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THE PHYSIOLOGICAL EFFECT OF LIFE IN THE ALPS.

Höhenklima und Bergwanderungen in ihrer wirkung auf den Menschen. By N. Zuntz, A. Loewy, F. Müller, and W. Caspari. Pp. xvi+494, and tables. Dedicated to E. Pflüger, in celebration of the jubilee of his doctorate. (Berlin: Bong and Co., 1905.)

ALPINE literature has a special charm; it re-kindles memories of happy hours spent among the mountains, and thrills us with echoes of that intense delight in life which was the prominent characteristic of days in Switzerland. No doubt many things contribute to the pleasure which the Alps give to thousands of men and women, but one obvious and potent factor is the sense of well-being; we feel that, like the elixir of life, mountain air and scenery rejuvenate body and mind.

In the important work just published by Prof. Zuntz, Prof. Loewy, and their comrades, a scientific basis is afforded for this rejuvenating influence. The volume contains an account of an expedition undertaken expressly to carry out physiological investigations at high altitudes. Such expeditions have been frequently made, the most notable being the pioneer one of Paul Bert, the extensive one of Kronecker and his colleagues, and those which Mosso has repeatedly carried out in the Monte Rosa district. The expedition conducted by Prof. Zuntz has no doubt reaped great advantages from the study of the work of its predecessors, and the results achieved are in consequence more convincing, and from the physiological standpoint more valuable.

Since the object of the expedition was the enlargement of physiological science, the essential features of the account are of necessity somewhat technical. But the volume contains many passages which are of general interest, including an extensive historical account of earlier expeditions. There are in every one of the twenty-two chapters passages which will appeal to all those who love the Alps, for Prof. Zuntz is himself one of this fraternal band, and reveals his own enthusiasm not only by the character of the descriptive writing, but more directly by the interpolation of many beautiful Alpine illustrations. Moreover, such practical details as clothing, food, and exercise are dealt with from the alpinist's point of view, and what is termed "sport" is treated in a most suggestive way.

To the majority of readers, especially if they should be medical practitioners, the most interesting portions of this really great work will be those which set forth the peculiarities of the climate in high altitudes and the influence which these peculiarities must exert, not only on vigorous athletes who climb the topmost peaks, but on the ever-increasing number of less ambitious mortals who seek the Alps in order to restore shattered health, or to check the advance of disease. In chapter xx. the benefits and dangers of life in moderately high altitudes are set forth in the light of the results of the expedition; the new basis for estimating the value of such benefit or the extent of such danger which is given in this part of the work should of itself secure the general reputation of the volume owing to its direct bearing upon some of the most important hygienic topics of the day.

It is impossible in the short space of this notice to do justice to such a comprehensive volume, but since the essence of the work lies in the physiological effects which were observed at high altitudes, and these form the basis referred to in the preceding paragraph, a brief summary of the physiological results must be attempted. In order to realise their nature, the plan of the expedition will be first described.

Two physiological professors, two assistant professors, and two younger members of the medical profession engaged in physiological research formed the *personnel* of the expedition. For more than twelve months each member of the party had made elaborate experiments of a preliminary character in the Berlin laboratories in order to become efficient in the quantitative work necessary for the investigation of the body metabolism. The details of the expedition were planned with great care and forethought; valuable aid was afforded by Prof. Kronecker, of Berne, and Prof. Mosso, of Turin, the most essential feature of this help being the offer of the working laboratories established in the Brienz district by Kronecker and in the Monte Rosa district by Mosso. In July, 1901, the actual work was begun at Brienz. This is situated at the east end of the lake of that name, and lies at the height of 1857 feet; it is connected by a mountain railway with the summit of the Brienz Rothhorn (7713 feet). At Brienz each member of the party, by strict diet and other precautions, placed himself in a condition of nitrogenous equilibrium, that is, a condition in which the quantity of nitrogen assimilated from the food is equal to that excreted in twenty-four hours. After a few days the party divided, three members going by train to the summit of the Brienz Rothhorn, the others remaining at the lower level; both groups performed given amounts of muscular exercise and conducted similar physiological investigations. Finally the groups changed places, and the work was continued as before. This formed the first part of the inquiry; the second part was of a more severe character. Starting from that delightful valley in which Gressoney-la-Trinité nestles amongst the flowery slopes of the Lysthal, the party ascended to the Col d'Olen, where, at a height of 9420 feet, Mosso has established his lower mountain laboratory. After spending some days in preparations, four members of the party and Prof. Sella, of Rome, climbed with guides and porters to the summit of the Signal Kuppe or Point Gnifetti of Monte Rosa, 14,965 feet. Here they stayed for seven days in the hut, now widely known as the Capanna Osservatorio Regina Margherita, which was erected for experimental pur-

poses through Mosso's endeavours. The first days were most tempestuous, and the account of the stay on the summit is full of interest; an incident in the week was the recovery of a collapsed Alpine tourist, who, to the surprise of the party, turned out to be a lady. The whole party suffered more or less severely from mountain sickness, and a valuable part of the investigations deals with this familiar complaint.

Animals were taken up all the ascents for experimental purposes, others being left below for control observations.

The physiological results are related respectively to the influence of moderate altitudes, *i.e.* up to 7500 feet, and of high altitudes up to nearly 15,000 feet, the former being chiefly the Brienz-Rothhorn experiments, the latter the Monte Rosa ones. They may be briefly summarised under the following different headings :—

(1) *Blood Changes.*—It is now well known that, as first suggested by Paul Bert, the blood is altered in high altitudes. The most striking change is that discovered by Viault, who found that the red blood corpuscles increased from five millions to seven or eight millions per cubic millimetre of blood. Similar increase was observed in the present expedition, but it was somewhat uncertain in character. The determination of the specific gravity of the blood and of the serum showed that the increase when present was not due to plasma diminution through the excessive evaporation of perspiration; moreover, an examination in animals of the tissue which is the seat of the corpuscular formation (the red marrow of the bones) showed that this was in a state of greatly augmented activity. There is therefore no question that the red corpuscles increase in number, and the authors state in their work that the stimulating influence is the diminished oxygen tension of the blood itself.

(2) *Digestive Efficiency.*—By careful quantitative examinations of the food and excreta, it was shown that altitudes up to 8000 feet exercised a favourable influence upon the completeness of the digestive processes, the indigestible residues diminishing especially when the surroundings were cold. In very hot surroundings this favourable influence was not so apparent, and in these circumstances muscular exertion caused it to be of the reverse type. At very high altitudes, 14,900 feet, the efficiency of digestion was greatly impaired.

(3) *Oxidation Processes.*—The extent of these was determined by the relation between the absorbed oxygen and the total heat production of the body. It appeared that even at such low altitudes as 1500 feet the total oxidation was increased, this being exceptionally high during muscular exertion, whilst in moderate and high altitudes the oxidation processes were greatly increased. The increase is set down to two circumstances; firstly, the diminished thermogenetic capacity of the muscles, which are impaired by the inadequate supply of oxygen in their circulating blood, thus throwing the necessary heat production upon the oxidation of more complex compounds than those offered by the muscles; secondly, the presence in the tissues of abnormal oxidisable substances.

(4) *Proteid Metabolism.*—The most important of the numerous changes brought forward in the results of the expedition are those connected with the fundamental nitrogenous substances, proteids. It has been firmly established in physiology that whilst every growing animal assimilates through food more nitrogen than is excreted, this is not the case in the adult except in special circumstances. Growth implies proteid storage, which is believed to be utilised for the increased formation of cellular structures, and even in the adult such local muscular growth may occur as the result of special muscular exercise, training, &c., but it soon reaches a limit and is comparatively insignificant. In the convalescent it is a marked feature of recovery from wasting illness. After making due allowance for all disturbing influences, a most important result was arrived at by the work of the expedition. Even at Brienz (1500 feet) a stage was reached in which the total N-import exceeded the N-export, whilst on the Rothhorn this excess was most marked. Moreover, this phase of metabolism persisted for a considerable time after leaving the moderately high altitude. This implies the production of a phase of nitrogenous metabolism resembling that of the growing animal; it is, in short, a renewal of youth. It is noteworthy that along with this nitrogen storage there was no corresponding increase of body weight, the intensity of the oxidation processes in non-nitrogenous compounds being more than sufficient to mask the proteid gain. At the highest altitudes the gain was not so apparent, but this is amply accounted for by the digestive derangement which was associated with the mountain sickness.

(5) *Respiration and Circulation.*—The decrease of the oxygen tension in the blood in consequence of the decreased partial pressure of the oxygen of the air was in accordance with the results obtained by Hüfner and others in connection with hæmoglobin. In opposition to Mosso's results the authors found that there was not a decreased tension of carbonic acid in the blood. They bring forward evidence which suggests that deficiency of oxygen in the blood can, like excess of carbonic acid, stimulate the respiratory centre; this is of interest as it is opposed to the physiological view now generally accepted. The peculiar type of breathing known as the Cheyne-Stokes respiration, described by Mosso as occurring at high altitudes, was observed by the members of the expedition on Monte Rosa, but the explanation now advanced is quite different from that offered by Mosso. Zuntz regards the phenomenon as impaired activity of the respiratory centres, which are only capable of being adequately roused if the carbonic acid has by accumulation reached a certain tension in the blood.

As regards the circulatory changes, the only one of a fundamental character appeared to be due to the altered activity of the heart. At moderate altitudes the heart's activity, like that of the respiratory mechanism, is augmented to meet the need for more oxygen and more effective oxygen transport by the blood, but at very high altitudes there appeared to be

a great tendency to cardiac weakness owing to the direct action of insufficient oxygen in the blood supplying the muscular walls of the heart.

This scanty and imperfect sketch may serve to show the very extensive field which is covered by the physiological work of the expedition, but, in addition, many valuable observations were made upon the symptoms, progress, and nature of mountain sickness. The cause of this complaint is, according to the authors, the deficiency of oxygen transport by the blood. The individual variations in the manifestation of the symptoms and the disappearance of the symptoms on habituation are considered to be due to the relative adequacy or inadequacy of the mechanisms by which the organism endeavours to protect itself against this oxygen deficiency. One such mechanism is the circulation flow, and if this is unable to bear the strain of increase, then nervous influences diminish the vascular area of the digestive organs in order to supply, so far as practicable, the higher nerve centres in the brain; in consequence of this anæmia, an extensive derangement of the digestive functions is produced which shows itself in the sickness and other symptoms that are the characteristic features of the trouble.

In conclusion, attention must be directed once again to the practical bearing of the Rothhorn experiments. These deal with the effects produced by moderately high altitudes, and to such altitudes thousands of men and women go every year, whilst the numerous sanatoria frequented by invalids are situated at these elevations. Moderate altitudes of less than 8000 feet appear, in consequence of the lessened atmospheric pressure, to benefit the whole organism in the following particulars. The tissue which produces the oxygen carriers of the blood is stimulated into greater activity, the oxidation of abnormal substances is increased, the heart's action is augmented, the respiratory muscular mechanism is brought into more energetic use, and, finally, that proteid assimilation which is so directly related to cell growth and cell restoration assumes the phase present in the young and growing animal. In consequence of all these changes, and particularly the last one, altitudes of from 4000 to 7000 feet must exercise a most beneficial and even rejuvenating influence. In the case of many invalids the effect will be to arm the body for its fight against such insidious foes as the tubercle bacillus and to hasten recovery in all cases of convalescence from bodily or mental prostration. Only those whose circulation is seriously impaired directly or indirectly by organic disease are debarred from the probability of such beneficial effects.

Experience has revealed to many the profound truth which is expressed in the beautiful and familiar words, "I will lift up mine eyes unto the hills, from whence cometh my help." In their monumental work Prof. Zuntz and his colleagues present physiological reasons for the assurance that whilst mountain scenery may arouse the imagination, mountain air will stimulate those organic functions which form the foundation for health of body and happiness of mind.

F. G.

A COMPREHENSIVE DYNAMICS FOR PHYSICISTS.

The Dynamics of Particles and of Rigid, Elastic, and Fluid Bodies. By Prof. Arthur Gordon Webster. Pp. xii+588. (Leipzig: B. G. Teubner, 1904.) Price 10 marks.

ATTENTION has been directed in more than one recent review to the tendency to over elaboration in the standard treatises to which an English reader would naturally turn for information on such branches of applied mathematics as the principle of least action, the potentials of ellipsoids, or the equations of motion of a perfect fluid. What has been said already must be said again, in order to make good the claims which Prof. Webster puts forward in his preface, and to prove that this book, written by an American and published in Germany, fills a distinct want.

That the student of physics should have to consult five volumes of Routh, three of Love, and a large work of Lamb is a state of affairs which could not very well be allowed to continue. It is true that these treatises afford an excellent preparation for the man who proposes to devote his whole lifetime to mathematical research, regardless of cost. But it is becoming more and more evident that the physicist must know something about the intricate mathematical machinery which has been so successfully employed to bring a large proportion of physical phenomena into one connected theory. We include under this category reversible phenomena. Whether the subject-matter of this book is called dynamics, or the study of quadratic forms, or the theory of geodesics in a hyperspace with special reference to particular definite applications makes no difference. The present reviewer may perhaps be allowed once more to state his conviction that irreversible energy transformations, whether statistical or non-statistical in character, cannot satisfactorily be accounted for as properties of quadratic forms except by the method of energy-accelerations, that is, by studying the *second*, and not the first, differential coefficients with respect to the time of the squares and products occurring in the energy function. But the omission of these phenomena leaves a great portion of modern physics which cannot be properly understood without some knowledge of a very extended and very advanced portion of applied mathematics.

In his preface—which, by the way, is so exhaustive as to leave a reviewer but little fresh to add—Prof. Webster states of the book that "It is obvious that it leads to no particular examinations, from which we in America are to a large extent fortunately free." Examples, as such, are therefore omitted, although most of the standard applications of general principles are included in the text; for instance, motion of a spherical pendulum, the brachistochrone and tautochrone under gravity, potentials of a disc and cylinder, form of a rotating liquid in a uniform field or under self-gravitation, torsion of elliptic and triangular prisms, and so forth. In connection with these applications an intentional feature is very con-

spicuous, namely, the attempt, wherever practical, to illustrate the conclusions by diagrams or by appeal to experiment. Prof. Webster is a firm believer in both the analytical and the geometric method, and he rightly emphasises the importance of Lagrange's monumental work, in which there are no figures, but only algebraic equations. But *in the interpretation of results* the geometrical method is often the most fruitful, and it certainly appeals best to the reader who, like Prof. Webster, regards geometry as a physical subject. Possibly it is not so generally known as it ought to be that one important branch of dynamics, namely, uniplanar rigid dynamics, can be treated practically without the use of analysis by drawing diagrams for each problem, and inserting a force, Ma, at the centre of each mass, and a couple, $Mk^2d^2\theta/dt^2$, about that centre. Be this as it may, the curves illustrating the motions of tops, the compounding of oscillations, and similar problems convey much more meaning than a mere formula.

The book consists of three parts. The first deals with general principles and applications to systems of particles. It contains the principle of least action, the theory of free and forced oscillations for finite systems, and a short account of the theory of cyclic systems. The second deals with statics and dynamics of a rigid body. The third practically treats of continuous distributions of matter the dynamical properties of which are determined by partial differential equations with regard to the space-coordinates. By this we include attractions, theory of the potential, spherical and other harmonic analysis, elasticity, hydrostatics, hydrodynamics and sound.

Like every other book, this one has some good features and some defects. To take one or two small instances chosen at random; it is pointed out, rightly (p. 205), that the statement that forces applied to a rigid body are sliding vectors with five coordinates is not a property of forces, but of rigid bodies. On the other hand, it would be surely better to employ the word translation for rotation-couple on p. 209. Again, on p. 404, the expression for the potential of a distant body is not nearly so convenient as the ordinary form involving $A+B+C-3I$, which is not given.

Prof. Webster assumes a fair knowledge of the calculus, but not of differential equations or of higher analysis. It would, however, appear that a fair knowledge of the geometry of x, y, and z is needed; in evidence of this need, the equation

$$\cos^2\lambda+\cos^2\mu+\cos^2\nu=1$$

appears assumed on the second page. For anyone so equipped, Prof. Webster has "attempted to provide a treatise which would in not over a year's time offer to the student an amount of knowledge of Dynamics sufficient to prepare him for the study of Mathematical Physics in general."

But we are surely justified in examining what chances the English student of physics or engineering has of taking his place beside his American and German rivals in drawing upon this store of knowledge. The hopes that might have been raised a year or two ago as to prospective reforms in mathematical teaching will be sadly dispelled by a study of recent papers set in examinations for leaving school or matriculation. In these we find the old tendency to choke off the learner of an inquiring turn of mind, the old artificial questions on solving meaningless equations and simplifying meaningless expressions, mostly fractional, in short, everything best calculated to encourage mere mental gymnastics and to destroy all power of intelligently assimilating new ideas. The training required to produce a human examination-answering machine capable of working at matriculation level and of going no further would, if directed into a right channel, enable that same learner to differentiate and integrate rational algebraic functions, to calculate the areas of their graphs, and perhaps in the third year of a college course to read this book. G. H. B.

A NATURALIST'S PHILOSOPHY.

Essays on Evolution and Design. By the late Prof. John Young. Edited, with an analysis and an introduction, by William Boyd. Pp. xiii+248. (Glasgow: James Maclehose and Sons; London: Macmillan and Co., Ltd., 1905.) Price 6*s*.

MANY who knew the late Prof. John Young as a versatile thinker and keen critic will be interested in this posthumous volume which discloses his philosophy. To a wider audience the book will appeal by its vigorous criticism of mechanistic interpretations, its protest against theories of fortuity, and its confession of faith in a cosmic plan. The author seems to have felt acutely that the scientific formulations which attempt to give a genetic description of how things have come about fall very far short of being adequate, and that in any case they are never *explanations* which will satisfy the human spirit. Prof. Young sought to show that whether we consider the fundamental concepts of matter and force, the living organism, or the mind of man, we find that the naturalistic scheme is either guilty of *petitio principii* or of that "materialism" which attempts to give a false simplicity to the facts. The principle of continuity breaks down at every point, and our only alternative to giving up scientific explanation (as so many have done) is to fall back on the idea of design, and to make appeal to "the regulating influence of plan of some sort."

To many it will appear that the bulk of the book is an *argumentum ad ignorantiam*, and that many of the failures in scientific interpretation on which the author laid an incisive finger are only partial and temporary failures. Where he found insuperable difficulties, *e.g.* in the application of the selectionist theory, others find corroboration and encouragement. But it may serve a useful purpose to have vividly pointed out some of the difficulties involved in the origin of living organisms with individualities of their own, in the evolution of many important phenomena of animal structure and function, in the rise and progress of mental life, and in the emergence of the distinctively human "ought." If we under-

stand the author aright, he believed not merely in a "cosmic plan," not merely in a "will behind phenomena," but that "processes are directed by an external power."

Prof. Young seems to have taken the evolution theory *cum grano salis*; he thought that the origin of variations is left unaccounted for, that natural selection is an over-rated factor, that it is a modal, not a causal principle, "subordinated to something other than itself," that the Lamarckian interpretation cannot be disregarded, and that far too little attention is paid by naturalists to the individuality of the organism itself. But apart from his insistence on the necessity of recognising "the regulating influence of plan of some sort," his book is critical rather than constructive. It is matter for regret that he did not live to work out the positive part of his thesis, that "many facts in various fields of inquiry point to the existence of a plan."

The value of the book is increased by an able introduction by the editor, Mr. William Boyd, who also supplies an admirable synopsis of each chapter. It is evident that the essays were not intended by Prof. Young to be given to the public in their present form, for in some parts the argument is neither accurate nor clear. Thus, in regard to Weismann's conception of the germ-plasm, the author wrote:—

"Romanes makes the difficulty more obvious by showing that Weismann's view requires us to believe that the germ plasm is independent of and unaffected by what happens to the parent. It is impossible, therefore, for acquired characters to exist, far less to be transmitted; for no variation, however favourable, can take place unless it was foreshadowed in the ancestral protoplasm. This protoplasm was the component of the first simple forms which came into being. It is immortal. On its characters depend those of its most remote descendants. Now on this view these characters must be represented by particles of some sort, certainly of some magnitude. *What is this but to declare design in its most authoritative form?*"

Still more perplexing is the comparison of the sea-urchin's pedicellariæ with young Crinoids, and the avicularіæ of Polyzoa with Brachiopods.

OUR BOOK SHELF.

Heat and Steam (Elementary). An Introductory Supplement to a Text-book of Marine Engineering for the Use of Naval Officers, &c. By Engineer-Commander Tompkins, R.N. Pp. 54. (Portsmouth: J. Griffin and Co.; London: Simpkin, Marshall and Co., Ltd., 1906.) Price 1s. 6d. net.

The author is instructor in steam and marine engineering at the Royal Naval College, Greenwich, and has prepared a text-book on marine engineering, primarily for the use of naval officers. This text-book has reached a second edition. In connection with recent changes in the training of cadets and junior naval officers, a new syllabus of instruction in heat and steam has been issued by the Admiralty. As a consequence, Commander Tompkins has found it necessary to modify certain portions of his text-book, and has done so in the present pamphlet, which he terms an "Introductory Supplement." Young naval officers will be enabled to use this at once, in association with the text-book, and as soon as arrangements can be made the new matter is to be incorporated in the second edition.

The supplement follows the text-book in clearness and simplicity of treatment, and should be of great value to the classes for whom it has been chiefly prepared. It embraces a brief historical review of the development of steam engines; an excellent summary of the principles of thermodynamics, written in simple language; and a sketch of the applications of those principles to engine design. The work is well up to date; it contains explanations of the types of steam turbines introduced by Parsons and De Laval, and of approved types of water-tube boilers. Measurement of power, the mechanical equivalent of heat the sources and conservation of energy, and estimates of efficiency are dealt with in a manner that makes the subjects intelligible to readers possessing only moderate mathematical knowledge. Some of the illustrations are based on most recent practice, including results obtained by the cruiser *Amethyst* fitted with turbine engines, and the sister ship *Topaze* fitted with reciprocating engines. Commander Tompkins has taken great pains to meet the requirements of the readers for whom the work has been primarily undertaken, and he has succeeded. Outside the officers of the Navy, however, there are many persons who may benefit by his work, especially those who desire to understand the principles of the steam engine and whose mathematical knowledge is limited.

Atlas of Japanese Vegetation. Edited by Dr. M. Miyoshi. Sets i.–iii.; plates 1–24. (Tokyo: Z. P. Maruya and Co., Ltd., 1905.)

These are the first three parts of an atlas depicting various types of Japanese vegetation, and containing twenty-four plates, accompanied by an explanatory text in English and in Japanese. The plates are reproductions from photographs, and it is remarkable, considering the skill and cheapness of artistic labour in Japan, to find that the plates of the third part bear the legend "printed in Germany."

The plates are of varied interest. Those in the first part will prove attractive to owners of gardens in this country. Plate vi. is a view of a garden laid out in Japanese style, and shows a scene entirely different from the so-called Japanese garden which is often seen at great houses in England, and where there is nothing characteristically Japanese in the arrangement of the plants or in the general effect produced by the laying out of the ground. A view of an iris garden is very pretty. Mr. Miyoshi states that the Japanese have evolved nearly 400 varieties of *Iris laevigata* var. *Kaempferi*, which show marvellous diversity in the size, shape, and colour of the flowers, and even in the character of the leaves. *Prunus mume*, also figured, is a Chinese species, so long cultivated in Japan that it is now generally known as the Japanese plum, and of it there are now more than 300 distinct varieties.

The second part consists mainly of forest scenes, the most peculiar of which is one of the Japanese beech (*Fagus Sieboldi*), with a dense undergrowth of *Sasa nipponica*, a small broad-leaved bamboo. The Japanese larch, the Hondo spruce, and some other trees are also figured. The third part is of great interest, showing pictures of plants in the little-known Loochoo Islands, and of these the most curious is a scene representing *Cycas revoluta* dotted over an extensive landscape. There is also a good picture of the screw-pine, *Pandanus odoratissimus*, the leaves of which are now being made into hats by the Japanese in Formosa. Augustine Henry.

The Integration of Functions of a Single Variable. Cambridge Tracts in Mathematics and Mathematical Physics, No. 2. By G. H. Hardy, M.A. Pp. viii+53. (Cambridge: University Press, 1905.) Price 2*s.* 6*d.* net.

Now that function-theory is fairly well developed, it is much easier than it used to be to discuss in an orderly way the elementary problems of explicit integration. By showing how this can be done, Mr. Hardy has produced a very instructive and pleasant supplement to the ordinary text-books. Moreover, he has done a useful service by emphasising the work of Liouville, whose theorem (quoted on p. 49) is of great generality, and occurs with others in memoirs which have not, perhaps, received all the attention they deserve. To these memoirs, as well as those of Abel, Tchebichef, &c., reference is made in the notes and appendix; this, of course, adds greatly to the value of the pamphlet.

It must be remembered that the "Cambridge Tracts," of which this is No. 2, are not intended to be exhaustive, but rather suggestive and helpful to those who are really interested in the progress of mathematical theory, and prepared to study it at first hand. Mr. Hardy seems to have carried out this idea as well as his opportunity admitted; and his reader ought to feel that he gets his half-crown's worth of entertainment. For example, on pp. 13–16 we have Hermite's beautiful way of finding, by elementary *rational* operations, the rational part of the integral of a rational function, and in connection with this an example involving, in an unexpected fashion, the theory of invariants. To the remark on p. 38 it may be added that the problem of deciding whether a given integral is pseudo-elliptic or not is likely to be of a nature quite similar to that of deciding whether two given conics can be associated with poristic circum-inscribed polygons. No finite number of rational operations can give an answer; but we can decide whether poristic polygons of any *assigned* number of sides exist or not. To the references on this subject the names of Halphen and Kowalevsky might have been added.

The Laboratory Book of Dairy Analysis. By H. Droop Richmond, F.I.C. Pp. viii+90. (London: C. Griffin and Co., Ltd., 1905.) Price 2*s.* 6*d.* net.

WITH the progress of technical instruction in dairying a need has arisen for a little handbook on milk composition and simple methods of milk analysis for dairy managers. There is also a need for a short handbook of dairy analysis for the trained chemists who find themselves called upon to undertake analyses of milk, cream, butter, and cheese in the laboratories of agricultural colleges and institutions. Mr. Richmond has attempted to serve both purposes in one little volume, and, as might be expected, the result is not entirely successful. For the chemist the illustrations of laboratory assistants performing simple laboratory operations, such as using a wash-bottle, are, to say the least, unnecessary, while to the dairy manager who is not a chemist the directions for the more difficult analyses would be quite unintelligible.

However, for the chemist the book provides a mass of useful details in a concise form. The analytical methods are well chosen, though it is curious to find no mention of the Westphal balance for the determination of the specific gravity of milk; and we can detect no errors or inaccuracies, though there is occasional need for greater clearness, for example, in the meaning of "the Reichert-Wollny figure." These defects are unimportant, and the book will find a useful place in many an agricultural laboratory.

T. S. D.

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.*]

Chemistry in Rural Schools.

IT has no doubt caused as much surprise to others as it has to myself to read, on the authority of the principal of the South-Eastern Agricultural College, that "chemistry is one of the least suitable of the natural sciences to teach children whose lives will be, or ought to be, spent in the country" (M. J. R. Dunstan, NATURE, March 29, p. 511). I have no doubt that Mr. Dunstan has good reasons to assign for this expression of opinion, but those who are interested in the subject of education in rural schools will probably want some more explicit statement before reconsidering their curricula. For my own part I had come to an opposite conclusion. It has been my privilege during the last few years to have been associated with the founders of two rural schools, one in Essex and the other in Sutherland. The curricula of these schools were very carefully considered by my colleagues and myself, and the question of the suitability of chemistry was never raised; on the contrary, we considered that from the disciplinary as well as from the utilitarian point of view it had everything in its favour. Nor have we had any reason during the existence of these schools to doubt the wisdom of including chemistry in the curricula. As a means of training in experimental method and of inculcating habits of careful observation and accurate reasoning, this science (with physics) has been taught with the greatest success. It is popular with the pupils and of distinct value to them in after life, even when that life is "spent in the country."

Perhaps the best justification I can offer for the conclusion to which my own experience has led me is furnished by the Sutherland Technical School, founded three years ago at Golspie by the Duchess of Sutherland. The pupils in this school are as "rural" a set of lads as could be gathered from any part of the Highlands, being for the most part of the crofter and fishing class. Their age varies from twelve and a half years upwards, and the course of instruction extends over a period of three years. During the first year four hours a week are given to elementary practical physics, and the same amount of time to practical chemistry during the second year. Both physics and chemistry will be continued in the third year. The headmaster, Mr. E. W. Read, writes to me as follows:—"The boys like the work, and find no particular difficulty with it: besides, I find their knowledge a great help in the natural history lessons and in the gardening. Further, I feel strongly that the mental discipline of chemistry properly taught is very great, and is likely to put a boy's mind in the attitude of desiring to keep pace with the progress of the times. Most of our boys will have to go straight to work, and I should be very sorry if a single one left without some knowledge of elementary chemistry."

We have had a similar experience in Essex, and it would be of interest to learn from others who have first-hand knowledge of the teaching of science in rural schools of a similar type to those founded by the Countess of Warwick and the Duchess of Sutherland how far chemistry has been successful as a recognised part of the curriculum. It would appear from Mr. Dunstan's letter that he considers this science to have been inserted in the curricula at the expense of the biological sciences. This is not the case in the two schools with which I am concerned. Natural history subjects (in the broad sense) are also taught, and one of the reasons which weighed with us in including chemistry was that an elementary training in this subject was considered essential as a preliminary foundation for the biological subjects. With respect to the education of young men who are actually "on the land" or who are preparing for rural occupations, the teaching of chemistry at the Central School of the Essex County Council at Chelmsford has always been most successful, both in popularity and in subsequent results. The former staff instructor, Mr. T. S. Dymond, now of the Board of Education, to whose zeal and ability the successful intro-

duction of chemistry among the Essex farmers and horticulturists is largely due, could no doubt furnish some interesting information on this subject. At any rate, it was by the close observation of Mr. Dymond's work during the period of my connection with the Essex Technical Instruction Committee that I was most strongly convinced of the suitability of chemistry as a subject for secondary rural schools.

Mr. Dunstan may, however, not include the work being done at the Chelmsford central school within the range of his criticism, as the pupils there catered for are certainly beyond the age of those attending the other two schools dealt with in this letter. In defending the claims of chemistry as a suitable subject—not dogmatically, for I am quite open to arguments against my view—it is hardly necessary to say that the most liberal interpretation of the definition of the term is asked for, and that my advocacy presupposes that the subject is properly, *i.e.* scientifically, taught. I am quite aware that distinguished authorities like Prof. Clifford Allbutt and Sir William Ramsay have expressed views similar to those of Mr. Dunstan. That makes it all the more necessary, however, to raise the whole question and have it authoritatively handled in the interests of rural education. R. MELDOLA.

April 5.

Carnivorous Habits of the New Zealand Kea Parrot.

IN your issue of December 28, 1905, there occurs a note referring to statements made at a meeting of the Philosophical Institute of Wellington with regard to the habits of *Nestor notabilis*, to the effect that the carnivorous habits that have been attributed to this parrot are exaggerated, if not totally untrue. It is unfortunate that this report of the meeting has obtained the wide currency that NATURE will give it, for it is abundantly evident that the speakers at Wellington were unacquainted with the facts about the kea.

In the course of various trips about the South Island of New Zealand during the last five or six years, I have made inquiries from shepherds and others likely to know about the kea as to how far their own personal acquaintance with this bird tallied with the common statements that they attack sheep. I was surprised to find that, in North Canterbury and in Marlborough, these men doubted the truth of these statements. They had never known the kea attack sheep in these districts. I was, consequently, inclined to take the view just put forward by the members of the Wellington Institute. I then wrote a series of identical letters to run-holders, shepherds, and others who were supposed to have had experience in this matter in Otago, with the result that overwhelming evidence of the existence of this habit was presented to me. Possibly the "naturalists and estate agents" of the Wellington Institute had not tapped the right district; that they gave their opinion in good faith I do not for a moment doubt.

It must be borne in mind that the kea is confined to the high mountainous country of the South (or Middle) Island, and does not occur in the North Island. It lives in the rough mountain tops in Alpine districts, and it is in this high, rough country that the damage to sheep has occurred, as Sir W. Buller has pretty fully described in his monograph on the "Birds of New Zealand."

It was in the Wanaka district, in Otago, that the greatest amount of damage was done in the early days of sheep-farming, and it was to managers of stations, to shepherds, musterers, and "kea shooters" employed on some of these stations that my inquiries were directed.

Several of these run-holders lost sheep by thousands, and reckoned their losses from kea attacks by thousands of pounds; some were practically ruined by the kea and the rabbit combined.

They engaged men specially to shoot and otherwise destroy keas; the county councils gave 1*s.* to 2*s.* 6*d.* a head for the birds; the squatters and Government also paid for beaks. Is it probable that these people would expend hundreds, nay, thousands, of pounds on a chimera?

Let me quote one or two extracts from letters received by me from men who have seen the kea attacking sheep, who have seen the sheep coming in at muster with holes in their sides and the entrails hanging therefrom, and on shearing have noted the wounds on the skin. These men, I may say, are well known in the district, and I have taken every care to apply only to those whose word may be relied on to give their own personal experience. These letters I hope to publish in full in the Transactions of the New Zealand Institute next year, so that their personal experiences in the early days of sheep-farming may be preserved.

Mr. Fraser, now stock inspector in Nelson province, writes:—"I was engaged sheep-farming in the Hawea and Wanaka lake districts in 1871–1883. I lost thousands of sheep from keas. I have seen the kea attacking the sheep, and also eating into a sheep when the latter was stuck in deep snow. I have opened scores of kea crops and found wool and meat therein. I have laid poison in dead sheep in snow, gone back later and found dead keas."

It was at Mr. Henry Campbell's station near Lake Wanaka, Otago, that these injuries to sheep were first (in 1868) traced to the kea, and I quote a letter from a Mr. J. H. King, who, early in the 'seventies, was employed to shoot the keas:—

"I have seen a flock of twenty or thirty birds attack a mob of sheep in the high precipitous country. The sheep as soon as attacked would huddle together as if driven by dogs; the keas would harass them until one kea would suddenly alight on a sheep's back, holding on to the wool of the rump. The sheep so attacked would immediately single itself from the mob and rush frantically about, and would either go over a bluff or drop down from exhaustion, when the kea which had still held on was joined by several others, and they soon destroyed the sheep."

Mr. King has shot a kea which was on a sheep's back.

It may be noted that the attacks are mostly made at night, hence the rarity of personal observation of these attacks; that they occur in a comparatively limited area, from the region of Mount Cook and the Mackenzie country in South Canterbury to the Takitimu range in Southland, but the centre of the area is round lakes Wanaka, Hawea, and Wakatipu.

Finally, as a comment on the irresponsible statements made at the Wellington Institute, I may quote from the *Otago Daily Times* of February 16, 1906:—"A meeting of landholders at Culverden to-day passed a resolution urging the Government to increase the bonus of 6*d.* each paid for keas' heads, and asking the county councils of Canterbury affected by the kea nuisance to cooperate with them in petitioning the Government for assistance in reducing the pest. The keas have been very numerous in the mountainous parts of Amuri county during the last two years. They seem to have moved northwards from Otago. . . ."

The report then proceeds to give the experiences of various Canterbury run-holders, which are in all respects similar to those recorded thirty years ago by the Otago men (*vide* Buller's "Birds" and Hutton's "Animals of New Zealand").

There can be no doubt that the keas have wrought, and are still causing, great havoc among sheep in certain districts.

It may be worth noting that the statement frequently made (*vide* Wallace's "Darwinism") that they "go for the kidney-fat" especially is an exaggeration. Those men whom I have interviewed tell me that the kea will eat any part, even the entire carcase, of a sheep, leaving the bones clean; they are not such "gourmets" as has been supposed. W. B. BENHAM.

Dunedin, February 18.

A New Product of Actinium.

RECENT work has directed attention to the great similarity in the modes of transformation of actinium and thorium. Thorium, probably itself inactive, gives rise to radio-thorium (Hahn, *Jahrbuch d. Radioact. u. Elektron.*, ii., 3330) which emits α rays; radio-thorium forms thorium X, which is followed by the other well known products, the emanation and the active deposit. Actinium behaves in a very similar way. By the same method, which was successful in separating thorium X from thorium, Godlewski (*Phil. Mag.*, July, 1905) showed that a new

product, actinium X, could be separated from actinium. Actinium X produces the emanation, and this in turn the active deposit. The similarity between these two substances is even closer, for I have found that a new product is present in actinium which is intermediate between actinium and actinium X, and, from analogy to thorium, will be called for convenience "radio-actinium." This product emits α rays, is half-transformed in about twenty days, and is the parent of actinium X.

The separation of radio-actinium from an actinium solution in radio-active equilibrium can be often accomplished by producing a very small precipitate in the solution, which settles down slowly and carries with it the new product, while most of the actinium and actinium X remain in the solution. Amorphous sulphur was found to be very convenient for that purpose. To a fairly strong hydrochloric acid solution of actinium some sodium thiosulphate was added, and the small amount of sulphur was allowed to settle down in the cold. After filtration the precipitate was tested for activity. It showed a strong α-ray activity, but comparatively very little β-ray activity, and gave out very little emanation.

The α-ray activity steadily rises to a maximum after about three weeks, the activity then being about two or three times its initial value. The activity then decays and ultimately according to an exponential law, with a period of about twenty days. The β-ray activity and emanating power reach a maximum at the same time, and decay with the same period. This rise of activity to a maximum is due to the formation of actinium X from the radio-actinium. This is shown by the increase of the emanating power, and was also verified by direct separation of actinium X from the radio-actinium. For instance, if one separates the actinium X when the activity of the radio-actinium is decreasing, the activity of the residue again rises and varies in the same way as in the above described experiment. Actinium itself, freed from all its products, gives out practically no α or β rays, but then slowly increases in activity, reaching a maximum after about four months. Godlewski obtained almost inactive actinium, showing that he had unknowingly separated the new product from the actinium. I have observed that when dissolving actinium in hydrochloric acid, generally a small portion remains undissolved, and this fraction contains radio-actinium to a large extent.

Giesel long ago stated that his preparations of emanium increased in activity for about six months. This may probably be explained by the formation of radio-actinium. In a recent paper, Marckwald (*Ber. d. d. chem. G.*, 1905, 2264) compared the chemical properties of actinium and emanium, and concluded that actinium and emanium were not identical, but the latter was the parent of the former, the activity of his actinium decaying in the course of several months. This is in contradiction with Debierne's statement that his actinium does not lose its activity. The decaying substance, separated by Marckwald, which he concluded to be the actinium of Debierne, may possibly be the product radio-actinium, because a precipitation of thorium with sodium thiosulphate carries down the radio-actinium also. But it remains to be explained why his actinium did not rise at first, or why it did not seem to contain actinium X.

It may be mentioned that the above described experiments were carried out both with the actinium of Debierne and the emanium of Giesel. The same results were obtained in both cases.

A more complete account of these experiments will be given later. O. HAHN.

McGill University, Montreal, March 27.

The April Meteors.

THESE meteors will return this year at a favourable period, the moon being near new and only visible as a slender crescent for a short time before sunrise. If the atmosphere should prove clear during the night following Saturday, April 21, a number of Lyrids will probably be seen. The shower is likely to reach its best after midnight, when the radiant at 271°+33° will have attained a sufficiently high altitude to favour the visible distribution of its meteors.

The display is seldom very rich, and has not developed striking brilliancy since 1803, but it sometimes offers fairly conspicuous features, as in 1901. Usually it does not equal the strength of the annual Perseid shower of August, and it is certainly of much shorter duration, for its period of special activity is often confined to a few hours. In 1901 the Lyrids were pretty bright and plentiful on April 21, though on the previous night the display could be scarcely recognised during a long watch. An interesting feature of this system is that its radiant, like that of the August meteors, exhibits a daily motion eastwards amongst the stars. This displacement is, however, very difficult to trace owing to the brief duration of the shower, and to its comparative feebleness at many of its returns.

Observers would do well to watch attentively for early Lyrids on April 18 and 19, and for late members of the stream on April 22, 23, and 24 next. Individual meteors, accurately recorded on these dates, may be regarded as very valuable, since it will be possible to compare their paths with duplicate observations secured elsewhere, and thus their radiant points and heights in the air may be determined with trustworthy precision.

Meteors from streams contemporary with the Lyrids are usually somewhat rare, but in recent years two showers of slow-moving meteors have been well pronounced from southern positions at 189°–31° and 218°–31°.

W. F. DENNING.

THE interesting Lyrid meteor shower passed unobserved last year owing to the generally unsatisfactory state of the weather that prevailed at the time of its expected appearance. In the event of better atmospheric conditions obtaining at the present epoch, the Lyrids are likely to be strongly in evidence, as the circumstances that regulate the intensity of these meteor apparitions will be exceptionally favourable. According to calculations by the writer, the Lyrid shower will fall in 1906 on the night of April 19, and will be visible at least in part from both sides of the Atlantic, though the main bulk of the display will descend over the American continent. The earlier maxima on April 19 fall due about 10h. 30m. and 14h. 30m. G.M.T.; the second and stronger phase of the shower will culminate at 19h. 30m., and will be followed by two other maxima, one of which occurs on April 19 23h. and the other on April 20 2h. The last and final outburst of meteoric activity will, of course, completely elude observations over the American continent. Of the minor showers associated with the period, the most prominent will be visible on the nights of April 23 and 25; on the former there is a well defined maximum at 13h., while on April 25 two or three maxima will take effect between 9h. and 12h. 30m. JOHN R. HENRY.

April 7.

Sea-sickness and Equilibration of the Eyes.

IN connection with the above subject, which Mr. Sang brought under the notice of your readers in your number for March 29, I would like to point out that it has been long known that the eyes may play an important part in sea-sickness. When making some investigations connected with a "New Variety of Ocular Spectrum" (Proc. Roy. Soc. Edin., vol. x.), I found that by acting on the eyes alone a very disagreeable sickness, similar to sea-sickness, could be easily produced. The subject was comfortably seated in a chair with his head in a large cylindrical box. The box was open below, but partly closed on the top by a circular piece of wood by which the box was suspended. The cylindrical sides of the box were made of tracing paper having broad black vertical bands painted on it. When the box was rotated on a vertical axis, the black and white vertical bars passed in succession in front of the observer. The effects on the subjects were various; sometimes they felt as if they were rotating in a direction the opposite of that of the box, but the most certain result was a very disagreeable sickness, which continued for some time after the experiment was made. Personally, I find the best preventive of sea-sickness is to lie down and read anything I may be interested in, holding the book in such a position that it shuts out the view of all other objects. JOHN AITKEN.

Ardenlea, Falkirk, N.B., March 31.

NOTES ON SOME CORNISH CIRCLES.[1]

II.

The Tregeseal Circles (*lat.* 50° 8′ 25″ *N.*, *long.* 5° 39′ 25″ *W.*).

THERE are two circles situated on Truthwall Common near to Tregeseal and not far from St. Just; the one is nearly to the east of the other, and

Photo. by Lady Lockyer.

FIG. 4.—The Eastern Circle at Tregeseal.

there are outstanding stones, including four holed stones, and several barrows. The eastern temple has

Photo. by Lady Lockyer

FIG. 5.—The Mên-an-tol.

a diameter of 69 feet, and includes, at the present time, nine erect and four prostrate stones; the original structure seems to have contained twenty-eight stones according to Lukis.

My wife and I visited the region in January, 1906, but previously to our going Mr. Horton Bolitho, accompanied by Mr. Thomas, whose knowledge of the local antiquities is very great, had explored the region and taught us what to observe.

The chief interest appears to lie on the N.E. quadrant, where, in addition to a famous longstone on a hill about a mile away, the nest of holed stones and several of the barrows are located. Carn Kenidjack, a famous landmark, lies to the north.

Of the two circles, I confined my attention almost exclusively to the eastern one, as the other is in a fragmentary condition, though it is still traceable. It is hidden almost entirely from the eastern circle by a modern hedge.

Mr. Horton Bolitho, who accompanied us in January, has again visited the spot, with Mr. Thomas, for the purpose of further exploration, and determining the angular height of the sky-line along the different alignments, which I have plotted from the 6-inch and 25-inch maps. My readers will therefore see that my part of the work has been a small one, and that they are chiefly indebted to those I have named.

No theodolite survey has as yet been made for determining the azimuths and the height of hills. The following approximate azimuths have been determined by myself from the 25-inch map, and the elevations by Mr. Horton Bolitho by means of a miner's dial.

Alignments	Azimuth	Elevation
Apex of Carn	N. 12° 8′ E.	4° 0′
Barrow 800′ distant	N. 20 8 E. ...	3 50
Two barrows 900′ distant	N. 50 8 E. ...	1 50
Holed stones ...	N. 53 20 E. ...	1 15
Longstone	N. 66 38 E. ...	2 10
Stone	N 76 3 E	

The carn referred to in the above table is Carn Kenidjack, called "the hooting cairn." The rocks on the summit, in which there is a remarkable depression, are still by local superstition supposed to emit evil sounds by night.

[1] Continued from p. 368.

Of the sight-lines studied so far, those to and from the Longstone and the holed stones seem the most important. The Longstone,[1] 1½ miles to the N.E., is a monolith 10 feet high on the western side of a hill; it is visible from the circle though furze has grown round and partly hidden it.

The meanings of the various alignments seem to be as follows:—

	Dec. N.	Star	Date
	° ′ ″		
Apex of Carn	42 33	Arcturus ...	2330 B.C.
Barrow 800′ distant	40 29	,, ...	1970 ,,
Two barrows 900′ distant	25 20 21	? Solstitial	
Holed stones	23 2 20	? ,,	
Longstone	16 2	May sun	
Stone	9 15	Pleiades ...	1270 B.C.

Regarding the possible solstitial alignments, the declinations obtained may be neglected until the azimuths and angular heights of the hills have been determined with a good theodolite. A change of −10′ in the angular elevation, and hence about that in the resulting declination, would bring the date given by the barrows to about 2000 B.C.

The position of the Longstone is well worthy of attention. Several very fine monuments which mark the surrounding horizon are visible from it in azimuths with which other monuments have made us familiar. They are as follows:—

Alignment	Az.	Hills
	° ′	° ′
Longstone to Mên-an-tol ...	N. 50 30 E. ...	0 34
,, 9 Maidens (Boskednan)	N. 54 0 E. ...	1 0
,, W. Lanyon Quoit	N. 67 0 E. ...	0 0
,, Lanyon Quoit	N. 72 45 E. ...	0 0

These values, of which the angular heights of the hills were determined approximately from the contours on the 1-inch Ordnance map, lead us to the following declinations:—

Alignment	Dec.	Star	Date
	° ′		
Longstone to Mên-an-tol	24 7 N. ...	Solstitial sun	
Longstone to 9 Maidens (Boskednan)	22 37 N. ...	Solstitial sun	
Longstone to W. Lanyon Quoit	14 3 N. ...	May sun	
Longstone to Lanyon Quoit	10 30 N. ...	Pleiades ...	1030 B.C.

[1] In Cornwall this is the name generally given to a monolith.

The May-sun alignment, it may be noted, differs from that from the circle. The heights of hills when determined may give us the same solar declination; that now used gives the declination of the sun for April 28 and August 15 in our present calendar.

Regarding the alignment on Lanyon Quoit, it need only be pointed out that the Pleiades date obtained is some 200 years after the date obtained for the analogous alignment from the circle, showing that if these two monuments—the Tregeseal circle and the Longstone—have any relationship, the removal to the high plain, now known as Woon Gumpus and Boswen Commons, was an afterthought improvement.

I next come to the holed stones, not only the nest of them not far from the circle, but the famous Mên-an-tol itself.

I had heard before going to Tregeseal that the four holed stones shown on the Ordnance map had been knocked down and set up again (not necessarily in their old places) two or three times. Mr. Horton Bolitho and Mr. Thomas, however, in their examination were convinced that the largest of them has never been moved. They also express the belief that the others are not more than a foot or so from their original positions, and that this change is only due to their re-erection by Mr. Cornish after they had fallen down. So far I have heard nothing of the direction of the hole in the stone which retains its original position.

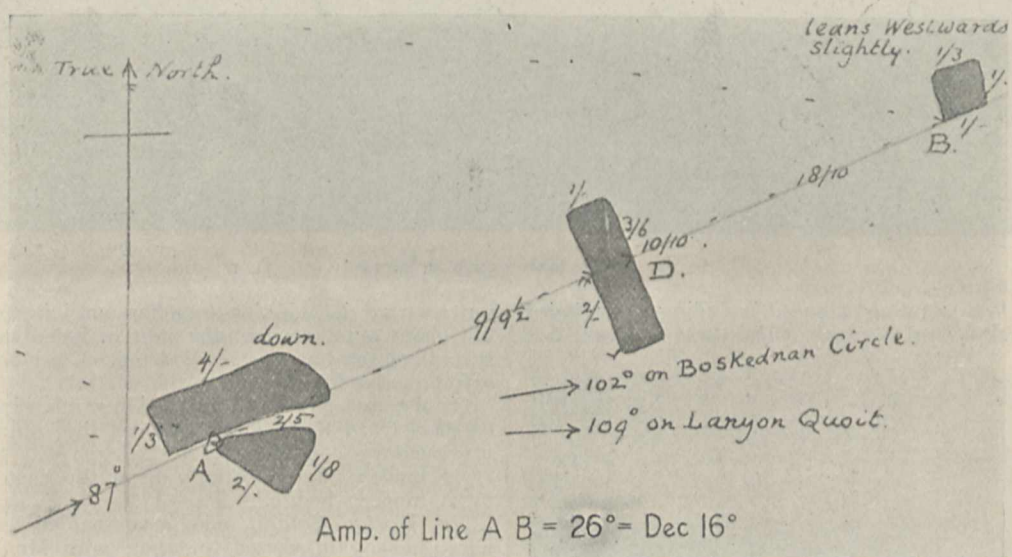

FIG. 6.—Plan of the Mên-an-tol from Lukis, showing that it was an apparatus for observing the sunrise in May and August in one direction and the sunset in February and November in the other. Sun's declination, 16° N. or S.

Another interesting matter is that the explorers in question were able to trace an ancient stone alignment from the circle to the holed stones.

I have long held that these holed stones were arrangements for determining an alignment. The famous Odin stone at Stenness, long since disappeared, was, if we may trust the very definite statements made about its position, used to observe the Barnstone in one direction and the chief circle in the other.

The azimuths suggest that theodolite measures may show that the Tregeseal stones might have been used in the same way; they, the Longstone and Lanyon quoit, are in nearly the same straight line, the alignment, holed stones to Longstone and Lanyon quoit, being N. 67° E., so that the May sunrise may have been noted in this way.

Several other monuments, *e.g.*, Chûn Castle and Cromlech, are to be found in the immediate neighbourhood of the Tregeseal Circle and the Longstone,

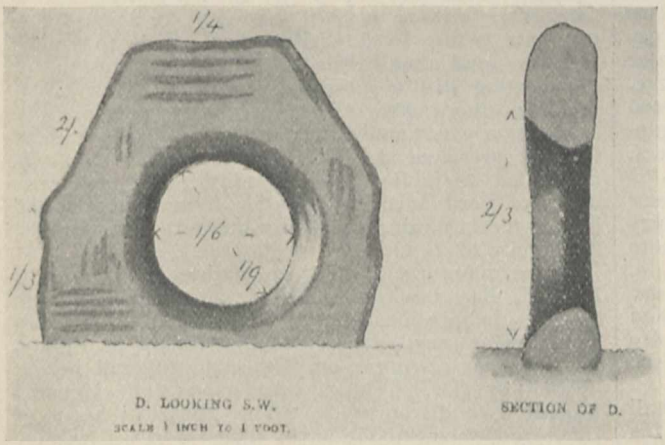

FIG. 7.—The Mên-an-tol. Front view and section, from Lukis.

but these will have to await further investigation as to their character and antiquity before any conclusions concerning their astronomical use can be deduced.

NORMAN LOCKYER.

IRRIGATION IN THE TRANSVAAL.[1]

THERE are few subjects on which such a great diversity of opinion exists as on the administration of South Africa. Free labour and Chinese labour, the electoral franchise of the Transvaal, the various routes from the interior to the coast, the language to be adopted in Government schools—on these and on many other points one hears well-informed and perfectly honest-minded people asserting, and that with considerable warmth, the most opposite views; views which they maintain are founded on facts.

But there is one subject on which it may be asserted all are agreed, and that is that the great want of South Africa is not gold or diamonds, but water in sufficient volume to be spread over the land when and where it is required. Not that the country is generally devoid of rain, but, as it has been well put, "When rain is wanted it is generally not there; when it is not wanted it is invariably present."

No one was more fully alive to this want than the late distinguished High Commissioner, Lord Milner. He borrowed the services of Sir William Willcocks, one of the most prominent members of the small band of English hydraulic engineers from India who have done so much on the Nile. He further procured two engineers, Messrs. Gordon and Strange, thoroughly trained in the excellent irrigation school of India, to advise, one in the Cape Colony and the other in the Transvaal, upon irrigation matters. Willcocks's tour took place during the war, when he was much hampered by the difficulty of getting about the country. His visit, also, was a short one, but not too short to prevent his submitting a very able report full of thoughtful suggestions. Gordon and Strange went to South Africa after the war. They are there still, and may render invaluable services to the country if the agricultural classes can be made to believe that they have anything to learn, and that there may be advantages in accepting a scheme which requires all to submit to certain restrictions for the benefit of all, instead of each farmer being free to follow his own devices. A distinguished member of the present Cabinet has remarked that the Boer farmer seems to have a perfect instinct for disobeying the law. Unless he learns to substitute for this instinct the dictates of reason, there is little hope of irrigation flourishing in South Africa.

Besides procuring the services of these officers, Lord Milner shortly before leaving South Africa appointed a commission to report on the legislation required to enable the water resources of the Transvaal and Orange River Colony to be thoroughly utilised, and also on "the precautions necessary in dealing with subterranean water, more especially in areas situated on the dolomite formation, so as to prevent as far as possible the diversion of such water from public streams and fountains to the detriment of the public."

It was directed that an interim report should be submitted as soon as possible on this last subject. This report, dated May 20, 1905, is now before us. The commission consisted of Mr. Justice Wessels, Judge of the Supreme Court of the Transvaal, three other Dutch and two English gentlemen, one of whom was Mr. Strange.

The commission has collected a large mass of interesting information and opinions from thirty-one witnesses, of whom no fewer than nine were professional geologists. South Africa is to be congratulated in possessing so many scientific gentlemen whose evidence was of great value. The other witnesses were principally engineers and farmers. Of the latter there were seven.

In framing an irrigation project the two first questions to ask are generally, How much land is it proposed to irrigate? How much water is available to irrigate it? In all but the most favoured countries the area which it is desired to water far exceeds the volume of water available. In the Transvaal the irrigable area can easily be marked out. It is not so easy to say how much water is at our disposal.

Usually irrigation is practised by canals and watercourses drawn from rivers and lakes, natural or artificial. By careful observation one finds how much water, at the season when irrigation is required, can be drawn from the river or lake. Elsewhere irrigation is practised by pumping water from wells, going down to the water-bearing stratum. Such a stratum is usually found in alluvial plains at no very great depth, and wells may be sunk within a few hundred yards of each other without causing injury by one exhausting the other. The recent Indian Irrigation Commission found that in that country about 13 millions of acres were yearly watered in this way.

The peculiarity of the situation on the dolomite formation of the Transvaal is that the subterranean water tapped by the boring rod is not due to the rain which falls vertically on the surface of the land above, but that the whole of the limestone substratum is pierced by holes and tunnels, flowing streams, and stagnant reservoirs, so that if water be pumped from a well there is no certainty that another well situated ten miles off may not be thereby sucked dry.

Ultimately the water finds its way out to the surface through springs discharging at times more than 50 cubic feet per second. It seems evident that the catchment basins of these subterranean waters do not necessarily correspond with those of the earth's surface above, and the problem of defining their limits and

[1] "Inter-Colonial Irrigation Commission." Interim Report. Pp xxxvii +166. (Pretoria: Government Printing and Stationery Office, 1905.) Price 7*s.* 6*d.*

calculating the volume of the water that may be drawn from them is not an easy one. Nor is it rendered more easy by the spirit evinced by the Boer farmer witnesses.

Three of the honoured name of Erasmus (two brothers and the son of one of them) refused to recognise any difference between the ownership of water flowing under his ground and of metals found there. Pressed again and again to see the difference between picking up a diamond found on his lands and pumping away the water drawn in from the lands of others, the reply of one of the farmers was quite clear:—"I consider that it is a bad principle when a man owning land under a properly registered title in any country cannot take full advantage of the profit he is able to make."

Not only did these farmers claim the right to use all the water they could suck into their pumps and employ in irrigating their own lands, but they also insisted on their right to sell to their neighbours the water they did not require themselves.

It might happen, then, that the owner of a small pump large enough for his own fields might find his water supply cut off by a larger pump in his neighbour's farm, and he might have to buy from the owner of this large pump the water that had hitherto been his own.

The situation is evidently a difficult one. If such a case were to occur in India it would probably be ruled that a very careful scientific survey should be made of all the subterranean channels with the view of finding exactly how the waters flow, and that until this point was cleared up farmers should have a restriction put on the area of their lands which they were allowed to irrigate. Probably no one would be wronged if they were each limited to irrigating two-thirds of their farms. But this would require a stronger Government than is ever likely to rule in the Transvaal. Probably the commissioners are right in the recommendations they make, and they know that none more drastic would have a chance of being adopted.

These recommendations, after providing for the wants of towns and of mine owners, are to the effect that farmers should be allowed to pump freely for their own use for watering cattle or for irrigation.

"That traffic in underground water should be prohibited, and that an owner should not be allowed to sell or barter underground water which he does not require for his own use." "That it is unnecessary to prove that water in the dolomite formation flows in channels . . . and that if the Judge thinks that the facts establish a connection between the pumping and the diminution of the water in a stream he can prevent the pumping to such an extent as he thinks fit."

This last recommendation is a most important one. Will the Transvaal judges have the courage to carry it into effect?

Since the above was written, an interesting notice has appeared in NATURE of March 1 (p. 426). From this it seems that the subject of underground waters has been occupying attention in the United States. The law there seems to favour the view of the Boer farmer, viz., that the owner of the surface of the land is equally owner of all that lies directly below that surface, whether it be rock, stagnant water or running water. This law is, however, receiving severe shocks from the advance of geological knowledge, and as means have now been found of measuring the flow of subterranean water it is probable that the law may be conformed to what is clearly only justice, and a landowner will not be permitted to take more than his due share of the water that passes under his soil.

THE FORTHCOMING MEETING OF THE BRITISH ASSOCIATION AT YORK.

THE fourth meeting of the British Association in York will be held in that city on August 1–8, the date being fixed earlier than usual to enable members and their hosts to combine attendance at the meeting with a subsequent tour abroad or a visit to the northern moors for the shooting season. The association was founded in York in 1831, and had for its first president the Earl Fitzwilliam, F.R.S. It celebrated its jubilee there in 1881, under the presidency of Lord Avebury, then Sir John Lubbock, and it now meets again, after three-quarters of a century, in the city of its birth.

At the inaugural meeting on Wednesday, August 1, Prof. E. Ray Lankester, F.R.S., president-elect, will assume the presidency and deliver an address. On Thursday, August 2, there will be a soirée; on Friday, August 3, a discourse on "Volcanoes" will be delivered by Dr. Tempest Anderson; on Monday, August 6, a discourse on "The Electrical Signs of Life, and their Abolition by Chloroform," will be delivered by Dr. A. D. Waller, F.R.S.; on Tuesday, August 7, there will be a soirée; and on Wednesday, August 8, the concluding meeting will be held.

The sections and their presidents are as follows:—(A) *Mathematical and Physical Science*, Principal E. H. Griffiths, F.R.S.; (B) *Chemistry*, Prof. Wyndham Dunstan, F.R.S.; (C) *Geology*, Mr. G. W. Lamplugh, F.R.S.; (D) *Zoology*, Mr. J. J. Lister, F.R.S.; (E) *Geography*, Sir G. D. Taubman Goldie, K.C.M.G., F.R.S.; (F) *Economic Science and Statistics*, Mr. A. L. Bowley; (G) *Engineering*, Dr. J. A. Ewing, F.R.S.; (H) *Anthropology*, Mr. E. Sidney Hartland; (I) *Physiology*, Prof. Francis Gotch, F.R.S.; (K) *Botany*, Prof. F. W. Oliver, F.R.S.; (L) *Educational Science*, Prof. M. E. Sadler.

To the antiquarian York has preeminent attractions, its Roman remains, its mediæval bars and walls, which still encircle the greater part of the city, its Norman castle and noble minster, being each objects of special interest. The city also contains several manufactories interesting to scientific men; opportunities will be given for visiting these under skilled guidance in the afternoons, after the meetings of the sections. Excursions will be organised to several places of interest.

The neighbourhood of York, though flat, presents many objects of geological and archæological interest, many of which are reached by good level roads; cyclists are therefore recommended to bring their machines with them to the meeting.

It is hoped that it may be possible to arrange for an exhibition of photographs taken by the members in South Africa, for which the reception room affords ample accommodation.

York enjoys exceptional railway facilities, being under four hours from London, five hours from Edinburgh. The various railway companies will issue return tickets, at a single fare and a quarter, from the principal stations in the United Kingdom to York. These tickets, which will be available from July 31 to August 14, may be obtained by members and associates attending the meeting on presentation of a certificate signed by one of the local secretaries. The North-Eastern Railway Company will also issue periodical tickets to members and associates, at cheap rates, for going and returning as often as desired during the time of the meeting between York and the chief places in the district.

An attempt may be made, provided sufficient support is forthcoming, to arrange at the end of the meeting a yachting excursion, lasting two or three weeks, to

Norway or other interesting district, limited to association ticket-holders.

A handbook dealing with the natural history and archæology of the York district has been specially written for the occasion, and a copy will be presented to each member of the association.

It is anticipated that there will be a large amount of private hospitality, and as so many members were unable to visit South Africa last year it is expected that there will be a very large meeting.

THE ERUPTION OF VESUVIUS.

THE activity of Vesuvius, incessant for some time past, has culminated in an eruption which, making every allowance for newspaper exaggeration, stands in the foremost rank of historic eruptions, even if it is not already the greatest of all. It is not yet at an end; we cannot say that it has reached its climax; but the interest excited is so great that some forecast of the future, so far as this is possible, may be attempted.

The late Prof. John Phillips pointed out that the volcanoes of the Phlegræan fields have had two periods of activity, each lasting about four hundred years, and that Etna has also had two great periods of activity, the first of which lasted about 800 years, reaching its maximum in the second century B.C., while the second, commencing about the fourteenth century, had attained its maximum about the end of the eighteenth, after which eruptions declined in violence and frequency; from this he concluded that a period of 700 or 800 years may be assigned to the periods of volcanic activity of Etna. It is probable that in all cases of volcanic activity there is some such period, in which the eruptions, spasmodic at first, increase gradually in frequency until they attain a maximum, and then die out again, the length of the period being determined by the size of the reservoir of molten rock which gives rise to the eruptions; but there is not as yet any means of determining what will be the duration of the present series of Vesuvian eruptions, or whether it has reached its maximum; all that seems certain is that there are no signs of this being passed.

Between A.D. 79, when Pompeii was destroyed, and 1631, eleven great eruptions were recorded; the seventeenth century gave four, the eighteenth twenty-three, and in the nineteenth, up to 1869, the date of Prof. Phillips's work, twenty-four were recorded. After that date there was the great eruption of 1872, and an almost continuous condition of activity ever since. It may be that we have now reached the climax, or the future may have catastrophes in store still greater than that which we are now witnessing; but, if there is any virtue in analogy or inference, centuries must elapse before the mountain resumes that condition of quiescence which existed before our era, and for prolonged periods in the centuries which followed its commencement.

The length of these periods of volcanic activity and the difference between those of neighbouring volcanic centres shows that the cause lies deep in the earth, and that the conditions are beyond our ken. Prophecy must necessarily be vague, and can do no more than indicate the future course of events in the most general and guarded terms; yet mankind will always want to peer into the future. Attempts will be made to predict the time of coming eruptions, and not wholly without justification, for extra-mundane conditions must, to some slight extent, influence the manifestations of volcanic activity. Prof. Palmieri believed that there was a distinct increase in the activity of ejection from the cone and in the abundance of the lava at the new and full moon, and it is possible that a connection exists with cycles of variation of climate, magnetic force, or the frequency and distribution of certain solar phenomena, but the relation may be only of the nature of the proverbial last straw that broke the camel's back. On occasion it may do so, but though sometimes the camel can bear many more straws, at others he has given way before even one was added to his load; and so it is with volcanoes. The cause of their eruptions is so preponderatingly mundane that any slight effect of extra-mundane causes must be elusive, difficult to establish, and only to be detected by the study of a long series of averages. For purposes of prediction they are of little use. There is, however, some comfort for the immediate future in the reported subsidence of Pozzuoli; if real, this probably indicates that the present paroxysm has reached its climax, and will now slowly cease.

From the Press reports of the eruption, the following particulars of scientific interest have been extracted and arranged as a diary of events:—

April 5.—Vesuvius in strong activity. Great blocks of rock hurled as far as the lower station of the funicular railway.

April 6.—The new crater began to emit lava in an abundant stream. The lava has arrived within three or four miles of the village of Bosco-Trecase.

April 7.—Bosco-Trecase destroyed. After midnight loud rumblings were heard, followed by a violent earthquake shock, which shattered the windows in the town. Then lava began flowing from Ciaramella, where a fresh fissure had opened up a few days previously. From the Ciaramella crater masses of incandescent rock were ejected, and a torrent of lava swept down at a terrific speed, flowing in two streams, one 200 yards broad moving towards the centre of the town. The town had hardly been evacuated when the lava invaded the houses, several of which were burned down, and soon Bosco-Trecase seemed to be enveloped in flames. At 6 a.m. Bosco-Trecase was completely surrounded by a stream of lava. The cone on the Pompeii side of Vesuvius collapsed, and on the opposite side a new crater opened at the base of the cone in the Atrio del Cavallo and vomited lava and stones. The principal crater was in violent eruption. Explosions were unceasing. A shower of grey-black ashes fell in the streets of Naples.

April 8.—Central crater of Vesuvius was again emitting quantities of lava. Repeated explosions were followed by subterranean rumblings and by earthquake shocks, which were distinctly felt in the villages at the foot of the mountain. At 12.31 a.m. a slight shock of earthquake was felt at Naples, and a second at 2.10 a.m., both disturbances being accompanied by rumblings. A telegram from Naples at 6.30 p.m. announced that Ottajano, Poggio Marino, and Somma had been entirely abandoned. At Ottajano the lava was flowing 7 feet deep through the streets. At 8 p.m. the flow of lava seemed to be generally somewhat slackening. A shower of black dust, like iron filings, fell throughout Montenegro, covering the surface of the country to a depth of a millimetre with an iron-grey layer. Prof. Mattucci, director of the Vesuvius Observatory, made the following report:—

"The eruption of Vesuvius has assumed extraordinary proportions. Yesterday and last night the activity of the crater was terrific and ever increasing. The neighbourhood of the observatory is completely covered with lava. Incandescent rocks are thrown up by the thousand to the height of 2400 feet, and even 3000 feet, and fall back, forming a large cone. Another stream of lava has appeared from a fissure the position of which is not well defined. The noise of the explosions and of the rocks striking together is deafening. The ground is shaken by strong and continuous seismic movements. The seismic instruments threaten to break, and it will probably be necessary to abandon the observatory, which is very much exposed to electric shocks. The telegraph is interrupted, and it is believed that the funicular railway has been destroyed."

April 9.—The stream of lava in the direction of Torre Annunziata has remained stationary since yesterday evening. The dynamic action of the volcano appears to be

diminished considerably, and the situation now seems to be more satisfactory. The shower of ashes has ceased to pour on Naples. The atmospheric conditions are unfavourable, and the seismic instruments last night registered several earthquake shocks. A steamer with 1000 persons on board left Capri this morning for Naples, but was unable to reach her destination, as when about a mile off the coast the passengers were nearly suffocated by falling cinders and ashes, and the vessel has anchored here so as to enable the passengers to witness the eruption.

Vesuvius Observatory, 6.30 p.m.—Report from Prof. Mattucci:—"The explosive activity of Vesuvius, which was very great yesterday and was accompanied by very powerful electric discharges, diminished yesterday evening. During the night the expulsion of rocks ceased, but the emission of sand increased, completely enveloping me and forming a bed more than ten centimetres deep, which carried desolation into this elevated region. Masses of sand gliding along the earth created complete darkness until 7 o'clock. Several blocks of stone broke windows of the observatory. Last night the earthquake shocks were stronger and more frequent than yesterday, and displaced the seismic apparatus. Yesterday afternoon and this morning torrents of sand fell. While I am telegraphing several balls of fire rise with loud rumbling from the enlarged craters and the new elevated crevasses."

April 10.—Report from Prof. Mattucci:—"Last night was calm except for a few explosions of considerable force from time to time. At 4 o'clock this morning the explosions became more violent. The seismic instruments of the observatory record strong disturbances in the interior of the mountain." The roof of the market of Monte Oliveto, Naples, fell in, on account of the accumulation of volcanic ash upon it.

NOTES.

AT a meeting of the council of the Royal College of Surgeons of England held on April 5, the Walker prize of 100*l.*, founded by the late Mr. C. C. Walker to encourage investigation into the pathology and therapeutics of cancer, was awarded to Prof. C. O. Jensen, of Copenhagen. The committee appointed to advise the council in reference to the award of the prize was influenced, not merely by the actual work which Prof. Jensen has done in investigating the nature of cancer and the effect of treatment upon it, but also by the extent to which he has opened up a field of research to those engaged in the study of cancer on certain lines, enabling them to carry out their investigations over longer periods of time and under better and more determined conditions than have up to the present time been possible. The Jacksonian prize for 1905 was awarded to Mr. R. C. Elmslie for his essay on "The Pathology and Treatment of Deformities of the Long Bones due to Disease occurring during and after Adolescence." The prize-subject for the year 1907 will be "The Operative Surgery of the Heart and Lungs, including the Pericardium and the Pleura." The subject selected for essays to be submitted in competition for the Cartwright prize for the period 1906–1910 was "Prevention of Dental Caries." The honorary medal of the college was awarded to Lieut.-Colonel Sir Richard Havelock Charles, I.M.S., in appreciative recognition of his gift of anthropological specimens—an addition to the museum of special value and importance, not only on account of the number and variety of the specimens presented, but also because of the authentic particulars attached to them.

AT a meeting of the Royal Geographical Society on Monday, Mr. Whitelaw Reid, the United States Ambassador, presented to Captain R. F. Scott, R.N., C.V.O., the gold medal of the American Geographical Society, in recognition of his sledge journey on Antarctic ice and the work of the National Antarctic Expedition.

THE secretary to the Post Office has informed the Decimal Association that letters addressed to France and Germany, weighing more than ½ oz. but not more than 15 grams, if only stamped 2½*d.*, are not surcharged. Although the difference in weight is but small (about 5 per cent.), still the fact should be generally known, because letters are frequently stamped with 5*d.* which, under this ruling of the Post Office, would go for 2½*d.*

COURSES of instruction in oceanic research will be held, as in former years, in Bergen, during the university vacation (August 8 to October 15), mainly on the lines previously adopted. The courses will consist partly of lectures, partly of practical instruction and assistance in laboratory work; excursions will also be made, during which the use of various appliances and instruments will be practically demonstrated. The course will be conducted by Dr. A. Appellöf, Dr. D. Damas, Mr. B. Helland-Hansen, Mr. E. Jørgensen, and Mr. C. F. Kolderup. Anyone desiring to attend the course should make application to the Oceanographical Institute of Bergen Museum, Bergen, Norway, before July 1.

A DEPUTATION waited upon Mr. Lloyd-George, M.P., President of the Board of Trade, on Monday to urge the necessity for further amendment of the patent law by legislation which would enforce in the United Kingdom the forfeiture of all British patents for inventions which were worked without, but not within, the United Kingdom, after the lapse of three years from the date of application in the country of origin unless the patentee could justify his inaction to the Board of Trade. In the course of his reply to the views placed before him by members of the deputation, Mr. Lloyd-George pointed out that the Patent Act of 1902 embodied the principle of compulsory working, and he wished to know where the Act had broken down. He thought it necessary to see that, while the commercial community was protected, protection was also afforded to those poor people who, while they have the brains, have not the cash to enjoy the full benefit of their ingenuity.

A COMMITTEE has been appointed to inquire into and report upon matters connected with the Department of Agriculture and Technical Instruction for Ireland. The committee is constituted as follows:—Sir Kenelm Digby, late Under-Secretary for the Home Department (chairman); the Hon. John Dryden, late Minister of Agriculture in Ontario; Mr. W. L. Micks, member of the Local Government Board for Ireland; Mr. F. G. Ogilvie, principal assistant-secretary for technology in the Board of Education; and Mr. Stephen Brown, chairman of the Kildare County Council. The committee is to inquire whether the provisions of the Agriculture and Technical Instruction (Ireland) Act, 1899, constituting the department, and the methods which the department has followed in carrying out those provisions, have been shown by experience to be well suited to the conditions of Ireland; whether any, and if so what, changes are desirable in those provisions and methods; and to report also upon the relations of the department to the Council of Agriculture, to the Agricultural Board, and to the Board of Technical Instruction; upon its relations to local statutory bodies; upon the funds at its disposal and the modes of employing them, and upon its position in regard to other departments, especially those charged with educational functions.

FROM the April number of the *Popular Science Monthly* we learn that the regents of the Smithsonian Institution have passed a resolution expressing their profound sorrow

at the death of Dr. S. P. Langley, secretary of the institution from 1887 to his death. The resolution includes the following appreciative record of Dr. Langley's work :—"In the death of Mr. Langley this institution has lost a distinguished, efficient, and faithful executive officer, under whose administration the international influence of the parent institution has been greatly increased, and by whose personal efforts two important branches of work have been added to its care—the National Zoological Park and the Astrophysical Observatory. The scientific world is indebted to Mr. Langley for the invention of important apparatus and instruments of precision, for numerous additions to knowledge, more especially for his epoch-making investigations in solar physics, and for his efforts in placing the important subject of aërial navigation upon a scientific basis. All who sought the truth and cultivated science, letters, and the fine arts, have lost through his death a co-worker and a sympathiser." The executive committee has been requested to arrange for a memorial meeting to be held in Washington; and Dr. A. D. White has been invited to prepare a suitable memorial which shall form a part of the records of the Board of Regents of the institution.

THE belemnites of the Speeton Clay form the subject of a paper by Mr. T. Shepherd, issued as No. 29 of Hull Museum Publications.

WE have received a copy of a fourth supplement to "A Catalogue of the Books in the Library of the Indian Museum," containing additions from the autumn of 1899 to that of 1903.

IN No. 1440 of the Proceedings of the U.S. National Museum, Mr. Knud Andersen describes horseshoe-bats collected in the islands of Nias and Engano, Malay Archipelago. No. 1441 of the same serial is devoted to a revision of American Palæozoic insects, by Mr. Anton Handlirsch, of the Imperial Natural History Museum at Vienna, to whom the Transatlantic specimens have been sent. A large part of the collection was obtained from the Upper Carboniferous shales of Mazon Creek, in Illinois, where they are found imbedded in washed-out nodules. Since only about one nodule in a thousand contains an insect's wing, the search would be impossible were it not for the fact that other fossils are comparatively common. Owing to ill-health, Prof. Scudder was unequal to the task of describing the collections, and it was for this reason that they were handed over to the Austrian palæontologist. The systematic conclusions reached by Mr. Handlirsch differ somewhat from those of Prof. Scudder, and render insect phylogeny simpler. The order of Palæodictyoptera, which is the oldest, is regarded as the ancestral stock from which all other insects are descended. In No. 1439 of the same serial Mr. Handlirsch describes a new and interesting type of cockroach from the Cretaceous beds of the Judith River, Montana.

PARTS iv. and v. of vol. xvi. of the Proceedings of the Royal Physical Society of Edinburgh have been received. The former is entirely devoted to a catalogue of the crustaceans of the Forth area, by Dr. T. Scott; while certain rotifers from the same district form the subject of a paper in No. 5, by Mr. J. Murray. The latter issue also contains an important paper by Prof. J. G. Kerr on the embryology of certain primitive fishes, more especially the lung-fishes and fringe-finned ganoids. As the result of his investigations, the author concludes that vertebrate limbs are probably modified external gills, the theory that they are derivatives from a pair of lateral skin-folds being, in his opinion, purely hypothetical, and not supported by embryological evidence. According to Prof. Kerr's view, two pairs of the primitive gills lost their respiratory function and assumed a motor one, developing at first into "stylopterygia," then into the "archipterygia" of Ceratodus, and finally, but independently, into "chiropterygia." This implies the theory that the archipterygium is really the primitive type of fin, and also involves the acceptance of Gegenbaur's idea that limb-girdles represent branchial arches. The limbs of Lepidosiren and Protopterus are regarded as reversions to the stylopterygian type. Further, the author asserts his belief in the intimate relationship between lung-fishes and salamanders. Dollo's theory that the diphycercal tail of modern lung-fishes is derived from a heterocercal type is considered improbable.

WE have received copies of the *Sitzungsberichte* of the Royal Bohemian Academy of Sciences for 1904 and 1905. One of the most interesting articles in the former of these is an account, by Dr. G. Eisen. of the now extinct Indians of the Santa Barbara Islands, off the Californian coast. Our knowledge of these Indians is derived from the accounts of the early voyagers, from the missionaries who subsequently settled on the islands, and from the remains in their refuse-heaps and the skulls and skeletons which have from time to time been collected. Some of the islands probably at one time had a population approaching 1000 each, but in 1823 only about 900 were left on Santa Barbara and the neighbouring islets; and by 1875 all had disappeared, the last survivor in San Nicolas having been deported in 1853. Although they manufactured a certain number of domestic utensils, these Santa Barbara Indians are described by the missionaries as the most degraded of all human beings, with a morality lower than that of animals. Insects, especially grasshoppers, formed a portion of their food, and, like the natives of the adjacent mainland, they probably fed to a great extent on the larger kinds of earthworms. Possibly they belonged to the Shoshonean stock of the mainland. Their extermination is attributed to the changed conditions of existence imposed upon them by the missionaries.

IN *Science* for March 9 and 16 several papers on yellow fever, read before the American Association for the Advancement of Science, are reported. Prof. Calkins discusses the protozoan life-cycle, and concludes that the yellow-fever microbe probably belongs to the spirochætes. Mr. J. H. White summarises the practical results of discoveries on yellow fever transmission, Mr. H. C. Weeks discusses the practical side of mosquito extermination, and Dr. J. Carrol, in a paper entitled "Without Mosquitoes there can be no Yellow Fever," reviews the evidence, showing that yellow fever is conveyed solely by the mosquito *Stegomyia fasciata*.

IN the first number of the *Philippine Journal of Science*, issued in January, Mr. E. B. Copeland, discussing the water relations of the coco-nut palm, attributes much value to an open position where transpiration is considerable and the trees receive full illumination. These observations would help to explain the fact that coco-nut trees growing near the sea shore produce more fruit than those growing further inland, although analyses show very little differences in the composition of the soils.

THE second number of the *Philippine Journal of Science* (i., No. 2) maintains the high standard of its predecessor. Mr. H. S. Walker discusses the keeping qualities of coco-

nut oil and the causes of its rancidity; the latter seems to be due to the growth of moulds in imperfectly dried copra. Mr. C. S. Banks describes and illustrates the principal insects attacking the coco-nut palm, and Mr. A. M. Clover writes on Philippine wood oils. Mr. W. D. Smith describes certain Orbitoides from the Binangonan limestone, and Dr. R. Strong experiments on vaccination against plague. Mr. M. Herzog details an investigation on beri-beri, from cases of which he has succeeded in isolating the kakke coccus of *Okata kokubo*.

IN the *Bulletin du Jardin impérial botanique* of St. Petersburg (vol. vi., part i.) Mr. A. Elenkin puts forward the view that in lichens the algal and fungal constituents do not exist for mutual benefit, but, being differently acted on by external factors, one flourishes at the expense of the other. Mr. B. Issatchenko, writing on the conditions under which chlorophyll is formed, dissents from the results obtained by Mr. W. Palladin that a concentration of 35 per cent. to 50 per cent. of sugar prevents its formation. Mr. P. Isuzew announces that he has found trees of the bird-cherry with rose-coloured flowers in the province of Perm, and also that early and late flowering varieties were observed growing side by side.

IN the *West Indian Bulletin*, vol. vi., No. 4, a number of papers on sugar and sugar cultivation are collected from which a fair idea of the state of the industry in the West Indies can be obtained. While it cannot be said that the industry has been as yet re-established on a sound basis, the opinions expressed by such capable judges as Sir Daniel Morris, Dr. F. Watts, and Dr. H. H. Cousins all point to a successful future if only planters will take advantage of the improved varieties, and if separately or in combination they will arrange for the establishment of factories equipped with modern machinery. New seedlings giving a higher proportion of saccharose are being evolved; the well known seedling B. 208, now under cultivation in Barbados, Jamaica, Queensland, and elsewhere, has been surpassed by another Barbados seedling, B. 1529, and some of the Jamaican seedlings of 1904 promise to give excellent results. The fluctuations of the sugar industry in Antigua and St. Kitts during the last twenty-five years can be readily followed from the diagrams given by Dr. F. Watts.

AN important contribution to the subject of foliar periodicity in tropical countries is provided by Mr. H. Wright in the Annals of the Royal Botanic Gardens, Peradeniya, vol. ii., part iii., 1905, recording a large number of interesting observations. Contrasting the influence of internal and external factors, two arguments in favour of the former are found in the small number of species that pass through a leafless period each year, and the striking fact that there is not a month in the year when all the deciduous species are in full leaf. On the other hand, since more than half the deciduous species pass through their leafless phase during the dry period from January to March, it is obvious that climate has considerable influence on periodicity. Of the physical factors that produce climate, Mr. Wright attributes the greatest importance to humidity. In this connection, the curves of monthly variations of temperature, rainfall, and humidity placed alongside the curve indicating the number of deciduous species in each month are especially instructive.

A VERY elaborate discussion of the climate of Beyrout, Syria, has been undertaken by Dr. S. Kostlivy, and published by the Royal Bohemian Society of Sciences. Since the year 1876 the observations have been regularly printed in the year-books of the Austrian Meteorological Service; the discussion in question refers to the twenty-five years 1876–1900. We can only briefly mention some of the principal results of Dr. Kostlivy's valuable work. The yearly variation of the monthly means of atmospheric pressure is considerable; the highest monthly mean was in January, 1898, 30·18 inches; the lowest in July, 1893, 29·70 inches, the mean variation being about half an inch. The highest monthly mean temperature occurs in August, 81°·5, the lowest in January, 55°·4. The absolute extremes were 101°·3, in October, 1898, and 30°·0, in December, 1897. The mean annual rainfall is 35·65 inches; of this amount 59·8 per cent. falls in winter, 18·5 per cent. in spring, 0·7 per cent. in summer, and 21·0 per cent. in autumn. During the whole series of twenty-five years, no rain fell in August in twenty-two cases, and none in July in twenty cases. The greatest fall in twenty-four hours was 5½ inches, in October. Snow is unknown at Beyrout, but hail occurs, on an average, on six or seven days in each year. Fog occurs very rarely; it was only observed on nineteen days during the whole period. The most prevalent wind is from the south-west, being about 31 per cent. of the whole of the wind notations; stormy days occur, on an average, only about seven times a year.

THE Meteorological Office has issued its "Annual Summary" for 1905, based upon observations made at 153 stations in the United Kingdom; it contains an interesting account of the conspicuous meteorological occurrences during the year. There was a remarkable absence, after the first three months, of gales which affected any large extent of country; during the three months ending with July no general gale was experienced on our coasts. The most violent storm of the year occurred on March 15; it came on with remarkable suddenness, and at Falmouth one of the gusts reached a velocity of 103 miles. Strong gales were also experienced in the last three months of the year. Rainfall was deficient over the kingdom generally, the loss being from 10 inches to 13 inches at some places; but at several stations in Scotland and Ireland the rainfall was above the average, and at Dungeness an excess of 8 inches was recorded. There was no snowstorm worthy of special mention, although snow was of frequent occurrence in the first months of the year. Thunderstorms were recorded in every month in some part of the country, but the distribution was very irregular. The most remarkable droughts occurred in the winter season; a period of dry weather which set in about the middle of December, 1904, was maintained with but unimportant interruptions until the middle of February, 1905. May was also a very dry month over an extensive region. The maximum temperature recorded was 87°, at Maidenhead, on July 26; there were many readings of 80° and upwards. The lowest temperatures in England occurred about January 19; at Llangammarch Wells a reading of 11° was registered. In Scotland and Ireland the greatest cold was about November 19; Braemar registered 5°. Fog was prevalent in the mornings from about the middle of October; November had also several foggy days, but the worst visitation of the year occurred from December 10–14. An exceedingly high tide swept down the east coast of England on the night of January 6–7, flooding extensive tracts and causing great destruction of property; it was accompanied with a hard north-westerly gale.

AN informal address by Dr. A. G. Bell to the Committee on Coinage, Weights, and Measures of the U.S. House of Representatives on February 16, giving an explanation of the reasons why the United States should abandon its heterogeneous systems of weights and measures, is printed in the *National Geographic Magazine*

for March. The committee had under consideration a Bill before Congress proposing that, from July 1, 1908, all the departments of the Government of the United States, in the transaction of business requiring the use of weight and measurement, shall employ and use the weights and measures of the metric system. Dr. Bell gave an exhaustive account of the anomalies of the British systems of measurement in use in the United States. He pointed out that all civilised countries, with the exception of the United States and Great Britain and her colonies, have adopted the simpler and more scientific decimal system. He reminded the committee that the metric system was legalised in the United States in 1866, and that its adoption by a portion of the population had increased the present confusion. By reference to the decimal system of coinage already in use in the States, Dr. Bell provided convincing instances of the simplification possible with it in the conversion of units, and explained that the United States, when it changed from the old system of pounds, shillings, and pence to the present dollars and cents, did not adopt the metric system of weights and measures because the latter, as we know it, did not appear until after the American Coinage Act of 1792. The facts that our whole system of arithmetic is decimal, that no difficulty whatever is experienced by ordinary workmen in the use of the metric system—provided there is no question of converting their measurements—and that the use of the metric system need not mean the use of new tools, were all clearly explained. It is interesting to note, in connection with this Bill before Congress, that the committee on publicity of the Metrological Society, of which Prof. Simon Newcomb is chairman, has circulated a letter urging all persons in favour of the introduction of the metric system to write, and also secure from other friends, as many letters to representatives in Congress as possible, so that they may see that public sentiment is in the direction of the adoption of decimal weights and measures.

IN the Proceedings of the American Academy of Arts and Sciences, xli., 24, for February, Mr. B. O. Pierce describes, with diagrams, experiments on the manner of growth of a current in the coil of a nearly closed electromagnet, as influenced by the width of the air gap.

WE have received part i. of the Transactions of the English Ceramic Society for the session 1905–6, and notice that, in view of the greatly increased activity of the society, it has become necessary to issue its publications in a serial form, instead of in a single volume at the completion of the session, as was formerly the case. The present number contains five papers read before the society during November and December of last year.

OUR ASTRONOMICAL COLUMN.

COMET 1906*c*.—The following extension of Dr. E. Strömgren's ephemeris for comet 1906*c* is taken from Circular No. 88 of the Kiel Centralstelle:—

Ephemeris 12h. Berlin M.T.

1906	α	δ	log Δ	Brightness
	h. m. s.	° ′		
April 10 ...	3 7 6 ...	+13 40 ...	0·2912 ...	0·37
14 ...	3 15 40 ...	+16 19 ...	0·3084 ...	0·31
18 ...	3 23 54 ...	+18 45 ...	0·3249 ...	0·27
22 ...	3 31 52 ...	+20 59 ...	0·3405 ...	0·23
26 ...	3 39 38 ...	+23 4 ...	0·3553 ...	0·20
30 ...	3 47 14 ...	+25 0 ...	0·3693 ...	0·17

Brightness at time of discovery = 1·0 = about mag. 8·0.

This object is now apparently leaving the constellation Aries for that of Taurus, and will pass through the Pleiades group on April 26–27.

In reference to the paragraph on comet 1905*c* on p. 545, where it was stated that that comet, also, would pass near to the Pleiades, the latter name was given in mistake for the Hyades.

MEASUREMENTS OF LINNÉ DURING THE TOTAL ECLIPSE OF THE MOON.—In Circular No. 113 of the Harvard College Observatory, Prof. E. C. Pickering publishes the results of a series of measurements of the bright spot around the lunar crater Linné, made by Mr. R. H. Frost during the total eclipse of the moon which took place on February 8.

These results show that the diameter of the spot began to increase as Linné passed into the earth's shadow, and to decrease rapidly on the return of sunlight to that portion of the moon's surface.

This apparently confirms Prof. W. H. Pickering's theory that the phenomenon is due to the formation and melting of hoar-frost.

THE TEMPERATURE OF THE SUN.—An important paper bearing on the question of the temperature of the sun's surface was communicated to the Paris Academy of Sciences by M. Henri Moissan on March 19.

In the course of his well known experiments with the electric furnace, M. Moissan recently succeeded in distilling titanium, and from the temperature therein employed he deduces probable limits for the temperature in that part of the sun's body where, as seen from the solar spectrum, titanium is volatilised.

The temperature of the arc employed has been previously determined as about 3500° C., and, taking into account the uncertainty as to the pressure existing in the solar atmosphere, M. Moissan concludes that the probable temperature varies between Prof. Wilson's estimated value of 6590° C. and the value obtained by M. Violle, viz. 2000° C. to 3000° C., the probability being that the latter value is nearer to the truth (*Comptes rendus*, No. 12).

THE MELBOURNE OBSERVATORY.—The thirty-ninth annual report of the work done at Melbourne Observatory deals with the period April 1, 1904, to March 31, 1905, its chief point being a statement of the progress of the work in connection with the Astrographic Chart. To this end the astronomical work has been almost entirely confined to meridian observations and stellar photography.

The catalogue series now totals 1149 satisfactory plates, and is complete, whilst for the second catalogue series 455 plates have been obtained. For the chart series, with single exposures of 6om., 565 plates have been passed, thus completing this part of the work. Four hundred and ninety-five plates, with triple exposures of 30m. each, have also been obtained for the chart.

On March 31, 1905, 317 Sydney and 612 Melbourne plates, containing 177,069 and 206,604 stars respectively, had been measured.

The measurement of the long series of magnetic curves extending back for thirty-seven years was nearly completed when the report was issued, 37,212 day-curves out of about 40,000 having been measured.

MOUNTING THE 60-INCH REFLECTOR AT HARVARD.—An interesting description of the method which is being employed in mounting the late Dr. Common's 60-inch reflector at Harvard College Observatory is given in No. 3, vol. xiv., of *Popular Astronomy*.

Instead of being supported on a solid pier, nearly the whole of the weight of the instrument is borne on a cylindrical steel float partly submerged in a tank of water, and so fitted as to be perfectly steady.

The coudé method of mounting has been employed, so that the observer may remain in a comfortably fitted room and make his observations through an eye-piece which retains a constant position and direction.

Electric motors have been employed to drive the telescope, and, by a number of switches conveniently placed in the observing room, the observer is able to maintain full control over all the necessary adjustments.

BIRD-LIFE AT THE SOUTH ORKNEY ISLANDS.

DURING the years 1903 and 1904 the Scottish National Antarctic Expedition made important ornithological researches in the icy regions of the far south, and also at the remarkably remote island of Diego Alvarez, otherwise Gough Island, in the South Atlantic. In both, extensive collections of birds were made, which were recently described in the pages of the *Ibis*.

The main scene of these investigations was at the South Orkneys, a group of more than a dozen islands lying some 600 miles south-east of the Falklands, and which, though discovered so long ago as 1821, had remained among the least known lands within the South Polar seas. The climate of this archipelago, in spite of its comparatively low latitude (60°–61° S.), is essentially polar, the summer temperature being much the same as in regions 10° further south, while in winter as many as 72° of frost were registered.

On Laurie Island, the second largest (30 square miles) of the group, eleven months were spent by the expedition, including the winter of 1903. During this period a number of interesting and valuable observations were made relating to the native birds (some of them little known), their habits, migrations, nidification, and geographical distribution; while the collections formed enabled me to describe phases previously quite unknown in the plumage of several rare species, and also included the eggs of forms never before obtained.

Only a few birds essayed to winter, but on the return of spring marvellous numbers arrived to spend the summer and to rear their young.

The penguins were by far the most numerous, and were of four kinds. The Adélie (*Pygoscelis adéliae*) was the most abundant, its numbers being estimated at not less than five millions; the ringed (*P. antarctica*), which was previously regarded as nowhere common, evidently has its metropolis at the South Orkneys, for at least one million nested on Laurie Island alone; while the gentoo (*P. papua*) was less numerous, since it here nears the southern limit of its range. Another species, the macaroni penguin (*Catarrhactes chrysolophus*), was found in very small numbers, but it probably breeds somewhere in the archipelago. The three first mentioned species of penguin nested in great "rookeries," some of which contained several millions of inhabitants, and extended as a broad belt for two or three miles over elevated plateaux bordering the sea. Their nests were constructed of small stones deliberately collected one by one, and, on an average, there was a nest to each square yard of the area occupied.

Life in these great bird cities was not altogether a happy one. The penguins are ill-natured and pugnacious birds, and woe betide the citizen who trespassed upon the domain of his neighbours, or the poor unfortunate who had not secured a mate and ventured within the precincts of the rookery. Then the bills of all the birds around were turned against the intruders, and a fearful commotion ensued which generally resulted in a free fight all round, each pair of birds attacking their neighbour, and ended in the rookery becoming a veritable pandemonium, rendered hideous by the harsh screeches of hundreds of thousands of voices. Such squabbles and their consequences, however, were mere trifles when compared with two scourges ever present among the sitting birds. Foremost among these were the savage giant petrels, the greatest of feathered ruffians, which wandered in numbers throughout the community gorging themselves to repletion on the eggs and young forcibly taken from the brooding penguins. The second terror was the Antarctic skua, many of which hovered overhead, like so many harpies, and incessantly swooped down to snatch the same treasures from the much persecuted parents.

When courting, as one of the pictures shows, the enamoured ones elevate their bills and utter their far from musical love songs. They do this in unison, moving their heads backwards and forwards or waving them from side to side all the while.

Next to the penguins, the petrels were the most numerous of the bird inhabitants of the island. Of these, eight species were present, most of which were nesting on the sea cliffs, or on the steep screes springing from their bases. On such sites was discovered the egg of the Cape petrel or pigeon (*Daption capensis*), a bird well known to voyagers for more than two hundred years, yet one which had hitherto succeeded in hiding its plain white egg from the gaze of oologists. Many of the eggs of this bird were found on the ledges of the cliffs, but collecting them was not a pleasant pursuit, for these birds, like some others of their order, have the power of squirting a quantity of evil-smelling oil at intruders, making good marksmanship at 8 feet. Fortunately the giant petrel (*Ossifraga gigantea*), a bird as big as a goose, did not practise this art, otherwise the taking of its egg would indeed have been an ordeal. This species, too, sat close, and when pushed off its nest, which consisted of a great heap of stones, it vomited the contents of its gorged stomach, and thus lightened was able to take wing. The other species resorting to the island for a summer home and nursery were Wilson's petrel (*Oceanites oceanicus*) and the ice petrel (*Pagodroma nivea*), both of which are very abundant. A single pair of the black-bellied storm petrel (*Fregetta melanogaster*) and their egg were found, and thereby a remarkable extension southwards in the previously known range of this species established. Possibly two other petrels were nesting, namely, the Antarctic and slender-billed fulmars (*Thalassoeca antarctica* and *Priocella glacialoides*), and a whale bird (*Prion banksi*) was seen off the islands.

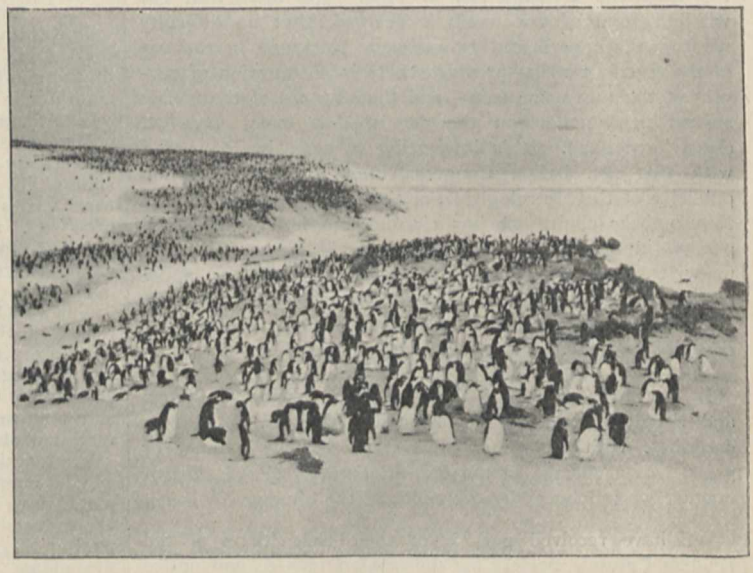

FIG. 1.—Adélie Penguins' Rookery on Cryptolite Island.

A tern (*Sterna hirundinacea*), a gull (*Larus dominicanus*), and a skua (*Megalestris antarctica*) nested in the vicinity of the shore, but the latter only was abundant. The blue-faced shag (*Phalacrocorax atriceps*), previously not a well known species in any respect, nested in numbers on islets off the coast; and lastly we found another little known species, namely, the white sheath-bill (*Chionis alba*), a remarkable bird distantly related to both the plovers and the gulls. It was quite common, and took up its quarters amid the nesting penguins, feeding on their dead young and broken eggs; in fact, these birds were

regular scavengers, to which the dung of seals did not come amiss.

The chief food of the millions of penguins and tens of thousands of petrels was the opossum shrimp (*Euphausia antarctica*), and when one remembers the vast numbers of this little crustacean consumed daily by the birds on Laurie Island alone, one can only compare their numbers in the sea with the grains of sand upon its beaches.

The Scottish National Antarctic Expedition is to be heartily congratulated on the excellence and importance of its ornithological work. Mr. Bruce, the leader of the expedition, has presented a complete set of the South Orkneys and other birds collected during the voyage of the *Scotia* to the Royal Scottish Museum, Edinburgh.

For the loan of the blocks from which the pictures have been reproduced we are indebted to the editors of the *Ibis*.

WM. EAGLE CLARKE.

FIG. 2.—Ringed Penguins courting (Brown's Bay).

INSTITUTION OF NAVAL ARCHITECTS.

THE annual general meeting of the Institution of Naval Architects was held last week, commencing Wednesday, April 4, and being continued over the following Thursday and Friday. A full programme of twelve papers had been prepared by the secretary, Mr. R. W. Dana. The subjects dealt with were of various interest, vessels fitted with internal combustion motors occupying a good deal of attention. There was, however, no paper on the steam turbine.

On members assembling on the morning of Wednesday, the president, the Right Hon. the Earl of Glasgow, took the chair, and after the usual formal business had been transacted, proceeded to read his annual address. He referred to the launch of the large line-of-battle ship *Dreadnought*, and gave certain figures relating to the Navy Estimates. Reference was made to the proposed experimental tank at Bushy. There had been, he said, a general appeal to members of the institution for financial support, but, as the result of preliminary inquiry, it had been ascertained that a certain proportion of the amount required for building and equipping such a tank would be guaranteed by private firms and public bodies. It was obvious that the condition of shipbuilding at the time the proposals were formerly made did not favour the movement, and it was therefore decided to suspend action. Since the scheme was first mooted, additional private experimental tanks had been either laid down or projected by some of the great shipbuilding firms of the country. Such tanks as these, however, could never supply the need that existed for pure research. The council had therefore decided to call together the committee that had the matter in hand, and ascertain the views of the members on the present position of the scheme, and the prospects of its being brought to a successful conclusion. Should the shipowners of the country be unwilling to subscribe the comparatively small amount needed to build, equip, and maintain such a tank, nothing would remain but to abandon the scheme and dissolve the committee. The president hoped, however, that, before such a conclusion was reached, a fresh effort might be successfully made to carry out upon scientific lines a work of vital importance to the development of naval architecture in this country.

The first paper read was a contribution by Admiral C. C. P. FitzGerald, the subject being the new scouts recently designed for the Royal Navy. Details of these vessels were given, and the subject of naval scouting was discussed both from the strategical and tactical point of view. A discussion followed, in which several naval officers took part, and it was pointed out that the scouts were analogous to the old 36-gun frigates, these being the most powerful ships that could be detached from the fleet without weakening the line of battle.

Sir Edward J. Reed next gave an account of the vessels he had designed for service in the colonies. They were of various descriptions, consisting of both screw and paddle boats, the former being of the ordinary or of the tunnel-screw type, whilst both stern-wheel and side-wheel boats were used on the shallow waters of colonial rivers.

On the second day of the meeting the proceedings opened by Mr. R. E. Froude reading a paper on yacht measurement rules, and the late International Conference on Yacht Rating. Delegates from different countries attended this conference, but America did not send any representatives, a matter which was to be regretted. The French delegates abandoned the position they originally took up, the formula they had brought forward not being pressed. The formula ultimately agreed upon by the conference was

$$\frac{L+B+\frac{1}{2}G+3d+\frac{1}{8}\sqrt{S-F}}{2},$$

where L = length, B = beam, G = chain girth, d = girth difference (*i.e.* skin girth minus chain girth), S = sail area, and F = freeboard. The reasons on which the formula was based were set forth in Mr. Froude's paper, and were also dealt with in the discussion by which it was followed.

Two papers on motor-boats followed. The first was by Mr. Linton Hope, and dealt with the speed of motor-boats and their rating for motor purposes, and the second was by Mr. James A. Smith, and was on the design and construction of high-speed motor-boats. These papers were read consecutively, and discussed together. The Marine Motor Association has adopted a formula for rating motor-boats for racing purposes. It is as follows :—

$$(P_2/A)+\sqrt{L}=\text{rating},$$

where P = motor-power, A = immersed sectional area at the point of greatest beam, and L = length. Motor-power is obtained by the following formula :—

$$\frac{A\times S\times R}{C}=MP,$$

where A is the total piston area of all cylinders in square inches, S = stroke in feet, R = maximum revolutions per minute, and C is a constant equalling 1000 for 4-cycle and 600 for 2-cycle motors. Mr. Hope gave particulars of a large number of existing motor-boats, and the lines of several of the best known. The most interesting part of his paper, however, was a diagram giving curves of speeds and ratings of a large number of existing boats, the data being obtained either from racing records or trials made specially. Mr. Smith, in his paper, also referred to the methods of handicapping motor-boats by a rating rule, and gave particulars of certain of the best known recent craft of this type. A discussion followed, in the course of which Mr. Froude objected to the formula adopted because it was not homogeneous, as it included as factors both length and area.

At the evening meeting on Thursday an interesting paper was read by Mr. J. E. Thornycroft on gas engines for ship propulsion. Particulars of different types of producers were described and illustrated. A large part of the paper was taken up by a description of the Capitaine system. This consists of a suction producer and a gas engine. It had been fitted into a yacht which took part in the reliability trials at Southampton last year. It had also been fitted in a canal barge which recently made a trip from the Thames through the canal system of England to Birmingham, Manchester, and back to London by way of Oxford. These practical illustrations are considered sufficient proof that the system can be applied to marine propulsion. In the discussion which followed the reading of the paper, the chief point raised was whether bituminous coal could be used in a suction producer. Up to the present anthracite has been the fuel employed, the bituminous coal being subjected to caking in the producer, and thus stopping the working. Mr. Thornycroft stated that Mr. Capitaine was endeavouring to solve this problem, and had already constructed a producer which appeared to answer the purpose.

A paper was next read by Prof. R. S. Weighton, of Newcastle, the subject being the efficiency of surface condensers. In this paper the author described a new form of condenser which was presented to the engineering laboratory of University College, Newcastle, by Messrs. Richardson, Westgarth and Co. Very exhaustive tests had been made, there having been 400 full experiments in all. The results of these were plotted, and given in tables and diagrams accompanying the paper. The condenser is of the surface type, fitted with tubes on the general principle adopted in marine condensers. The tubes are divided into three nests, each nest being placed in a separate compartment. Water circulates through the tubes and the steam amongst them. On entering the first compartment a large part of the steam is condensed in the usual way. In place, however, of allowing the resultant water to flow over all the remaining tubes, it is trapped by means of a diaphragm, and flows at once to a receptacle at the bottom of the condenser. The steam that remains uncondensed flows into the next compartment, and circulates amongst the second nest of tubes; here a further quantity is condensed, and the water again trapped off. Any remaining steam is then condensed in the third compartment. From the voluminous tables attached to the paper it was to be gathered that for a given size of condenser and a given volume of cooling water a much larger quantity of steam could be dealt with in the form of condenser described.

On the last day of the meeting, Friday, April 6, the proceedings commenced with a paper on freeboard rules, the author being Mr. J. Foster King. The paper explained the difference between the British and the German rules in regard to freeboard, the latter allowing a deeper lading than in the case of vessels belonging to this country. For some time past the Board of Trade has been giving attention to this question, and amendments of the load-line tables have been under consideration. The President of the Board of Trade has given his sanction to amended rules and tables, such as are shown by the author in his paper, so as to bring the practice of this country more in conformity with the German rules, thus removing certain disabilities under which ships flying the British flag labour in comparison with German competitors.

A paper by Mr. J. L. Twaddell on the overhead wire cableway as applied to shipbuilding was next read. This system of transporting material on the building slip has been installed at Newcastle under the superintendence of Mr. Twaddell. It takes the place of the more elaborate overhead gantries and electric travelling cranes which have been a marked feature in some of our best equipped shipyards. In some respects the cableway is more flexible and convenient, but the durability of the cables was a point raised during the discussion which followed the reading of the paper. Experience will show how far this may prove a defect in the new system.

A paper by Mr. Alex. Murray on the introduction of cranes in shipyards dealt with a subject of a similar nature, and served to illustrate how enterprising German shipbuilders have proved themselves to be in the equipment of their yards. The cantilever cranes and tower cranes erected in one German yard, and illustrated in the paper, are of the most elaborate, and must be also of the most costly, description.

A paper by Mr. Herbert Rowell on oil-tight work in ships of light construction gave particulars of riveting and other details of strengthening surfaces necessary to make steel-plated vessels oil-tight.

The last paper read was by Mr. J. R. Barnett, and gave particulars of a number of steam yachts built within the last twenty-five years.

PHYSICAL AND CHEMICAL CHARACTERS OF HUFF.

AT a recent dinner of the Royal Society Club, Major MacMahon, who represents the Royal Society on the governing body of Winchester College, was so good as to present to the club a quantity of huff—a variety of ale for which the college has long been famous. It is brewed (from malt and hops only) in March of every other year, and is the "duplex visia" or "double beer" of Shakespeare, called "huff cap" in Greene's "Looking Glass for London and England, A.D. 1594," "because," according to the editor, "it inspirited those who drank it to set their caps in a huffing manner." The sample offered to the club was stated to have been ten years in bottle. In appearance it was clear and bright, and of a deep brown colour. Its taste was that of a well-hopped ale of high alcoholic strength.

As several members of the club expressed a desire to know something of the composition of this fine old ale, and in particular as to how it compared in character with

other beers of repute, Major MacMahon was so good as to permit an examination of it to be made in the Government Laboratory.

The results were as follows :—

Specific gravity	1·00873
Original gravity	1·11667
Percentage proof spirit	25·3
Ash—per 100 c.c.	0·465 gram.
Albumenoids—per 100 c.c.	1·001 ,,
Total acid—per 100 c.c. (as acetic) ..	0·18 ,,
Volatile acid—per 100 c.c. ,, ...	0·04 ,,
Specific rotatory power $[\alpha]_{D\ (3\cdot86)}$	+65·4

The alcohol which it yielded by distillation was further examined, with the following results, calculated to proof strength :—

	Per cent.
Esters (as ethyl acetate)	0·0524
Aldehyde	0·004
Higher alcohols	0·240

Huff is the strongest ale of which the Government Laboratory has any record. The nearest to it in point of alcoholic strength and general character is the strong Burton ale known as "Royal Ale." A sample of this, brewed in March, 1905, exported from Liverpool to New York, on analysis in the Government Laboratory gave the following numbers :—

Specific gravity	1·02275
Original gravity	1·10862
Percentage proof spirit	20·2
Ash—per 100 c.c.	0·490 gram.
Albumenoids—per 100 c.c.	0·945 ,,
Total acid—per 100 c.c. (as acetic) ...	0·16 ,,
Volatile acid—per 100 c.c. ,, ...	0·036 ,,
Specific rotatory power $[\alpha]_{D\ (3\cdot86)}$	+96·0

Examination of Alcohol—Results Calculated to Proof Strength.

	Per cent.
Esters (as ethyl acetate)	0·022
Aldehyde	Nil
Higher alcohols	0·05

A number of analyses of various ales and stouts, taken from a paper by Mr. A. R. Ling in the *Brewer's Journal* for July, 1903, are appended, and for comparison the results of the examination of huff and the sample of "Royal Ale" are expressed in the same terms.

	Burton Pale Ale (Bottled)	Other Ales			Strong Burton Ale	Dublin Stouts		London Stouts		"Huff"	"Royal Ale"
		A	B	C		A	B	A	B		
Original gravity	1061·3	1052·8	1040·2	1059·0	1108·6	1081·4	1074·1	1072·2	1069·7	1116·67	1108·62
Attenuation gravity	1012·5	1010·4	1008·0	1013·4	1021·6	1018·2	1021·7	1022·8	1020·9	1008·73	1022·75
Absolute alcohol (by weight) ...	5·20	4·57	3·55	4·88	9·36	6·69	5·51	5·20	5·13	11·72	9·25
Total acidity expressed as acetic ...	0·10	0·08	0·07	0·08	0·16	0·20	0·20	0·16	0·14	0·18	0·16
Composition of the Extract.											
Fermented matter	64·75	64·92	64·55	62·93	66·11	63·5	58·7	55·7	56·6	76·96	65·42
Maltose (apparent)	6·05	8·04	8·32	8·74	4·19	5·1	9·6	12·1	12·2	2·38	3·30
Dextrin (apparent)	14·88	13·97	14·06	15·46	14·21	16·9	19·8	14·1	13·4	6·09	14·74
Ash	2·41	2·03	2·14	1·93	1·99	2·0	2·3	2·7	2·2	1·54	1·75
Other substances	11·91	11·04	10·93	10·94	13·50	12·5	9·6	15·4	15·6	13·03	14·79

It will be seen that the appellation of "duplex visia" as applied to huff—a liqueur among beers—is fully justified.

T. E. T.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year, tenable for two years, is offered by the governing body of Emmanuel College to an advanced student commencing residence at the college in October. The exhibition will be awarded at the beginning of October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than October 1.

PROF. E. A. MINCHIN has resigned the Jodrell chair of zoology in University College, London, in view of his appointment to the new chair of protozoology in the University of London. Prof. E. H. Starling has been appointed to the Jodrell chair of physiology at University College. The title of emeritus professor of zoology has been conferred upon Prof. E. Ray Lankester, and that of emeritus professor of civil engineering and surveying on Prof. L. F. Vernon-Harcourt.

AMONG educational benefactions to the colleges of the United States recently announced by *Science* the following may be mentioned. By the will of Dr. W. T. Bacon his estate is given for life to Mrs. Bacon, but at her death the Hartford Medical Society will receive an endowment of 20,000*l.*, and Yale University will receive a part of the residuum of the estate, which is understood to be worth nearly 60,000*l.* It is reported that Mrs. J. B. Stetson has offered to give 20,000*l.* to Stetson University on condition that the present trustees resign. Parsons College, Fairfield, Iowa, recently received 16,000*l.* additional endowment through the will of Colonel Charles Parsons, of St. Louis. This increases the donor's gifts to 29,200*l.* Through the generosity of a Chicago physician (anonymous) and of Dr. Benjamin Taylor Terry, of New York City, Indiana University has received offers of two endowments for pathological research. The income of each fellowship is 150*l.* a year. Both offers are made under the condition that the University provides adequate library and laboratory facilities for such work.

THE Government measure to amend the law relating to education in England and Wales was introduced in the House of Commons on Monday by Mr. Birrell, Minister of Education. It is proposed that the limit of twopence as a rate for secondary education should be removed, that Wales should have a National Education Council, and that complete public control should be secured for all elementary schools receiving State aid. The first clause of the measure proposes that, after January 1, 1908, a school shall not be recognised as a public elementary school unless it is a school provided by the local education authority, so that no elementary school will receive a penny of public money, either from rates or taxes, if it does not become a provided school within the meaning of the Act. Every elementary school receiving rates and grants will thus become at once a provided school; and it will supply the same kind of religious instruction as is now given in provided schools. No catechisms or distinctive religious formularies will be taught, and the conscience clause will operate. This will be the general rule throughout the land. The second clause of the Bill authorises a local education authority, for the purpose of continuing any existing voluntary school as a provided school, to make, with the consent of the Board of Education, arrangements for carrying on a public elementary school with the owners of the schoolhouse, subject to the condition that the education authority must, during the continuance of the agreement, assume the whole responsibility of maintaining the fabric. The cost of this change is estimated at about 260,000*l.* a year. To meet the expenditure involved in these proposals, a further annual grant of 1,000,000*l.* is

to be given, in addition to the existing grants. It is proposed in another part of the Bill to make educational endowments as serviceable as possible for the advancement of education, and to consolidate, simplify, and improve the administrative machinery now in use. No provision is made for the training of teachers. We are not concerned here with the sectarian difficulties which seem to make it hopeless to contemplate a permanent settlement of the question of religious teaching in State schools. The denominationalists regard the provision of religious instruction without creed or catechism, prescribed by the Bill, as opposed to their principles and as an endowment of undenominationalism; therefore they will oppose the measure. The Labour Party, on the other hand, has taken the logical position that State aid should only be given for secular education; and that all religious instruction should be abolished in elementary schools, though moral or ethical teaching could be given based upon the best thoughts and works to be found in the literature and history of the world. Until a common factor of agreement is found in sectarian doctrines, or religious instruction is banished entirely from elementary schools, our educational system promises to continue to be the shuttlecock of opposing parties.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 7, 1905.—"On a Property which holds good for all Groupings of a Normal Distribution of Frequency for Two Variables, with Applications to the Study of Contingency-tables for the Inheritance of Unmeasured Qualities." By G. Udny **Yule**. Communicated by Prof. O. Henrici, F.R.S.

Suppose a contingency-table to have been formed for two characters which have been assigned in some way (not necessarily quantitatively) into classes. Extract from the general contingency-table the frequencies in any four adjacent compartments, and consider these as forming, by themselves, an elementary contingency-table. If the sign of association in all such elementary tetrads be the same, the general contingency-table may be termed *isotropic*. In an isotropic table the sign of the association is the same, not only for every tetrad of adjacent frequencies, but for every set of four frequencies in the compartments common to two rows and two columns. The table remains isotropic in whatever way it may be condensed by grouping together adjacent rows or columns, and if, as an extreme case, it be reduced to four-fold form, the sign of the association in such four-fold table is the same as in the elementary tetrads of the original table. If the rows and columns of an isotropic table be disarranged, the disarrangement is no longer isotropic, but the rows and columns can easily be rearranged in isotropic order. The normal frequency distribution for two variables is isotropic, and possesses the preceding properties. An examination of a number of tables recently published by Prof. Pearson for inheritance of anthropometric measurements (stature, span, forearm and head measurements) shows that all are at least approximately isotropic. On the other hand, the tables for inheritance of eye-colour published by the same writer on the basis of Mr. Galton's material, are, without exception, anisotropic, the divergence from isotropy being of such a kind as would be produced by an excess of frequency in the diagonal compartments of the table corresponding to identity of eye-colour in the two relatives. This excess, in the case of the tables for inheritance in the first degree, is not, however, so great as would be given by the theory of simple alternative inheritance, which accordingly requires modification. The same type of anisotropy appears to hold for the great majority of the tables for inheritance of coat-colour in horses given by Prof. Pearson, and also for the miscellaneous characters, mental and physical, in man, given by him in the Huxley lecture (1903). The marked prevalence of this type of distribution for such very diverse qualities, as compared—so far as investigation has gone—with its complete absence in the case of measured characters, raises the question whether it may not be, in whole or in part, of subjective origin.

The above abstract should have preceded that printed in last week's NATURE (p. 551).

January 18.—"The Growth of the Oocyte in Antedon: a Morphological Study in Cell-Metabolism." By Dr. Gilbert **Chubb**. Communicated by Prof. E. H. Starling, F.R.S.

The paper deals with the growth of the oocyte in *Antedon bifida*, Pennant, and is an attempt to utilise the morphological changes accompanying this process to determine the relative physiological significance of the various cell-structures.

The most striking expression of nucleolar activity consists in the intermittent discharge of spherules into the cytoplasm throughout the growth of the egg. Of these spherules, those discharged during the earlier period of the egg's growth constitute the yolk-nucleus, and both the origin and later behaviour of the latter structure are shown to be due to the progressively changing physical consistency of the cytoplasm. Neither the yolk-nucleus nor the nucleolar matter discharged subsequent to its formation take any part in yolk formation.

Evidence is adduced to show that the chromatin is responsible for the formation of the nucleolus, and that it is in this latter structure that the waste products of cytoplasmic activity undergo their final changes.

The irregularity of the germinal vesicle, so often accepted as an indication of the direct participation of this structure in yolk formation, is shown to be due to purely physical causes. The actual process of yolk formation is shown to be unaccompanied by increased nuclear activity, and to consist merely in the automatic conversion into a more stable form of material deposited in solution in the cytoplasm by the chromatin throughout the entire growth of the egg.

Zoological Society, March 20.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Descriptions of the species of the coleopterous genus Sciobius: Guy A. K. **Marshall**. The genus comprised forty-one species, of which twenty-two were described as new.—A contribution to the study of evolution based upon the Mexican species of Cnemidophorus: Dr. Hans **Gadow**. The main object of the paper was to trace the correlation of certain variations exhibited by the lizards of this genus, and the environmental, bionomic conditions. To do this a revision of the numerous species of the genus had been necessary, most of the ample material for which had been collected by the author himself. Especial attention had to be paid to an exhaustive study of the surprisingly great variability of certain characters, in particular the changes of the colour-pattern and the scutellation of the collar and of the limbs. The distribution of the many races, into which some of the species seemed to have recently differentiated themselves, was likewise followed up in detail.

Geological Society, March 21.—Mr. Aubrey Strahan, F.R.S., vice-president, in the chair.—The Chalk and Drift in Möen: Rev. Edwin **Hill**. The problem of Möen is to account for portions of Drift, isolated, and seemingly included, in cliffs of Chalk. It has been assumed that these portions occupy dislocations, and that the dislocations were either simultaneous with, or subsequent to, the deposition of the Drift. But cases are here described where Drift is seen to occupy cavities in dislocations, which had been water-worn, and consequently had been produced, before the advent of the Drift. A probable assumption that there were pre-Glacial cliffs similar to the present, with clefts and furrows in the cliffs, which were covered in Glacial times with a mantle of Drift now in course of removal by denudation, explains every variety of Drift-inclusion. Slopes of uniform inclination, which rise from the beach to the bases of the vertical cliffs, appear to be talus-slopes. In reality they are everywhere solid Chalk, with only a skin of débris; this suggests post-Glacial changes in sea-level.—The relations of the Chalk and Boulder-clay near Royston (Hertfordshire): Prof. T. G. **Bonney**. On the uplands south of Royston, Mr. H. B. Woodward has described three sections (Quart. Journ. Geol. Soc., vol. lix., 1903, p. 362), which in his opinion indicate that a great ice-sheet, as it advanced from the north, sheared off large masses of Chalk and mixed them up with its ground- or englacial moraine (the Chalky Boulder-clay). The author points out that this interpretation rests on an hypothesis—namely, that the latter deposit is the direct product of

land-ice—which, as it involves some serious difficulties, cannot yet be taken for granted. That ice is capable of shearing off and thrusting before it large masses of rock is also an hypothesis, for which the author, after doing his best to study ice-work in the field, can find no valid evidence. He maintains that these sections do not suggest the above explanation. At the Pinner's Cross Pit the Boulder-clay is not, strictly speaking, "banked-up" against the Chalk, but occupies a hollow in the Chalk. In the pit south-west of Newsell's Park, a shear-plane can indeed be seen in one face, which, however, is explicable by ordinary faulting. A few yards farther to the south-east, Boulder-clay appears above the floor of the pit, filling an arched cavity. This is, no doubt, a singular position, but there is nothing to show that the Chalk has been thrust over the Clay. The author suggests that, as in Möen, the Clay has been carried down from above into cavities already formed in the Chalk.—Brachiopod homœomorphy: Pygope, Antinomia, Pygites: S. S. **Buckman.** This paper deals with the diphyoid Terebratulæ, of which so many species have borne the name *Terebratula diphya* (Colonna). It is pointed out that this name is pre-Linnean, and can only date from the time when it was revived by L. von Buch in 1834. It appears that *Terebratula diphya* is not the type of the genus Pygope. Reasons are given for taking as the type of Pygope one of the forms of *T. antinomia* which is considered to be the same species as *T. deltoidea*, Val. Then the later generic name Antinomia, Catullo, is discussed. The genus was founded on five species, and one of them is now selected as the type—the genolectotype. This is *A. dilatata*, Catullo, supposed to be equivalent to *Terebratula antinomia*, Catullo, that is, to what is now selected to be the type of that species. In that case the species would bear the name *Antinomia antinomia* (Cat.). But there is yet another series of diphyoids, typified by *Terebratula diphyoides*, d'Orb. It is pointed out that, although the species covered by the name *diphyoides* are very like Pygope as now used, yet they all differ in having particular characters in the preperforate stage—a dorsal ridge and a ventral sulcus.

Royal Microscopical Society, March 21.—Rt. Hon. Sir Ford North, P.C., F.R.S., vice-president, in the chair. —A contribution to our knowledge of the Rotifera of South Africa: C. F. **Rousselet.**—A new form of finder which can be used on any microscope, and by which the object registered on one microscope can be found on any other: J. M. **Coon.**—Some Oribatidæ from Sikkim: N. D. F. **Pearce.** Most of the tropical species were on the average smaller than those found in temperate climes. —The limits of resolving power for the microscope and telescope: E. M. **Nelson.**

Entomological Society, March 21.—Mr. F. Merrifield, president, in the chair.—Six ♂♂ examples of the Pierine genus Eronia with corresponding ♀♀s: Dr. F. A. **Dixey.** Attention was directed to the extreme diversity shown by the ♀♀s in these closely allied species. Dr. Dixey considered that this characteristic was due to the fact that in every instance the ♀ had been diverted from the ordinary aspect of the group by the operation of mimicry, either Müllerian or Batesian. The species of entirely different affinities which had acted presumably as models were associated also with the exhibit. —Two specimens of *Emmelesia unifasciata* which emerged in August last from pupæ which had lain over since the autumn of 1900, thus having passed five seasons in the pupal stage: R. **Adkin.**—Progressive melanism in the Riviera of *Hastula hyerana*: Dr. T. A. **Chapman.** A discussion followed on melanism and its causes.

Physical Society, March 23.—Prof. J. Perry, F.R.S., president, in the chair.—Unilateral electric conductivity over damp surfaces: Prof. F. T. **Trouton.** Some time ago the author noticed a rather perplexing difference in electrical resistance depending on the direction in which the measuring current was passed. The resistance under examination was that of the layer of moisture which adheres to glass when exposed to moist atmospheric conditions. The arrangement in which this resistance measurement was effected was one used for determining the temperature of deposition of dew. For this purpose two parallel wires of platinum were melted on to a glass surface at a small distance apart. The surface could be artificially cooled. A cell and a galvanometer were inserted in series with the two platinum wires. As soon as moisture condensed on the glass the circuit was completed and a current passed, thus permitting the accurate determination of the dew-point. When a delicate galvanometer is used a small current can be detected long before the true dew-point is reached. It is at this stage that the anomalous behaviour in the resistance is found. On passing a current across the glass surface when exposed to ordinary atmospheric conditions, it was found to diminish to a certain minimum value, the amount of which depended on the hygrometric state. On reversal, the current assumed its original value, and then diminished to a minimum as before, and so on for further reversals. In order more conveniently to study the matter with larger currents, tinfoil grids were prepared by pasting strips of tinfoil on to glass plates. The theory put forward to account for the phenomenon depended on the transportation of moisture over the surface by the current. In this way the effective thickness of the layer might be much diminished by a banking up of the moisture along the edge of one of the metallic electrodes.—The construction and use of oscillation valves for rectifying high-frequency electric currents: Prof. J. A. **Fleming.** The author recalled the fact that so far back as 1890, when investigating the Edison effect in glow-lamps, he had shown that the space between the incandescent carbon filament and an insulated metal plate placed in the vacuous bulb possessed a unilateral conductivity, negative electricity being able to pass from the filament to the plate, but not in the opposite direction. This led him to suggest an arrangement of the above kind for separating out or rectifying the oppositely directed currents in an alternating current. This effect was now recognised as due to the copious emission of negative ions or electrons from the incandescent carbon. It was by no means obvious, however, before trial, that any such rectifying arrangement or valve would operate with currents of very high frequency. For example, electrolytic rectifiers such as the aluminium-carbon cell were not available for high-frequency currents because a time element entered into the chemical actions involved. In 1904, however, the author discovered that if the carbon filament in an electric glow-lamp was surrounded with a metal cylinder connected to an insulated terminal by a wire sealed through the bulb, and if the filament was made incandescent by an insulated battery, then between the insulated terminal and the negative pole of the battery a unilateral conductivity existed which was operative with currents of any frequency, and the valve so made might be employed to render electrical oscillations measurable by an ordinary sensitive galvanometer. The author exhibited oscillation valves made on this plan.—The use of the cymometer for the determination of resonance curves: G. B. **Dyke.** The experiments described in the paper were made with a view to the adaptation of the direct-reading cymometer to the delineation of resonance curves and the determination of the logarithmic decrements of wave trains and the resistance of oscillating sparks.

EDINBURGH.

Royal Society, February 19.—Dr. R. H. Traquair, vice-president, in the chair.—The elevation of the boiling point of aqueous solutions of electrolytes: Rev. S. M. **Johnston.** The paper contained a detailed account of the method of experiment, and after giving the experimental results in a number of cases, proceeded to examine into reasons for the observed increment in the value of the elevation constant as indicated by theory. When the ratio of the molecular conductivity for a given concentration to the value for infinite dilution was plotted against the elevation constant, the graph for each salt was, up to a certain ionisation, a straight line parallel to the ionisation axis, but changed direction at this point. Arguments were adduced that this increment in the value of the elevation constant was due to hydration; and if this explanation be assumed, the observations gave a means of determining the ionisation, and therefore the concentration, at which hydration commences. Thus for solutions of CdI_2, LiCl, NH_4Br, and NH_4I, with concentrations respectively of 1·8, 0·92, 0·74, and 0·7 gram equivalents per litre,

it was calculated that hydration commenced at ionisations (respectively) of 0·103, 0·57, 0·678, and 0·694.—The formation of certain lakes in the Highlands: Dr. L. W. **Collet** and Dr. T. N. **Johnston**; with a note on two small lakes in the Alps. The paper and the appended note dealt with the characters of certain lakes in relation to their origin as rock basins or barrier basins.—The methods of standardising preparations of the suprarenals: Dr. Isabella **Cameron.**

March 5.—Prof. Crum Brown, vice-president, in the chair.—The igneous geology of the Bathgate and Linlithgow Hills, part ii., petrography: Dr. J. D. **Falconer.** In this continuation of a former paper the petrography of the igneous rocks was discussed under three heads:—(1) the lavas; (2) the contemporaneous intrusions; (3) the later intrusions, chiefly in the form of dykes and sills, and probably of late Carboniferous age.—Three papers dealing with some of the zoological results of the Scottish National Antarctic Expedition were communicated, namely, the South Orkney Collembola: Prof. G. G. **Carpenter**; the Turbellaria collected by the expedition: Drs. J. F. **Gemmill** and R. T. **Leiper**; and the *Echinorhynchus antarcticus*: Dr. J. **Rennie.** The last paper was an account of a new species of parasitic worm obtained from the stomach of a Weddell whale.

PARIS.

Academy of Sciences, April 2.—M. H. Poincaré in the chair.—Photography of the solar protuberances with coloured screens during the eclipse of August 30, 1905: H. **Deslandres** and G. **Blum.** The object of the work was to use coloured screens in order to cut off, as far as possible, all the permanent gaseous radiations of the protuberances. Three screens were used, a green screen transparent from λ 505 to λ 580, a lighter green screen transparent from λ 500 to λ 580, and a yellow screen transparent for the red, orange, and yellow. Owing to the presence of some clouds the scheme could not be carried out completely, but the general results were satisfactory, and the authors recommend the method for use in future eclipses.—The action of the radium emanation on chromogenic bacteria: Ch. **Bouchard** and M. **Balthazard.** There are two groups of chromogenic bacteria; in the first the colouring matter produced remains adhering to the bacterium, in the second the colouring matter becomes diffused throughout the culture medium. The radium emanation is not capable of modifying the chromogenic power of the first group, but exerts a distinct effect on the second group. A detailed study was made of the pyocyanic bacillus, and it was found that, amongst the various biological properties of this organism, the power of secreting pigments was the one most sensible to the action of the radium emanation. The virulence of the organism was also clearly reduced; much larger doses of the emanation were necessary to affect the reproductive power of the organism.—The heart of King Rameses II. (Sesostris): M. **Lortet.** The microscopic characters of the muscle peculiar to the cardiac muscle of the heart were clearly made out.—A new arrangement of the spectroheliograph: G. **Millochau** and M. **Stefanik.** The spectroheliographs at present in use have the disadvantage of registering on the photographic plate all the vibrations produced by the various rolling and rubbing parts used in the construction. In the instrument described an attempt has been made to reduce these effects.—Remark on the preceding note: J. **Janssen.**—The analytical reduction of any system of forces in E_n: P. H. **Schoute.**—Hypertranscendental functions: Edmond **Maillet.**—The most probable numerical value of the ratio ϵ/μ_0 of the charge to the mass of the electron in the kathode rays: C. E. **Guye.** A correction is introduced into the usual formula for deducing the ratio of the charge to the mass of the electron, the effect of which is to reduce the difference between the experimental values of Simon and Kaufmann. This result is favourable to the hypothesis of the identity of the electrons which constitute the kathode rays and the β rays of radium.—The influence of compressibility on the formation of drops: H. **Ollivier.** It is shown that the formation of small liquid drops is largely influenced by the elasticity of the walls and by the compressibility of the liquid; the experimental measurements can be applied to measure the latter.—The halogen combinations of thallium: V. **Thomas.** A thermochemical paper.—The action of some alkaloids with respect to pollen tubes: Henri **Coupin.** Most alkaloids have a very toxic action on pollen tubes. Certain alkaloids, which for a given dose are toxic to the tubes, at a greater dilution may actually serve as food.—The action of carbonic acid on the latent life of some dried seeds: Paul **Becquerel.**—A contribution to the physiology of grafting: G. **Rivière** and G. **Bailhache.**—Some larval forms from the collections of the Prince of Monaco: H. **Coutière.**—The isopods of the French Antarctic Expedition: Mlle. Harriet **Richardson.**—The influence of feeding on the value of the urological coefficients and on the mean weight of the molecule elaborated: A. **Desgrez** and J. **Ayrignac.** The experiments were made on twenty-five healthy subjects, and the effects of varying diet studied. The diets included milk alone; milk, eggs, and vegetables; milk and vegetables; mixed diet, with a little meat; mixed diet, with much meat; and an absolutely vegetarian diet. The results are given in tabular form.—Demonstration of the fibrinogenic function of the liver: MM. **Doyon**, Claude **Gautier,** and Albert **Morel.**—The origin and mode of formation of Oolitic iron minerals: Stanislas **Meunier.**

DIARY OF SOCIETIES.

WEDNESDAY, APRIL 18.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Some so-called Vagaries of Lightning reproduced Experimentally: A. Hands.—Note on the Value of a Projected Image of the Sun for Meteorological Study: Catherine O. Stevens.

ROYAL MICROSCOPICAL SOCIETY, at 8.—*Exhibition:* Lantern Slides of Plant Structure prepared by Mr. A. Flatters.

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