments, and inscriptions of 2000 B.C. to 1200 B.C., and stelæ of Ptolemaic and later dates, recently discovered by Prof. Garstang, Mr. E. Harold Jones, and the Hon. R. H. Trefusis.

MANCHESTER.—By the will of the late Mr. Mark Stirrup the university has received the following bequests:—Specimens of volcanic rocks and fossils; 1000*l.* for the maintenance of a geological and palæontological collection; 1500*l.* for the foundation of a palæontological scholarship, tenable for two years by anyone who has studied geology in the university.

Mr. J. W. Bews has been appointed to the newly instituted post of lecturer in economic botany.

OXFORD.—In a convocation to be held on September 30, the degree of D.Sc. *honoris causa* will be conferred upon Prof. Charles Barrois, Lille; Prof. A. Heim, Zürich; Prof. A. Lacroix, Paris; Prof. A. Penck, Berlin; Dr. Hans H. Reusch, Norway; Prof. F. Zirkel, Leipzig.

Dr. George Dreyer, lecturer in general and experimental pathology in the University of Copenhagen, has been elected to the newly established professorship of pathology.

SHEFFIELD.—The University has just issued its list of results of examinations, and we observe that three students have obtained the new degree of Bachelor of Metallurgy (B.Met.), viz. R. Mather, Z. T. K. Woo, and G. S. Ludlam. It seems only appropriate that the University's first three graduates should have taken their degree in metallurgy, as this department has for many years upheld a high standard of training in the metallurgy of iron and steel compatible with the ancient fame of the city as the home of the manufacture of high-class and special steels. It may not be inappropriate to note, in connection with the present trend of affairs in the East, that one of the honour graduates is a native of China.

PRIVATE enterprise has succeeded in founding, with the sanction of the Ministry of Education, confirmed by the Czar, an Institute of Archæology and Archæography in Moscow. The institute, which has just obtained its charter, ranks with a university, and is open to all graduates of Russian or foreign universities. Its aim is to prepare qualified archæologists and "archæographists." The latter term is applied to persons skilled in the preservation and use of historical archives, libraries, museums, and other collections, public and private, demanding special knowledge. The Moscow Institute of Archæology is the first institution in Russia founded on autonomous principles; it has the right to elect its own staff of professors, and generally to conduct its own internal affairs, subject only to a possible veto of the Minister of Education in certain cases. The course is a three years' one, the final year of which must be spent in practical work either in archæological expeditions and research among the monuments of antiquity as yet so little studied in Russia, or in similar special work at home or abroad. The institute grants the degree of doctor of archæology or archæography. Among those connected with the new institute whose names are favourably known outside Russia may be mentioned Dr. Uspensky, director of the institute, the author of fifty capital monographs in Russian; Dr. Fleischer, who was associated with English and American archæologists in recent excavations in Persia; Prof. Grot, and other Moscow professors. Privat-docent Visotsky has been appointed secretary to the institute.

THE first meeting of the governing body of the Imperial College of Science and Technology was held on July 12 at the Victoria and Albert Museum, South Kensington. Mr. R. McKenna, M.P., President of the Board of Education, who was accompanied by Sir Robert Morant, opened the meeting. The following members of the governing body were present:—The Earl of Crewe, Sir F. Mowatt, Sir Julius C. Wernher, Sir W. H. White, Principal MacAlister, Mr. A. H. D. Acland, Mr. F. G. Ogilvie, Mr. J. C. G. Sykes, Dr. Glazebrook, Sir E. H. Busk, Prof. Capper, Prof. Farmer, Sir A. W. Rücker, Mr. A. Acland Allen, M.P., Mr. H. Percy Harris, Sir C. Kinloch-Cooke, Mr. R. A. Robinson, Mr. J. T. Taylor, Sir J. Wolfe-Barry, Sir Owen Roberts, Sir W. S. Prideaux, Viscount Esher, Sir A. Geikie, Prof. Tilden, Prof. Gowland, Prof. Dalby, Sir Alexander Kennedy, Mr. T. Hurry Riches, Mr. R. K. Gray, Sir Hugh Bell, Dr. Elgar, Prof. Divers, Mr. A. Sopwith, and Mr. W. McDermott, with Mr. F. E. Douglas as secretary (*pro tem.*). Mr. McKenna, in opening the meeting, took the opportunity to explain the arrangements which would have to be made for the transfer of the Royal College of Science and Royal School of Mines to the control of the governing body, and referred to the importance of the work which lay before the governing body in connection with the provision and organisation of advanced technical education within the Empire. On the motion of Viscount Esher, seconded by Sir Alexander Kennedy, Lord Crewe was unanimously elected chairman. On Lord Crewe taking the chair, Mr. McKenna handed to him the Letters Patent containing the Grant of the Charter of the Imperial College. Provisional committees (including a finance committee, of which Sir F. Mowatt was appointed chairman) were appointed to deal with preliminary matters and to report to the next meeting of the governing body, which was fixed for July 19.

A RECENT issue of the Journal of the Department of Agriculture and Technical Instruction for Ireland contained an exhaustive article on technical instruction in Belfast, by Mr. F. C. Forth, the principal of the municipal technical institute in the city. This account has now been published in a separate form. In the inauguration of the scheme of technical instruction the Corporation had as the chief object the provision of instruction in the principles of those arts and sciences bearing upon the trades and industries of Belfast. The success of the trade classes has been due in great measure to the enlightened view which officers of trade societies in Belfast have taken of the operations of the technical institute and to the encouragement which has been given by employers. In 1900 it was decided to build the excellent technical institute which has now been practically completed at a cost of 100,000*l.* The Belfast Corporation was, it is satisfactory to note, well advised, and as the work of each department developed sufficiently to warrant such a step, a principal teacher for it was appointed, and his first duty was to superintend the equipment of the department allotted to him in the new building and to be responsible for the expenditure of his share of the 40,000*l.* set aside for the equipment of the new institute. Before the building was out of the contractor's hands a number of classes were transferred to it, and useful experience was gained which led to some modifications in arrangements before the building was completed finally. The great bulk of the equipment is now installed, and it is hoped that when the date for the formal opening arrives, the building and its contents will be complete. Belfast is to be congratulated upon the provision the Corporation has made for providing young men and women with a modern and thorough type of technical education.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, June 18.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—The growth-forms and supposed species in corals: Dr. F. W. **Jones**. The author showed that the growth-form of the colony was the outcome of the conditions of the environment, and was not a specific character. The growth-form was largely the result of the method of division of the zooids of the colony, and different external conditions produced different methods of division, so that almost any coral could show almost any method of division.—The lizard of the Ionian Islands which had been named *Lacerta ionica* by Herr Philip Lehrs: G. A. **Boulenger**. The author stated his opinion that this lizard was not entitled to specific rank, and that it was merely a variety of *Lacerta taurica*, Pallas.—Neotropical Lycænidæ: H. H. **Druce**. A large number of new forms were described, and the synonymy of many others discussed.—Descriptions of *Velifer hypselopterus* and of a new fish of the genus Velifer: C. T. **Regan**.—The anatomy, classification, and systematic position of the teleostean fishes of the suborder Halotriognathi: C. T. **Regan**. The paper showed that the Lampriditdæ, Veliferidæ, Trachypteridæ, and Lophotidæ formed a natural group closely related to the Beryciformes, from which they differed especially in the structure of the mouth.—Monkeys of the genus Cercopithecus: R. I. **Pocock**. All the known forms of this genus may be arranged into groups typified by the following species:—*patas*, *aethiops*, *petaurista*, *cephus*, *nictitans*, *leucampyx*, *albigularis*, *mona*, *neglectus*, *l'hoesti*, and *diana*.—Some African species of Felis, based upon specimens exhibited in the society's gardens: R. I. **Pocock**. Special attention was directed to some interesting points connected with *F. nigripes*, *F. serval* and *servalia*, and *F. aurata* (=*chrysothrix*). A specimen of the last-named species from Sierra Leone changed from red to dusky grey while living in the gardens, thus proving that the differences in colour between individuals of this species were not of specific or subspecific value.—The jelly-fish of the genus Limnocnida collected during the third Tanganyika expedition: R. T. **Günther**. The material was obtained on four distinct dates in September, November, and February, by Dr. W. A. Cunnington, and therefore during the season of the great rains. The greater number of specimens in all the collections showed a vigorous growth of young medusa-buds on the manubrium, and that therefore the theory that asexual reproduction occurred during the dry season only, which was propounded by Mr. Moore, must be abandoned. Dr. Cunnington's material threw new light upon the order and succession in which the tentacles developed, and had enabled the author to record all the stages of tentacle development as exhibited by individuals ranging from 2 mm. to 22 mm. Certain variations in the arrangement of radial canals and of sense-organs were discussed. So large a percentage as 24 per cent. were found to possess five or more radial canals, the greatest number being seven instead of the normal four. The Victoria Nyanza form of Limnocnida collected by Sir C. Eliot, which was also dealt with in the paper, was believed to be a variety, which differed from the Tanganyika form in that the tentacles were more deeply embedded in ridges of jelly of the exumbrella than in the Tanganyika form. All the individuals in a collection from the Victoria Nyanza were females. The result of a re-investigation of both Limnocnida and Limnocodium led the author to the conclusion that both genera were to be referred to the Trachomedusæ, in spite of the fact that no other known trachomedusan had gonads on the manubrium. Reasons for this view were given, as also for the association of both fresh-water medusæ with the Olindiadæ. It was considered exceedingly doubtful whether either Limnocodium or Limnocnida ever passed through a hydroid stage at all.

Geological Society, June 19.—Dr. Aubrey Strahan, F.R.S., vice-president, in the chair.—The Inferior Oolite and contiguous deposits of the Bath-Doulting district: L. **Richardson**. In this paper a detailed description is given of the Inferior Oolite of the country between Doulting and Bath. It is shown that there is within the area no Inferior Oolite deposit of earlier date than the Upper Trigonia Grit —a deposit of Garantianæ hemera. In one appendix Mr. S. S. Buckman indicates the deposits in Dorset equivalent to those studied; in another the late Mr. J. F. Walker and Mr. Richardson deal with the Brachiopoda of the Fullers' Earth, naming seven new species; and in a third Mr. Richardson describes a new Amberleya and Spirorbis. The micro-fauna of the upper coral bed is dealt with by Mr. C. Upton, who obtained from material furnished him from Midford and Timsbury Sleight most of the micro-brachiopoda such as were found by Charles Moore at Dundry Hill.—The Inferior Oolite and contiguous deposits of the district between the Rissingtons and Burford: L. **Richardson**. This paper is presented with the preceding, because there are several points of similarity between the two districts described. Both are near lines of country along which movements of upheaval were frequent during the time of formation of the Inferior Oolite rocks.—The flora of the Inferior Oolite of Brora (Sutherland): Miss M. C. **Stopes**. This paper is to place on record the discovery of a bed containing impressions of plants, which represent a flora bearing a strong likeness to that of the Inferior Oolite of the Yorkshire coast. Previously, but one species and a second doubtful one were known from these coal-bearing beds. The bed in which the plants were found was a thin shale-band cropping out below high-tide level on the coast, about 1¼ miles south of Brora.—The constitution of the interior of the earth as revealed by earthquakes (second communication): some new light on the origin of the oceans: R. D. **Oldham**. The attempts which have been made to account for the oceans and continents are all subject to an uncertainty, in that we have had no means of knowing whether it is a mere irregularity of form that has to be accounted for or whether this irregularity is but the expression of a deep-seated difference in the constitution of the earth. The paper is an attempt to clear up this uncertainty by a comparison of the European records of the San Francisco and Colombian earthquakes of April 18 and January 31, 1906. The general conclusion is drawn that oceans and continents are not mere surface irregularities of the earth's form, but are accompanied by, and probably related to, differences in the constitution of the earth beneath them, which extend to a depth of about one-quarter of the radius. It is not possible to state exactly in what this difference consists, beyond that it causes the rate of propagation of the second-phase waves to be less, in comparison with that of the first-phase waves, under the oceans than under the continents.—The Swansea earthquake of June 27, 1906: Dr. C. **Davison**. With the exception of the Hereford earthquake of 1896, the Swansea earthquake was the strongest which has been felt in this country for more than twenty years. It disturbed an area of 66,700 square miles, reaching from Rochdale on the north to Penzance on the south, and from beyond Maidenhead on the east to Waterford on the west. The centre of the isoseismal 8 lies about three miles west of Swansea, the longer axis of the curve being directed E. 5° N. and W. 5° S. At Swansea, Neath, &c., the total number of chimneys thrown down or damaged must have amounted to several hundred. The shock consisted of two distinct parts, the first part being much weaker than the second, except at places within an oval area lying some miles to the east of the Swansea epicentre. The existence of a secondary focus beneath this area is also indicated by the relative positions of the isoseismal lines, the isoseismal 8 being much nearer the isoseismal 7 at the western than at the eastern end. Observations, fifty-three in number, were obtained from thirty-nine pits, distributed over an area forty-nine miles in length, from near Kidwelly to near Pontypool. The shock was, as usual, less strongly felt in pits than on the surface, and the sound was more uniform and monotonous underground. Both shock and sound were observed in pits over about the same area. The originating fault in the neighbourhood of Swansea must run from E. 5° N. to W. 5° S., heading to the south, and passing not far from the line joining Llanelly to Neath, which is five or six miles to the north of the great east-and-west fault under Swansea Bay.—The Ochil earthquakes of September, 1900, to April, 1907: Dr. C. **Davison**. During this interval a series of slight shocks was felt chiefly in the villages of Blairlogie, Menstrie, Alva, and Tillicoultry,

lying between the Ochil Hills and the river Forth. There were four shocks in 1900, one in 1903, ten in 1905, nineteen in 1906, and eight up to the end of April, 1907. The strongest shock of the series occurred on September 21, 1905; its intensity was 6, and it disturbed an area of about 1000 square miles. The originating fault must be directed from about E. 27° N. and W. 27° S., hading to the north, and passing not far from the villages mentioned above. It cannot therefore be identified with the great Ochil fault, which in the district referred to runs from about E. 13° N. to W. 13° S., and near Dollar hades to the south, although it is possible that some or many of the slighter shocks may have been due to slips along this fault.

Linnean Society, June 20.—Prof. W. A. Herdman, F.R.S., president, in the chair.—The distribution of conifers in China and neighbouring countries: the late Dr. M. T. **Masters.**—A group of papers on the collections of H.M.S. *Sealark*: J. Stanley **Gardiner.** A group of papers on collections obtained during the cruise of the yacht *Silver Belle*.—The pre-Glacial flora of Britain: Mr. and Mrs. Clement **Reid.**—Species and ovicells of Tubucellaria: A. W. **Waters.** The collections dealt with were from the Red Sea, Zanzibar, and the Atlantic.—Cephalopoda of the Sudan: Dr. W. E. **Hoyle.**—Triassic species of Zamites and Pterophyllum: E. A. N. **Arber.**—Plants collected on Mt. Ruwenzori by Dr. A. F. R. Wollaston (1906): E. G. **Baker,** S. L. **Moore,** and A. B. **Rendle.** The plants from the Ruwenzori range were collected from two camps, one at about 3500 feet above sea-level on the south-east slopes of the range between the mountains proper and Lake Ruisamba, the other at 6500 feet in the Mubuku Valley on the east side of the range. Expeditions were made to intermediate and higher altitudes, the highest camp being at about 12,500 feet, whence plants were collected up to the snow-level at about 14,500 feet on the east side. The time of year was January to July. Dr. Wollaston gives notes on the vegetation at different altitudes from 3000 feet to 15,000 feet, and has brought back some photographs showing the nature of the country and different aspects of the vegetation. The plants at the lower elevations include some common tropical weeds, with a fair percentage of more localised species and some novelties. Cultivation ceases above 7000 feet, and at from 7000 feet to 8000 feet is found the largest forest of the range; a large Dombeya is noticeable, and one of the finest trees is a Podocarpus. Above 8000 feet the forest thins out, and is gradually replaced by a belt of small tree-heaths and Podocarpus. The bamboo zone begins on the east side at about 8500 feet, and continues up to 10,000 feet. The big tree-heaths begin about 9500 feet, at which level a number of terrestrial orchids were found, with numerous ferns. From 10,000 feet to 11,000 feet moss is plentiful on the ground and trees, forming cushions 2 feet deep; here were found two tree Lobelias. In the next thousand feet Helichrysums, Lobelias, tree-heaths, and tree Senecios are the most conspicuous plants. The heaths cease about 12,500 feet, but the Senecios continue almost to 14,000 feet. Another Lobelia appears at about 12,500 feet, and is found on the steepest slopes almost to the snow-line. Helichrysums, sometimes forming bushes 4 feet or 5 feet high, grow luxuriantly. A small Arabis was found at 14,000 feet, and a rush, a grass (a new species of Poa), and mosses were found growing up to the level of permanent snow.—The anatomy of the Julianiaceæ: Dr. F. E. **Fritsch.**—Certain critical fresh-water algæ: G. S. **West.**

Faraday Society, June 25.—Prof. S. P. U. Pickering, F.R.S., in the chair.—The thermochemistry of electrolytes in relation to the hydrate theory of ionisation: W. R. **Bousfield** and Dr. T. M. **Lowry.** The process of ionisation of a neutral salt in aqueous solution "*is usually attended with a development of heat*" (Nernst, "Theoretical Chemistry," 1904, 659), *e.g.* $KCl \rightarrow K^+ + Cl^- + 250$ cal. (Arrhenius, *Zeit. phys. Chem.*, 1889, iv., 106). It is pointed out that the decomposition of potassium chloride into molecular potassium and molecular chlorine involves an absorption of 105,600 cal., and that a further absorption must accompany the decomposition of the molecules into atoms. The electrification of the atoms is also probably an endothermic action, and the change represented by the above equation, so far from involving the liberation of 250 cal., must actually involve the absorption of more than 100,000 cals. The process of ionisation must therefore involve some powerful exothermic action not shown in the ordinary scheme, and it is suggested that this is supplied by the combination of the charged atoms or "ionic nuclei" with the solvent to form hydrated ions.—Influence of non-electrolytes and electrolytes on the solubility of gases in water. The question of hydrates in solution: Dr. J. C. **Philip.** The author supported the view according to which the diminished power of a solution to dissolve hydrogen and oxygen as compared with pure water is due mainly to the hydration of the solute and the consequent diminution of the "free" solvent.—Hydrates in solution: discussion of methods suggested for determining degree of hydration: Dr. G. **Senter.** It is pointed out that recent attempts to account for the properties of aqueous solution on the basis of association alone have not only proved inadequate to afford a quantitative representation of the facts, but in some respects do not appear to be even in qualitative agreement with experiment. The different methods of investigation indicate that the degree of hydration varies with the atomic weight; for example, in the case of the chlorides of the alkalis, the hydration decreases with increasing atomic weight of the alkali metals. From a quantitative point of view our knowledge of hydration is much less satisfactory, and the results so far obtained must be regarded as of a preliminary character.—The stability of hydrates as indicated by equilibrium curves: Dr. A. **Findlay.**

Chemical Society, July 4.—Sir Alexander Pedler, F.R.S., vice-president, in the chair.—*iso*Nitroso- and nitro-dimethyldihydroresorcin: P. **Haas.** The first of these substances is obtained by treating the potassium salt of dimethyldihydroresorcin with potassium nitrite in acid solution, and it is converted into the nitro-compound by treatment with nitrous gases in ether solution.—The structure of carbonium salts: F. **Baker.** *p*-Rosaniline and its monohydrochloride give absorption spectra conforming to the two types characteristic of carbonium salts such as the triphenyl- and trianisyl-carbinol sulphates, whence it is concluded that the magentas are carbonium salts.—Studies of dynamic isomerism, part vi., the influence of impurities on the muta-rotation of nitrocamphor: T. M. **Lowry** and E. H. **Magson.** The view previously arrived at that the mutarotation of nitrocamphor in solvents is conditioned by the presence of alkaline impurities is confirmed.—The relation between absorption spectra and chemical constitution, part viii., the phenylhydrazones and osazones of α-diketones: E. C. C. **Baly,** W. B. **Tuck,** Miss G. **Marsden,** and Miss M. **Gazdar.** Examination of the absorption spectra shows that these substances, in neutral solution, possess the ketonic structure, whilst phenylhydrazones in alkaline solution tend to assume the enolic configuration.—Permanganic acid: M. M. P. **Muir.** A solution containing 17 per cent. of this acid can be obtained by adding the calculated quantity of dilute sulphuric acid to a solution of barium permanganate and concentrating the filtrate in a vacuum.—Methyl dicarboxyaconitate: S. **Ruhemann.** Descriptions are given of additive and condensation products obtained by the interaction of this ester with (*a*) phenylhydrazine and (*b*) aniline. The action of heat on αα′-hydroxycarboxylic acids, part iii., αα′-dihydroxysebacic acid and its diacetyl derivative: H. R. **Le Sueur.** Both these compounds are decomposed at 250°–270° with the formation of carbon monoxide and the dialdehyde corresponding to suberic acid.—Dihydroxyadipic acids: H. R. **Le Sueur.** Two dihydroxyadipic acids are formed when the bromine atoms in αα′-dibromoadipic acid are replaced by hydroxy-groups. These are probably stereoisomerides.—The relation between absorption spectra and optical rotatory power: A. W. **Stewart.** The absorption spectra of racemic acid in concentrated solution differ from those of the optically active tartaric acids, but on dilution approximate to them in character, indicating that the acid breaks down into its two optical antipodes.—Experiments on the synthesis of the terpenes, part xi., synthesis of 4: *iso*propylidene*cyclo*-

hexanone and its derivatives: W. H. **Perkin**, jun., and J. L. **Simonsen**.—Purification of acetic ester: J. K. H. **Inglis** and Miss L. E. **Knight**.—Solubility of lead sulphate in concentrated solutions of ammonium acetate: J. J. **Fox**.—Researches on morphine, part iii.: F. H. **Lees**. By the hydrolysis of chloromorphide a second isomeride of morphine, neo*iso*morphine, has been obtained which on methylation furnishes the substance already known as *pseudo*codeine.

Association of Economic Biologists, July 4.—Mr. A. E. Shipley, F.R.S., president, in the chair.—Some notes on ticks: Cecil **Warburton**. The author dealt with the classification and means of identification, and discussed the leading generic characters.—Results of experiments with the spruce-gall and larch-blight disease: E. R. **Burdon**. The results showed that a paraffin emulsion applied early in the year, before the buds open and whilst the insects are still hibernating, is most effective.—The Cecidomyidæ or gall midges: W. E. **Collinge**. The author gave an account of his work, and appealed to entomologists and others for assistance in working out the life-histories, &c., of this very difficult family of Diptera.—A disease of bees in the Isle of Wight: Prof. A. D. **Imms**.—The American gooseberry mildew and the proposed legislative measures: E. S. **Salmon**.—The bionomics of the calypterate Muscidæ and their economic significance: C. G. **Hewitt**.—The next meeting will be held at Edinburgh about Easter, 1908.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part i. for 1907, contains the following memoirs communicated to the society:—

July 28, 1906.—Measurements of the vertical electric current in the atmosphere, I.: H. **Gerdien**.

January 12.—A characteristic property of the *Klassenkörper*: Ph. **Furtwängler**.—A convergence theorem: E. **Landau**.—The most general conception of the plane continuous curve: A. **Schoenflies**.—The occurrence of genera and groups of Ammonites in the several zones of the Lower Chalk of Germany: A. **von Koenen**.

February 9.—The composition of quadratic forms: H. **Weber**.

February 23.—Researches from the Göttingen University chemical laboratory: O. **Wallach**. (1) Carbon acids of cyclic carbohydrates; (2) the behaviour of the nitrites of primary bases, and on the enlargement of the "ring" of carbocyclic systems.—(1) The Jacobian transformation of the quadratic forms of an infinite number of variables; (2) the transformation of assemblages of bilinear forms of an infinite number of variables: O. **Toeplitz**.

March 9.—Orthogonal systems of functions: F. **Riesz**.

PARIS.

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