THURSDAY, AUGUST 21, 1902.

A MONOGRAPH OF THE BRITISH LIVERWORTS.

The Hepaticae of the British Isles, being Figures and Descriptions of all Known British Species. By William Henry Pearson. Vol. i. text, vol ii. plates. Pp. vi + 520, and vii + plates 218. (London: Lovell Reeve and Co., Ltd., 1902.) Price 7*l.* 10*s.* net.

A TRUSTWORTHY work on the British Hepaticæ has long been needed by those who are interested in this somewhat difficult group of plants. Since the appearance of Sir W. J. Hooker's "British Jungermanniæ" in 1816, we have had no treatise on our native species that can be regarded as either up-to-date or as of much use to the student. A beginning was made some years ago by Dr. Carrington in cooperation with the author of the volumes before us, but, unfortunately, the attempt was not destined to meet with success, and the enterprise was abandoned at an early stage of its publication.

So many new forms have been added to the British flora since Hooker's time, partly as the result of revisions of older species and genera and partly owing to the discovery of new ones, that the whole subject has come to present a very different aspect from that which it wore ninety years ago. The vast majority of hepatics were then included in the single genus Jungermannia, whereas only comparatively few species are now retained in it. A more extensive study has gradually rendered it possible to segregate the species into smaller and more natural groups, such as are familiar to those who have been accustomed to use the well-known "Synopsis Hepaticarum" of Gottsche, Lindenburg, and Nees v. Esenbeck.

It is pleasing to remember that our own countryman Spruce, who added so much to our knowledge of liverworts, was one of the foremost to discriminate between, and give expression to, the affinities existing between the species of the larger and more complex genera. He was thus able to break up these unwieldy collocations of species into smaller and more manageable subgenera.

Mr. Pearson, in the fine work before us, has adhered to the general arrangement of Spruce as laid down by him in his "Hepaticæ Amazonicæ" and elsewhere, which has, with more or less modification, served as the basis for most of the modern forms of classification. The first volume is devoted to the text, and opens with an introductory chapter in which organography and other preliminary matters are very briefly dealt with. It is in connection with this chapter that we would express regret that Mr. Pearson should have allowed to slip by the opportunity of attempting some reform in the esoteric terminology that has grown up in association with this group of plants. Many terms possessing a perfectly well-known meaning in connection with the rest of the vegetable kingdom are, in the systematic literature of Hepaticæ, habitually distorted so as to imply something totally different from what they mean elsewhere. Thus the so-called stipules are not in the least degree comparable with stipules as generally understood, and the word ought to be altogether dropped in favour of *amphigastria*, a neutral term that may well be retained to designate the ventral leaves of these, usually dorsiventral, plants. The radially constructed species prove clearly enough that the amphigastria have nothing to do with true stipules, but are merely special leaves which owe their particular (often reduced) form to the dorsiventral habit of the stems. To continue to apply the older and misleading term of stipules to these structures is clearly an unjustified anachronism. Similarly, the expressions "Postical" and "Antical" might with advantage be replaced by the words Dorsal and Ventral, as universally used elsewhere. And once more, why continue to speak of "Pistillidia" instead of Archegonia, the word invariably employed in modern botanical works to designate these structures? Of course, Mr. Pearson is not to be held responsible for the introduction of these terms; they are of hoary, and we had hoped of senile, antiquity. And though he has probably retained them purposely, we could have wished that he had otherwise decided.

As regards the rest of the work, there is much deserving of praise. The descriptions of the species are clear and full, and the shorter notes that accompany many of them are interesting and often of critical value. Especially is this the case with species likely to be easily confounded. The special diagnostic characters are then discussed and emphasised, as, for example, in the two common species of Pellia, *P. calycina* and *P. epiphylla*. Curiously enough, however, no reference is made to the anatomical differences, pointed out by Leitgeb, between the cells of the thallus in these two plants. The geographical distribution of each species is mentioned, and frequently the actual localities also. Naturally these are not exhaustive, and those especially who have collected the plants in the more southern parts of England will be able readily to supplement them. Some species that are described as rather rare, *e.g. Reboulia hemispherica*, would probably not be so regarded by many people. A glossary, table of literature and a good index complete the volume. A chapter on the interesting biological features in which the liverworts are so exceptionally rich would have been a welcome addition to the book. There is hardly another family of plants that displays so manifold a variety of form or such a remarkable series of structural modification in relation to the environment as does that of the hepatics, and these fascinating adaptations deserve far more attention than they commonly receive.

The second volume is devoted to the figures, and it contains no fewer than 228 plates. These form a splendid adjunct to the text, and will prove of material service in the proper identification of the various species. The plates are in nearly all cases excellent, and each generally includes a life-size representation of the species, as well as drawings, on a large scale, of dissections, fructifications, &c. The cellular structure of the leaves is also depicted, and this will often be found of much value in deciding between doubtful cases. In the genus Fossombronia the spores are carefully drawn, as furnishing perhaps the most easily recognised characters by which the species of this somewhat difficult genus can be identified.

Although we have freely criticised certain features in the book wherein our own judgment happens not

altogether to have coincided with that of the author, we have done so feeling that to pass over these points of difference would be to pay Mr. Pearson but a poor compliment. For we fully recognise the great value of the work in all essential matters, and we cannot but admire the energy with which a task of no ordinary difficulty has been carried to completion. Mr. Pearson has laid British botanists under great obligations, and has succeeded in producing a book that ought to serve to rescue from comparative though altogether unmerited oblivion a family, by no means the least interesting, of the vegetable kingdom. J. B. FARMER.

STRUCTURALLY ACTIVE MEDIA.

De la Double Refraction elliptique et de la Tétraréfringence du Quartz dans le Voisinage de l'Axe. Par G. Quesneville. Pp. xiv + 361; avec 4 planches. (Paris: Gauthier-Villars et Fils, 1898.)

THE peculiar phenomena exhibited by quartz in directions slightly inclined to the optic axis were explained by Airy in 1831 on the hypothesis that in any such direction two streams of permanent type can be propagated, these streams being oppositely and elliptically polarised with their planes of maximum polarisation respectively parallel and perpendicular to the principal section. With the aid of these assumptions, he calculated the forms of the interference patterns displayed in plane and circularly polarised light by plates of quartz perpendicular to the optic axis, and also discussed the remarkable phenomena that are observed when two such plates of equal thickness but of opposite rotations are superposed and traversed by a convergent stream of polarised light that is subsequently analysed. The close agreement between these calculated results and the experimental forms of the curves led to a general acceptance of Airy's views, and the conviction of their correctness has since been strengthened by experimental investigations of a more direct character.

This theory M. Quesneville, without disguising the magnitude of the task, has undertaken to refute, replacing it by a new one devised by himself. He maintains that the interference exhibited by plates of quartz in polarised light is in at least one important particular at variance with the results calculated by Airy, and claims that Jamin's investigations (the only experiments that he discusses), so far from confirming the accepted theory, actually lend support to that which he himself enunciates. Further, he alleges a theoretical objection to Airy's hypotheses. According to these there is, of course, a continuous change in the polarisation of the waves of permanent type as the position of their normal changes from a direction inclined to the optic axis to that of the axis itself, while it is the circular polarisation, and not the rotary phenomenon, that is the fundamental property of an active crystal in this latter direction. M. Quesneville, however, contends that Airy's formulæ involve a discontinuity in the phenomenon, inasmuch as a rotation of the primitive plane of polarisation nowhere occurs therein, for "s'il existe suivant l'axe, il est inadmissible que tout près l'axe, alors que les ellipses sont presque des cercles, elle ait disparu."

This idea is the key-note of his own theory, according to which the streams in an active crystal, propagated in a direction slightly inclined to the optic axis, only become of permanent type after a certain zone has been traversed within which a rotation of the plane of polarisation is "le phénomène primordial." On entry into the crystal, a beam of plane polarised light is supposed to be resolved into two elliptically polarised streams of opposite sign with their planes of maximum polarisation respectively parallel and perpendicular to the primitive plane of polarisation; after a small distance has been traversed, these are regarded as having for their resultant a stream that is plane polarised in a new azimuth, while this is, again, equivalent to two fresh elliptically polarised streams; this process is supposed to continue during passage through the first zone, within which the elliptic vibrations change both in form and in orientation. It is not clear what circumstances determine the limitation of the zone, but it is assumed that after a certain length of path, that diminishes as its inclination to the axis increases, the two elliptically polarised streams cease to occasion a rotation of the last plane of polarisation, and that they then enter the second zone, where each gives rise to two streams of the permanent type assumed by Airy. In this manner the four-fold refraction of quartz in the vicinity of the axis is arrived at; there is, however, no assumption of more than two wave-velocities corresponding to a given direction, neither is there any recognition of a separation of the streams by refraction, so that the four elliptically polarised waves may be grouped together in pairs, the constituents of each group travelling with the same speed in the same direction, and there consequently is no question of a four-fold refraction, even if the author's contention be correct.

The limitation of this review precludes a discussion of the physical and mechanical difficulties involved in these ideas; they are, however, sufficiently obvious. It is claimed that the theory is not merely kinematical, but that it represents the actual state of things that occurs during the passage of light through a plate of quartz, though its author confesses his inability to formulate any hypothesis respecting the distribution of the ether round the axis of an active crystal from which it could be deduced.

The book in which this theory is expounded is divided into three sections, preceded by an introduction giving a sketch of the plan and scope of the work. In the first section the author discusses some investigations prior to his own. MacCullagh, in 1836, showed that the addition of certain terms to the differential equations of motion for inactive uniaxal crystals would lead to the elliptic polarisation assumed by Airy. Starting from a mistaken conception of the significance of these equations, M. Quesneville professes to show that "Convenablement interpretées," they prove that

"Il existe dans le quartz une première zone pendant laquelle les rayons dès l'entrée donnent lieu à la rotation du plan primitif de polarisation, non seulement suivant l'axe, mais obliquement à l'axe jusqu'à la périphérie."

He then proceeds to a discussion of Jamin's experiments, deducing therefrom the result that in calculating the difference of phase between the two oppositely polarised

streams, introduced by passage through a plate of quartz, only the distance travelled in the second zone is to be taken into account. It may at once be conceded that Jamin's results do not afford a very striking confirmation of Airy's theory, which may in great measure be attributed to the experimental methods that he employed; but M. Quesneville in his criticism does not appear to have sufficiently recognised the distinction between the phase-difference of the streams on emergence into air and that of the rectangular plane polarised components of the resultant elliptically polarised train of waves.

In the second section we have the author's own experimental investigations, that were made with double prisms of quartz cut in different directions with respect to the optic axis and arranged in the shape of rectangular parallelopipeds. When the primitive polarisation is circular, M. Quesneville's theory leads to the same final results as that of Airy, but a divergence occurs when the initial polarisation is plane. Consequently it is found in accordance with both theories that if the light traverse the first prism along the optic axis and its path in the second be inclined to this direction, the emergent pencils can be completely quenched by means of a quarter-wave plate and an analyser; on the other hand, with a pair of prisms, such that the direction of propagation of the light was in the first perpendicular to the optic axis and in the second inclined to it at an angle varying from 5° to 9°, M. Quesneville was unable to obtain complete extinction of the emergent streams either with an analyser alone or with a quarter-wave plate and analyser, whatever might be their orientations. He thence deduced the inference that each pencil is formed of two elliptically polarised streams of opposite rotations that, having traversed the quartz with the same velocity, remain superposed on emergence, and on this experiment he relies for his proof of the four-fold refraction of quartz near the axis. It is noteworthy that this result was only obtained with small prisms, a fact for which a very inadequate explanation is offered.

The last section is devoted to a discussion of the rings produced by plates of quartz in polarised light. Two instances must suffice to show the manner in which Airy's formulæ are treated. On p. 280 it is argued that these would give the so-called quadratic curves even when the initial and final planes of polarisation are parallel, the fact being overlooked that the term that introduces this form of the curves has a factor that is then equal to zero; and on p. 341 the result that in the same circumstances the circles in white light would be black instead of coloured is deduced by equating to zero a sum of essentially positive terms. This section, however, contains several points of interest, the most important being the question whether or no circles exist in conjunction with the phenomenon known as Airy's spirals. In the photographs published in the book these circles do not appear, though they are present in those given by other authors. A question therefore arises as to the accuracy of the plates employed by M. Quesneville, but if his contention be proved it must be recollected that Airy's result is confessedly only approximate, and it is possible that a more complete investigation would lead to a formula giving spiral curves alone.

The book is wanting in the clearness of exposition that we are accustomed to expect from a French writer on a physical subject, and it is a matter for regret that the author, in his anxiety to make a strong case for his own views, should have permitted himself to repeatedly accuse Verdet and other physicists of "prudently passing over in silence" facts that tell against the theory that he is attacking.

ELEMENTARY PHYSICS.

A Text-book of Physics, with Sections on the Applications of Physics to Physiology and Medicine. By R. A. Lehfeldt, D.Sc. Pp. 304; 112 figures. (London: Edward Arnold, 1902.) Price 6*s*.

A COMPLETELY new arrangement has been adopted in this book in the order in which subjects are presented to the student. The traditional order of the text-book of physics has been abandoned, in many cases with advantage, but often a student will be sadly at loss in consequence. He will find it hard to fathom the object of proving (p. 81) that the elasticity of a gas is equal to its pressure before he is familiar with the idea of the elasticity of liquids (p. 85) or of solids (p. 130), and he can derive little help in his efforts by being given for the time being the definition of "constant ratio of stress to strain" when the immediate object is to prove that it is not constant, but equal to the variable p. The study of gases alone would never have suggested attaching importance to the ratio of stress to strain.

Again, to take another example, the subject order adopted involved introducing in connection with conductivity of heat (p. 72) the question of the anomalous expansion of water described later (p. 90).

Likewise, in treating of electrolysis (p. 188), the term electrical charge is used without explanation. In the order adopted this does not appear until p. 249.

Of course, it is not always possible to avoid such anticipations. Students often, however, in consequence fancy they do not understand the point in hand, when it is really the anticipation which is troubling them.

In the order of the chapters, "Heat" comes before "Properties of Fluids," and next comes "Properties of Solids." Sometimes the analogies adopted in consequence come quaintly to one accustomed to the old traditional order of things, and are apt to appear upside down, as the analogy taken from conductivity of heat to help the reader to grasp the idea of flow in liquids.

The work contains a vast number of distinct things for its size. Scarcely any branch of physics is omitted, but it is a question whether there is not too much in the book and whether less matter more carefully arranged would not have better chance of sticking. We must avoid giving our students mental indigestion from overloading. There is an unpleasant feeling throughout of being rather rushed, and that nothing must be left out which the external examiner may perchance alight on in setting the paper. Perhaps the fault, if it be one, may not lie with the book.

The attractions and repulsions of currents appear to be no further alluded to than in the statement describing the Kelvin current balances, that "of the two fixed coils on the right, one attracts the movable coil

near it, the other repels," leaving the reader to wonder why they do not both attract or do not both repel, or, indeed, why on earth they do either.

The plan of describing instruments and their working instead of the principles involved is to be deprecated in elementary text-books. At the very outset (p. 5) a description of how a tuning-fork is run by an electric current is given, with an explanation of the mode of action which, were it true, would mean that the vibration of the fork could not be kept up by the current. It seems unnecessary at the start to introduce the question at all, but if it must be so, the student should certainly be warned of the necessity of supposing some lag in the current.

One or two serious errors have crept in and must be altered in any future edition. In describing rigidity, the ordinary definition of a simple shear is given, but what follows will certainly bewilder the student.

"When a pair of steel shears or scissors is used, the force applied is distributed over a very small area, the area of the 'edge' of the shears, so that the shearing stress (per sq. cm.) is great, and the finer the edge the greater the stress becomes; consequently the material so stressed can be cut."

The area here spoken of is at right angles to the area meant in the definition, and in fact has nothing to do with the simple shear. Besides, the action in question is in reality anything but a simple shear.

Another passage requires rewriting. The air supplied to an organ pipe is spoken of as

"setting in motion a reed fixed in the end, or if there be none, the 'lip' or thin lamina of wood or metal near the front aperture of the pipe."

One misses the old familiar fundamental experiments of the text-books, and in many cases this absence is to be regretted. Thus, at p. 251, the attractions and repulsions of electrified bodies are not described as fundamental observations, but follow as corollaries in rather a cart before the horse fashion from the assumed shortening and swelling of things called lines of force. The student is given a picture of lines of force, and is told that it is "evident that positive and negative charges attract each other."

On p. 233 the metals have got evidently inverted, when it is said that "both soft iron and steel show retentivity, the former to even the greater extent of the two."

It is errors such as these which are just the ones which trouble the student.

From what has been said it might be inferred that the book was found to be without interest; such is not the case. With some alteration it is easy to imagine it made into a thoroughly useful one, especially for medical students, for whom it was more particularly written. The chapter on chemical physics is splendid and forms a most excellent introduction to the subject. The chapter on light is also good. Here the diopter system is introduced with effect; the parts touching on geometrical optics are simply described, no proofs being given. This has much to commend itself in a book of this scope, but at the same time the average student must not be asked to draw conclusions without being carefully given the premisses, as at p. 281, where he is told without further ado that "the distance B F is called the focal length and in case of a mirror is *clearly* half the radius of curvature." A first-class student will see there is something to prove and will prove it; others will not do either. This sort of thing tends in the long run to woolliness in thinking.

The book is well printed and the diagrams are good. There are few misprints; the following, however, were noticed and are given with the view of correction in a future edition. On p. 41, *l.* 32, heads should be altered to beads; p. 60, *l.* 21, 19°·57 to 195°·7; p. 78, *l.* 17, T to P; p. 141, *l.* 35, 0·93 to ·093; p. 267, *l.* 5, E to F.

On p. 180, *l.* 11, 48 watts per hour are spoken of; "per hour" should be omitted.

On p. 240 we find it stated that if a wire of length *l* be moved across a field of strength H, "the electromotive force due to a motion of 1 cm. will be proportional to *l*H"; "per sec." has dropped out.

THE VOICE AND RESPIRATION.

Health, Speech and Song: a Practical Guide to Voice-production. By Jutta Bell-Ranske. Pp. 158. (London: Swan Sonnenschein and Co., Ltd.; New York: E. P. Dutton and Co.) Price 4*s.* 6*d.* net.

ALTHOUGH the subtitle of this book is "A Practical guide to Voice-production," the space is chiefly occupied by a description of the organs of voice and respiration, accompanied by statements of the somewhat peculiar views of the author as to the anatomy and physiology of these organs, and criticisms of the views of the many schools of voice-production. There are but a few pages devoted to giving practical instructions on the training of the voice, and what little is said upon this subject is too vague and general to be of much service.

The book throughout is written in a very rhapsodical fashion, so much so that it becomes exceedingly difficult to trace out any meaning in some of its passages, while in other cases the effect produced can only be described as ludicrous.

The following passage may be cited as illustrating this:—

"Since I have stated that the vocal instrument consists of three elements, it might at first appear that each element must be of equal importance. And if the motor element which drives the organ were given us for the sole purpose of creating song, it would be so, but this element has a far more important function, being the element of life itself; hence song becomes only an overflow of life. Life is breath."

The author repeatedly deplores the ignorance of physiology shown by voice trainers, but the physiological statements made in the book are often very peculiar and occasionally erroneous. Thus it is stated on p. 27 that

"The diaphragm flattens, that is, is drawn down. The chest is expanded upwards, downwards and outwards, at the expense of the abdomen. The floating ribs, which are attached to the outer rim of the diaphragm, are pressed forward and outwards, thereby greatly expanding the bases of the lungs, an act which constitutes rib or costal breathing."

Other statements in the book (p. 28, *et seq.*) clearly show that the author confuses costal and diaphragmatic breathing, regarding these as identical and to be care-

fully distinguished from abdominal breathing, which is stigmatised as an exceedingly vicious process.

The description of the larynx and its muscles given in chapter iv. is very amusing to a person who is only acquainted with that organ as usually described. Thus, on p. 44, we are gravely told, though certain important intrinsic muscles of the larynx have been passed over without a word, that

"The only muscle that remains to be mentioned is the epiglottis, which is a thin, leaf-shaped cartilage that covers the aperture of the larynx when we eat, so as to prevent anything entering the voice-tube when food passes into the gullet (œsophagus)."

Many of the chapters in this novel scientific treatise are headed by beautiful quotations, such as

"He likened her voice to a string of pearls."

"And pure the pearls of matchless beauty they,
Yet purer still her song, for there was soul therein."

It may have been these quotations which suggested the statement to the author that song when not improved by development of the psychological side is a "pearl of value, but a *dead* jewel for all that."

The author deprecates the misunderstanding of psychology as it is used in voice-production; this arises, it is stated, from confusing its component parts, which are:—(1) Cognition—knowing; (2) volition—will; (3) feeling—affective states. Certainly there seems to us to be some ground for confusion here, especially as the author explains the matter no further, but simply leaves it thus.

In a chapter on deportment we are told that more than half the trouble existing around us springs from neglect of the diaphragm, and in this chapter also is found the remarkable statement that

"The contraction of the diaphragm flattens the abdomen, and invigorates all the various muscles that influence the liver and kidneys."

A very short chapter follows on "Advice to Singers," and the book then concludes with a recapitulation of the views of various authors as to the musical instrument which the voice most closely resembles.

B. MOORE.

OUR BOOK SHELF.

The Principles of Simple Photography. By F. W. Sparrow, R.N. Pp. 130. (London: Hazell, Watson and Viney, Ltd., 1902.) Price 1*s.* net.

THERE are now so many guides for beginners in photography that the first question with regard to a new one is as to the reason for its production. It is fitting that the author, who dates from H.M.S. *Royal Oak*, Mediterranean, should give a chapter on shipboard photography and hints for work abroad. This is evidently a description of the results of experience, and as such is a valuable record. It is, however, rather straining matters to suggest that differences of exposures of *six*, or even twenty, per cent. would make an appreciable difference in the result, even if it were possible to obtain plates of a uniformity of sensitiveness that would render such variations possible. The desirability of carrying plates rather than films is insisted on "for several reasons"; they can be obtained at almost any port of call, and on the whole are more trustworthy and more easy to work. The methods of extemporising a dark room on board ship are clearly described, and the apparatus in general and water supply are practically considered.

The other part of the book deals with apparatus, plates, exposure, development, printing, picture composition, &c., in very much the old-fashioned way. For development, pyro. and ammonia are prescribed, and the operation is either "normal," that is, rapid and risky, or "tentative," that is, slow, with the gradual addition of the accelerator. So long as the author follows the usual lines his information is trustworthy and useful, if not quite up to date; but when he departs therefrom he is not always a safe guide. The idea that "the perspective of a picture depends entirely on the focal length of the lens" is erroneous, though perhaps not original. There is confusion in the statement that a "very high tower with parallel sides" will show a convergence towards the top. We do not remember any guide to photography before this which states that the diaphragm cuts off the light that passes through the circumferential portions of the lens and thus gives the equivalent of a lens of smaller diameter; or that "chemical fog" (produced by unwise development) may be removed by an acidified alum clearing bath; that in fixing "the emulsion is eaten away from . . . the plate"; that a perfectly trustworthy method of intensification still remains to be discovered; that when varnishing, if the negative is made too warm the film will melt; that in modern printing out papers "the emulsion is composed of nitrate of silver—replaced by a chloride in toning—which is borne on a gelatine solution: hence the term gelatino-chloride paper"; that in many cases "hypo. is used to bleach the pulp" of which paper and mounting boards are made. Blemishes such as these enforce the opinion that, although this is one of the newest elementary guides for beginners in photography, it is not one of the best.

Philosophy of Conduct. By G. T. Ladd. Pp. xxii + 663. (London: Longmans, Green and Co., 1902.) Price 21*s.*

PROF. LADD'S remarkable industry is once more evinced by this bulky and comprehensive work on ethics. The general standpoint adopted, which will be already familiar to readers of other books by the same author, is that of idealist philosophy tempered by a strong interest in the facts and methods of psychology and anthropology. Prof. Ladd's latest work, while presenting a fairly complete survey of the facts of morality from this point of view, can hardly be said to add anything fresh to our comprehension of the theoretical and practical problems raised by the moral life. The author's arrangement of the subject-matter is perhaps adapted to be of service to students beginning a course in moral philosophy, though the connection he seeks to establish for it with the fundamental factors in psychological analysis seems forced. He treats first of the psychology of the moral life, the nature of the feelings of obligation and approbation, the origin and meaning of moral personality and moral freedom; next of the different types of action esteemed as virtuous or right by the moral judgment; and finally of the metaphysical implications of ethics and religion as held by believers in a personal absolute being. His treatment of the psychology of ethics, though largely acceptable to thinkers of all schools, suffers from a certain want of thoroughness and tendency to dogmatise. This is partly due to his habit of presupposing the results of his previous works on psychology. Now this would be a defensible plan of procedure if systematically followed, but it is at least tantalising to be offered lengthy disquisitions upon such all-important topics as moral freedom and personality, in which all the crucial positions are simply taken for granted. Prof. Ladd should either have dispensed with discussion at all or have made his discussions more thorough. Incidentally I may remark that the professor shows some acrimony in his treatment of opponents, frequently hinting that their opinions on the psychology and metaphysics of ethics are morally "dangerous," and now and then descending to the calling of names. There is a

particularly deplorable personal reference at p. 417 which might well have been spared.

The fundamental difficulty in the author's psychological theory is his ambiguous treatment of the self. He speaks of it, now as a product and process of development, in terms which seem to identify it with the moral character, again as a mysterious something behind character and acting causally upon it. The discussions of particular virtues in part ii., if somewhat too diffuse, are, to my mind, the most suggestive things in the whole book. In part iii. the attack on "utilitarianism" is too bitter to be discriminating. Egoistic Hedonism may be an illogical theory, but an egoistic Hedonist need not in practice be a worse man than his neighbours; it is mere vituperation to assert that "few prostitutes are so vile" as to be egoistic Hedonists.

The religious problems raised and in part treated by Prof. Ladd are too grave to be dealt with in a summary note like the present. A. E. T.

The Thompson Yates Laboratories Report. Edited by Rubert Boyce and C. S. Sherrington. Vol. iv., part i., 1901, and vol. iv., part ii., 1902. Pp. 563. (London: Longmans and Co.)

THE first ninety pages of part i. of this Report are occupied by a description of the filariæ or blood-worms obtained by the Liverpool Expedition to Nigeria. This practically constitutes a monograph upon this important group of parasites, is from the pen of Messrs. Annett, Dutton and Elliott, and a number of new species are described and illustrated. Dealing with human filariæ, the opinion is expressed that, notwithstanding certain differences between them, the weight of evidence is on the side of the identity of *Filaria nocturna* and *F. diurna*. The bibliography accompanying this paper should prove of the greatest value to future workers in the subject. The other important papers in part i. are the "Flora of the Conjunctiva in Health and Disease," by Dr. Griffith, and the use of bile-salt broth as a test for fæcal contamination, by Drs. MacConkey and Hill. The former gives a very complete account of the bacteriology of the conjunctival sac, and, like Lawson, Griffith has found the Xerosis bacillus to be a common inhabitant of the normal sac. In MacConkey and Hill's bile-salt broth we have a very useful medium for the detection of the *Bacillus coli* and allied species in water, but the procedure recommended, viz. to add 1 c.c. of the water to each of three tubes, would detect, in all probability, only a highly polluted water, not one in which the *B. coli* was present in small amount, in which case it is essential to concentrate the water by filtration through a porcelain filter and to examine the deposit. The same remarks apply to the examination of samples of the Liverpool water supply; the quantity of water examined (1 c.c.) is far too little to give a trustworthy negative result.

In part ii., Mr. Macdonald contributes an exhaustive paper upon the "Injury Current of Nerve," and Dr. Grünbaum and Prof. Sherrington make an important contribution to the physiology of the cerebral cortex in the higher apes. Dr. Annett produces some startling figures relative to the frequency of expectoration in public thoroughfares and the risk of infection with tuberculosis therefrom. The volume contains several other papers of minor importance upon various points of bacteriological, pathological and clinical interest, and concludes with the Report of the Liverpool Expedition to Brazil to study yellow fever, by Dr. Durham and the late Dr. Myers. The latter is somewhat disappointing, the ætiology of yellow fever being left very much where it was, save that a fine bacillus, difficult to stain and impossible to cultivate, was detected in the tissues.

In conclusion, it may be said that these volumes maintain in every respect the standard of their predecessors. R. T. H.

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.*]

Sunset Effects.

AT Baveno (Lago Maggiore) on the evening of July 10, when the sun was setting behind the mountains in the north-western quarter of the horizon, a number of bright streaks of light appeared to radiate from behind a bank of clouds in exactly the opposite quarter of the sky. As these streaks were very bright near the point from which they apparently emanated and gradually faded away with increasing distance from that point, the effect was to produce the impression that the sun had set in the south-east instead of in the north-west. The explanation of the phenomenon is perfectly simple, being that the beams of sunlight, cut off by clouds and mountains, had travelled overhead through a clear atmosphere and, reaching the hazy air over the plains of Lombardy, had illuminated this air, which was especially thick at a point opposite the sun, the streaks appearing to converge to a vanishing point by the laws of perspective. The effect no doubt occurs whenever the necessary conditions prevail, viz., banks of clouds or mountains in the direction of the setting sun, a clear sky overhead and a thick atmosphere in the quarter opposite the sun.

G. H. BRYAN.

THE letter on iridescent sunset effects in the current number of NATURE (p. 370), and the correspondence now going on in the columns of *Science*, prompt me to send the following extract from my journal which was made on board the barquentine *Dayspring* while lying at anchor in Friday Island Passage, Torres Straits, on November 29, 1897:—

"The sun was setting behind cumulostratus clouds, while a little to the southward the horizon was occupied by a large storm cloud through which lightning was constantly playing, and other clouds of various types were scattered over the sky. Behind the storm cloud and between it and the sun were several very fine even-textured cirrostratus patches; these assumed *prismatic* coloration. The colours were very vivid and included the blues and greens as well as those of the red end of the spectrum; and they appeared to be arranged in the sequence of Newton's rings. The appearance of the clouds reminded me of a polarisation phenomenon. The colours were disposed in broad concentric bands shading into one another; they appeared to be dependent upon the *thickness* of the cloud mass, and were most brilliant at its thinner parts. The colours changed but slightly as the sun sank behind the horizon, but after a time the prismatic effect gave place to the ordinary sunset glow."

The phenomenon thus described made a great impression upon me at the time, and I am quite convinced that it had nothing in common with the normal "glow" reflected by the setting sun. S. PACE.

Hounslow, August 18.

THE OLDER CIVILISATION OF GREECE: FURTHER DISCOVERIES IN CRETE.[1]

IN a review of No. VI. of "The Annual of the British School at Athens," published last year (vol. lxiv. p. 11), the great importance of the discoveries of Mr. A. J. Evans at Knossos in Crete was pointed out, and the opinion was expressed that that volume contained "matter of extraordinary interest to students of the history, not only of Greece, of Egypt, and Western Asia, but also of mankind in general," for, since "the culture which now dominates the world is the child of the civilisation of Ancient Greece, . . . any archæological discovery which tends to increase our knowledge of the beginnings of Greek civilisation possesses an importance and an

1 "The Annual of the British School at Athens." Part vii. Session 1900–1901. Pp. vii + 191. (London: Macmillan and Co., Ltd.)

interest far greater than that of any other possible discovery whatever in the archæological field." The writer then proceeded to sketch briefly the position of Mycenæan civilisation in history, insisting more especially upon what is now a commonplace of archæological knowledge—the fact that "the culture of classical Greece, as we know it, is but the second epoch of Greek civilisation. Classical Greece had a past, the true history of which had been half forgotten, had been preserved in confused and contradictory legends. The culture of the past had bloomed from end to end of the Greek world, in cities, some, like Athens or Knôssos, of renown in classical as well as præ-classical days, others, like Mycenæ and Tiryns, cities whose fame ceased to be when the Dorians entered Greece. This culture was bronze-using, and was, in fact, the Greek phase of the European culture of the Bronze Age, a phase earlier in date than the phases of Central and Northern Europe, and in all probability not only their forerunner, but to a great extent their forebear."

In Mycenæan discovery progress is swift, and the ideas of one year are never precisely those of the year before; and since these lines were penned the appearance of Prof. Ridgeway's "Early Age of Greece" has caused many defenders of the usual view to look well to their armour. For many weighty reasons which cannot be discussed here, it does not, however, seem probable that the view that the Mycenæan culture was not only the forerunner, but the forebear of the European culture of the Bronze Age, will be hastily abandoned in favour of the interesting theory propounded by Prof. Ridgeway. The discoveries of the last two years have pushed back the existence of human civilisation of the highest and most developed type in the Ægean basin to so remote a date B.C. that the possibility of this culture having derived its origin from Central Europe is fast fading away; it is to Egypt, if anywhere, that we must look for the first impulses of Ægean culture, and it is to this Ægean culture that we must look for the origins of the European civilisation of the Bronze Age. So that while it may be an exaggeration to say that the relation of the prehistoric civilisation of Greece to this general European culture is quite clear, it is none the less a mere affectation of reserve to imply that the nature of this relation is not, generally speaking, pretty clearly indicated by what evidence we have. The evidence points to the Ægean culture having been the forebear of the general European civilisation of the Bronze Age, of which it itself may be regarded as the Greek phase.

No dogma can be proclaimed as to the ethnic affinities of the people to whom this Ægean culture belonged. In "The Oldest Civilization of Greece," pp. 105, 202, the present writer has essayed the opinion that "the Mycenæan culture had well begun before the arrival of the Aryan Hellenes"; and we may, in fact, well hold that its originators belonged to that "Mediterranean Race" of Sergi, which extended from Armenia to Spain. When, however, the fair-haired invaders from the north —the "Celts" of Prof. Ridgeway—descended upon the Ægean world, it would seem that they took over the civilisation of their predecessors, over whom they henceforth ruled and with whom they mingled, while giving them their Aryan language. So it is that "the whole of Greek culture from the solid rock of the Athenian acropolis up" is indeed one, for the civilisation of the Aryanised "Hellene" was directly descended from that of the un-Aryan "Pelasgian" of Knossos or Phaistos without any "very violent break." Thus it is possible, without inconsistency, to write also that "the Mycenæan culture belonged primarily . . . to Hellenes," when one is not using the word "primarily" in the sense of time at all, and when, too, one has expressly, in order to make one's meaning clear even to the most careless critic, inserted between the words "primarily" and "to Hellenes" the sentence (in brackets) "*not entirely or necessarily originally*" ("Oldest Civilization of Greece," p. 104; not in italics in original). The sentence, "the Mycenæan culture belonged primarily (but not entirely or necessarily originally) to Hellenes" cannot be made to disagree with that previously quoted to the effect that "the Mycenæan culture had well begun before the arrival of the Aryan Hellenes," without suppressing the words within brackets, and thus suggesting a meaning for "primarily" not intended by the author.

The present writer holds, therefore, to his opinion, as expressed in "The Oldest Civilization of Greece," that the Ægean culture belonged originally to the præ-Hellenic race or races, but that in all probability some of its most important developments took place among populations already "Hellenised," *e.g.* in Argolis; *i.e.* it "belonged primarily to Hellenes." How far Cretan discovery may modify this position it is impossible as yet to say; in all probability, however, the modification will be in the direction of considerably reducing the probable connection of the Aryanised "Hellenes" (Achaians) with, at any rate, the Cretan monuments of the "Ægean" or early Mycenæan age, and in bringing the præ-Aryan, præ-Achaian population into greater prominence. Such a development has long been foretold by Prof. Ridgeway; but it is not probable that his drastic proposition "No 'Mycenæans' were Achaians" will ever be accepted in its entirety. To him, however, the inception of the idea is due; the point on which one would be inclined to criticise him is his proposition that the Pelasgians were Aryans, which, since the work of Kretschmer and Sergi has appeared, seems an old-fashioned view. Following Kretschmer, the present writer has maintained the view that the primitive population of the Ægean basin was of "kleinasiatisch" race, and that this race was not Aryan, since Lycian, the typical "kleinasiatisch" language, and its cognate idioms, Carian, &c., are obviously not Aryan, *pace* Prof. Bugge and one or two other Scandinavian philologists who still maintain the opposite view. In *Sphinx*, vol. ii. p. 120, the well-known veteran archæologist, Prof. Piehl, of Upsala, still holds the Scandinavian view, saying:

"Nous savons, grâce à Bugge, à Thomsen et à Torp, que cette langue [Lycian], très-vraisemblablement, est d'origine aryenne bien authentique."

With all respect to Prof. Piehl, it, however, must be recorded that, except in Scandinavia, Kretschmer's view seems to be now generally accepted, more especially since his philological results agree so remarkably well with those obtained by Sergi from craniological study.

We shall return to the question of race later; the above preliminary remarks are necessitated by the progress which has been made in Mycenæan study during the past year.

In the present number of the "Annual of the British School at Athens" Mr. Evans proceeds to describe the results of his further excavations at Knossos in 1901, when he was assisted by Dr. Duncan Mackenzie as excavator, and by Mr. D. T. Fyfe as architect. Mr. Fyfe has prepared the very clear and intelligible ground-plan of the palace which accompanies the memoir, and his services have no doubt been, generally speaking, of the greatest use to Mr. Evans, since nobody who has not visited Knossos can have much idea of the great amount of regular architectural, not to say engineering, work which has had to be carried out during the course of the excavations, consisting not only in the housing-over of the Throne Room (illustrated in NATURE, lxiv. p. 14, Fig. 4), but in excavating, shoring-up and underpinning staircases, remains of upper stories, &c., especially in the vicinity of the Hall of the Colonnades (Plan, G 10). Mr. Hogarth, who in 1900 excavated the town-ruins, did not work at Knossos in 1901, but transferred himself to the eastern end of Crete, where he worked on the

Mycenæan site at Zakro; his results are described in the present number of the "Annual."

The operations carried on at Knossos in 1901 are summarised by Mr. Evans on pp. 1, 2. Space forbids us to do more than select for description and discussion some of the more important results of his excavations.

The underlying Neolithic settlement was further investigated, and a report of the results obtained was made by Mr. Evans to the Anthropological Section of the British Association (Glasgow meeting, September, 1901; see NATURE, lxiv. p. 615).

The "Kaselles" (*κασέλλαις*), stone cists or receptacles beneath the floors of the Magazines (see NATURE, lxiv. p. 13, Fig. 2), have been proved to be chiefly safes for the keeping of treasure ("Annual," pp. 44 *ff.*).

The housing-over of the Throne Room has already been referred to. This work was urgently needed to protect the throne, &c., from the weather.

"In order to support the roof it was necessary to place some kind of pillars in the position formerly occupied by the Mycenæan columns, the burnt remains of which were found fixed in the sockets of the stone bench opposite the throne."

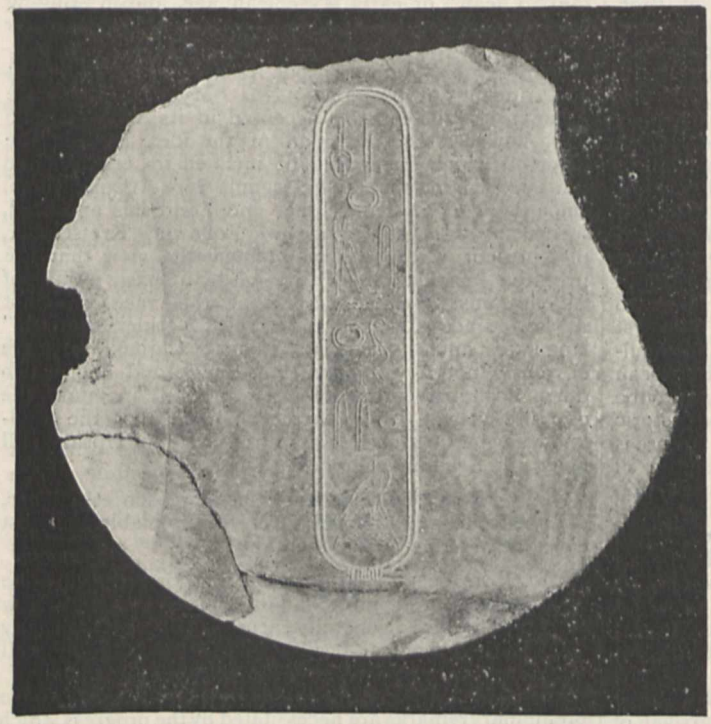

FIG. 1.—Egyptian alabastron-lid, inscribed with the name of the Hyksôs King Khyan (*c.* B.C. 1800). Found at Knossos.

Accordingly pillars of Mycenæan design were erected, and the whole roofed over. This necessary work of conservation is analogous to that at Dêr el-Báheri; no attempt at "restoration," as it is understood on the Continent, has been made. All who have seen the result can testify that it is entirely successful.

One of the chief results of the excavation is the inkling it gives of the great extent of the palace, which seems, in fact, to have not only covered the whole of the knoll on which it stands, but to have descended in a series of several-storied halls and towers down the eastern side of the hill to the bank of the stream which runs below. And now that Mr. Evans has announced the discovery at Knossos this year of contemporary representations of Mycenæan houses we may perhaps be able soon to acquire some idea of what the palace may have looked like when seen from the opposite eastern downs or from the way leading up from the sea. Mr. Fyfe's restored longitudinal section and plan (Fig. 33) give a very good idea of how the palace descended the eastern slope. On the left is seen one of the most sensational of Knossian discoveries, the quadruple staircase which descended from the Central Court to the Hall of the Colonnades, a hall which reminds one more of a court with *loggie* in an Italian palace than anything else! At the point of the staircase the palace was certainly three and probably four stories high; in fact, three flights of steps still remain. Originally the staircase "consisted of fifty-two stone steps, of which thirty-eight, and the indications of five more, are preserved." The excavation of the lowest flight "was of extraordinary difficulty, owing to the constant danger of bringing down the stairway above. It was altogether miner's work, necessitating a constant succession of wooden arches" (p. 104).

Down the greater part of this staircase it is now possible to walk, and in doing so the visitor gets a very good idea of the difficulties, already alluded to, which have beset Mr. Evans's work at Knossos, and of the successful way in which he has overcome them. But this heavy kind of work needs money, if it is to be properly carried out: the reader of NATURE who has a guinea or two to spare for archæological purposes could hardly do better than devote them to the Cretan Exploration Fund.

Mr. Evans is of opinion that "the whole result of the most recent excavations has been more and more to bring out the fact that, vast as is the area it embraces, the Palace of Knossos was originally devised on a single comprehensive plan. The ground scheme of a square building, with a central court approached at right angles by four main avenues, dividing the surrounding buildings into four quarters, is a simple conception which, as we now know, long before the days of the later Roman *Castra*, was carried out in the *Terremare* of Northern Italy. . . . The Minoan architect may claim the credit of adapting the same root idea to an organic whole, and fitting it in to a complicated arrangement of halls, chambers, galleries, and magazines, forming parts of a single building" (p. 100).

Further confirmation of the generally accepted date for the earlier parts of the palace, *c.* 1700 B.C. and later, was found in 1901 by the discovery in the "early Palace stratum," a deposit "containing a large proportion of charcoal, and representing the burnt remains of an earlier structure," and situated "immediately under the Mycenæan wall-foundations, at a depth of 40 centimetres below the later floor-level," of "the lid of an Egyptian alabastron, upon the upper face of which was finely engraved a cartouche containing the name and divine titles of the Hyksôs King Khyan" (see Fig. 1), who reigned somewhere about 1800 to 1700 B.C. The style of the hieroglyphs and phraseology of the inscription show us that this object is contemporary with the king whose name it bears. Therefore the discovery of this object of *c.* 1800–1700 B.C. may be taken to confirm the weaker evidence of the thirteenth dynasty statuette of Âbnub, son of Sebek-user (date *c.* 2000 B.C.), which was discovered in the course of the excavations of 1900, and with this to indicate roughly the date of the beginnings of the great Palace of Knossos, which is undoubtedly, as its excavator maintains, the veritable Labyrinth of Minos.

The store of Knossian inscribed tablets has been largely increased during the course of the excavations; it is much to be regretted that the Cretan Assembly seems unable to see its way to allow any of these tablets to leave Crete for the purpose of study and possible interpretation.

Our knowledge of Mycenæan life has been increased in a rather startling way by the discovery of a fresco-painting depicting, side by side with the well-known "cowboys" of the common Mycenæan scenes of ταυροκαθάψια, of *female* toreadors in the act of tackling infuriated bulls. Mr. Evans remarks (p. 95):—

"The episode is sensational in the highest degree, but we have here nothing of the mere catching of bulls, wild or otherwise, as seen on the Vaphio Cups. The graceful forms and elegant attire of these female performers would be quite out of place in rock-set glens or woodland glades. They belong to the arena, and afford the clearest evidence that the lords of Mycenæan Knossos glutted their eyes with shows in which maidens as well as youths were trained to grapple with what was then regarded as the king of animals. The sports of the amphitheatre, which have never lost their hold on the Mediterranean world, may thus, in Crete at least, be traced back to prehistoric times. It may well be that, long before the days when enslaved barbarians were 'butchered to make a Roman holiday,' captives, perhaps of gentle blood, shared the same fate within sight of the 'House of Minos,' and that the legends of Athenian prisoners devoured by the Minotaur preserve a real tradition of these cruel sports."

The sinister impression which is given by this discovery is not dispelled by the sight of the deep walled pits, described by Mr. Evans on pp. 35, 36, which are, no doubt, as he says, the dungeons of the palace.

"In these deep pits with their slippery cemented sides above, the captives would be as secure as those 'beneath the leads' of Venice. The groans of these Minoan dungeons may well have found an echo in the tale of Theseus."

One is irresistibly reminded of Watts's picture in the Tate Gallery of the horrible Minotaur leaning over the high battlements of Knossos, looking out to sea, awaiting the bringing of his prey. The civilisation of Knossos was probably by no means Arcadian, even if it was Pelasgic!

The artistic triumphs of this Minoan civilisation are further established by the discoveries of 1901: *e.g.* the splendid vase illustrated on p. 91 (Fig. 30), the high reliefs in painted *gesso duro* (Figs. 6, 29, pp. 17, 89) which are so characteristic of Knossian art, the carved stone weight (Fig. 12, p. 42), &c.; an interesting hint of costume is given us in Fig. 17, a fresco-painting, presumably of a girl, whose coiffure is exactly parallel to that of the men from *Keftiu*, who are depicted in the Eighteenth Dynasty tomb of Rekhmarā at Thebes in Egypt; while the wonderful gaming-board of gold, ivory, crystal, and *kyanos* (Fig. 25, p. 79) tells us something of the minor amusements of the princes of Knossos. A curious find, "which strongly suggests a more seamy side of the high civilisation here represented," is that of "a clay matrix formed by making a stamp from the impression of an actual seal, and which could thus be itself used as a signet for making counterfeit impressions of the same kind. The original of this was evidently a large gold signet-ring of a kind resembling, both in its form and the character of its subject, that found in the Akropolis Treasure of Mycenæ. That this, like the other, was a royal signet is highly probable, and what adds to the interest of the matrix is that several clay impressions taken from the original ring were subsequently found in association with a very important deposit of inscribed clay tablets. . . . It would seem that the [counterfeit] clay matrix was actually used for forging the royal signature" (p. 19).

A rather startling discovery was that of a quantity of small bone objects, perhaps for inlay, many of which are inscribed with signs, among which occur most of the letters of the later Greek alphabet, though "the Mycenæan date of these bone pieces is as well ascertained as anything found within the walls of the palace" (p. 119). Here is an enigma.

It is a strange thing, this Cretan civilisation of perhaps the eighteenth to the fourteenth centuries B.C. Mycenæ we know, but this is not Mycenæ, though it is "Mycenæan." Knossos is older, and Knossos is more civilised. Knossos is no hill fort, ἐν μυχῷ, Ἄργεος, like Mycenæ or Midea; Tiryns is more like it. But Tiryns itself is strongly fortified with galleries and casements, which even now are wonderful; Knossos, however, seems open to the attack of any enemy. It seems a palace of secure peace, apparently undefended by walls, a palace of luxurious baths and polished dancing-floors, inhabited by princes who seem to have taken their pleasure in the leading of a life of luxurious ease, surrounded by a court of ladies in most amazingly modern low-necked dresses and coiffures like the triumphs of a Regent Street window, and men with hair as long as the women's and almost as elaborately dressed, served by crowds of slaves and tribute bearers, and diverted by the witnessing of brutal sports of the arena, in which women figured as well as men, sports connected possibly with the worship of a cruel deity to whom human sacrifice was not unknown, for whom, perhaps, were incarcerated the victims in the oubliettes, like the holes of the trap-door spider, which exist within the palace walls. Knossos was the seat of the just and mighty Minos: it was also the Labyrinth of the Minotaur.

This is conjecture, but it conveys the impression which Knossos, and also Phaistos and Gournia, give: an impression of an ancient culture, highly developed, peaceful, art-loving and luxurious, effeminate if you will; but brutal withal and possessing sinister traits which oppress the mind.

What overthrew it? What overwhelmed the City of Live-at-Ease with a storm of long-forgotten war, and burnt its halls and towers with fire? The conquering Aryan from the north, probably; but we do not know. Who the Minoans themselves were we hardly know. Dark Pelasgians, of Sergi's "Stirpe Mediterranea," speaking a language akin to that of the Lycians, most probably; identical with the *Keftiu* of the Egyptian tombs, there is no doubt. To one who has not made himself fully acquainted with the details of the subject the thought may occur that these *Keftiu* and the famous Youth with the Vase, or Cupbearer, from Knossos perhaps belonged to some intermediate race (in Northern Palestine, perhaps), which sent tribute on the one side to the dynasts of Knossos, on the other to Pharaoh of Egypt. Such an opinion is easily refuted, as follows:—The Cupbearer is Mycenæan in costume: so are all the other male figures at Knossos; Mycenæans like the men of the Vaphio Cups. And since Knossos was a "Mycenæan" town inhabited by Mycenæans, the probability is that the representations of Mycenæans upon its walls are representations of Cretan Mycenæans. And since it is not "alleged," but is a *fact* well known to all who have eyes to see, that the eighteenth dynasty representations of the *Keftiu* at Thebes are practically identical, even down to minute details of costume, with the Knossian Cupbearer, the natural conclusion is that these *Keftiu* were Cretan Mycenæans. The date thus indicated for the coming of Cretan ambassadors to Egypt is *c.* 1550 B.C. That they may have come from Knossos or Phaistos is by no means impossible.[1]

The excavations of Mr. Hogarth in a Mycenæan town

[1] In "The Oldest Civilization of Greece" the present writer has expressed the view that these *Keftiu* were more probably Cyprian than Cretan Mycenæans. The progress of discovery in Crete has, however, now convinced him that they were more probably Cretans.

at Zakro, on the eastern coast of Crete, identified by Spratt with the site of Itanos, described by him in pp. 121–149 of the "Annual," are of great importance, not only as giving us much new knowledge of Mycenæan house-building, but as throwing light upon the question of Mycenæan connections with Libya. The use of bricks for the upper courses of house-walls is now proved. The bricks were large and flat, the largest measuring 24 × 16 × 4 inches, and "well and squarely laid" (p. 130). In the houses, besides vases, bronze implements, &c., was found a large number (nearly 800) of clay sealings, bearing impressions of intaglios, three of which are figured by Mr. Hogarth (Fig. 45; see Fig. 2 below). These "Minotaur" types are in the highest degree curious. This female figure with a bull's head; this bull-headed woman with a bird's wings and tail—are they mere fanciful designs, or do they point to the veneration of some strange androgynous deity?

However late in the Mycenæan age the existing remains of the settlement may be placed, "*these were still anterior to the Age of Iron*," says Mr. Hogarth (italics in original). . . . "Nor were any fragments observed of distinctly geometric vases. . . . The fact that the remains . . . come to a clean and abrupt finish with" the close of the Bronze Age, "showing no admixture of remains of the succeeding epoch, is in favour of those who hold that the use of iron and the

FIG. 2.—Clay Seal. Impression from Zakro.

inception of the geometric style resulted from some violent and radical social change in the Ægean, such as conquest by a distinct race" (p. 146). Whether this was an Achaian or a Dorian conquest, Prof. Ridgeway and his critics must settle: personally, we still prefer the second alternative.

The settlement is regarded by Mr. Hogarth as a trading outpost of Knossos, and in view of the objects of Knossian type discovered, this view seems a very probable one.

"Its position," he says (p. 147), "indicates that Zakro traded with Libya direct, and not (as has been supposed) by a circuitous route through Rhodes and Cyprus." While still holding to his view that the circuitous route, by which we know came the great armament which attacked Egypt in Rameses III.'s time, in which it is possible that Cretan Axians were included,[1] was the most likely one for primitive navigators to follow, the present writer is inclined to think that he has, in "The Oldest Civilization of Greece," to some extent underestimated the possibility of direct communication in Mycenæan times between Crete and Libya. The bay of Zakro, remarks Mr. Hogarth (p. 123), "is the best known *rendezvous* and port of call for the fishing fleets of the eastern islands, which sail annually to the sponge-grounds off the Libyan shore. . . . For sailing craft the bay of Zakro is still the principal station on the road from the Ægean to Libya."

[1] It is true that Axos was an inland town but this was no bar to its having taken part in an over-sea expedition: see also Herodotos, iv. 154, which should not be forgotten.

The argument is a fair one, but we have no certainty that Mycenæan sailors were as familiar with the direct route to Africa as the modern sponge-fishers. The geographical objection to the theory of direct connection, which has been stated to be non-existent, is simply the absence of any coast leading the primitive voyager from Crete to Libya; he would naturally follow the coast round, as the later Greeks went from Greece to Sicily, and not sail south into an open and unknown sea. However this may be, space forbids the further discussion of the point here.

Mr. Hogarth appends a description by Dr. Boyd-Dawkins of proto-Mycenæan dolichocephalic skulls found by him, which the distinguished craniologist pronounces to possess characters which "point unmistakably to the fact that the possessors of the skulls . . . led the artificial life of highly civilised peoples" (p. 151). These skulls are regarded by him as belonging to the long-headed Pelasgic or Mediterranean stock of Sergi, which is what we should have expected.

The review of last year's "Annual" spoke of it as "the most important contribution to our knowledge of the early history of mankind that has appeared for many years" (NATURE, lxiv. p. 15). It can only be said of this year's number that in interest and importance it suffers very little by comparison with No. VI. H. H.

ALEXANDER KOWALEVSKY.

THE illustrious Russian embryologist and student of the anatomy of lower animal forms, Kowalevsky, died, to the great grief of the whole zoological world, on November 22, 1901, of an attack of apoplexy.

Kowalevsky was one of those rare men whose name is associated by all his contemporaries with a new departure in the branch of science which he cultivated. Albert Kölliker, still alive and well, had as long ago as 1844 followed with his microscope and drawn the division of the single cell constituting the egg of the cuttlefish, and had traced the process of the formation of the mass of embryo-cells by division of the cells resulting from the cleavage of the first or primary egg-cell. Remak, in 1850–58, had traced the evolution of definite tissues from the embryonic cells, and later students of the embryo chick had followed out the earlier indications of von Baer and were busy with the discussion of the origin and outcome of the embryonic layers of cells. But Kowalevsky went further than this, and in small transparent embryos (such as those of Ascidia, Amphioxus, Sagitta and Argiope) traced the history of adult organs cell by cell to the original egg-cell. It is this procedure which must immortalise Kowalevsky. Ten years after his first papers were published, the aim which he had given to embryological science became the definite and recognised purpose of successive generations of embryologists in England, Germany and the United States. Before Kowalevsky's work on the development of Amphioxus, carried out in 1864–65, and on Ascidia in 1866, zoologists were content to regard the cell-masses resulting from the first cell-divisions of the animal egg-cell as intricate heaps of units which no one could expect to analyse. Some way was made in the direction of their comprehension by the application to invertebrate embryos of the doctrine of cell-layers, but it was not until the avowed purpose of the embryologist became the definite tracing of the genesis of the cells of cell-layers one by one from pre-existing cells and finally from the first cell-divisions of the egg-cell that Kowalevsky's work bore its full fruit, and a thorough-going cellular embryology was established. Much still remains to be done on this basis, but we see it clearly foreshadowed in Kowalevsky's great memoirs on the development of Amphioxus and of Ascidia, wherein the identity of the nervous system, the

notochord, the alimentary canal and the primitive branchial slits of those two apparently unrelated animals is shown by the method of tracing the exact derivation of the cells constituting those organs in the two cases.

Kowalevsky published several embryological memoirs on Sagitta, Alcyonians, Holothurians, Argiope, Hydrophilus, Chiton and other forms, in which exact observation of the cell-lineage was his purpose and his result. His writings are singularly free from generalising theory; his delight and his power lay in the making and recording of exact observations destined to build up our understanding of animal structure on a sound basis. His later zoological researches included some minute studies on the anatomy of the vascular system in insects and some novel and important researches on the phagocytes of lower animals. He collaborated for a time with Marion, of Marseilles, and wrote with him on the Neomenians (Solenogastres). He was the discoverer of the planariform dwarf male of Bonellia, and was the first to describe the anatomy of the Balanoglossus of Della Chiaje and to demonstrate its perforate pharynx. In his last years he was occupied with researches on the structure of the leeches (especially the rare and extremely interesting setigerous leeches of the genus Acanthobdella) from Russian fresh waters, and on some other strange worm-like forms (the Hedylidæ) from the Sea of Marmora.

Alexander Onufrievitch Kowalevsky was born on November 20, 1840, in a country house situated not far from Witebsk, in the north-west of Russia. His father was a Pole and his mother a Russian. After his early education at home he was placed at the Engineering School of Roads and Highways at St. Petersburg. But he preferred the study of science to a practical career, and entered the faculty of natural sciences of the University. The University disturbances of 1861 obliged Alexander Kowalevsky to quit Russia and pursue his studies abroad. He went in the first instance to Heidelberg, where he was for some time a pupil of Bunsen. He actually published two small memoirs of a purely chemical nature under the guidance of the great German chemist. But very soon Kowalevsky's taste for zoology and comparative anatomy declared itself. After studying with Bronn and with Pagenstecker, Kowalevsky passed on to Tubingen, where he became the assiduous pupil of Leydig (still living and honoured in his old age). It is there that the young Russian learnt histological methods and prepared himself for his delicate researches on the anatomy and embryology of the lower animals. In 1864 he published in Russian his first zoological work, which was entitled "The Anatomy of Idothea." The paper contains anatomical details as to this Isopod, which is very common in the Bay of Finland. After having "passed his licentiate" (the equivalent of a bachelor's degree in England) at St. Petersburg, Kowalevsky went in 1864 to Naples with a definitely-thought-out programme of researches on the lower animals. He spent about eighteen months there (there was no Stazione Zoologica in those days), and it is there that he carried out his beautiful researches on the embryology of Amphioxus and of many other marine forms (Argiope, Sagitta, Holothurians, &c.), and also made his important discoveries as to the anatomy of Balanoglossus (revealing for the first time its curious branchial structure), which he subsequently published. In 1865 he had to return to St. Petersburg to pass his examination for the degree of "magister zoologiæ," and presented his memoir on Amphioxus as his inaugural thesis. He then returned to Naples, and at Ischia in 1866 he made his researches on the development of Ascidia, which he published in the course of the same year. It was this memoir, taken in conjunction with his similar discoveries with regard to Amphioxus, which startled the zoological world, led to the recognition of the Ascidians as Vertebrata, gave a new impulse and direction to embryological research, and among other things led to the development of the important doctrine of degeneration as applied to other than parasitic animals.

An epitome of Kowalevsky's researches on Ascidia and Amphioxus was written by Prof. Michael Foster at the request of the editors of the *Quarterly Journal of Microscopical Science* in 1870, and zoologists were divided into those who had and those who had not "bowed the knee to Kowalevsky." Kowalevsky, after being for a time "privat docent" at the University of St. Petersburg, was appointed professor extraordinarius at Kazan in 1868, professor ordinarius at Kiev in 1869, and at Odessa in 1874. He remained at Odessa until 1890, when he was made "titular member" of the Academy of Sciences of St. Petersburg. He was professor of histology during two years at the University of St. Petersburg, but later concentrated his activity on the Academy of Sciences and occupied himself much with the biological station at Sebastopol, of which he was director. Besides being a foreign member of the Royal Society, Kowalevsky was a member and correspondent of a great number of scientific academies, and was decorated by the Emperor of Germany with the order "pour le merite." He was married in 1868 and was the father of one son and two daughters. His son is a chemist, and one of his daughters (Madame Tchistovitch) is a doctor of medicine; the other is married to M. Cheviakoff. The celebrated mathematician Sophie Kowalevsky was the wife of a younger brother of Alexander Kowalevsky, the same who published some valuable work on mammalian palæontology about thirty years ago and died a few years later.

Personally Kowalevsky was a man of retiring disposition, devoted to his microscopic work, and of the most gentle and courteous address. He visited England with one of his daughters in October, 1895, for a few days, but took alarm at the dangers of the London streets and left somewhat abruptly.

The writer is indebted to his and Kowalevsky's friend, Prof. Elias Metschnikoff, of the Institut Pasteur, Paris, for the biographical details above given. Prof. Metschnikoff is preparing a biography of Kowalevsky for publication. A list of Kowalevsky's publications is given below. E. RAY LANKESTER.

List of Papers by Alexander Onufrievitch Kowalevsky.

(1) Anatomy of the marine cockroach *Idothea entomon*, and list of the Crustacea which are met with in the freshwaters of the St. Petersburg Government. [In Russian.] (*Estest. Izslyed. St. Petersb. ghub.* (*Russ. Entomol. Obshchest. S. Petersb.*), 1864, Tom. i).

(2) Le développement de l'*Amphioxus lanceolatus*. (*Archives Sci. Phys. Nat.*, xxvii. 1866, pp. 193–195; *Ann. Mag. Nat. Hist.*, xix. 1867, pp. 69–70; *St. Pétersb. Acad. Sci. Mém.*, xi. 1868, No. 4).

(3) Beiträge zur Anatomie und Entwickelungsgeschichte des *Loxosoma Neapolitanum*, sp. n. [1865.] (*St. Pétersb. Acad. Sci. Mém.*, x. 1867, No. 2).

(4) Anatomie des Balanoglossus, Delle Chiaje. [1866.] (*St. Pétersb. Acad. Sci. Mém.*, x. 1867, No. 3; *Ann. Mag. Nat. Hist.* xx. 1867, pp. 230–232).

(5) Entwickelungsgeschichte der Rippenquallen. [1865.] (*St. Pétersb. Acad. Sci. Mém.*, x. 1867, No. 4; *Ann. Mag. Nat. Hist.*, xx. 1867, pp. 228–229).

(6) Entwickelungsgeschichte der einfachen Ascidien. [1866.] (*St. Pétersb. Acad. Sci. Mém.*, x. 1867, No. 15; *Quarterly Journ. Microsc. Sci*, x. 1870, pp. 59–69).

(7) Untersuchungen über die Entwickelung der Cœlenteraten. (Göttingen, *Nachrichten*, 1868, pp. 154–159).

(8) Beitrag zur Entwickelungsgeschichte der Tunicaten. (Göttingen, *Nachrichten*, 1868, pp. 401–415; Halle, *Zeitschr. Gesammt. Naturwiss.*, xxxii. 1868, pp. 343–344).

(9) Beiträge zur Entwickelungsgeschichte der Holothurien. [1866.] (*St. Pétersb. Acad. Sci. Mém.*, xi. 1868, No. 6).

(10) Die Entwickelungsgeschichte der Störe. [1869.] (*St. Pétersb. Acad. Sci. Bull.*, xiv. 1870, col. 317–325; *Rev. Sci. Nat.*, 4, 1875–76, pp. 146–151).

(11) Weitere Studien über die Entwickelung der einfachen Ascidien. [1870.] (*Archiv. Mikrosk. Anat.*, vii. 1871, pp. 101–130).

(12) Embryologische Studien an Würmern und Arthropoden. [1869.] (*St. Pétersb. Acad. Sci. Mém.*, xvi. 1871, No. 12).

(13) Ueber die Vermehrung der Seesterne durch Theilung und Knospung. (*Zeitschr. Wissensch. Zool.*, xxii. 1872, pp. 283–284).

(14) Zur Anatomie und Entwickelung von Thalassema. (*Zeitschr. Wissensch. Zool.*, xxii. 1872, p. 284).

(15) Ueber die geschlechtslose Fortpflanzung des Amarœcium. (*Zeitschr. Wissensch. Zool*, xx. 1872, p. 285).

(16) Ueber die Knospung der Ascidien. (*Archiv. Mikrosk. Anat.*, x. 1874, pp. 441–470).

(17) Sur le bourgeonnement du *Perophora listeri*, Wiegm. [Trad.] [1874.] (*Rev. Sci. Nat.*, iii. 1874–75, pp. 213–235).

(18) Ueber die Entwickelungsgeschichte der Pyrosoma. (*Archiv. Mikrosk. Anat.*, xi. 1875, pp. 597–635).

(19) Du développement des Actinies. [Trad.] [1875.] (*Rev. Sci. Nat.*, iv. 1875–76, pp. 15–26).

(20) Du mâle planariforme de la Bonélie. (*Rev. Sci. Nat.*, iv. 1875–76, pp. 313–320).

(21) Weitere Studien über die Entwickelungsgeschichte des *Amphioxus lanceolatus*, nebst einem Beitrage zur Homologie des Nervensystems der Würmer und Wirbelthiere. (*Archiv. Mikrosk. Anat.*, xiii. 1877, pp. 181–204).

(22) Ueber die Entwickelung der Chitonen. Vorläufige Mittheilung. (Carus, *Zool. Anzeiger*, ii. 1879, pp. 469–473).

(23) Zur Entwickelungsgeschichte der Alcyoniden *Sympodium coralloides*, M.-Edw., und *Clavularia crassa*, M.-Edw. (Carus, *Zool. Anzeiger*, ii. 1879, pp. 491–493).

(24) Weitere Studien über die Entwickelung der Chitonen. (Carus, *Zool. Anzeiger*, v. 1882, pp. 307–310).

(25) Observations on the Development of Brachiopods. [In Russian.] (Moscow, *Soc. Sci. Bull.*, xiv. 1874, pp. 1 (*bis*)–40 (*bis*)).—[Abstract.] (*Archives Zool. Expér.*, i. 1883, pp. 57–76).

(26) Note on the author's journey to the Caspian Sea. [In Russian, 1869.] (*Kiev Soc. Nat. Mém.*, i. 1870, pp. 19–20).

(27) Note on the structure of the alimentary canal in the Dendrocœla. [In Russian, 1869.] (*Kiev. Soc. Nat. Mém.*, i. 1870, pp. 109–110).

(28) Contribution to the embryology of the shark, from observations on *Mustelus laevis* and *Acanthias vulgaris*. [In Russian.] (*Kiev Soc. Nat. Mém.*, i. 1870, pp. 163–187).

(29) Development of the ova in *Sternaspis thalassemoides*, Otto. [In Russian.] (*Kiev Soc. Nat. Mém.*, i. 1870, pp. 287–290).

(30) Contribution to the embryology of *Amphioxus lanceolatus*. [In Russian.] (*Kiev Soc. Nat. Mém.*, i. 1870, pp. 327–338).

(31) Contribution to the embryology of the tortoise *Emys europaea*. [In Russian.] (*Kiev Soc. Nat. Mém.*, i. 1870, pp. 378–385).

(32) Preliminary report to the Society of Naturalists of the Vladimir University on measurements in the Black Sea. [In Russian.] (*Kiev Soc. Nat. Mém*, iii. 1873; *Proc.*, pp. 33–37).

(33) Observations on the development of the Cœlenterata. [In Russian.] (Moscow, *Soc. Sci. Bull.*, x. No. 2, 1874, pp. 1 (*bis*)–38 (*bis*)).

(34) *Neomenia gorgonophila*. [In Russian, 1880.] (Moscow, *Soc. Sci. Bull.*, xxxvii. No. 1, 1881, pp. 181–186).

(35) Embryogénie du *Chiton polii*, Philippi, avec quelques remarques sur le développement des autres chitons. (*Marseille Mus. Ann.*, i. 1883, No. 5, 46 pp.).

(36) Étude sur l'embryogénie du Dentale. (*Marseille Mus. Ann.*, i. 1883, No. 7, 54 pp.).

(37) On the history of the development of the Chitons. Preliminary communication. [In Russian.] (*Zapīskī Novoross. Obshchest. Estest. Odessa*, Tom. viii. pt. 1, 1882).

(38) On the preparation of the organs of some insects, spiders and centipedes. [In Russian.] (*Zapīskī Novoross. Obshchest. Estest. Odessa*, xiv. pt. 2, 1889).

(39) Observations sur les organes excréteurs des animaux invertebrés. (*Zapīski Novoross. Obshchest. Estest. Odessa*, xiv. pt. 1, 1889).

(40) On the spleen of Mollusca. [In Russian.] (*Zapīskī Novoross. Obshchest. Estest. Odessa*, xv. pt. 2, 1890).

(41) Ein Beitrag zur Kenntniss der excretionsorgane der Pantopoden. (*St. Pétersb. Acad. Sci. Mém.* xxxviii. 1892, No. 12).

(42) Einige Beiträge zur Bildung des Mantels der Ascidien. (*St. Pétersb. Acad. Sci. Mém.*, xxxviii. 1892, No. 10).

(43) Une nouvelle Glande lymphatique chez le Scorpion de l'Europe. (*St. Pétersb. Acad. Sci. Mém.*, v. 1897, No. 10).

(44) Études anatomiques sur le genre Pseudovermis. (*St. Pétersb. Acad. Sci. Mém.*, xii. 1901, No. 4).

(45) Phénomènes de la fécondation chez l'*Haementeria costata*, Müller. [In Russian.] (*St. Pétersb. Acad. Sci. Mém.*, xi. 1901, No. 10).

(46) With Barrois (Jules), Matériaux pour servir à l'histoire de l'Anchinie. (Robin, *Journ. Anat.*, xix. 1883, pp. 1–23; *Ann. Mag. Nat. Hist.* xii. 1883, pp. 1–20).

(47) With Marion (A. F.), Études sur les Neomenia. [1881.] (Carus, *Zool. Anzeiger*, v. 1882, pp. 61–64).

(48) With Marion (A. F.), Sur le développement des Alcyonaires. (Paris, *Acad Sci. Compt. rend.*, xcv. 1882, pp. 562–565).

(49) With Marion (A. F.), Documents pour l'histoire embryogénique des Alcyonaires. (*Marseille Mus. Ann.*, i. 1883, No. 4, 50 pp.).

(50) With Marion (A. F.), Contributions à l'histoire des Solenogastres, on Aplacophores. (*Marseille Mus. Ann.*, iii. 1887, No. 1, pp. 76, 7 pls.).

(51) With Ovsyannikov (F. V.), Ueber das Centralnervensystem und das Gehörorgan der Cephalopoden. [1866.] (*St. Pétersb. Acad. Sci. Mém.*, xi. 1868, No. 3).

(52) With Shulghīn (M. A.), Zur Entwickelungsgeschichte des Kaukasischen Scorpions, *Androctonus ornatus*. Preliminary communication. [In Russian.] (*Zapīskī Novoross. Obshchest. Estest. Odessa*, xi. pt. 1, 1866, pp. 39–55).

And quite recent papers on leeches (Acanthobdellidæ) and on the curious worm-like Gastropods, the Hedylidæ of the Sea of Marmora and Black Sea, published in the *Transactions* of the Imperial Academy of Sciences of St. Petersburg (the latter since his death).

NOTES.

THE Berlin official *Reichsanzeiger* announces that the order "Pour le Merite" has been conferred upon Lord Avebury and Prof. A. Agassiz, of Harvard University.

THE Hugh Miller centenary will be celebrated at Cromarty to-morrow, August 22. At the public meeting addresses will be given by Mr. Arthur Bignold, M.P. (chairman), Sir Archibald Geikie, F.R.S., the Right Hon. James Bryce, M.P., Principal Rainy, D.D., and Prof. J. M. Clarke, of Albany, New York.

THE *Daily Mail* reports that millions of winged ants descended on the Bohemian watering-place of Teplitz in a dense cloud on Saturday, August 16. At Brussels also there were swarms of ants, and the streets in some places were so thickly strewn with their bodies that the firemen had to be called out to wash them away.

A REUTER message from Yokohama states that the small island of Tori Shima, which is one of a chain extending between the Bonin Islands and the main island of Japan, was overwhelmed by a volcanic eruption between August 13 and August 15. There were about 150 inhabitants, and the whole of them appear to have perished. The island is covered with volcanic débris and all the houses have disappeared. The eruption was still proceeding on August 18, together with a submarine eruption in the vicinity of the island, and passing vessels report that the place is dangerous of approach.

THE manager of the Eastern Extension, Australasia and China Telegraph Company sends us the following extract from a letter received from the superintendent at Banyuvangi, Java, dated July 6:—"The Rooang volcano, which is about thirty-five miles from

Banyuvangi to the west, and has the appearance of being much closer, is, as a rule, very quiescent, only a very slight column of smoke being visible. On May 1 it commenced to throw up large columns alternately of black and white cloud, the whole mountain being at times quite hidden with the cloud. This continued until May 4, when it again assumed its usual peaceful appearance. It is curious that this should have occurred about the same time as the big affair in the West Indies." Since about the end of April, reports of volcanic eruptions, earthquakes and other disturbances apparently connected with them have been received almost every day. It is suggested by the *Newcastle Daily Chronicle* that the numerous colliery explosions which have recently been recorded may have some relationship with the seismic disturbances, and that a commission should be appointed to bring together the records of eruptions and earthquakes with a view to determine whether they have any connection with the occurrence of explosions in coal mines. Whatever may be the result of such an inquiry, there are many indications that the present year is an abnormal one in several respects.

THE death is announced, from Vienna, of Dr. Leopold Schenk, formerly professor of embryology and author of a work on the artificial determination of sex by means of diet.

A REUTER message from Bulawayo states that further discoveries have been made in the great ruins at Zimbabye. Two ancient ascents leading up to the citadel have been found, and the citadel itself has been cleared. An old stairway was also discovered, and various objects, including gold bangles and pieces of pottery, were found. One of the passages which was penetrated for the first time is 994 feet in length.

WE learn from the *Times* that Prof. Barbosa Rodrigues, director of the Botanical Garden of Rio de Janeiro, has arrived in England on a short visit. The Brazilian Congress has voted a considerable sum for the printing of his work "Sertum Palmarum," in which he describes 160 species of palm trees, entirely new and discovered by himself in his journeys in the interior of Brazil for more than thirty years, the letterpress to be accompanied by large coloured plates drawn in the places where each species grows spontaneously.

SOME time ago it was decided by some of Mr. Nicholson's friends and colleagues to offer him, privately, on the occasion of his retirement from the Curatorship of the Royal Gardens, Kew, some tangible evidence of the high regard in which he is held. We now learn from the *Gardeners' Chronicle* that the committee formed to carry out the proposal received contributions sufficient to purchase several articles to remind Mr. Nicholson of his old friends, among them being a salver bearing this inscription :— "Presented to George Nicholson, V.M.H., late Curator of the Royal Gardens, Kew, by his friends and colleagues, who, while admiring his qualifications as a man of science and a gardener, have a warm appreciation of his worth as a friend. 1902."

The *Times* announces that the following prizes have been awarded for essays on subjects connected with tropical diseases :— (1) A prize of the value of 10*l.*, entitled the Sivewright prize, presented by Sir James Sivewright for the best article on "The Duration of the Latency of Malaria after Primary Infection, as proved by Tertian or Quartan Periodicity or Demonstration of the Parasite in the Blood," awarded to Dr. Attilio Caccini, assistant physician, Hospital of Santo Spirito in Sassia, Rome. (2) A prize of the value of 10*l.*, entitled the Belilios prize, presented by the Hon. E. R. Belilios, C.M.G., for the best article on "The Spread of Plague from Rat to Rat, and from Rat to Man by the Rat-flea," awarded to Dr. Bruno Galli-Valerio, professor in the University of Lausanne, Switzerland. The prize of the value of 10*l.* entitled the Lady Macgregor prize, presented by Lady Macgregor for the best article on "The best Method of the Administration of Quinine as a Preventive of Malarial Fever," was not awarded. The judges were Surgeon-General Roe Hooper, president Medical Board, India Office, Colonel Kenneth MacLeod and Mr. Patrick Manson, F.R.S.

AT the forthcoming meeting of the British Association the address of the president of the Section of Anthropology, Dr. A. C. Haddon, F.R.S., will deal with the wide subject of totemism, and may be expected to lead to discussion; other folklore papers are offered by Mr. T. N. Annandale, on the popular religion of the Malays of Patani; by Rev. J. H. Holmes, on the religious ideas and initiation ceremonies of the natives of the Papuan Gulf; by Mr. E. S. Hartland, on the stone of destiny at Jara, and the appointment of a king by augury; and by Mr. F. T. Elworthy, on perforated amulets. Archæology, especially British, will be well represented. Mr. W. J. Knowles has a paper on plateau-implements from interglacial gravels, and a series of exhibits illustrating the manufacture of stone implements; Miss Layard describes a new Palæolithic site at Ipswich; Messrs. Clinch, Fennell and MacRitchie discuss the significance of British underground dwellings of Neolithic and later periods; and Mr. Coffey describes the Irish equivalents of the Hallstatt period of culture, in relation to the introduction of iron in western Europe. There is an important paper on the types of British Neolithic pottery by the Hon. John Abercromby, and a full report of this year's excavations at Silchester and in Crete. Physical anthropology will be represented only by Prof. D. J. Cunningham's paper on the Irish giant, whose skeleton will be present, and by a few minor exhibits of an anatomical kind; but there will be several important papers in descriptive ethnography; on the Lolos of Szechuan, by Mr. Augustine Henry; on the Nagas, by Dr. Furness, of Philadelphia; and on the races of the Malay Peninsula, by Messrs. Annandale and Robinson. A paper by Dr. Graham on the mental and moral characteristics of the people of Ulster is likely to lead to some discussion. Important reports will be presented by the committees on the age of stone circles, on Canadian ethnography, and on the teaching of anthropology in Great Britain and elsewhere.

WE are glad to note the formation of an Imperial Vaccination League. The Vaccination Act of 1898 will expire at the end of 1903, and from this it follows that legislation of some kind will be necessary next year. The League desires mainly to assist the community to study carefully certain possible amendments of the 1898 Act. Foremost of these is the necessity for obligatory revaccination of school children at a specified age. This practice is universal in Germany, and to it the freedom of that country in recent years from epidemic small-pox must be assigned. The League will also consider the question whether the entire supply of glycerinated calf-lymph should not be guaranteed and regulated by some public authority. In Germany fifty-five millions of people are supplied by twenty-two State laboratories; Great Britain and Ireland, with forty millions of people, have but one. The League intends to put its views upon these subjects before members of both Houses of Parliament and to circulate literature. For this purpose it appeals for funds, which may be sent *inter alia* to Dr. Edwardes, at the offices, 53 Berners Street, W.

AN interesting address was given by Sir James Crichton Browne, the president of the Sanitary Inspectors' Association assembled last week at Middlesbrough. Sir James referred to the *rôle* played by flies in the propagation of disease. Leaving aside the researches concerning the part played by the Anopheles in malarial infection, he confined his attention to the common house-fly. "This most fearless and audacious of all creatures" is probably the carrier of many varieties of bacterial infection.

It appears that cultures of many pathogenic organisms have been obtained recently from the excreta of the common house-fly, *Musca domestica*. The *rôle* played by these insects in the dissemination of enteric fever in South Africa was referred to, and Sir James remarked that one of the collateral advantages of our campaign in South Africa might prove to be the opening of our eyes to the part played by flies as disease mongers. The enormous fertility of the ordinary fly forms one of the chief obstacles to its extermination; it has been calculated that one female fly may have 25,000,000 descendants during one season.

MESSRS. COOK, the tourist agents, have put forward a proposal to run an electric railway to the crater of Vesuvius from the Naval Arsenal in Naples to take the place of the funicular railway now used. The Faculty of Science in the University of Naples has forwarded a strong protest against the scheme to the Italian Government, on the grounds that it would interfere with the seismic and magnetic observations and records which are made at the University.

THE lecture delivered by Mr. J. Swinburne before the Incorporated Gas Institute, on the electrolysis of gas mains, is a valuable and impartial *résumé* of the whole subject. Few will disagree with the conclusion that the question is not really settled, and that although electrolysis undoubtedly takes place it is hardly possible at present to say whether it is serious or not. Mr. Swinburne urges the gas and water companies to watch carefully; should serious corrosion be observed some means must be found of making those who are responsible pay for the damage, though it is to be feared there will be difficulty in fixing the responsibility in towns, such as London, where there are a number of electric tramways and railways. The lecture is reprinted in the last two issues of the *Electrician*.

IT is proposed to work electrically that part of the New York Central Railway which runs through the city, the principal motive for the conversion lying in the fact that two miles of the track are in a tunnel. The scheme involves the electrification of thirty miles of track, at a cost of nearly three million pounds, and requires a power station with an output of 100,000 h.p. As a result of tests with a dynamometer car on a portion of the lines, estimates of the cost of working with different electrical systems have been prepared. These are embodied in a paper read by Mr. D. J. Arnold before the American Institution of Electrical Engineers. Local conditions have largely determined what system should be recommended, and that which works out cheapest has in consequence not been chosen. The one selected comprises a combined alternating- and direct-current generating station near the outer end of the line and a substation at the other end, with batteries in both. The alternate-current transmission is at 11,000 volts and the direct-current working pressure is 600 volts. The total cost with this system is estimated at 23·63 cents per locomotive-mile as against 24·18 cents with steam. The economy is little enough, and would not be sufficient to justify the conversion unless there were other considerations. The *Electrician* justly points out that the scheme, if adopted, can hardly fail to be merely the stepping-stone to the complete conversion of the whole railway.

A PAPER has been contributed to the Lombardy *Rendiconti*, xxxv. 15, by Dr. Edoardo Bonardi, in which the author asserts his disbelief in the existence of specific characters in bacteria, and considers that a curative serum has no rigorously specific action, but that its action in curing infectious diseases consists in its strengthening the animal organism against the attacks of disease germs.

FROM Prof. Garbasso we have received the reprint of a note communicated to the *Atti* of the Italian Electrotechnical Association on the condition under which two conductors arranged in multiple arc are equivalent to a single conductor when self- and mutual-induction are taken into account. A more general discussion of the discharge of a condenser by n wires arranged in parallel is given by the same author in the *Annalen der Physik*, 8.

IN acoustics it is common to measure large intervals of pitch in octaves and smaller ones in "commas." M. A. Guillemin proposes to adopt instead of these units the *savart* and the *millisavart*. By the savart is meant an interval of ten to one, which equals three octaves plus a major third. The millisavart, which is the thousandth part of the savart, represents the interval between two French standard diapasons giving one beat per second.

WE have received a reprint from the *Astronomical Journal*, for January, of Dr. G. Johnstone Stoney's paper on the effect of meteoric deposits on the length of the terrestrial day. It deals exclusively with the effects so far as they are due to an alteration of the moment of inertia of the earth, the object being to show that when the earth's compressibility is taken into account the increase in the moment of inertia is much smaller than would appear from calculations in which this influence is omitted.

IN a preliminary note contributed to the *Atti dei Lincei*, 9, Dr. Quirino Majorana describes certain novel magneto-optic phenomena. The analogy of Kerr's phenomenon has suggested that when a substance possessing magnetic properties is placed in a field of force, the state of strain set up should give rise to double refraction. Dr. Majorana has investigated this magnetic double refraction, which he finds exists in a small degree in ferrous chloride and to a greater extent in dialysed iron or ferric oxide in colloidal suspension. But another phenomenon was observed, particularly in solutions of ferric chloride that had acted on hydrates of iron. This phenomenon consisted in a rotation of the plane of polarisation when this plane was neither parallel nor normal to the lines of force. In each case the direction of the incident light was perpendicular to the lines of force, and if the direction of polarisation was either parallel to or perpendicular to the lines of force, no phenomenon of the kind considered was observed, while, on the other hand, the effect was a maximum when the direction of polarisation made an angle of 45° with these lines, and it consisted in a rotation of the plane of polarisation which the author describes as positive when its direction is towards the lines of force. For this phenomenon the name of bimagnetic rotation is proposed.

THE report of the director of the Liverpool Observatory for the year 1901 has been published, by order of the Mersey Docks and Harbour Board, and contains the usual daily results of meteorological and other observations, which are the more valuable from the fact that they have been continued and carefully prepared for a long series of years. The Observatory lies within the area of the usual tracks of our prevalent westerly gales, and this is doubtless one reason for the special attention that is given to wind observations; these embrace anemometrical records of the horizontal motion of the air and the extreme pressure on the square foot. In addition, the tables show the maximum daily velocities recorded on a Dines's pressure-tube anemometer, and thus afford a valuable check on the registrations of the ordinary instruments. In addition, to the regular work of a first-class observatory we observe that telegrams are forwarded daily to the Meteorological Office for use in the preparation of weather-forecasts and storm-warnings, and that special observations of clouds are supplied in connection with the monthly international balloon ascents, which are frequently noticed in our columns. The earth disturbances that have been registered during the year have also been carefully collated.

WE have received vol. xliii. part 2 of the *Annals* of the Astronomical Observatory of Harvard College, containing observations and investigations made at the Blue Hill Meteorological Observatory at Massachusetts in the years 1899 and 1900 under the direction of Dr. A. Lawrence Rotch. The first five tables include the observations made twice daily, together with summaries of them both at the base and valley stations, and a summary of visibility of objects in different azimuths; all these refer to the year 1899, while similar information is brought together in tables vi. to x. for the year 1900. Tables xi. to xiii. give general summaries for the lustrum 1896–1900, and table xiv. is devoted to phenomena which show the advance of the seasons for the 15 years 1886–1900. Appendix A. contains a very interesting study of the visibility of distant objects 18 to 40 miles away in different azimuths, based on observations made during the years 1896–1900. A very valuable series (1851–1900) of temperature observations made at Milton is discussed in Appendix B.

IN No. 3 of vol. ii. of the *Journal of Hygiene*, Dr. Ritchie continues his interesting *résumé* of "Current Theories on Immunity." Mr. Irons discusses the value of neutral-red in water-examination, and concludes that used alone this method is likely to give misleading results. Dr. Savage, in an interesting paper on the presence of the *Bacillus coli* in drinking waters, gives some useful data for estimating the significance to be attached to this organism. Post-scarlatinal diphtheria is dealt with by Dr. Pugh in an exhaustive paper; vital statistics are represented by Dr. Hayward, who writes on the construction and use of life-tables; and the diseases of tropical countries are dealt with by Major Aldridge, R.A.M.C., and Dr. Stanley, who contribute papers on "Enteric Fever and Sewage Disposal" and on "Beri-Beri" respectively, and the number concludes with an obituary notice on Dr. Thurburn Manson. Every number of this comparatively young journal hitherto published covers a wide field and contains many valuable contributions.

HAVING regard to the varied opinions that have been expressed relative to the thermal death point of the tubercle bacillus in milk (see NATURE, vol. lxiii. pp. 166, 205 and 353), a paper by Mr. H. L. Russell (*Philad. Med. Journ.*, November 16, 1901) on bovine tuberculosis and milk supplies is worthy of note. Milk was infected with tubercle bacilli from cultures and was then pasteurised in a rotating commercial pasteuriser, and after treatment the milk was tested by inoculation. It was found that even a ten-minutes' exposure at 60° C. was sufficient to destroy the vitality of the tubercle bacillus so thoroughly that no trace of disease developed in the inoculated animals. In an open vessel, however, a fifteen minutes' exposure had no effect. This difference seems to be due to the film which is formed when milk is heated in an open vessel. Provided the pasteuriser be closed so that no film forms, a temperature of 60° C. acting for not less than ten minutes, preferably for 20–30 minutes, is sufficient to destroy the infective properties of tuberculous milk, while such treatment hardly alters the flavour and nutritive qualities.

THE voluminous reports annually issued by the various experimental stations as well as by the central Government are proofs of the fostering care exercised by the State for agriculture in the United States. In an excerpt from the "Eighteenth Annual Report of the Wisconsin Agricultural Experimental Station," 1901, which has recently reached us, among other valuable papers is one by Messrs. Babcock and Russell upon the "Causes Operative in the Formation of Silage," and the view is expressed that the changes which lead to silage production are hardly explicable on the theory that these are caused by the growth of micro-organisms, but rather that the internal processes of the living plant cells themselves are the factors which inaugurate the series of changes that result in the formation of typical silage.

TO the July number of the *New Phytologist*, Prof. F. W. Oliver contributes an article on "Gymnospermous Seeds," in which he traces a suggestive connection, possibly phylogenetic, between the fossil types Lagenostoma and Pachytesta and the existing genus Torreya. The examination of rhizomic material of the unique fern *Matonia pectinata* collected by Mr. Tansley on Mount Ophir forms the subject of some notes by Miss G. Wigglesworth. The arrangement of concentric steles differs in some respects from the specimen collected in Borneo and described by Mr. Seward. The notice by Mr. V. H. Blackman of a recently published monograph, by Mr. H. Lohmann, on Coccoliths will be useful to those botanists to whom the original memoir is not available. The revised classification of the green Algæ undertaken by Mr. F. F. Blackman and the editor is continued. It was the expressed desire of the editor that the correspondence columns should form a medium for the communication and discussion of educational matters. The attention of teachers may well be directed to the account of a trial of the heuristic method in a secondary school, as well as to a letter which points out the adaptability of systematic botany to meet the requirements of instruction for children.

WE regret that in our last week's issue the name of the fossil Austrian rhinoceros described by Prof. Toula was given as *Rhinoceros sumatrensis* instead of *R. hundsheimensis*.

WE have received a useful paper on American insects injurious to agriculture and horticulture and insecticides, by Mr. C. P. Gillette, forming *Bulletin* No. 71 of the experiment station of the Agricultural College of Colorado.

IN a paper published in the *Memorie* of the Royal Institute of Lombardy (vol. xix. part 7) Dr. A. Negri claims to have discovered in the red blood-corpuscles of mammals a special substance which is abundant during fœtal life and gradually diminishes with advancing age.

THOSE remarkable horned ungulates the titanotheres, of the Oligocene of North America and Eastern Europe, are shown by Prof. Osborn (*Bull. Amer. Mus.*, vol. xvi. art. 81) to be divisible into four branches, or "phyla," characterised by the proportion of the length to the breadth of the skull, and in some cases by the relative length of the limbs. In this respect they resemble the rhinoceroses, the various "phyla," as in the case of the latter, being regarded by the author as representing as many genera.

PROF. OSBORN'S studies of the groups just referred to have led him to take into consideration (*Bull. Amer. Mus.*, vol. xvi. art. 7) the morphological importance of length or shortness in the skulls of mammals—dolichocephalism and brachycephalism—and he concludes that both these features are characteristic of specialised types, the former condition being (as in the horse) often, although not invariably, connected with length of limb and neck, and adaptation to speed, while brachycephalism may be correlated with short limbs and an abbreviated neck. Exceptions to this rule, as exemplified by the cats, are due to special adaptive causes. It may be added that, in a paper published in the *Comptes rendus* of the late Geological Congress at Paris, Prof. Osborn figures a restoration of an American ancestral form of the horse nearly related to the English Eocene Hyracotherium; the animal is represented as fully striped.

IN their recently issued Report the Royal Commissioners strongly urge the necessity for a central authority to have control of the whole of the salmon fisheries of Great Britain, or even of the United Kingdom. As a temporary measure a

controlling authority of sufficient independence might be obtained by a modification of the present departmental arrangements in each of the three countries of the kingdom; but a single department to have charge of all questions connected with salmon-fishing in both seas and rivers is what is really wanted. Whether, however, the control be triple, dual, or single, it is essential that the holder of the office should himself be an expert on matters connected with salmon and salmon-fishing, and that his time should not be frittered away by attention to official details. The second section of the report deals with the life-history of the salmon, which is set forth in considerable detail. The Commissioners point out many deficiencies in our knowledge of this subject, such as whether fish entering rivers at different seasons of the year frequent particular branches or parts of the main river at spawning time. Information is likewise much needed with regard to the migration of kelts, and still more so concerning the history of the fish, both in its immature and adult condition, during its sojourn in the ocean. Experiments have shown that while a certain number of fish return to the rivers they left, others seek fresh spawning-grounds; and it will be obvious that fuller information on this point is of prime importance before steps are taken for the improvement of the fishery in any given district. In regard to the general idea of the deterioration of salmon-fisheries, the Commissioners are extremely cautious, stating that "it is useless to attempt to submit the popular belief that there has been a deterioration to any severe test. We can only accept the fact that such belief exists."

THE parliamentary Blue-book just issued on the working and expenditure of the British Museum for the past year shows that important additions have been made to the natural history collections at South Kensington, and considerable improvements effected in regard to the arrangement of the specimens exhibited to the public at that branch. It is satisfactory to learn that, in cooperation with the Trustees, the Egyptian Government vigorously carried on the survey of the fishes of the Nile during the year, nearly 700 miles of the river having been examined, resulting in the acquisition of several new generic and specific types. In the spring of 1901 Dr. Smith Woodward was dispatched by the Trustees to explore the well-known mammaliferous beds of Pikermi, Attica, with the result that a fine series of remains from this horizon (previously very poorly represented in the collection) was acquired for the Museum. During a visit made to the Fayum district of Egypt in company with Mr. Beadnell, of the Geological Survey of Egypt, Dr. Andrews was fortunate enough to be the joint-discoverer of a hitherto unknown Tertiary vertebrate fauna of remarkable interest. Collections were also made under the auspices of the Trustees in Tripoli. In the Museum itself a section of economic zoology has been established. Among other acquisitions, the collection has been enriched by the magnificent series of birds' eggs bequeathed by the late Mr. Crowley, as well as by the gift of Lord Walsingham's unrivalled cabinet of micro-Lepidoptera and library pertaining to the same. The elephant-seal presented by Mr. Walter Rothschild is likewise a notable addition, which is exhibited in a case (also the gift of the same benefactor) with the Antarctic seals presented by Sir G. Newnes. The series of domesticated animals has been largely increased; and much progress has been made in arranging and mounting the collection of recent mammals and birds according to modern ideas. The insect collection—both in the public galleries and in the study rooms—has likewise claimed a large share of attention on the part of the staff. Indeed, the whole Natural History Branch of the Museum is to be congratulated on a good record of progress.

THREE pamphlets for the information of the islanders have recently been published by the Imperial Department of Agriculture for the West Indies. No. 14, by Mr. Maxwell-Lefroy, deals with "Screw Worm in Cattle at St. Lucia." In October last it was reported to the Department that a "fly maggot" was causing injury to cattle in the island. Mr. Hudson, the agricultural instructor, made careful observations of the habits of the fly and the extent of the injuries it inflicted, and Mr. Maxwell-Lefroy, on the suggestion of the administrator, visited St. Lucia to investigate the matter personally. The fly proved to be the "screw worm" of the southern United States, and also widely distributed in the West Indies. The pamphlet is devoted to the life-history of the worm, its mode of attack, the treatment of the wounds, prevention, &c. No. 15 is entitled "Plain Talk to Small Owners at Montserrat," being the substance of an address to the small cultivators in the island by Mr. Watkins, the Commissioner of Montserrat. In a small compass much information is conveyed in simple language on the value of the soil, manuring, the cultivation of foodstuffs for home consumption and for export, the regulation of the quality of fruit for exportation, bee-keeping and other subjects. No. 16 is by the same authority, "Hints on Onion Cultivation," also an address to the small cultivators of Montserrat. Based on experiments carried on during the past two years on the island, the prospects of the onion industry are considered to be distinctly promising, and this little brochure of twenty-five pages, which gives the essential particulars at every stage, from the selection of soil and seed to harvesting, packing and shipping, should prove invaluable, not only to the onion growers of Montserrat, but also to those of the other islands where the industry is being introduced.

FOR several years past explorations have been carried on by the Geological Survey of Canada in the North-West Territory, chiefly in the Belly River formation of Assiniboia and Alberta. This formation underlies the Fox Hills-Ft. Pierre Group, and is, therefore, Mid-Cretaceous, as distinguished from the Upper Cretaceous Laramie of Wyoming and Colorado, which overlies these marine beds. It thus enables an examination to be made of the characters of the Mid-Cretaceous land fauna of North America. The fossils have been collected by Mr. Lawrence M. Lambe, who has also prepared and figured them. The manuscript report upon this collection, entitled "On Vertebrata of the Mid-Cretaceous of the North-West Territory," has just been completed under the direction of Prof. Osborn. It includes two parts, the first a general introduction entitled "Distinctive Characters of the Mid-Cretaceous Fauna," by Prof. Osborn, the second entitled "New Genera and Species from the Belly River Series, Mid-Cretaceous," by Mr. Lambe. It will be illustrated by twenty-one plates and a large number of text figures, and will appear from the press of the Canadian Geological Survey early in the autumn. The comparison of these Belly River Dinosaurs, especially the Iguanodonts and horned Dinosaurs or Ceratopsia, with those of Montana appears to demonstrate that a part at least of the Montana fauna is contemporaneous with the Belly River and represents an older horizon than the Laramie of Wyoming described by Marsh. The Belly River contains some of the older Jurassic families, which, so far as known, are wanting in the Laramie. The Montana fauna has hitherto been regarded as contemporaneous with the Wyoming and Colorado Laramie fauna, but there do not appear to be adequate grounds for this opinion in the vertebrates now known.

IN the April number of the *Journal of Physical Chemistry* is a paper by Mr. J. E. Mills in which several interesting applications of the kinetic theory of gases are made. By considering the transition from the liquid to the gaseous state in a particular way, an equation is obtained in which all the quantities are measurable, and it affords an experimental test of the

assumption that the molecular attraction varies inversely as the square of the distance from the molecule and does not vary with the temperature. This assumption is found to be in agreement with the experimental data as tested by the equation. It is further shown in the paper that the molecular attraction differs from the attraction of gravity in being determined primarily by the chemical constitution of the molecule and not by its mass.

IN the July number of the *American Chemical Journal*, Messrs. Morse and Frazer give an account of their experiments on the preparation of cells for the measurement of high osmotic pressures. Osmotic-pressure determinations are well known to be attended with considerable difficulties, and the number of experimenters who have succeeded in carrying out the measurement of even low osmotic pressures is comparatively small. Specially constructed porous cells made of fine materials, very uniformly mixed and hard burned, were employed, and the semipermeable membranes were produced in these by electrolysis. The electrical resistance of the membranes so obtained varied very considerably, the lowest resistance being about 3000 ohms and the highest more than 200,000 ohms. From the observations made by the authors it appears that high-resistance membranes are those which are requisite for successful osmotic-pressure measurements, but no certain method of obtaining such membranes has been discovered. Experiments were carried out with half-normal and normal cane-sugar solutions. For the former the osmotic pressure was found to be about 13·5 atmospheres, and for the latter a lower limit of 31·4 atmospheres was determined. It is extremely interesting to note that this osmotic pressure of more than thirty atmospheres was developed within two hours of commencing the experiment, and that the membrane within the cell had a resistance of more than 200,000 ohms.

ALTHOUGH the electrochemical equivalent of silver has been the subject of several very careful investigations, the results obtained by different experimenters indicate that the quantity of silver deposited by a given quantity of electricity is dependent to a certain small extent on the form of voltameter and on the conditions under which this is employed. Messrs. Richards and Heimrod (*Zeitschrift für physikalische Chemie*, vol. xli. p. 302) have investigated minutely the cause of these differences, and find that the most important disturbing factor in the ordinary silver voltameter is the formation of a complex silver ion at the anode which diffuses towards the kathode, and by its decomposition increases the quantity of silver deposited at the kathode. An improved form of silver voltameter is described in which the anode and kathode are separated by a porous cell which prevents the diffusion of the anode solution to the kathode, and the accuracy of the results obtained by the use of this instrument is demonstrated by several series of experiments. As a result of this investigation it appears that the electrochemical equivalent of silver as determined by Lord Rayleigh's voltameter is at least ·05 per cent. too high, and that the quantity of electricity associated with one gram equivalent must now be taken as 96,580 coulombs.

The additions to the Zoological Society's Gardens during the past week include a Geoffroy's Cat (*Felis geoffroii*) from Paraguay, presented by Dr. Jose Carlos Rodriguez; a Somali Ostrich (*Struthio molydophanes*) from East Africa, presented by Mr. A. Marsden; two Lion Marmosets (*Midas rosalia*) presented by Miss E. M. Unwin; a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa, a Macaque Monkey (*Macacus cynomolgus*), a Roofed Terrapin (*Kachuga tectum*), a Hamilton's Terrapin (*Damonia hamiltoni*), four Bungoma River Turtle (*Emyda granosa*) from India, a Moustache Tamarin (*Midas mystax*) from the Upper Amazons, four Long-necked Chelodines (*Chelodina longicollis*), two Vulpine Phalangers (*Trichosurus vulpecula*) from Australia, nine Tigrine Frogs (*Rana tigrina*) from the East Indies, a Californian Toad (*Bufo boreas*), four Pennsylvanian Mud Terrapins (*Cinosternon pennsylvanicum*) from North America, two Blackish Sternotheres (*Sternothoerus nigricans*) from Madagascar, a Lesueur's Water-Lizard (*Physignathus lesueuri*) from Queensland, two Black-pointed Teguexins (*Tupinambis nigropunctatus*) from South America, deposited; a Hoolock Gibbon (*Hylobates hoolock*) from Assam, purchased; a Crested Porcupine (*Hystrix cristata*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

A NEW REGISTERING ACTINOMETER.—M. G. de Fontenoy, of Paris, communicates to the *Bulletin de la Société Astronomique de France*, of August, a description of a novel registering actinometer which he has made and has found to act consistently.

The record is produced by the sunlight acting on a sensitised roll of paper fastened to an inner cylinder in the usual way, but in order to differentiate the varying intensities of the actinic effect, the light is allowed to act on the sensitised surface through a series of small windows, pierced in an outside cylinder of thin brass, which are equal in area and equidistant, but have different degrees of transparency. The whole instrument is rotated so that the common axis of the cylinders is always at right angles to the path of the sun's rays, and the inside cylinder is rotated by clockwork once in every twenty-four hours.

The paper is divided into equal spaces, representing hours, by a series of lines drawn on its surface perpendicular to the direction of its rotation, and a reproduction of one of the charts resulting from the exposure and working during one day in June plainly shows the traces made by the light which passed through the various windows; the longest trace (*i.e.* the one which is shown for the greatest number of hours) is the one which was formed by the light which passed through the most transparent window, the shortest is the one due to the light which passed through the most opaque window. By joining the ends of these traces one gets a curve, the integration of which gives the total amount of light registered during the twenty-four hours if one has previously determined the actinic constant for each window by submitting the instrument to the action of a standard light.

SOLAR PHENOMENA DURING 1901.—The "Commission Solaire" of the Société Astronomique de France has published the observations of sun spots and faculæ during 1901.

Numerous observers scattered all over the globe make these observations and then submit them to the commission. Observations were made on 357 days during the year 1901, and it is hoped that, with the assistance of several recently enlisted volunteers, a complete record will be obtained for this and future years.

During 1901 twelve separate groups of spots, including 392 individual spots, were observed, the sun presenting a spotted surface on sixty days out of the 357 days of observation.

It is recommended by the secretary, M. F. Bouët, that members should also record the barometric pressure, the temperature, and the state of the surrounding atmosphere at the same time that they record the numbers of solar spots and faculæ.

A DARK SPOT ON JUPITER.—In a letter to the *Observatory* Mr. Theodore Phillips describes the movements of the dark spot which was observed in the neighbourhood of the red spot last year. On June 19 this year it was observed than an enormous area of dark material, extending for 35°, followed the *f* "shoulder" of the red spot, and on June 26 a dark spot was observed close to the *p* "shoulder," or *west*, of the red-spot hollow.

Mr. Phillips asks, "How did it arrive at its present position?" and then discusses the various solutions to the question, finally arriving at the conclusion that the dark material must have been diverted to the south by the red spot, and, after passing that obstruction, have regained its former latitude. As there is still a portion of the dark area to the east of the red spot, it would be advisable for observers to pay special attention thereto, as valuable additions to our knowledge of Jovian phenomena may thereby be secured.

Mr. Phillips also records an apparent acceleration, of late, in the velocity of the red spot.

ROYAL SOCIETY REPORT ON THE WEST INDIAN ERUPTIONS.[1]

THE Soufrière mountain forms the northern extremity of St. Vincent, and its general form at once suggests a comparison with Vesuvius. It is a simple cone without lateral or parasitic craters. The one at its summit is surrounded on the north side by the remains of a gigantic crater ring, which has the same relation to the present crater as Somma has to Vesuvius. On the north-east lip of the main crater there is a smaller one known as the New Crater, as it is believed to have originated in the eruption of 1812. It is only one-third of a mile in diameter. It is doubtful whether the New Crater was active during the late eruption, and there can be no doubt that it was from the principal crater, or "Old Crater," that the materials mostly were emitted. Deep valleys, often with precipitous sides, have been cut in the slopes of the mountain, especially on its southern side, and it is in these—and particularly in the Wallibu, Rozeau and Rabaca Dry River—that the greater part of the ejecta of the recent eruption have collected.

Premonitory Signs of Activity.

The eruption of May, 1902, though sudden in its outburst and disastrous in its effects, was far from unexpected. In the north of St. Vincent there were two settlements of the Aboriginal Caribs, and these had been so startled by the frequent violent earthquakes, that in February of last year they were considering the advisability of deserting the district. But the first signs of actual volcanic activity were on Tuesday, May 6. The inhabitants of the leeward side were fortunate in having a clear view of the crater, and warned by the outbursts of steam they fled to Chateaubelair, and other places along the coast-line to the south, so that few lives were lost in this quarter. But, on the windward side, the summit of the mountain, as is frequently the case, was wrapped in cloud. Here, at the base of the mountain, there is an extensive stretch of flat land, known as the Carib country, on which were situated some of the largest and richest estates in the island, with a dense population, mostly black or coloured. So little alarm was felt here, that even on the morning of Wednesday, May 7, when the leeward side was practically deserted, sugar-making was in progress on several estates, and all the operations of tropical agriculture were being conducted as usual. From Kingstown, telephonic messages were sent to Georgetown, which is not far from the base of the hill, stating that the Soufrière was in eruption, but they appear to have occasioned little anxiety. And when, about mid-day on Wednesday, the danger was too obvious to be overlooked, the Rabaca Dry River, and some of the streams on the windward side, usually dry except after rains, were running boiling hot, and could not be crossed. Many fugitives in this way found their escape cut off. It was here that the loss of life was greatest, which, though many escaped, is estimated to have amounted to 2000, including about a dozen white men—the overseers of the plantations. The exact number will never be known, as many were entombed in the ashes where they fell.

Progress of the Eruption.

About mid-day on May 6 the first signs of the eruption were observed by those dwelling on the south-western side of the mountain. At 2.40 that afternoon there was a considerable explosion, and a large cloud of steam ascended into the air. By 5 o'clock a red glare was visible in the steam cloud on the summit. Activity continued during the evening, and at midnight there was a great outburst, and red flames were noticed on the lip of the crater. Next morning from Chateaubelair a splendid view could be obtained of gigantic mushroom-shaped clouds rising to a great height in the air—estimated at 30,000 feet—and drifting away before the north-east trade wind. As the day advanced the eruption increased in violence; by 10.30 a.m. enormous clouds of vapour were being emitted with loud noises, accompanied by much lightning. It is remarkable that at that time the inhabitants of the windward side were still in doubt about the reality of the eruption, since they mistook the dark cloud covering the mountain for a thunder cloud. The mountain was now in a state of continuous activity, and from Chateaubelair it could be seen that the materials were mostly discharged from the old or principal crater. Vast clouds of steam, showers of dark matter (probably mud), and of stones, could be seen projected from it, partly on the leeward, but mostly on the windward side. At mid-day the slopes of the mountain were still green, and the rich mantle of tropical vegetation had not yet been destroyed. A thin layer of fine ash had fallen over the lower ground, only sufficient to give the leaves a greyish colour. The enormous columns of vapour continued to ascend from the crater, with frequent violent outbursts, projecting showers of stones and mud.

About this time it was noticed that steam was rising from some of the valleys on the south side of the hill, and this increased until at 12.50 the whole mountain was suddenly enveloped in a dense cloud of vapour. Just before this the rivers Wallibu and Rabaca had been seen rushing down in raging floods of boiling water. It is most probable that these phenomena were due to the escape of the crater lake, which was driven over the lower or south lip of the crater between 12 o'clock and 1 o'clock on the Wednesday afternoon, and poured down the valleys to the sea. So far as we know there were no mud lavas, in the ordinary sense, flowing down these valleys, but only a tremendous rush of boiling water, which left no traces which we could recognise when we visited the district.

By 1 o'clock the roaring of the volcano was tremendous. Showers of stones were being projected both to windward and to leeward. The enormous columns of steam continued to ascend from the crater. The lightnings were terrific, and after the large outbursts, which took place every few minutes, volumes of vapour might be seen covering the whole area. Hitherto the eruption had been of a type with which geologists are familiar, and the destruction done was confined to the higher parts of the mountain in the close vicinity of the crater.

But about 2 o'clock—to quote the words of an eye-witness (Mr. T. M. McDonald, of Richmond Vale Estate)—"there was a rumbling and a large black outburst with showers of stones, all to windward, and enormously increased activity over the whole area. A terrific huge reddish and purplish curtain advanced to and over Richmond Estate." This was the strange black cloud which, laden with hot dust, swept with terrific velocity down the mountain-side, burying the country in hot sand, suffocating and burning all living creatures in its path, and devouring the rich vegetation of the hill with one burning blast.

The Hot Gases and Dust.

On the leeward coast few were overtaken by the black cloud, as the inhabitants had fled and taken refuge in the villages south of Chateaubelair. Those who were caught were killed or badly burned. One boat was near Richmond at the time the blast swept down. The occupants describe the heat as fearful. Hot sand rained into the boat, and the sea around was hissing with its heat. The darkness was so complete that a man could not see his hand. They saved their lives by diving into the water; when they returned to the surface the air was suffocating, but they continued to dive again and again, and, when at their last gasp, they found that the air cleared, and they could breathe again. This occupied only a few minutes—probably much less in reality than it appeared to them. One man was too exhausted to continue diving; he clung to the gunwale of the boat, and the tops of his ears were severely scorched.

On the windward side of the island an uninterrupted view of the progress of the eruption could not be obtained, owing to the veil of cloud which obscured the summit. By mid-day on Wednesday even the most sceptical were convinced that the Soufrière was in eruption, and that the noises heard continuously were not due to a thunderstorm. Before mid-day there had been very heavy rain-showers, and it was noticed that the raindrops carried down fine particles of ash. Work ceased on the plantations, and those labourers who still remained endeavoured to escape to Georgetown or shut themselves up in their houses. By 2 o'clock fine ashes, with occasional larger stones, were falling steadily, but, as yet, little damage had been done, and no one had been injured. Then came the climax of the eruption, and those who were in the open air saw a dense black cloud rolling with terrific velocity down the mountain. They took refuge in their houses and in the plantation works, where they crowded together in such numbers that in one small room 87 were killed. The cloud was seen to roll down upon the sea, and was described to us as flashing with lightning, especially when it touched the water. All state that it was intensely hot, smelt strongly of sulphur, and was suffocating. They felt as if something was compressing their throats, and as if there was no

[1] Abridged from a preliminary report by Dr. Tempest Anderson and Dr. J. S. Flett, just published in the *Proceedings* of the Royal Society, vol. lxx. pp. 423-445.

air to breathe. There was no fire in the ordinary sense of the word, only the air was itself intensely hot and was charged with hot dust. The suffocating cloud only lasted a few minutes. Those who survived this ordeal mostly escaped, though many died within a few hours from shock, or from the severity of their injuries. In some cases a few survived, entirely or almost entirely uninjured, in a room in which many others died. Most of those who escaped had shut themselves up in the rum cellars or in substantially built houses, and had firmly closed all doors and windows. By the time the hot blast had reached the coast the sand it contained was no longer incandescent, and though still at a very high temperature it did not set fire to wood or burn the clothes of those exposed to it. The burns on the survivors were chiefly on the outer aspect of the arms and legs, and on the faces, and confined to parts not protected by their clothes.

The Rain of Dust.

Complete darkness now covered the whole north end of St. Vincent—a darkness more intense than any the inhabitants had ever before experienced. The fugitives had to creep along the roads or feel their way along the roadsides. The roaring of the mountain was terrible—a long, drawn-out, continuous sound resembling the roar of a gigantic animal in great pain. Fine ash and sand rained down over the whole country with occasional showers of large stones. Some of these were so hot as to set fire to the trash roofs of huts in the south-end of Georgetown, at a distance of 7 miles from the crater. In Kingstown, 12 miles from the Soufrière, the ash was at first moist, but afterwards dry. It had a strong sulphurous smell, and pattered on the roofs like a heavy shower of tropical rain. Around the volcano the earth shook and trembled continuously, and the motion was described to us as undulating rather than resembling the sharp shock of an earthquake. Only in one or two cases were the walls of houses injured. What was taking place on the summit of the mountain no one can tell, but all who passed that night in the vicinity of the Soufrière agree that there was one black suffocating cloud, and only one. In all probability the eruption had reassumed the ordinary phase, and the showers of ash and stones were produced by violent upward explosions of steam. By half-past 5 o'clock the ash was falling in Barbadoes, 100 miles to the eastward, whither it had been carried by the upper currents of air in a direction opposite to that of the trade winds. In St. Vincent the darkness lessened slightly before nightfall, but the rain of dust and the noises lasted until early in the ensuing morning.

When day broke it was seen that in St. Vincent, and even in Barbadoes, everything was covered with fine grey ash resembling a fall of snow. The dust had penetrated into the interior of the houses, where it lay in a thin film on walls and furniture. In Kingstown there were stones as large as a hen's egg; in Georgetown and Chateaubelair some had fallen as much as 1 foot in diameter. Little damage, however, appears to have been done to growing crops, except in the north-end of the island. In fact, many believe that the sulphurous ash had insecticidal properties, and benefited the vegetation. From Chateaubelair it could be seen that the volcano was still emitting puffs of slaty-coloured steam, and showers of fine dust were falling on the leeward side of the mountain. For several days these discharges of vapours continued, but a new phenomenon now attracted more attention. The ravines which furrow the south side of the mountain were found to be discharging clouds of vapour, and this gave rise to reports of fissures having opened on the flanks of the Soufrière, of subsidiary eruptions arising from these fissures, and of streams of lava flowing down the valleys. As a matter of fact, they were really due to the action of water flowing through the hot sand, which in some places had almost obliterated the old stream courses, as will be explained more fully later on. By May 15 the volcanic activity had apparently subsided, and the mountain remained clear and unclouded. The explosions of steam in the valleys continued and are probably still going on.

The state of quiescence continued until Sunday, May 18. Confidence was being restored, and the inhabitants of those districts near the mountain which had not suffered severely were returning to their homes. On the windward side the work of burying the bodies had been completed and things were resuming their normal course. But about 8 o'clock that evening an ominous sound was heard from the crater. Its nature was at once recognised and struck the black population with terror. The noises were as loud as those of the first eruption, and the lightning was very vivid. On the leeward side complete darkness prevailed, and ashes and sand fell freely for some hours. In Georgetown the fall of ashes was quite inconsiderable, not exceeding a thin film on the roofs of the houses. Gradually the noises lessened, the darkness lifted, and the moon appeared again. No lives were lost and practically no damage was done, but exactly what happened on those parts of the mountain nearest the crater it is, in the circumstances, impossible to say. This second eruption was the last which proceeded from the main crater. Clouds of steam were sometimes seen gently rising for some days later, but nothing of the nature of a volcanic outburst has since taken place.

Products of the Eruption.

We arrived at Kingstown on Tuesday, June 10, and proceeded at once to Chateaubelair, where Mr. Jas. E. Richards, of Kingstown, kindly placed a house at our disposal. The geological products of this eruption proved to be of very simple character. The Soufrière and the surrounding country were covered with a layer of ashes mostly in the form of fine dark-coloured sand, but mixed with spongy bombs of various sizes and many ejected blocks composed of fragments of the old rocks of the hill. Lapilli and scoria are there in plenty, as is obvious where the heavy rains have washed away the finer material, but the greater part of the ejecta consists of fine sand which, when dry, is hot and yellowish-grey in colour, but when wet becomes almost black. This sand, as has already been noted by many observers, contains plagioclase felspar, hypersthene, augite, magnetite and fragments of glass, and represents a fairly well-crystallised hypersthene-andesite magma which has been blown to powder by the expansion of occluded steam.

The coarser material is mostly a slaggy andesite with crystals of plagioclase and pyroxene. There is little pumice, though we obtained a few fragments which floated on water and contained but few crystals visible to the naked eye. The larger bombs are often black, highly lustrous and glassy when broken across. Some were seen at Wallibu (4 miles from the crater) 3 feet in diameter. The ejected blocks consist of weathered andesites and andesitic tuffs such as can be seen in the walls of the crater. They are very numerous, and some are more than 5 feet across. In addition to these, fine-grained dark green banded rocks occur, which appear to be baked and indurated sediments, probably the mud from the bottom of the crater lake, or the finer beds intercalated in the older volcanic series. Another type of ejected block which is very common in some parts of the hill is a coarse-grained aggregate of felspar, hornblende (brown under the microscope), and perhaps olivine. It is not vesicular and contains little or no glass, being apparently holocrystalline. These rocks are very friable, and the crystals are loosely aggregated together. They seemed to us to be comparable to the sanidinites of the Eifel and many other modern volcanic districts. They are certainly quite unlike true plutonic diorites, both in their structure and in the character of their minerals.

It may be noted that none of these rocks are characteristic of this eruption, but all can be found among the older materials of the hill. The hardened, baked sediments were well known to the Caribs, who have long used them for the manufacture of their finer stone implements. The felspar-hornblende blocks were found by us among the older rocks, and in some places even as rounded masses enveloped in the old lavas. Some of the fresher bombs in the river beds and the seashore can hardly be distinguished from those which were the product of this eruption, though undoubtedly of much older date.

The conclusion was forced upon our minds that immense quantities of hot sand had rushed down the hill into these valleys in an avalanche which carried with it a terrific blast, and piled the ashes deep in the sheltered ravines, at the same time sweeping everything off the exposed ridges which lay between. The rain of volcanic material, which lasted for hours after the hot blast had passed, then covered the surface of the country with a final sheeting of fine dust and scoriæ.

Effects produced by the Hot Blast.

When we ascended the Soufrière, the evidence of the passage of a hot blast laden with sand was overwhelmingly clear. The various stages of its action, and its varying intensity at different spots, are most easily observed on the windward side, where the country is more flat and open, and there are fewer ravines and

spurs to modify the course of its operations than in the Wallibu Valley.

The track to the summit passes across the Rabaca Dry Valley near the shore, then turns upwards through the sugar-cane fields of Rabaca and Lot 14. These were covered with 3 or 4 feet of sand and scoriæ, the trees all bare, their leaves stripped by the falling cinders; but few branches were broken, and no trees had been uprooted or cast down. The woodwork of the houses was unburnt, though the roofs of some of the verandahs, and of the labourers' huts, had collapsed from the weight of ashes that had fallen on them. Many people were killed on these estates. The survivors described to us how the dark cloud had rolled down from the mountain, and how hot and suffocating the air had been when it enveloped them. But it was evident that the velocity of the blast was not above that of an ordinary gale, and the dust it carried, though hot, was not incandescent.

At Lot 14 it was seen that many trees had their limbs twisted off and broken, and some of the negroes' houses had taken fire (probably mostly from hot falling bombs). The blast was more violent here, but not hot enough to set fire to the woodwork or char the green wood of the standing timber.

On the flat ground above the plantation buildings (at an elevation of about 1000 feet), a further stage of devastation was encountered. The fields were here swept bare, the trees broken down, though not as a rule uprooted, their smaller branches swept away; a deep layer of black sand covered the crops of sugar-cane. The blast was here a violent gale.

A little further up the effects of the blast were remarkable. Enormous trees had been uprooted and cast down. Their leaves and finer branches, of course, had disappeared. In every case the fallen trunks pointed directly away from the crater. Even the great cotton-trees, 10 feet or more in diameter, were broken off or uprooted. The smaller trees had in a few cases been swept away like straws. The larger were merely cast down, and lay side by side, their tops directed down the valley, their roots towards the summit of the mountain. Most were charred, some deeply, but, as the wood was green, only the smaller branches had been consumed. The effect was like that produced by a violent hurricane, only more complete, for many of these trees had withstood the hurricane which ruined St. Vincent in 1898. At the lower limit of this region some curious effects of the hot sand blast could be seen. Where any branches or trunks were still standing, they invariably showed themselves to be burnt and eroded on one side—that next the crater—the wood having been charred and the charred material removed by the action of a hot sand blast. On the side away from the crater, the original bark was still left, unburnt, but dry and peeling off; that is, there had been no erosion on the sheltered or lee side of the stems. The wood was too green to take fire, but the sand had been sufficiently hot to char the surfaces which were exposed to it.

Further up the hill—that is to say, above the 1500-feet level, there was little left of the rich tropical vegetation which had covered it from summit to base. Blackened remains of tree-trunks were to be seen, overturned or broken off near the ground, and buried in dark sand. The highest parts of the mountain are as bare and desolate a scene as could be imagined. The ash is 5 to 12 feet deep, and though full of large blocks and spongy bombs, is mostly so fine that when thoroughly wet it becomes a fine mud, very tenacious and slippery, in which one sinks to the knee. In it there is a good deal of burnt timber, utterly blackened and converted into charcoal. Everything has been mown down, and at the same time the intense heat has consumed all the smaller fragments and charred the larger. There is nothing to show what was the velocity of the blast when it left the crater. After a couple of miles it was that of a hurricane or tornado. The limit between the zone of uprooted trees and that of trees still standing, but broken and much damaged, is surprisingly sharp. At 4 miles from the crater the blast was travelling at 20 to 40 miles an hour, and rapidly slowing down. This agrees with the evidence of an eye-witness who saw it when it reached the sea near Chateaubelair. It came over the water with a wave before it, but it did not overturn the small boats which lay in its course.

Another peculiar feature of this blast is the manner in which its course was modified by irregularities in the configuration of the ground over which it passed. To the north of the crater stands the encircling crater wall, already referred to as the Somma. There can be no doubt that a black cloud descended over this side of the mountain, though here the devastation is comparatively slight, and it is inferred that the high intervening ridge overlooking the crater served as a rampart and helped to protect the country behind it from the effects of the blast. The southern lip of the crater, on the other hand, is the lower, and the avalanche of hot sand seems to have poured over this lip almost like a fluid. Down the deep open valley between the Soufrière and the Morne Garu Mountain it rushed, ever following the steepest descent. It clung to the valley bottoms and coursed along them in a manner which somewhat recalls a raging torrent in a river. The streams in these valleys after descending the first part of the hill turn sharply at a right angle towards the coast, deflected by the opposing mass of the Morne Garu. The hot blast mostly followed these valleys, and in them it piled up enormous deposits of sand, but part of it swept up the shoulders of Morne Garu, and tore up the heavy timber which was growing there. The direction in which the fallen trunks point shows that the blast was split into two parts—one taking the east and one the west side of the mountain, rushing upwards obliquely from below. The mountain protected the country behind, and the line of demarcation between the burnt and the green forest almost corresponds with the dividing ridge. The south side is green; the north side towards the Soufrière is devastated and burnt.

Geological Modifications.

Apart from the changes which have taken place within the crater, and the deposits of ash which have formed in the river valleys, and on the surface of the hill, the only other important geological modification of the country has been the disappearance of a narrow strip of coast along the leeward side of the island. Near the mouth of the Wallibu and from thence northward to Morne Ronde, the sea has encroached on the land for perhaps 200 yards. Below Wallibu plantation there stood a village of labourers' huts on a low flat beach with a bluff behind. Here the sea now washes the foot of a cliff some 30 feet high. This cliff consists of soft tuffs covered with several feet of new hot ashes, and is in an unstable condition, as masses are constantly falling down from its face. In this way a new beach is now forming in front of it. It is agreed by those who knew the district before the eruption that not only has the old beach disappeared, which carried the village and the public road, but that part of the bluff behind has also subsided. We were informed by Mr. T. M. McDonald, who is intimately acquainted with this coast-line, that similar subsidences had also taken place, though on a much smaller scale, at several places further north. There is no evidence elsewhere of any changes of level of land and sea. The tide-marks on the rocks and the landing-stages at the villages enabled us to ascertain that the level of high-water was at any rate within a few inches of what it had been before. It was clear that the alterations in the coast-line were due to local subsidence of the foreshores, and that they had mostly affected loose and ill-consolidated deposits, such as beach gravels and the fans of alluvium which had formed at the mouths of the streams. The submarine slopes on the leeward side of St. Vincent are very steep, averaging about 1 in 4. Within half a mile of the shore the depth is often more than 100 fathoms.

It seems most probable that owing to the concussions and earthquakes produced by the explosions, some of the less coherent accumulations on these steep slopes slipped bodily into the deep. On this supposition most of the facts would be explained, but at the same time it is possible that at Wallibu the inner margin of the depressed tract may be a fault line. It has a very straight trend, and it is a curious fact that this shore was formerly known as Hot Waters. This might indicate the existence of a fissure up which hot springs were rising.

Comparison of the Soufrière with Mont Pelée.

When we arrived at Martinique, we had the pleasure of meeting Prof. Lacroix, the head of the French Scientific Commission, which had spent some time in making a preliminary survey of Mont Pelée, and the north-end of the island, and from him we obtained much valuable information regarding the sequence of events and the geological consequences of the eruptions in that quarter. It was our intention to make merely such reconnaissances as would enable us in a general way to ascertain the points of difference and of similarity between the outburst of Mont Pelée and that of the Soufrière, and to see what light the phenomena in Martinique threw on the events which had happened in St. Vincent.

Both volcanoes are of the same type, simple cones with a large vent near the summit and without parasitic craters. They are both deeply scored with ravines, and on their south-west sides there is a broad valley—occupied at Martinique by St. Pierre City, at St. Vincent by the Wallibu. It is in these valleys that the destruction has been most pronounced. In both, the recent eruptions have been characterised by paroxysmal discharges of incandescent ashes, and a complete absence of lava streams.

In St. Vincent, however, the mass of material ejected has been much greater, and a considerably larger area of country has been devastated than in Martinique. That the loss of life was not so large can be accounted for by the absence of a populous city at the foot of the mountain. Had the city of St. Pierre been planted at the mouth of the Wallibu, there can be no doubt it would have been equally completely destroyed.

On Mont Pelée, we understand that a fissure has opened on the south side of the mountain between the summit and St. Pierre, from which the blast was emitted which overwhelmed the city. But on the Soufrière the old orifices have been made use of. The eruption of Pelée began with the flow of mud lavas, but none such were seen in St. Vincent. On the other hand, the hot blast which swept down on the doomed city was essentially similar to that which we have described as having taken place at the Soufrière. Both eruptions produced principally hot sand and dust, with a small proportion of bombs and ejected blocks.

Observations of an Eruption of Mont Pelée.

We were fortunate in having an opportunity to witness one of the more important eruptions of Mont Pelée before we left Martinique, and this enabled us to see how far the actual phenomena corresponded with the ideas we had been led to form from an inspection of the effects of the earlier outbursts. On July 9 we were in a small sloop of 10 tons, the *Minerva*, of Grenada, which we had hired to act as a convenient base for our expeditions on the mountain. The morning was spent in St. Pierre City, and on the sugar-cane plantations on the lower slopes of the mountain on the banks of the Rivière des Pères. The volcano was beautifully clear. Every ravine and furrow, every ridge and crag, on its gaunt naked surface stood out clearly in the sunlight. Thin clouds veiled the summit, but now and then the mist would lift sufficiently to show us the jagged broken cliff which overlooks the cleft. From the triangular fissure which serves as the crater hardly a whiff of steam was seen to rise, and the great heap of hot boulders which lies on the north side of and above this fissure could be perfectly made out. Small land-slides took place in it occasionally, and small jets of steam rose now and again from between the stones.

A little after mid-day large steam clouds began to rise, one every 10 or 20 minutes, with a low rumble. As they rose they expanded, becoming club-shaped and consisting of many globular rolling masses, constantly increasing in number and in size as they ascended in the air. They might be compared to a bunch of grapes, large and small, or to a gigantic cauliflower. When their upward velocity diminished they floated away to leeward, and fine ash rained down in a dense mist as they drifted over the western side of the mountain. They occasioned no anxiety in our minds, as we had found that the mountain was never long without exhibiting these discharges, and they were due merely to an escape of steam carrying with it fine dust. They rose, as a rule, to heights of 5000 or 6000 feet above the sea.

That afternoon as the sun was getting lower in the heavens and the details of ravine and spur showed a contrast of light and shadow which was absent at mid-day, we sailed along from St. Pierre to Précheur, intention obtaining a series of general photographs of the hill. The steam puffs continued, and, about 6 o'clock, as we were standing back across the bay of St. Pierre, they became more numerous, though not much larger in size. We ran down to Carbet, a village 1½ miles south of St. Pierre, where there is a supply of excellent water and good anchorage. About half-past six it was obvious that the activity of the mountain was increasing. The cauliflower clouds were no longer distinct and separate, each following the other after an interval, but arose in such rapid succession that they were blended in a continuous emission. A thick cloud of steam streamed away before the wind so laden with dust that all the leeward side of the hill, and the sea for 6 miles from the shore, was covered with a dense pall of fine falling ash. The sun setting behind this cloud lost all its brightness, and became a pale yellowish-green disc, easily observable with the naked eye. Darkness followed the short twilight of the tropics, but a 4 days' old moon shed sufficient light to enable us to see what was happening on the hill-side.

An Incandescent Avalanche.

Just before darkness closed in, we noticed a cloud which had in it something peculiar, hanging over the lip of the fissure. At first glance it resembled the globular cauliflower masses of steam. It was, however, darker in colour, and did not ascend in the air or float away, but retained its shape, and slowly got larger and larger. After observing it for a short time, we concluded that it was travelling straight down the hill towards us, expanding somewhat as it came, but not rising in the air, only rolling over the surface of the ground. It was so totally distinct in its behaviour from the ascending steam clouds that our attention was riveted on it, and we were not without apprehension as to its character. It seemed to take some time to reach the sea (several minutes at least), and as it rolled over the bay we could see that through it there played innumerable lightnings. We weighed anchor and hoisted the sails, and in a few minutes were slipping southward along the coast with a slight easterly wind and a favourable tide. We had, however, scarcely got under way when it became clear that an eruption was impending. As the darkness deepened, a dull red reflection was seen in the trade-wind cloud which covered the mountain summit. This became brighter and brighter, and soon we saw red-hot stones projected from the crater, bowling down the mountain slopes, and giving off glowing sparks. Suddenly the whole cloud was brightly illuminated, and the sailors cried, "the mountain bursts!" In an incredibly short space of time a red-hot avalanche swept down to the sea. We could not see it start from the crater owing to the intervening veil of cloud, but the lower parts of the mountain were clear, and the glowing cataract poured over them right down to the shores of the bay. It was dull red, with a billowy surface, reminding one of a snow avalanche. In it there were larger stones which stood out as streaks of bright red, tumbling down and emitting showers of sparks. In a few seconds it was over. A loud angry growl had burst from the mountain at the moment when this avalanche was launched from the crater. It is difficult to say how long an interval elapsed between the time when the great glare burst on the summit and the incandescent avalanche reached the sea. Possibly it occupied a couple of minutes: it could hardly have been more. Undoubtedly the velocity was terrific. Had any buildings stood in its path they would have been utterly wiped out, and no living creature could have survived that blast.

The Lightning Discharges.

Hardly had its red light faded when a rounded black cloud began to shape itself against the starlit sky, exactly where the avalanche had been. The pale moonlight shining on it showed us that it was globular, with a bulging surface, covered with rounded protuberant masses, which swelled and multiplied with a terrible energy. It rushed forward over the waters, directly towards us, boiling, and changing its form every instant. In its face there sparkled innumerable lightnings, short, and many of them horizontal. Especially at its base there was a continuous scintillation. The cloud itself was black as night, dense and solid, and the flickering lightnings gave it an indescribably venomous appearance. It moved with great velocity, and as it approached it got larger and larger, but retained its rounded form. It did not spread out laterally, neither did it rise into the air, but swept on over the sea in surging globular masses, coruscating with lightnings. When about a mile from us it was perceptibly slowing down. We then estimated that it was 2 miles broad and about 1 mile high. It began to change its form; fresh protuberances ceased to shoot out or grew but slowly. They were less globular, and the face of the cloud more nearly resembled a black curtain draped in folds. At the same time it became paler and more grey in colour, and for a time the surface shimmered in the moonlight like a piece of silk. The particles of ash were now settling down, and the white steam, freed from entangled dust, was beginning to rise in the air.

The cloud still travelled forward, but now was mostly steam, and rose from the surface of the sea, passing over our heads in a great tongue-shaped mass, which in a few minutes was directly above us. Then stones, some as large as a chestnut, began to

fall on the boat. They were followed by small pellets, which rattled on the deck like a shower of peas. In a minute or two fine grey ash, moist and clinging together in small globules, poured down upon us. After that for some time there was a rain of dry grey ashes. But the cloud had lost most of its solid matter, and as it shot forwards over our heads it left us in a stratum of clear pure air. When the fine ash began to fall there was a smell of sulphurous acid, but not very marked. There was no rain.

The volume of steam discharged must have been enormous, for the tongue-shaped cloud broadening as it passed southwards covered the whole sky except a thin rim on the extreme horizon. Dust fell on Fort de France and the whole south-end of Martinique. The display of lightning was magnificent. It threaded the cloud in every direction in irregular branching lines. At the same time there was a continuous low rumble overhead.

What happened on Mont Pelée after this discharge cannot be definitely ascertained. For some hours afterwards there were brilliant lightnings and loud noises which we took for thunder. That night there was a heavy thunderstorm over the north-end of Martinique, and much of the lightning was atmospheric, but probably the eruption had something to do with it, and the noises may have been in part of volcanic origin.

Characteristics of the Eruptions.

There can be no doubt that the eruption we witnessed was a counterpart of that which destroyed St. Pierre. The mechanism of these discharges is obscure, and many interesting problems are involved. But we are convinced that the glowing avalanche consisted of hot sand and gases—principally steam; and when we passed the hill in R.M.S. *Wear* a few days later, we had, by the kindness of the captain, an excellent opportunity of making a close examination of the shore from the bridge of the steamboat. The south-west side of the hill along the course of the Rivière Seche was covered with a thin coating of freshly fallen fine grey ashes, which appeared to be thickest in the stream valleys. The water of the rivers flowing down this part of the hill was steaming hot. This was undoubtedly the material emitted from the crater on the night of the eruption. There was no lava. We saw no explosions of combustible gases, and nothing like a sheet of flame. We were agreed that the scintillations in the cloud were ordinary lightnings which shot from one part of its mass to another, and partly also struck the sea beneath.

The most peculiar feature of these eruptions is the avalanche of incandescent sand and the great black cloud which accompanies it. The preliminary stages of the eruption, which may occupy a few days or only a few hours, consist of outbursts of steam, fine dust and stones, and the discharge of the crater lakes as torrents of water or of mud. In them there is nothing unusual, but as soon as the throat of the crater is thoroughly cleared, and the climax of the eruption is reached, a mass of incandescent lava rises and wells over the lip of the crater in the form of an avalanche of red-hot dust. It is a lava blown to pieces by the expansion of the gases it contains. It rushes down the slopes of the hill, carrying with it a terrific blast, which mows down everything in its path. The mixture of dust and gas behaves in many ways like a fluid. The exact chemical composition of these gases remains unsettled. They apparently consist principally of steam and sulphurous acid. There are many reasons which make it unlikely that they contain much oxygen, and they do not support respiration.

THE PERSEID METEORIC SHOWER OF 1902.

THE display of Perseid meteors was fairly abundant this year, though somewhat marred, and only partially observed, in consequence of the unsettled weather which prevailed. In the west of England the first half of August proved an exceptionally cloudy period, and comparatively few observations could be secured. In the eastern counties atmospheric conditions appear to have been decidedly more favourable, for while at Bristol only meagre results could be gathered from skies wholly or partially veiled with clouds, observers in metropolitan suburbs reported clear weather and collected a plentiful harvest of meteor flights. At Hampstead Mr. G. M. Knight counted 500 meteors during the first fortnight of August. Between August 1 and 5, 167 were recorded, and on August 10, from 11h. 30m. to 15h. 15m., 239 were seen. The majority of them were Perseids of the usual swift, streak-leaving type, and there were minor showers in Cassiopeia, Andromeda, Cepheus and other regions. Mr. Knight has forwarded the writer some charts containing projections of his recorded paths, and the place of the Perseid radiant appeared to be indicated as under. The ephemeris positions given in the *Monthly Notices*, December, 1901, p. 169, are also added for comparison:—

1902.	Radiant.	No. of meteors.	Ephemeris.
	° °		° °
August 1–3 ...	37 + 55 ..	12 ...	33·9 + 55·0
,, 4–5 ...	40 + 55½ ...	26 ...	37·0 + 55·6
,, 10 ...	44½ + 57 ...	43 ...	44·3 + 56·9

The agreement is fairly good, though the places observed this year in the early part of August are somewhat east of the predicted centres. A certain allowance has, however, to be made for errors of observation.

At Bristol the writer watched for the Perseids on parts of the nights of August 2, 6, 10, 12 and 14, but clouds prevented anything like a thorough investigation of the progress of the display. The Perseids were fairly numerous, and shot from the radiants given below, but very few meteors were seen on August 6 and 14 owing to the clouds, so that the points of emanation on those nights were merely suspected:—

1902.	Radiant.	Ephemeris.
	° °	° °
August 6 ...	39 + 57 ...	38·9 + 56·0
10 ...	45 + 58½ ...	44·3 + 56·9
12 ...	47 + 58½ ...	47·1 + 57·3
14 ...	50 + 57 ...	50·0 + 57·7

The year 1900 not having been a leap-year, the maximum was expected on either August 11 or 12. There was an unusually bright exhibition of these meteors on August 11, 1898. It seems that the maximum intensity was well defined this year, for "a magnificent shower of Perseids" is reported to have been witnessed at Odessa on Tuesday night, August 12. The chief radiating point is said to have been at an altitude of 45° or 50° in the north-east firmament. The latter position corresponds approximately with the normal place of the Perseid centre. But, unfortunately, the report mentions no details as to the number of meteors observed or the duration of the observations, and it is impossible, therefore, to form any exact conclusion as to the character of the display witnessed. It will probably be found, however, when particulars come to hand, that it represented nothing more than a tolerably plentiful return of the stream. There are no other descriptions favouring the inference that a strikingly brilliant shower was witnessed. In and since 1898 the Perseids appear to have been richer than usual, though it is extremely difficult to ascertain the relative strength of the shower from year to year owing to the variable conditions affecting the visibility of the meteors. W. F. DENNING.

THE ZOOLOGICAL SOCIETY'S NEW APE-HOUSE.

THE ordinary plan of keeping monkeys in zoological gardens is to house them in cages which, while closed in winter, can be opened to playing-places in the external air in summer. The objection to this course is that, though it gives the great advantage of fresh air, the monkeys emerging from a heated chamber into a cooler atmosphere are very liable to catch cold and suffer from pulmonary complaints. In the case of some of the hardier Quadrumana (such as the Tcheli monkey of Mantchuria and the Cape baboon), there can be no doubt that such animals will thrive best without artificial warmth of any kind beyond the protection of a dry roof, and may be kept in the open air all the year round. This plan, however, would hardly answer in the case of the anthropoid apes, which live in hot, moist climates and are accustomed all their lives to a high and uniform temperature. In constructing the new ape-house for the special accommodation of these animals, the Zoological Society has adopted the plan, which has been tried with some success on the continent, of separating the animals entirely from the evils of a changeable climate by an air-tight glass screen through which only they can be seen by the public. The

further advantage of this plan is that the apes can receive no germs of disease from the visitors, and can be kept behind the screen in a higher temperature than is maintained in the portion of the building allotted to the spectators.

The new ape-house, for which there was much difficulty in finding a convenient site in the already crowded Gardens in the Regent's Park, is nearly square in shape, being about 70 feet in length and breadth. The principal floor is raised some 5 or 6 feet above the level of the ground, in order to secure the animals from the damp of the stiff clay soil upon which the house is built; and the chambers below the principal floor are devoted to the keeper's apartments and to feeding and heating purposes. On entering the spectators' portion, which occupies the north side of the building, by one of the flights of steps which ascend to the outside platform, the apes will be found occupying four large and roomy chambers on the south side. They are entirely separated from the spectators by the glass screen which runs across the building and corresponds to the windows of a fashionable shop in Regent Street. The spectators are on the outside of the screen and the objects to be inspected on the inside. They are in a good light because the interior is made bright and clear by skylights and by four large windows which occupy the south aspect of the building, while the spectators stand in a darker light. The screen has the further advantage that the animals cannot be improperly fed or unnecessarily stirred up with sticks and umbrellas, as is too often the case in the ordinary monkey-house. The apes themselves can hardly be said to be in cages, but live in large rooms some 16 feet square, which are fitted up with tree-branches, swings, and other contrivances for their amusement and exercise. All round these four rooms runs a narrow passage by which the keepers can gain access to any part of them. The temperature of the rooms for the animals is kept at from 80° to 85° F., while that of the portion of the house devoted to the spectators is usually from 10° to 15° less.

The apes that at present tenant the new ape-house are some seven or eight in number, and consist of chimpanzees, orangs and gibbons, representing all the three usually distinguished genera of the anthropoid apes. Besides these, one of the compartments is occupied by a small individual of the very curious proboscis monkey of Borneo (*Nasalis larvata*), one of the most peculiar forms of Old-World monkeys. This has always been found to be a most delicate animal in captivity, and very few specimens of it have ever reached Europe alive. When adult the proboscis monkey is rather a large animal, measuring, perhaps, some 30 inches in the length of its body, while the tail is nearly as long. It is remarkable for its large and elongated nose, of which, however, there is comparatively little appearance in the present young specimen. The young animal is also much more simple in coloration, being of a nearly uniform pale rufous above and grey below, while the adult is brightly and mostly distinctly coloured with yellow and chestnut. The proboscis monkey is an inhabitant of Borneo, and was made known to European science by Wurmb, the Dutch Governor of Batavia about 1780. Preserved specimens of it were first brought to Europe by Sir Stamford Raffles. Captain Stanley Flower received some living examples of it at the Ghizeh Gardens, Cairo, in 1899 (see *P.Z.S.*, 1899, p. 785), but they did not last long even in the favourable climate of Egypt.

THE HABITS OF THE LARVÆ AND ADULTS OF SIREX AND THALESSA.

WE have received from Mr. E. P. Stebbing, of Dehra Dun, India, an account of the habits of the larva of a Himalayan species of sawfly (Sirex) and its parasite, an ichneumon allied to Thalessa, of which the following is an epitome. The adult sawfly deposits its eggs in the wood of dead spruce-trees (*Picea morinda*). When hatched, the grubs bore horizontally into the wood for a short distance and then drive a tunnel vertically upwards or downwards after the manner of the European *S. augur*. The débris, after passing through the body of the grub, is so closely jammed in the tunnel that no holes are visible in the wood when sawn through. The pupa is formed at the end of the tunnel, where it lies naked at an angle to the axis of the stem at a variable distance from the exterior. In place of following the old, tortuous track of the grub—for several reasons a matter of difficulty—the adult insect cuts its way to the exterior by the nearest route, which, unlike that of the European species, is not, as a rule, at right angles to the larval tunnel. The mature insect never seems to have the slightest hesitation in determining the direct route to the outer world. It may be added that the larval state seems to last for several years, as grubs of different ages occur in the same trunk.

With regard to the parasitic ichneumon-fly allied to or identical with Thalessa, Mr. Stebbing is of opinion that it never makes the mistake of attacking wood in which pupæ of the sawfly Sirex are not entombed. As to the statement that the ichneumon-fly frequently dies from its ovipositor becoming inextricably fixed in the wood, he suggests that the insect, after depositing its last egg, dies in the position then assumed, as is certainly the case with many of the bark-boring beetles of the family Scolytidæ. As the ovipositor of the ichneumon does not exceed an inch and a half in length, while the spruce-bark may be fully an inch thick, it is considered that the Thalessa must have some means of fixing the position of the Sirex eggs and of the tunnels of the young grubs in the wood underlying the bark. Without such knowledge it would seem an impossibility for the parasite, the ovipositor of which appears of inadequate length for its task, to reach the larval tunnels. Numbers of dead ichneumons were observed in partially bored galleries, this being apparently due to the circumstance that the Sirex larvæ often travel with their parasites to such a depth in the trunk that the adults of the latter are unable to cut their way out. The numbers of the ichneumon are thus, involuntarily, kept down by the sawfly larvæ.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. J. GRAHAM KERR, of Christ's College, Cambridge, has been appointed professor of natural history in the University of Glasgow, in succession to Prof. John Young, who has resigned.

THE Martell scholarship in naval architecture, offered for competition for the first time this year, has been awarded by the council of the Institution of Naval Architects to Mr. L. Woollard, of the Thames Ironworks, Blackwall. The scholarship is of the annual value of 50*l.* and is tenable for three years.

AN exhibit to illustrate the state of education in the British Empire will be sent by the Government to the Universal Exposition to be held in St. Louis in 1904. The official exhibits will be limited to education and the fine arts, but facilities will be afforded to trade and individual exhibitors to show products representing British industries.

THE last annual report of the Technical Instruction Committee recently presented to the Oxfordshire County Council supplies further evidence of the serious deficiency in the supply of secondary education in many parts of the country, which it is hoped the passing of the Education Bill, now before Parliament, will do much to remedy. The Committee again directs attention to the lack of secondary schools for girls throughout Oxfordshire, and for boys in the district between Chipping Norton and Bicester. In other directions favourable conditions mark the educational activity of the Committee; there has been a general improvement in the agricultural instruction in the rural centres, and good work has been done in supplementing the training of elementary school teachers.

IN accordance with the action of the Board of Trustees and the provisions of the will of the late Jonas G. Clark, the founder, the collegiate department of the Clark University, Worcester, Massachusetts, will be opened on October 1. There is to be no charge for tuition for the year ending 1903; for the next year the charge is to be twenty-five, and for the third year fifty dollars. After the third year, the charge per student in all classes will be at a rate to be fixed by the Board of Trustees. The preliminary announcement issued by the president of the college, Dr. Carroll D. Wright, shows, amongst other provisions, that mathematics will be taught as the groundwork of the college education and that sports will be permitted solely "for the development of physical and moral conditions." Special attention is in the future to be given to the "new" psychology, to economics and to sociology.

THE Volta Bureau of Washington, U.S.A., for the increase and diffusion of knowledge relating to the deaf, has issued its second international report of schools for the deaf. The data brought together from all parts of the world give a gratifying assurance that a marked improvement has taken place since

1895, the date of the last report issued by the Bureau, in the provisions made in all countries for the education of this unfortunate class. Not only are the charitably disposed of European and American countries fully alive to the possibilities of assisting the deaf by suitable methods of instruction, but, as the report shows, there are schools in good working order in China, Japan, Algiers and other places not often associated with educational progress. It is interesting, too, to learn that upwards of thirty periodicals for the deaf are issued in Europe, and nearly sixty in America.

THE following list of successful candidates for Royal Exhibitions, National Scholarships and Free Studentships (science) has been issued by the Board of Education, South Kensington:—Royal Exhibitions: Charles Cook, Landport, Portsmouth; Gilmour E. Brown, Balloch, Dumbartonshire, N.B.; Charles J. Stewart, Fratton, Portsmouth; George H. Childs, Portsmouth; William Welch, Fratton, Portsmouth; Edward L. Macklin, Buckland, Portsmouth; Alfred Jones, Crewe. National Scholarships for Mechanics: Herbert G. Tisdall, Beeding, Sussex; Joseph J. Holloway, Saltley, Birmingham; George H. Andrews, Sheerness; John Alexander, Glasgow; Christopher J. Lees, Oldham; Robert Royds, Oldham. Free Studentships for Mechanics: William E. Gardner, Edgbaston, Birmingham; Harold Fowler, Urmston, Manchester; Leonard E. B. Pearse, London. National Scholarships for Physics: Ambrose E. Woodall, Swinton, Lancs.; James H. Brinkworth, Chippenham; Herbert Moss, Leeds; Thomas F. Connolly, St. Albans; A. Henderson McKenzie, Salford, Manchester, Free Studentships for Physics: Evan J. Evans, Llanelly; Wilfrid M. Hooton, Sutton Bridge, Lincs. National Scholarships for Chemistry: Alfred F. Joseph, London; Alexander McDonald, Middlesbrough; Donald F. Blyther, London; James M. Hird, South Woodford, Essex; Howard H. Morgan, Rhayader, Wales; John W. Birkby, Leeds. Free Studentship for Chemistry: Robert G. Kirkby, Whitstable. National Scholarships for Biology: William F. Collins, London; Thomas Southwell, Todmorden; Arthur E. Pratt, London. National Scholarships for Geology: George Haworth, Burnley; Thomas Dewhurst, Burnley.

SCIENTIFIC SERIAL.

American Journal of Science, August.—The terraces of the Westfield River, Mass., by W. M. Davis. Miller's theory of defending ledges gives a better explanation of these terraces than any other, the normal action of a meandering and swinging river sufficing to account for nearly all the details of terrace form.—Notes on the Cretaceous turtles, Toxochelys and Archelon, with a classification of the marine Testudinata, by G. R. Wieland.—The magnetic effect of electric displacement, by J. B. Whitehead, jun. After a short historical account and criticism of the previous work done in this field, new experiments are described, the net result of which is against the presence of the magnetic effect of electric displacement in an amount given by Maxwell's expression. Only once was a positive result obtained, and this is regarded as being liable to question.—Certain relations of plant growth to ionisation of the soil, by A. B. Plowman. The experiments described show that negative charges stimulate and positive charges paralyse the embryonic protoplasm of plants.—The demagnetising effects of electromagnetically compensated alternating currents, by Z. E. Crook. An experimental study of the effects of the alternating current on the magnetic properties of iron and steel, with special reference to the effect due to the current independently of that produced by the circular magnetism.—Nepheline and other syenites near Port Coldwell, Ontario, by A. P. Coleman.—The double ammonium phosphates in analysis, by M. Austin. A study of the best conditions for the determination of zinc and manganese as double ammonium phosphates.—On the electrical resistance of glass, quartz, mica, ebonite and gutta-percha, by O. N. Rood.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 11.—M. Bouquet de la Grye in the chair.—Reflection and refraction by a body undergoing a rapid translation, by M. J. Boussinesq.—On the law of pressures in cannon, by M. E. Vallier. As the expression originally proposed by the author necessitates complicated interpolations, an empirical formula of a simpler nature is suggested which is sufficiently exact.—On entire functions of finite order, by M. Ernst Lindelöf.—On the mode of formation of kathode and Röntgen rays, by M. Th. Tommasina. The study of the unipolar production of the X-rays by M. Jules Semenov led him to the conclusion that the antikathode gives off rays only if it carries an electric charge, and if connected to the earth it gives off practically no rays. Having regard to the theoretical importance of this fact, the author has submitted it to further experimental study. The following conclusions are stated:—The diffuse reflection of the anode flux alone is sufficient to give rise to kathode rays and to Röntgen rays; the phenomenon takes place even when the antikathode is connected to the earth, and the multiple reflection by the walls of a vacuum tube suffices to produce the partial transformation of the anode flux into both kathode and Röntgen rays.—Phenomena observed at Zi-Ka-Wei, China, during the Martinique eruption, by M. de Moidrey. A magnetic disturbance was observed, as at Paris and at Lyons, at a time corresponding with the explosion of Mont Pelée, together with an earth tremor which lasted about eight hours.—New contributions to the physiology of the leucocytes, by MM. H. Stassano and F. Billon.—Hæmoglobinuria of muscular origin, by MM. Jean Camus and P. Pagniez.—On the existence of a kinase in snake poison, by M. C. Delezenne. Snake poison contains a diastase possessing the same properties as enterokinase, or the microbial kinases. It has not yet been determined whether it is distinct from the poisonous principle of the snake venom.—The toxin of tetanus. Observations of the electrical resistance and of the index of refraction, by MM. Dongier and Lesage.—The distribution of the suprarenal bodies of the Plagiostomes, by M. Ed. Grynfeltt.—Observations on the germinative duration of seeds, by M. Jules Poisson. The seeds of plants growing in moist soils preserve their vitality longer than others provided that they do not leave their moist situation.—The verification of the law of barometric heights, by M. W. de Fonvielle.

CONTENTS.