THURSDAY, MAY 16, 1901.

THE SIGNIFICANCE AND SCOPE OF NATURAL SELECTION.

Ueber Bedeutung und Tragweite des Darwin'schen Selectionsprincips. Von L. Plate, Privatdozent an der Universität Berlin. Pp. 1–153. (Leipzig : W. Engelmann, 1900.)

THE great merit of this interesting and thorough piece of work is its explicit recognition of the principle of selection as an indispensable element in organic evolution. We are in some degree prepared for the author's attitude on this question by the last sentence of his preface, in which he asserts that the principle of selection affords at the present time the only scientific explanation of the harmony existing between the endowments of an organism, whether structural or functional, and its surrounding conditions. From this statement it might be supposed that the author not only holds selection to be an essential agent in organic evolution, but that he is also prepared to dispense with the Lamarckian factors, which have certainly been appealed to as furnishing an alternative or concurrent explanation of the same harmonious relations between organism and environment. Such, however, as will be seen later, is not the case.

Nothing could be better than the impartial and judicial spirit of the opening pages, in which the author moves methodically on from point to point, clearing the ground of misconceptions, and disposing conclusively of a long series of well-known but futile objections to the theory of natural selection. Presently he takes in hand the case of the superior oblique muscle of the orbit, and shows admirably how the difficulties disappear on reference to the facts of comparative anatomy. But at this point he lets fall an *obiter dictum* which, in view of his opening declaration, is somewhat startling. The development of a muscle-tendon, he thinks, may be explained as the consequence of a pull exercised in a certain direction through many generations. We are thus confronted with a re-entry of Lamarckism ; and, reading on, we find abundant proof that Plate, so far from really holding that the phenomena of adaptation are only to be explained by selection, thinks it necessary to supplement that principle by the hereditary transmission of acquired characters. Thus the parachute-like membranes of the flying squirrels, *Galeopithecus*, flying lizards, and the like, are considered by him to have originated from a stimulus exercised by the outstretched limbs upon the skin of the sides of the body, the effects of which accumulated for many generations (p. 31). The ischial callosities of monkeys were produced by the sitting posture (p. 36). The loss of hair and development of blubber in the whales may be due to the direct action of water on the skin and subcutaneous connective tissue (pp. 111, 142). In short, the author leaves us no room to doubt that he believes in use-inheritance, and in the possibility of the transmission of characters however acquired.

On turning to the grounds for his belief, we find them stated as follows (p. 55) :—(1) All or almost all of the somatic cells may be supposed to contain germ-plasm ; this is made probable by the phenomena of regeneration. Moreover, the whole of the germ-plasm, whether of the somatic or genital cells, may be conceived of as forming a network whose nodes are situated in the nuclei of the different cells. A peripherally-started impulse would be propagated along such a network in all directions, and in this way a somatogenic character might become transmissible by descent. (2) Use-inheritance forms the simplest explanation of co-adaptation. (3) Many phenomena can only be understood by reference to orthogenesis, *i.e.*, the cumulative effect of a stimulus acting through many generations. (4) The gradual dwindling of rudimentary (vestigial) organs must be accounted for by inheritance of the effects of disuse.

Of these, the first is mainly speculative; moreover, were the initial assumptions granted, it would still be far from clearing up the actual mode of the supposed transmission. Two of the others have no doubt been felt as difficulties by some of the upholders of natural selection, and have already been pressed home by Herbert Spencer ; but there are other ways of accounting for these and similar phenomena which seem more satisfactory than the recourse to Lamarckians' explanations. Plate very candidly admits that there is at present no direct proof of the transmission of acquired characters, and it is unfortunate that he burdens his argument for selection with the unnecessary weight of an unproved and improbable hypothesis. His real reason for declining to rank himself with the anti-Lamarckian is probably the difficulty that he finds, in common with many others, in assigning selection-value to the early stages of variation. But, as Wallace and others have shown, when the actual variations come to be fairly examined, it appears that ample material for selection exists from the outset. It is worthy of note that Plate himself, in discussing Cunningham's strictures on Weldon's experiments with crabs, admits that the latter has virtually shown the selection-value of slight differences of structure.

A large portion of the treatise is devoted to the subject of sexual selection. An excellent classification of secondary sexual characters is given, and the whole question is treated on broad and generally rational lines. It is to be regretted, however, that the author, in emphasising the slenderness of the evidence for female choice that at present exists, has failed to do justice to the statements of some opponents. An instance of this occurs in the case of an observation of Poulton's, whom Plate represents as having watched the female of such a moth as *Saturnia carpini* resting motionless amidst a crowd of fluttering males, all of them most eager to pair, but unable to do so until the female, in some way imperceptible to the observer, made her choice. Poulton's interpretation of the facts is somewhat curtly rejected, and the subject is dismissed. A reference, however, to the original account will show that the argument is inaccurately given. The moth specified is not *Saturnia carpini* or one of its allies, but the widely removed *Charaeas graminis*. On the other hand, Poulton expressly says that the female of *Saturnia carpini* "in its present condition is certainly passive, and probably always accepts the attention of the first male to arrive." The slip would matter little were it not that it has the effect of obscuring Poulton's argument, which rests on the observed facts that the females of some moths

(as *Saturnia carpini* and *Orgyia antiqua*) accept the first male that arrives, while those of others (as *Charaeas graminis*) allow a period of competitive courtship ; and, further, that as a rule moths with bright colours belong—or at a former period did belong—to the latter group rather than to the former.

Plate's own view as to female choice is that it is exercised only as between pairing and not pairing. There is, he thinks, plenty of evidence as to success or failure of incitements employed by the male, but little or none of choice by the female between individual suitors. The distinction seems rather delicate. A would-be pairer may fail from want of sufficient power to charm the female ; but rejection implies choice, and if competitive incitement *does* take place, as Plate seems to allow, whether simultaneously or successively, how does this differ from sexual selection in Darwin's sense ?

On the subject of "sports," the author is no doubt right in contending that they have little or no bearing on the question of species-formation. But before unreservedly asserting that they must tend to be swamped by intercrossing with the parent species, he would have done well to examine the evidence brought forward by Standfuss and others in support of the position that the crossing of an aberration with the parent form may often result, not in the production of intermediate types, but in the sharp cleavage of the offspring into two groups, each resembling one of the parents and not the other. If these observations and experiments are to be relied on, they imply the theoretical possibility of a sport, supposing it to be selected, eventually displacing the parent form ; and, indeed, there is little doubt that under domestication something very much like this has actually occurred.

The treatment of adaptation is in many respects excellent. Kallima, the well-known Indian genus of leaf-like butterflies, is once more brought to the front and used as a conclusive instance of selection, furnishing also a good *reductio ad absurdum* of the "photographic" theory. But the author introduces a needless confusion by his method of handling the subject of "direct" and "indirect" adaptation. The former, he says, is repudiated by the "School of so-called Neo-Darwinians," of whom he specifies Weismann, Wallace and Spengel. It is certainly repudiated by them in the sense that they see no evidence for the "transmission of modifications due to individual plasticity," to use Lloyd Morgan's expression. But a distinction much more in accordance with the facts is that between "variable" and "invariable" adaptations. In the former are included such cases of individual assimilation in colour to surrounding conditions as have been principally made known, in the instance of caterpillars and chrysalises, by the labours of a "Neo-Darwinian." These adaptations are apparently "direct" in the sense that they mark a reaction of the individual to its own environment, but not in the sense that they are in any way actually produced by that environment. In common with all other cases of adaptation, whether variable or invariable, they are ultimately the result of a process of selection. The sensitive species is selected, not because it is green or because it is brown, but because in response to the appropriate conditions it is capable of becoming either one or the other. Plate's inclusion of Haeckel, Lloyd Morgan, Osborn and Henslow in the same category of believers in "direct adaptation," together with his criticism of Baldwin on an earlier page, serves to show that he has imperfectly grasped the point at issue. What we hold to be the true doctrine has been excellently expressed by Spengel in a passage quoted by Plate with disapproval (p. 141).

Though we have felt bound to express dissent on many points, we must not be taken as undervaluing Plate's labours. On the contrary, we have formed a high opinion of his knowledge, industry and argumentative power. As a champion of the indispensability of natural selection he has done excellent service, and it is only to be regretted that in adopting this illuminating principle he has failed to set himself free from the bonds of what seems to us a fanciful and unnecessary adjunct. F. A. D.

A TEXT-BOOK OF ELECTRICITY.

Deschanel's Natural Philosophy. III. *Electricity.* By J. D. Everett. Pp. xii + 358. (London : Blackie and Son, Ltd., 1901.)

PROF. EVERETT'S "Deschanel" is too well known to need commendation, and the new edition which is now before us has the many merits of its predecessors. The account it gives of fundamental electrical phenomena is admirable, the descriptions of apparatus are clear and good, though at times slightly too concise, the printing is well arranged and accurate, and the illustrations are excellent. In places, it is true, we recognise old friends which have done duty somewhat too often.

At the same time, the task just now of writing a really satisfactory text-book of electricity is a most difficult one, and Prof. Everett's success is not complete.

"The work," he says in his preface, "is in the main new. Electrical theory has been revolutionised during the past few years ; and great need exists for a text-book which shall present the subject in its present shape as a clear and connected whole without demanding on the part of the reader an exceptional amount of mathematical knowledge. This is the want which I have endeavoured to supply."

"The work is *in the main* new." Prof. Everett has hampered himself in his attempt to give a modern theory of electricity by retaining even that part of the old which he has kept ; the result is somewhat of a patchwork. Thus, Maxwell's conceptions with regard to electric action in dielectrics are introduced as "a new chapter in electrostatics." What was wanted was not an additional chapter in an old book, but an elementary account of the fundamental phenomena of electrostatics, given in the language of Maxwell's theory.

The book commences with electrostatics, and of necessity the language used at first is that of the theory of action at a distance. A charged body attracts light bodies and repels other bodies similarly charged ; the action of a gold leaf electroscope depends on the repulsion between the like charges of the leaves ; the electrophorus is described as a means of obtaining electricity in small quantities, but no explanation is given in §30 of its action.

The idea of electric potential is introduced in chapter vi., the first of the chapters in large type. These, it is

said, "will be found to contain a connected account of everything essential to a first course of modern electrical theory."

But in chapter vi. the definition of potential is a mathematical one. The distinction between scalar and vector quantities is drawn, and it is pointed out that in many cases the line integral of a vector between two points is independent of the path, and that in this case the vector is said to have a potential, the value of the line integral being the difference of the potentials at the two points which are taken as the extremities of the path.

A number of mathematical propositions connected with the theory of potential are then proved or illustrated in a very interesting way; but the application of the theory to the fundamental facts discussed in the earlier chapters is hardly attempted.

The beginner might be given some idea of the nature of potential without being asked to grasp the meaning of a line integral. Faraday's and Maxwell's notions as to the tension along the lines of force and the pressure perpendicular to them which occurs in a dielectric medium may be used, without the introduction of symbols, to explain the simple attractions and repulsions described in the earlier chapters; the link between the ancient observations and the modern theory is wanting, and the loss to the reader is very marked.

The same want is illustrated in the two following chapters. The quantity K, the specific inductive capacity of a medium, is defined in the usual way in §70, and a footnote tells us "it is identical with the permittivity or dielectric co-efficient K." This statement is repeated in the next chapter, on electric action in dielectrics, but the author does not explicitly establish the connection; a few words at the end of §86 would do it, the words, however, are wanting.

Or again, K is defined as the ratio of the polarisation, or the intensity of the electric displacement, to the force. Now the force has a perfectly definite meaning, and the inductance K can be defined in unambiguous terms; why then make it depend on "a peculiar distortion called electrical displacement" which is "roughly represented by supposing every tube of force to be divided into cells by elastic membranes firmly attached to the tube, these cells being completely filled with incompressible liquid. The distortion does not displace the sides of the tube, but it displaces the liquid a little way along the tube, in the direction of the force F, further displacement being prevented by the elastic resistance of the membranes."

The inductance of a dielectric is too important a physical quantity to be defined in terms of something which can only be explained by an incomplete analogy; it is surely better to say that the force between two given charges is found to depend on the medium in which they are placed, so that the complete law of force is $F = ee^1/Kr^2$, where K is a constant for a given medium, and is known as the permittivity or inductance of the medium. Then the statements in §80 as to the modification of fundamental formulæ follow naturally; as it is, they seem to the reader to depend on the analogy between the flow of a liquid and electric displacement, and not to rest on an experimental basis.

The earlier chapters on magnetism are clear and good, §148, giving the reason why a bar of soft iron sets parallel to the lines of force, may be specially commended. Chapter xiii. gives a useful development of magnetic theory; the proof of the relation, however, between B and H, §158, might be given in fuller detail, and a reference to §83 as well as to §90 would not be misplaced.

The rest of the book is taken up with the theory of electric currents and electro-magnetism, and can, on the whole, be warmly commended. The description of instruments, ammeters, voltmeters and the like is brought up to date. At times, possibly, almost too much is attempted for the space available, *e.g.*, in the very condensed account of the ballistic galvanometer in §200. Again, some preliminary account of a voltaic cell is needed before §213, which begins "In a circuit consisting of a battery of four similar cells."

In places the book would be improved by a more distinct reference to the fundamental experiments on which the various laws are based. Thus in chapter xix., after a reference to a statement as to the force exerted on a wire carrying a current in a magnetic field, we pass on to "two fundamental formulæ." These formulæ give the electrical and mechanical forces on a conductor carrying a current when in a magnetic field, and various important deductions are drawn from them in an admirable manner in the following paragraphs. But we miss any clear indication of the method by which these two fundamental formulæ are deduced from experimental results.

The chapter on dynamos is specially good; there is sufficient detail to enable the student to grasp the principles which underlie the action of the various forms, while at the same time the book is not overburdened with accounts of small differences of construction which, though they are of great importance to the student of dynamo design, have no place in a general text-book.

Enough, perhaps, has been said to show the value of the book. Prof. Everett has rendered a real service to his readers by his new edition; the book is one which is sure to become popular and to be valued alike by teacher and by student.

AN ESSAY IN CRITICAL BIBLIOGRAPHY.

The Periodic Classification and the Problem of Chemical Evolution. By G. Rudorf. Pp. xvi + 228. (London: Whittaker and Co., 1900.) Price 4*s.* 6*d.*

THE object of this work, as stated by the author in his preface, is one which should command hearty approval. The author aims at presenting a summary of the work done and the speculations advanced in the particular field indicated in the title. The publication of such summaries has long been customary in Germany, and it is to be hoped that the custom may become more common in England. Most text-books published in this country suffer from one or other of two defects. Either they are very elementary in scope and wholly didactic in treatment, or they are diffuse in treatment and of unmanageable size. This work certainly does not fall under either condemnation. It deals with a difficult subject, and is rather suggestive and argumentative than didactic. On the other hand, it is neither unreasonably long nor over-elaborate in treatment. Indeed, it sometimes errs in the other direction.

The first part deals with the history of the periodic law and the experimental evidence for periodic variation of properties with atomic weight, and in many cases information is given in so condensed a form that it must be well-nigh unintelligible to those whom the author has avowedly sought to benefit, students "who may not have either time or opportunity to refer to the original literature." This is particularly the case in the portions which deal with various attempts to formulate numerical relations between the atomic weights.

In the second part of the book the author seeks to establish the theses (1) that "the elements have a fixed, definite structure," (2) that "the elements are complexes of some primary material," and (3) that this primary material is hydrogen. Dealing with the first of these, the author gives a sketch of the evidence to be derived from stereo-chemistry which is so short that it amounts to little more than a series of references, but which is useful so far as it goes. The inference that the elements in any one group of Mendeléeff's table should all have the same shaped atom is somewhat sweeping, but is opportunely supported by the recent work of Messrs. Pope and Peachey on optically active tin compounds.

As to the second, the arguments which have been advanced in support of it are fairly well presented, but the author misses altogether the point that the "meta elements" of Crookes supply an essential link in the chain of reasoning by which it is possible to reconcile the discontinuity implied in the atomic theory and the periodic law with the continuity predicated in the hypothesis of protyle.

In support of the third proposition, that protyle and hydrogen are one, the author adduces several well-known arguments, many of which, particularly those based on stellar spectroscopy, are fairly well stated and of acknowledged cogency. But his answer to the obvious difficulty that the atomic weights are not whole multiples of that of hydrogen is, though not unfamiliar, decidedly unsatisfactory. That the third law of motion may be valid only where molar masses are concerned is, of course, a legitimate suggestion, but it is a suggestion in support of which no fact save the difficulty under discussion can at present be adduced. It is surely as reasonable to regard that difficulty as fatal to the hypothesis that hydrogen is protyle as to find in it a reason for doubting the universal applicability of the third law of motion.

The author, moreover, minimises in an extraordinary way the remarkable evidence which has been accumulated through the study of ions produced in gases by the action of Röntgen rays, Becquerel rays and ultraviolet light. "The portion of this book dealing with chemical evolution was," we are told, "submitted to Sir Norman Lockyer," and some of the notes which he made upon it are prefixed to the volume. In them attention is drawn, more than once, to the importance of this work on gaseous ions in relation to the problem under discussion. The author does, it is true, add to these notes a brief abstract of one of Prof. J. J. Thomson's papers. But the matter is far too important to be thus disposed of in a prefatory note. The fact that the negative ion in gases has a mass which is very small compared with that of an atom of hydrogen is well established, not only by the researches which the author quotes, but by other and later work of Prof. Thomson on the negatively charged particles given off when ultraviolet light falls on a zinc plate, and also by the experiments of MM. Becquerel and Curie on the radiations emitted by radium. The conclusions to be drawn from these researches, while they are in full accord with the view that the elementary atoms of the chemist are themselves complex aggregates of yet smaller particles, require that these particles should be of an order of magnitude so far inferior to that of a hydrogen atom that they cannot fairly be described as "hydrogen" at all.

If, as may be expected, a second edition of the work is called for, it is to be hoped that the author will take the opportunity of incorporating these results, and with them the still later work of Prof. Townsend on the variations of conductivity in rarefied gases, the results of which also emphasise in a remarkable way the extreme smallness of the negative ions.

In conclusion, it must be said that the author has occasionally suffered unduly at the hands of his printer. There are a number of ordinary misprints which might be expected in a work of the kind, but a worse piece of printing than that of the numerical expressions illustrating the summary of Dr. Dulk's paper (on p. 71) it would surely be difficult to find. A. F. W.

OUR BOOK SHELF.

Der Gesang der Vögel. Von Dr. Valentin Häcker. Pp. 1+102. (Jena: Gustav Fischer, 1900.)

THIS is an exceedingly interesting and useful contribution, and may be regarded as perhaps the most accurate and complete summary of this subject extant.

The author devotes the opening pages of his work to purely anatomical details, illustrated by numerous text-cuts representing voice organs of the passerine type. He introduces, for purposes of comparison, a short description and a figure of the tracheo-bronchial region of the reptile, the tortoise being selected as the most suitable.

The second chapter opens with a reminder that the variety of tone and range of vocal power depends largely on the modification of the upper ends of the bronchial tubes and the lower end of the syrinx. This is supported by a brief survey of the simpler types of syrinx ending in the very perfect voice organ of the Passeres, with its complicated muscular system and fusion of tracheal rings —the tracheo-bronchial syrinx.

That muscular development, however, does not necessarily imply great powers of song is, as he rightly remarks, well shown by the fact that the muscles of the raven and thrush are precisely the same in number and distribution. Furthermore, the muscular system of the raven is the better developed of the two; but there can be no doubt, in spite of this, which is the better songster! Again, though the songs of the true Passeres are extremely varied, yet there is no perceptible variation in the muscular system; indeed, such variation is obviously unnecessary, for the same bird may, and does, repeat the song of numerous other birds as proficiently as the birds to whom the songs rightly belong.

It is interesting to note that Dr. Häcker seems to have shown that sexual distinctions in the syrinx can undoubtedly be demonstrated, that of the female being always more feebly developed. This being the case, one would scarcely have supposed that the female, as in the case of the bullfinch, for instance, would sing as well as the male, but so it is.

Castration acts directly on the syrinx, much as on the horns of deer, for instance; the capon having a syrinx

like that of the female. Young males appear to have a more powerful syrinx than adult females.

The chapter dealing with the development of song and other forms of display are full of thoughtful matter. Special mention is given to Rohweder's recent interpretation of the curious bleating or drumming of the snipe. This observer contends that this strange music is caused by the rapid vibration of the horizontally extended and half-closed wings, which drive a strong current of air against the stiffened outer tail feathers, setting them in rapid vibration, and causing the curious tremulous bleating sound. This explanation differs somewhat from that of Meeves and others, and is probably the most nearly correct explanation we have yet had.

We heartily commend the book to the notice of ornithologists. W. P. P.

Physikalisch-chemische Propädeutik. Zweite Hälfte, 1-3 Lieferungen. Von H. Griesbach. (Leipzig : W. Engelmann, 1896-1900.)

THIS book, the first part of which has already been reviewed in NATURE, is chiefly intended for those interested in medical science. In it Prof. Griesbach discourses of everything from the law of gravitation and the conception of potential to the chemical nature of disinfectants and the morphology and physiology of bacteria. There is no particular arrangement in the book ; chapter xxiii, on molecular mixtures, occupies 232 pages, whilst chapter xxiv, on the factors of energy, occupies 4. It must not be supposed, however, that the book is on this account uninteresting—far from it ; it is excellent reading, and is both wonderfully accurate and wonderfully complete. Indeed, the struggle after completeness seems to be the author's chief failing. In connection with semipermeable membranes, he happens to mention sugar. This at once prompts him to give the means of detecting sugar :—smell of caramel, "French word from Latin *canna mellis*, honey-cane, *i.e.* sugar cane," and reduction of Fehling's solution, which necessitates a short biography of Fehling. Exact instructions for the preparation and use of Fehling's solution are then given. This, of course, involves reference to Rochelle salt, whence "Pierre Seignette, born when and where ? physician and apothecary in Rochelle, died at Rochelle, 11 March, 1719." After nearly two large and closely printed pages we get back once more to semipermeable membranes. This is propædeutic with a vengeance.

Despite its faults of method the book is a mine of valuable information, and can be cordially recommended to any medical man with a taste for the physical sciences.

Annals of Politics and Culture (1492-1899). By G. P. Gooch, M.A., with an introductory note by Lord Acton. Pp. 530. (Cambridge : University Press, 1901). Price 7*s.* 6*d.* net.

THE object of this work, as set forth in the preface, may at first sight appear pretentious and impossible of achievement, viz., to present "a concise summary of modern times, embracing the life of mankind in its entire range of thought and action." As soon, however, as the reader has mastered the plan of the book it will be found that the author has carried out his object—originally suggested by Lord Acton—with remarkable skill and completeness. Politics occupy the left and culture the right hand series of pages. At the top corner of each page is the date in conspicuous type, and a further subdivision under the two headings enables the reader to pick out at once the particular subject or country. The political subjects are classified under countries and the culture subjects under various headings, such as art, science, philology, history, philosophy, literature, education, economics, archæology, social, deaths, &c. Of course it is the scientific references that will chiefly appeal to our readers, and so far as we have tested these they appear to be both accurate and complete. The author has evidently been well advised in his choice of scientific events and due proportion as to the relative importance of discoveries in different branches of science which, under a chronological classification, have necessarily to be brought into juxtaposition, has on the whole been carefully observed throughout the long period of more than four centuries covered by the work. A very complete index, composed both of names and subjects, is correlated with the contents of the volume by reference numbers and not pages, ordinary numerals referring to politics and italicised numerals to culture subjects. As a book of reference, workers in the history of science will find Mr. Gooch's volume of great value. R. M.

The Child: His Nature and Nurture. By W. B. Drummond. Pp. 146. (London : J. M. Dent and Co. ; no date.) Price, 1*s.* net.

IN the preface of this primer it is stated that the book is intended as an introduction to the study of the physical and mental development of the child, and it is admirably fitted for this purpose. It covers a wide range, but is concise, clear and interesting, and brings within a small compass the result of recent work in the study of children. It is a book which should be in the hands of every one who has to do with children, and besides being a practical help in dealing with the infant and growing child, we think it will stimulate further child-study.

LETTERS TO THE EDITOR.

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

The Smithsonian Solar Eclipse Expedition.

THE Smithsonian Institution has sent out a small party to Sumatra, under the immediate charge of Mr. C. G. Abbot, to continue certain of the observations described in NATURE of July 12, 1900, where these, on account of the narrowness of the eclipse track and the brevity of the time, were indeterminate.

The expedition sailed on February 16 in the Government transport *Sheridan*, and the Institution has learned of the arrival of the party at Padang, Sumatra, on the *General Alava*, a United States naval vessel.

The objects principally sought are, such a thorough photographic search in the neighbourhood of the sun, for possible intramercurial planets, as may be apt to set the question of their existence at rest ; and also a further and more complete study, by the bolometer, of the heat of the corona.

The observations of May 1900 were three in number :—

(1) One on the radiation from the screen. This was arbitrary and may be called zero.

(2) One on the dark moon, giving on the millimetre scale − 18, showing that the bolometer was radiating to the moon.

(3) One on the inner corona, giving − 13, showing that the bolometer was radiating to it, though in a less degree than to the moon.

The algebraically increased reading for the coronal radiation then (− 13 − (− 18) = + 5) was probably due to this coronal radiation, together with possibly something from the different radiations of the closely neighbouring parts of the sky used in the two observations.

Since the Wadesboro experiments the bolometer has been set on a screen of its own temperature, giving zero ; on the bright moon, giving + 55, and on the night sky near the moon, giving − 30.

From my study of the visual photometric observations made at Pike's Peak in 1878, and at other places, it appears that the average visual brightness of the portion of the corona covering the bolometer at Wadesboro was approximately equal to that of the full moon.

I infer, then, that the full moon being of the average brightness

of the observed portion of the inner corona, the bolometric effect of its visual radiation may be supposed to be equal to that of the latter; but the observations above recorded show that the total radiations from the moon being 55+30, or eighty-five bolometric divisions, are seventeen times as great as the radiations from the inner corona, and hence it may be supposed that the corona lacks that large amount of infra-red radiation which is proper to the moon's spectrum.

The moon's spectrum, however, is that of a heated solid body, and all heated solid bodies, and heated gaseous bodies as well, send to the bolometer large amounts of infra-red radiation. So far, then, we might conclude that the inner corona has not the radiations of a hot solid or gaseous body, but, owing to the lack of a contemporary measure of the sky radiation just outside the corona, and of a full knowledge of the influences that the atmospheric radiations would have on our ability to discriminate this, the above conclusions seemed to me only probable, and worth verification at the forthcoming eclipse.

Smithsonian Institution, April 29. S. P. LANGLEY.

The Persistence of the Spectrum of Carbon Monoxide.

THE letter of Dr. Carl v. Wesendonk (p. 29), which gives an account of the spectrum of carbon monoxide appearing in a vacuum tube containing silicon tetrafluoride, affords an instance of the extreme difficulty of obtaining vacuum tubes charged with perfectly pure substances. The case he cites of silicon fluoride being prepared from "pure" sulphuric acid, glass and fluor spar, without any but glass joints to connect the different parts of the apparatus, is one in which neither the perfect freedom of the sulphuric acid, nor of the glass itself, from carbon compounds can be relied upon. In experiments on the absorption spectrum of ozone made by me in 1881, it was found that strong sulphuric acid free from all the usual impurities was not absolutely clear, but by being kept in an atmosphere containing a large proportion of ozone it became perfectly brilliant and absolutely colourless when seen in volumes of half a gallon to two gallons at a time. It appeared from further experiments that the impurities were either carbon or some form of organic matter probably coming from dust or dirt. As to the purity of the glass used for vacuum tubes, it may be remarked that dust and condensed vapour from carbonaceous matter, such as the products of combustion from lamp oil or coal, adheres to its surface with much tenacity. It is probable that the fluor spar contained organic matter, for the reason that this substance is associated with limestone of a bituminous character in England and that it has been asserted that its colour is due to organic substances. By the action of sulphuric acid a gaseous carbon compound might easily be evolved which would contaminate the silicon fluoride even if there were no carbonates present. Next we have to consider the traces of air which may remain in the tube, and must not regard these as being absolutely free from hydrocarbons. M. Armand Gautier has shown that there are combustible gases in the atmosphere, one of which is a hydrocarbon, the other hydrogen, and there is also some carbon monoxide. The difficulty of removing these by ordinary chemical treatment is so great that special operations and reagents were provided for their removal.

In vacuum tubes it is known that carbon monoxide shows its spectrum brilliantly when the pressure is extremely low, and that subsequently it disappears. The very interesting research of Prof. Smithells on "The Spectra of Carbon Compounds," in the April number of the *Phil. Mag.*, illustrates this. Furthermore, it shows distinctly that the same spectrum is obtainable from both carbon monoxide and carbon dioxide (*loc. cit.* pp. 489 and 490). We know, too, from the experiments of Regnault and of Bunsen on the analysis of atmospheric air, that carbon dioxide is absorbed by glass. In view of the facts quoted by Prof. Smithells, the carbon monoxide spectrum is, in his opinion, really due to carbon dioxide, but this latter may easily be decomposed into carbon monoxide and oxygen under the influence of the spark discharge.

The Swan spectrum, attributed variously to a hydrocarbon and to the element carbon by previous investigators, is, according to Smithells, to be attributed to carbon monoxide. It appears also in Dr. v. Wesendonk's letter that when the glass tubes in which the electrodes were fused had become heated, the carbon monoxide spectrum was faintly visible. This would be quite in accordance with the probability that carbon dioxide was evolved from the glass.

A tube containing silicon hydride also showed the carbon monoxide and the Swan spectrum, as well as hydrogen and mercury lines, but no silicon lines were observable. Considering all the facts of the case, it is not conceivable that the spectra in question arise in any way from the decomposition or dissociation of the silicon in the compound, either in the state of vapour as fluoride, of gas as hydride, or in the solid state as glass. W. N. HARTLEY.

April 25.

The Use of "Axis-vectors."

THE effort to popularise the elements of vector algebra is commendable. The power and the direct insight conferred by the use of vector quantities should be sought consistently in the study of physics; and it is true that the introduction of these methods has been needlessly postponed. But it lies in the very nature of such benefits that they are not to be secured except upon tenable grounds and as the result of a continuous argument. If a particular quantity is to be classed with vectors, that cannot be done upon a basis which is reducible to the bare statement: "This magnitude may be represented by a straight line of given direction and length; therefore it is a vector." Witness, for example, moment of inertia, which is not properly a vector, although its magnitude can be associated with a rotation-axis. Vector quantities must be subject to the process of "geometrical addition"; there is a total obtainable as the vector sum of constituent parts. This is equivalent to saying that there is a greatest value Q (resultant) for one direction, and that the law of orthogonal projection applies. Thus the value Q_1 for any other direction must satisfy the equation

$$Q_1 = Q \cos (Q_1, Q).$$

This projective property must be proved somehow in each case.

The conception of a vector is usually established as an elementary matter with the aid of instances like velocity and force. Velocity is so closely connected with linear displacement that the operations of geometrical addition and projection can be almost intuitively recognised as valid for both quantities. The graphical representation of forces, and the application to them of the "parallelogram construction," can be approached from the experimental side, furnishing a timely reminder that this procedure (as regards physical quantity) is ultimately justified by appeal to phenomena. The inclusion of "axis-vectors" (*e.g.* angular velocity and acceleration; moments of force and of momentum) in the class is a second step, of no less importance than the first. The proofs put forward to cover this extension of the thought afford fruitful material to the student of applied logic, through their variations of scope and emphasis. The analysis of some demonstrations now current prompts the remarks which follow.

First, linear vectors, like velocity, force, magnetic field, have what may be termed objective direction. But direction is assignable to axis-vectors by usage only, in the line of a (possible or actual) rotation-axis. Further, the sense in this line is arbitrary, being determined, for example, by the "rule of the right-handed screw." This double convention underlying the graphical representation of axis-vectors must be insisted upon.

Secondly, the theorem known as the "parallelogram of angular velocities" is really intended to prove that the linear velocities of all points in a rigid body satisfy the conditions of rotation in certain cases. The characteristic of rotation is a relation to the axis as regards the direction and the magnitude of all velocities, usually expressed as $v = r\omega$, v being perpendicular to both r and the rotation-axis. The proof of the theorem is only implicitly complete, if we content ourselves with showing that simultaneous angular velocities about intersecting axes produce zero linear velocity on a particular line. And the corollary covering the most important point is often not even mentioned. Similar considerations apply to angular acceleration.

Thirdly, the direct graphical representation of force-moment is connected with areas and not with lines. These areas are in general parallelograms, with adjacent sides representing the force and the distance of its point of application from a chosen point on the rotation-axis. The fundamental case is that in which the parallelogram is perpendicular to the axis, and its area shows the moment for a line through one vertex. For an oblique axis through the same vertex, the moment is obtained by projecting that area upon a plane perpendicular to the new axis. This follows easily from the definition of force-moment.

On adopting a convention governing signs, couple-moment can be represented, for a normal axis, by an algebraic sum of areas. The application here also of the projection-process is an immediate consequence, and it is seen that the values of couple-moment for all parallel axes are equal. The final step in making the transition to the axis-vector is the convention according to which areas are represented by lengths properly laid off on their normals. The process of reasoning for moment of momentum is entirely parallel to that outlined for moment of force. And it can be shown (cf. Heaviside, "Electromagnetic Theory," i. p. 181) to cover the cases of angular velocity and acceleration. For the representation of an area by a length of its normal is the basis of the idea in the vector product of two vectors. The argument of the present instance forms a good elementary introduction to that conception. F. SLATE.

University of California, April 24.

The New Comet.

ALTHOUGH others besides myself have probably noticed the remarkable inconsistencies in the published reports of the new comet, it seems worth while to draw attention to them. Its reported position for April 25, May 2 and May 4 are based on telegrams from the Cape and Peru, and there seems no reason to doubt their correctness. If, however, they are accurate, the comet could not have been seen in England in the morning, as at no time did it rise till after the sun. Yet Mr. Chambers saw it at Eastbourne at 3.5 a.m. on the 2nd, and a correspondent in the *Daily News* says it was fifteen degrees above the southern horizon at 3.30 a.m. on the 7th. E. C. WILLIS.

Southwell Lodge, Ipswich Road, Norwich, May 13.

Blood-Rain.

IN view of the recent letters in NATURE regarding the fall of red rain in Italy, the following extract from Roger of Wendover's Chronicles of the year 1223 may possibly be of interest:—"In the same year it rained blood-coloured earth at Rome for three days, to the great wonder of numbers of people (vol ii. p. 444 of Bohn's edition of Wendover's "Flowers of History.") It is rather curious that so miserably superstitious a *gobemouche* as Wendover should have described the phenomenon so accurately instead of calling it a rain of blood.

Polperro, Cornwall. F. H. PERRY-COSTE.

THE ANTI-VIVISECTION SOCIETY AND LORD LISTER.

THE Anti-Vivisection Society held its annual meeting last week in St. James's Hall. We know these annual meetings; they are accompanied by an annual crop of distortions of scientific work and an annual volley of scurrilous charges against scientific workers and philanthropic administrators. Beforehand, all the perseverance of the accomplished party "whip" is drawn upon to get these meetings together, and afterwards all the ingenuity of the unscrupulous pamphleteer to boom in the Press what has taken place at them. The usual copies of certain daily papers marked in blue pencil under the name of Mr. Stephen Coleridge are sent out broadcast, reporting in detail the sentiments of the audience and the horrors of so-called vivisectors. Were this all it might well be passed over in contemptuous silence, but this year it pleased the meeting to impugn the philanthropic impartiality of one whom all the scientific, and indeed cultured, world delights to honour.

Mr. Coleridge gravely informed his audience, after having discoursed inaccurately on Lord Lister's scientific work, that this man of science was the intimate friend of fifty-eight licensed vivisectors, presumably because he had signed a certificate exempting them from the use of anæsthetics in their scientific experiments. These certificates were signed by Lord Lister in his capacity as president of the Royal Society, and the probability is that personally he was not acquainted with half-a-dozen of the licensees. Mr. Coleridge carefully avoided telling his audience that the vast majority of these "horrid vivisections," in which the use of anæsthetics was dispensed with, were simply inoculations, or, in other words, mere pin-pricks; also that by the Prevention of Cruelty to Animals Act only very few persons of high scientific standing and training can sign these certificates, and that the president of the Royal Society is one.

Mr. Coleridge next turned his attention to scurrilous charges against Lord Lister, in particular, as chairman, and the committee, in general, of the Prince of Wales's Hospital Fund. He impugned the integrity of these gentlemen in that he stated they had given larger grants per bed to those hospitals which either had licensed laboratories attached to their medical schools, or had upon their staffs physicians and surgeons who were actually vivisecting, or had at some past time done so, than to those hospitals which had no connection either direct or remote with vivisectors. Further, that the Hospital Fund Committee had done this with the express object of encouraging so-called vivisection. Mr. Coleridge deduced the necessary corollary from this assertion, and stated point-blank that the Prince of Wales's Hospital Fund had simply been used to endow vivisection on a huge scale.

If we examine the facts we shall find that any hospital in London of any eminence whatever and performing philanthropic work of any magnitude, has upon its staff physicians and surgeons who have at one time or another experimented on animals. The small hospitals received small grants because their need was relatively small, and the large hospitals large grants because their need was relatively large, not because the former were unconnected and the latter connected with so-called vivisectors. Mr. Coleridge did not include in his speech the fact that he himself had endeavoured to strike a bargain with a London hospital, promising this institution the pecuniary support of the Anti-Vivisection Society if it would exclude from its staff all those whose medical knowledge had been derived from experiments upon living animals. The reply of this institution is worthy of record: it refused to allow any other considerations than those of medical or surgical efficiency to guide it in the choice of its officers.

This point has just now a very special interest, in that we believe that vivisection is to be made a party cry in the case of contributions to the Hospital Sunday Fund. Contributors are to be asked by the Anti-Vivisection Society when giving their contributions to demand that they shall only be devoted to hospitals having no connection with vivisectors or vivisection. So valuable have the results of experiments upon animals been to medical science that scarcely a hospital can be found independent of medical men who have derived their knowledge from them; and the Anti-Vivisection Society, with all its ingenuity and perseverance, cannot find amongst the ranks of its supporters a single medical man or indeed biologist of eminence. It is earnestly to be hoped that this fact will have its full weight with all contributors to hospitals, and that they will give their donations as they have done before, resting assured that their money will be duly apportioned by competent philanthropists accustomed to weighing justly the relative claims of charitable institutions, and not easily influenced by the clamourings, however loud, of ignorant partisans.

THE ARMY EDUCATION COMMITTEE.

WE are glad to learn that Sir Michael Foster has been added to the committee appointed to consider the present methods of selecting and training officers for the various branches of the Army. As stated in our number of May 2 (p. 23), this committee, as originally constituted, consisted of Colonel Jelf, Lieut.-Colonel Hammersley and Captain Lee, together with the Head Master of Eton, the High Master of St. Paul's, and the Right Hon. A. Akers-Douglas (chairman) and Captain Cairnes (secretary). Such a change as that

which has been made was therefore very desirable, and we feel sure that the addition of a representative of science to the committee will meet with general approval.

As the methods of selecting candidates for the Army have been altered repeatedly during the last twenty years, and as the present regulations, which we owe largely to the exertions of Sir Henry Roscoe, came into action no later than November 1898, it is clear that only an exceedingly small proportion of our present officers have been selected under those regulations and that only a few of these can as yet have reached positions higher than that of a lieutenant. It is certain, therefore, that any defects that may have been detected during the trials of the last two years must, so far as they are due to systems of selection at all, be the outcome, not of the present system, but of those narrower schemes which preceded it, and which, as we pointed out again and again before they were altered, tended to exclude certain classes of candidates from a profession which they were well fitted to adorn. This defect was remedied by the regulations now in force, and we trust that whatever changes may be found necessary there will be no reverting at this critical moment to the narrower policies of the earlier scheme.

There is said to be a strong and, we would venture to add, a highly reasonable feeling on the part of leading military authorities that what the Army wants is a plentiful supply of able candidates. If this be true, as we hope it is, we trust that the committee may find themselves able to make recommendations which will enable clever candidates who may not happen to be endowed with private incomes, or to be cadets of well-to-do families, to enter the Army more freely in the future than has been possible in the past. And, secondly, that they will take care that any new scheme of examination they may propose shall have no tendency to restrict the field of selection, but offer reasonably equal chances, as the present scheme does, to candidates of all suitable types and aptitudes. It would be a national misfortune if any present necessity of the Army should be made the basis of changes which would tend to reproduce the conditions of ten or a dozen years ago.

STUDIES ON THE STRUCTURE OF THE UNIVERSE.[1]

A VERY interesting publication has recently been issued by Mr. Stratonoff, of the Russian Observatory at Tachkent, on the structure of the universe, a problem which has a fascination of its own for most readers quite apart from any real progress which may be made towards its solution.

The question is so vast that the researches of our greatest astronomers have done little more than lead us to the top of Pisgar and show us from afar the promised land, but every newly ascertained fact, or even confirmation of old ones, is a valuable contribution towards the general stock of knowledge which is being gradually accumulated, out of which, perhaps, the genius of some future Newton may evolve some general law.

Before any real advance can be made in the study of the structure of the universe, it is necessary to commence, and perhaps finish, with the Milky Way, that great band of faint stars which has puzzled mankind from the earliest times and which has been explained more according to the imagination of the observers than with any regard to the facts. Indeed, before the age of modern scientific instruments there were no facts to explain anything, and even now, with all our present resources, fresh facts are only being very slowly brought out ; we still depend very largely on eye observations, only the eye we now use is the photographic camera.

We know in a general way that the galaxy is composed of very faint stars, presumably at an immense distance from our system, and that the stars have a tendency to thin out as we leave this region and approach the galactic poles. The great researches of Herschel, W. Struve, Argelander and Seeliger have thrown much light on the distribution of the larger stars as shown in the various catalogues ; there, however, still remained the telescopic stars to deal with, and it is this part of the question that Mr. Stratonoff has taken in hand.

Mr. Stratonoff has devoted himself to the making of a series of charts showing the distribution of the stars in the northern hemisphere and down to 20° south, and for this purpose he has divided the part of the sky dealt with into 1800 separate areas, and tables are given showing the density of the stars in each. These particulars are represented in the maps by a colour scale by which the regions containing the largest number of stars may be seen at a glance.

The first eight maps show the distribution of stars to each half magnitude from the 6th to 9·5 ; and the well-known tendency of the stars below the 6th magnitude to leave the poles and crowd more and more towards the galactic equator is well shown in the case of each magnitude.

The Milky Way itself Mr. Stratonoff considers to be an agglomeration of immense condensations, or stellar clouds, which are scattered round the region of the galactic equator. These clouds, or masses of stars, sometimes leave spaces between them and sometimes they overlap, and in this way he accounts for the great rifts, like the Coal Sack, which allow us to see through this great circle of light.

Mr. Stratonoff also finds evidence of other condensations of stars in these maps ; the nearest is one of which our sun is a member, chiefly composed of stars of the higher magnitudes, which thin out rapidly as the Milky Way is approached.

A second condensation is also found at a distance represented by the stars of magnitudes from 6·5 to 8·5, and a third, still further off, at about the distance occupied by stars of magnitudes from 7·6 to 8.

Mr. Stratonoff has also pushed his inquiries into the distribution of the stars according to their spectral type.

For the purposes of this inquiry the Draper Catalogue has provided the materials. In this catalogue the stars are divided into sixteen classes, known by letters from A to Q. In order, however, to facilitate mapping, Mr. Stratonoff has put all these classes into two :—Class I. embraces the divisions A, B, C and D, and Class II. takes in the rest. These two classes are too large to make these two maps of the distribution of the spectral types of much service, but they may be taken to give some rough idea of the position in the heavens of the stars of Secchi's types I. and II. From a glance at these maps it is seen that the stars of type I., which includes the Sirian and Orion stars, are situated principally near the Milky Way, while those of type II., which includes our sun, are principally condensed in a region coinciding roughly with the terrestrial pole, and only show a slight increase, as compared with other stars, as the galaxy is approached.

This mapping out of stars in their spectral classes is of the highest interest in the study of the structure of the universe, but we doubt whether the study of these types is sufficiently advanced to get any real information which can assist the student in this respect, and we must be content to wait until a far larger number of stars has been accurately observed before such maps can have anything more than a passing value. Mr. Stratonoff, however, has skilfully used the material he had, and we hope that he will take up this part of his subject later on.

[1] "Publications de l'Observatoire Astronomique et Physique de Tachkent. Etudes sur la Structure de l'Univers," par W. Stratonoff, Astrophysician de l'Observatoire de Tachkent.

The atlas also contains five maps showing the distribution of the nebulæ in the northern and southern hemispheres according to the various classes into which they are generally divided. Mr. Stratonoff states that the law which operates to cause the galaxy to be poor in nebulæ is a general one and extends to all classes of these objects, bright, feeble, large and extended. The nebulæ, however, do not appear to have been studied from a spectroscopic point of view, as it is well known that the gaseous nebulæ are chiefly found in the Milky Way.

The last map is devoted to star clusters in both hemispheres, and shows that these objects are intimately connected with the galaxy, the globular clusters, as distinct from star clusters generally, being the only ones which show no tendency to accumulate in this region.

Mr. Stratonoff has executed a laborious piece of research, and we congratulate him on making so interesting a contribution to stellar literature. HOWARD PAYN.

THE GEOLOGICAL SOCIETY AND ITS MUSEUM.[1]

THE Geological Society of London, which was founded in 1807, began in early days to accumulate a collection of rocks and fossils, minerals and recent shells; and when, in 1828, the Society was provided with apartments in Somerset House, adequate space was afforded for the arrangement of the museum. Although many specimens were distributed throughout the rooms, two of these were specially set aside for the museum, an upper room containing the foreign specimens and a lower room mainly for the British rocks and fossils, while the minerals and recent shells were stored in cabinets in the smaller library. The museum then supplied a real educational want, and was of great service in preserving specimens which illustrated many of the papers read before the Society and published in its *Transactions*. Its state may be judged of from the Report of the committee in 1836; they express "the pleasure they derived from the excellent state of preservation of the whole museum, and from the unwearied zeal and discriminating skill displayed by the curator in arranging the collections." For fourteen years William Lonsdale devoted himself to the welfare of the Society, not only reorganising the museum but editing the publications. He retired in 1842 and was succeeded by Edward Forbes. There is no doubt that in those days the museum was fully appreciated, and the lower room particularly, with its cosy fires, was in winter time a pleasant resort for conversation and study.

Meanwhile, however, the work of the Society increased, the library growing especially, while the museum made little progress, and although a curator (who gave his whole time to the museum) was now and again appointed for a period, it was not possible to offer remuneration sufficient for the purpose; and increasing difficulty was felt in keeping the collections properly named and in proper order. In 1868 the Council "decided on the discontinuance of the formation of a general collection," and restricted it "in future to specimens illustrative of papers read before the Society and those received from abroad." In 1874 the Society removed to its present rooms in Burlington House, and took the opportunity to present "superfluous duplicates" to the British Museum, the Museum of Practical Geology and other institutions. Since this date, however, the museum, while occupying valuable space, has been of comparatively little service to science or to any of the fellows. The collection, as a whole, has been sadly neglected, owing to the fact that the other work of the Society has fully occupied the officers. It has been realised, too, that the want which the Society in its earlier days supplied was now better supplied elsewhere, and that the fellows have ceased to take much personal interest in the museum. As Sir John Evans remarked, in his address to the Society in 1875, "the best home for a collection of British specimens was at the headquarters of the Geological Survey" in the Museum of Practical Geology. In 1896 a proposal was made to transfer great part of the Geological Society's collection to the British Museum, but the transfer was not then agreed to. On March 27 of the present year a special general meeting of the Society was again called to consider the matter, and it was then resolved "That in the opinion of this meeting the time has now come when this Society shall transfer its collections to some other museum." That this is a wise resolution most of those who know the museum and value its contents will cordially agree. Nor is this view inconsistent with the possession of a considerable amount of sentiment for the museum and its associations with the early history of the Society, with Greenough, Lonsdale, Fitton, Murchison, Leonard Horner, Daniel Sharpe, Falconer and others who actually worked in the museum or largely contributed to its stores. Those inspired with such sentiment would prefer to see the specimens well taken care of and accessible. It is reckoned that there are 2460 figured or described fossils. In the interests of geological science it is desirable that these be placed in the British Museum, Cromwell Road, where as many type-specimens as possible should be deposited; and it would not be difficult to find appropriate resting-places for all other specimens worthy of preservation.

The question is simply this: How can the specimens in the museum be best dealt with in the interests of geological science? And we hope the Society will soon settle it to the satisfaction of the fellows and of geologists in general.

[1] An article on "The New Museum of the Geological Society" at Burlington House, appeared in NATURE for January 20, 1876, p. 227.

THE ROYAL SOCIETY CONVERSAZIONE.

THE conversazione held at the rooms of the Royal Society on May 8 was a very successful one, and a large gathering assembled to examine the many interesting objects contributed by the fellows and others. We regret that the pressure on our space does not permit the publication of the various explanations carefully given in the official catalogue. But some of the more important of the exhibits have already been referred to in our columns, and we propose to return to more of them later on.

Mr. J. E. S. Moore, the Tanganyika problem. This exhibit was intended to give some idea of the additions which have been made by Mr. Moore, during the second Tanganyika Expedition, to our knowledge of the faunæ in the great African lakes.

Dr. H. E. Annett and Mr. J. E. Dutton, of the School of Tropical Medicine, University College, Liverpool: (1) Specimens of some new blood Filariæ, (2) specimens illustrating the life-history of *Ankylostoma duodenale* of the Chimpanzee. Mr. J. Mackenzie Davidson: (1) Stereoscopic transparencies of electrical discharges, and (2) skiagrams of bullet wounds. Mr. Eric S. Bruce, the meteo-parachute, a new instrument for investigating the upper atmosphere.

Commander D. Wilson-Barker, cloud photographs. Prof. J. W. Judd, F.R.S., on behalf of the Coral Reef Committee of the Royal Society, specimens of Foraminifera and Ostracoda, from Funafuti, Ellice Islands. Mr. H. J. Elwes, F.R.S., reversible drawers of butterflies from the Holarctic Region arranged to show wide distribution and adaptability to extremes of climate. Also to show variation and difficulty of applying binomial system of nomenclature. Mr. Killingworth Hedges, fulgurites, or lightning tubes, from the sand hills at Kensington, N.S.W.

Mr. J. E. Barnard and Dr. Allan Macfadyen exhibited luminous bacteria (from the Bacteriological Laboratory of the Jenner Institute of Preventive Medicine). The luminous bacteria are a group of organisms, whose natural habitat is sea-water. They are the cause of the so-called phosphorescence to be seen at times on such objects as dead fish, meat,

or other substances which are suitable soils for their growth and development. Their luminous properties are dependent on a supply of free oxygen and a suitable percentage of a soluble chloride in the nutritive medium. The exhibit consisted of artificial cultivations of these organisms on suitable nutrient soils, and showed their luminous properties and the variations that occur under different physical conditions.

Mr. Everard im Thurn, C.B., C.M.G., exhibited arrow-heads of rock crystal from British Guiana, and orchids growing wild in British Guiana; Mr. Vaughan Cornish, photographs of waves, &c., in sand, cloud and snow; Mr. J. Wimshurst, F.R.S., photographs which exhibit some of the properties of the light emitted by Röntgen ray tubes; Mr. Hugh Ramage, diagrams of corresponding lines in homologous spectra; the Meteorological Office, pilot charts of the North Atlantic and Mediterranean for April and May, 1901; the Cambridge Scientific Instrument Company, Ltd., Callendar and Griffith's patent temperature indicator, and photographs of the spectroscope, made for Sir David Gill, for use with the McClean telescope, Royal Observatory, Cape of Good Hope; and the Carl Zeiss Optical Works, stereoscopic binocular range-finder. The reading is taken direct from a scale within the instrument without calculations, giving the distances in meters. Range from 75 to 3000 meters; Prof. J. C. Bose, experiments on binocular alternation of vision; and Mr. R. Shelford, swords and knives from Sarawak, Borneo.

The Director, British Museum (Natural History), exhibited models illustrating the structure of the gills of bivalve mollusca; examples of mormyrid fishes from the Nile; a series of adult and young birds and eggs of the Adelia penguin (*Pygopcelis adeliae*); trephined skulls of natives of the Bismarck Archipelago, collected by the Rev. J. Crump and deposited in the British Museum by Mr. W. E. de Winton. These skulls illustrate native methods of performing the operation of trephining, and are of especial interest owing to the clinical histories of their owners being known. Claw and tooth of Neomylodon Patagonia, and coloured model of the right whale; Prof. A. G. Greenhill, F.R.S., showed a reflecting stereoscope; trochleostatic—diagram and models of pulleys; Mr. C. V. Boys, F.R.S., tool grinding appliance; Dr. Dawson Turner, a mechanical interrupter for an induction coil; and the Marine Biological Association, examples of marine plankton from the neighbourhood of Plymouth. The term marine plankton is used to denote organisms whose normal mode of life is to swim freely in the sea-water, in contradistinction to such as live in contact with the sea-floor. The Observatory, Cambridge, exhibited a machine for measuring astronomical photographs; and Prof. Callendar, F.R.S., a standard barometer.

Photographs of Nova Persei were exhibited by Sir Norman Lockyer, K.C.B., the Rev. W. Sidgreaves, S.J., and Mr. Frank McClean, F.R.S.

The Zoological Society of London exhibited living specimens of the Heloderm (*Heloderma suspectum*) from Arizona, the only venomous lizard known; Dr. J. H. Gladstone, F.R.S., ancient Egyptian gold; Mr. W. Flinders Petrie, casts and photographs of Egyptian jewellery of the 1st dynasty, 4700 B.C., and specimens of molecular transference in ancient bronze; Prof. A. W. Rücker, Sec. R.S., and Prof. J. W. Judd, C.B., F.R.S., specimens of atmospheric dust which fell at Taormina, Sicily, during the month of March, giving rise to the so-called "blood rain"; Sir W. Roberts-Austen, K.C.B., masses of chromium, manganese, ferro-titanium and cobalt. These specimens of metal were reduced from their oxides by means of finely divided aluminium, by Dr. Hans Goldschmidt.

Dr. P. L. Sclater, F.R.S., exhibited two bandoliers from the Semliki Forest, Congo Free State, made from the skin of a new mammal; Dr. H. Woodward, F.R.S., coloured casts of objects of natural history, prepared at the British Museum (Natural History); an enlarged model of the shell of Ascoceras, a cephalopod occurring in the silurian rocks of England, Sweden and North America; and table of British strata, coloured; Mr. G. Abbott exhibited symmetrical concretions, and "growth" in inorganic matter. Also specimens of four varieties of the cellular or magnesian limestone of Sunderland (Permian), which show a striking resemblance to corals, yet are believed to be only concretionary and inorganic. Hon. Walter Rothschild, M.P., exhibited leg bones and egg of *Æpyornis titan*, Madagascar; Mr. W. Duddell exhibited the musical arc. If a *direct current* arc between *solid* carbons be shunted by a suitable self-induction and condenser in series, alternating currents will flow round the shunt circuit, the arc thus converting part of the direct current into alternating current. The frequency of the alternating current is determined, as in the case of the oscillatory discharge of a Leyden jar, by the capacity and the self-induction of the circuit. These alternating currents superposed on the direct current through the arc will cause it to emit musical notes, the pitch of which can be varied by altering the capacity or self-induction, and a tune can be played on the arc by this means.

The Telegraphone Syndicate exhibited the telegraphone. This instrument, the invention of Mr. Poulsen, of Copenhagen, depends for its action upon the fact that the variations of the magnetic field of an electro-magnet are so accurately represented by the magnetisation of a steel wire which is drawn through it, that if the wire be again passed through the field, currents exactly similar to those which produced the magnetisation of the wire are reproduced in the coils of the magnet. This principle has been applied to the reproduction of speech transmitted through an ordinary microphone transmitter.

The following demonstrations were given by means of the electric lantern:—Dr. Arthur Rowe, life-zones in the White Chalk, and their significance in connection with the evolution of species; Mr. Francis Fox, some engineering problems and their solution; Prof. Silvanus P. Thompson, F.R.S., kinematograph diagrams, illustrating magnetic fields.

THE NATIONAL ANTARCTIC EXPEDITION.

PROF. J. W. GREGORY has to-day (May 15) cabled his resignation of the leadership of the scientific staff of the National Antarctic Expedition in circumstances which will shortly be fully explained to the Fellows of the Royal Society by one of their number.

The great majority of scientific men in this country were confident that Prof. Gregory possessed unique qualifications for the post of scientific leader of an expedition in which many branches of science required study and coordination. Under his direction, and with a competent naval head who should have an absolute veto upon all operations which involved risk to ship and crew, great scientific results were assured.

The opposition of the representatives of the Royal Geographical Society, which had obtained most of the funds voluntarily subscribed, and of a few scientific men belonging to the Navy, rendered it impossible that these full powers could be granted; but a compromise acceptable to Prof. Gregory was passed by a large majority (16 to 6) of the Joint Antarctic Committee, including the officers of both societies and almost every expert on their joint lists.

The compromise provided, in the words submitted on February 12 to the joint committee, "that a landing party, if possible, be placed on shore, under the charge of the Director of the Civilian Scientific Staff." Prof. Gregory was informed of this, accepted it, and, the next day, sailed for Melbourne.

The Royal Geographical Society's council refused to accept the compromise, and deputed three of their number to suggest to the officers of the Royal Society that the matter should be settled by a new committee of six, three to be appointed by each council. The Royal Society consented; the committee, chiefly composed of non-experts, met, and proposed modifications which Prof. Gregory has been unable to accept.

We shall await with some interest to see whether the majority of Fellows of the Royal Society, and of other scientific men in this country, will approve the manner in which the Royal Society has acted as the guardian of scientific interests.

NOTES.

INTELLIGENCE has just reached us from Melbourne that on April 10 news had been received from Charlotte Waters, both by letter and telegram, of the safety of Prof. W. Baldwin Spencer and his energetic co-explorer, Mr. Gillen. They report themselves in good health and already busy taking phono- and

kinematographic records; and it is good news that the Postmaster-General of South Australia has provided them with a pocket apparatus for tapping the overland telegraph line when in the vicinity of their route. We are also informed that during Prof. Spencer's absence some of his duties are being partly performed by Miss Ada M. Lambert, a distinguished student of the Melbourne University, whose name and work will be well known to all who follow the progress of zoology at the Antipodes.

DR. GUSTAV ZEUNER, of Dresden, has been elected a correspondant of the Paris Academy of Sciences, in the section of mechanics. Dr. Oudemans has been elected a correspondant in the section of geography and navigation.

ONE noteworthy feature of the modern educational revival in this country is the gradual conversion and development of the older grammar schools so as to bring them more into harmony with the requirements of the time. Among the latest examples of this enlightened policy is the King's Middle School at Warwick, one of the most ancient foundations in the country. Its founder is said to have been Lady Ethelfleda, daughter of King Alfred, and in date it is coeval with the castle, although the present buildings are modern. The School was opened on May 4 as a School of Science by Sir George Kekewich, who addressed a large meeting in the central hall, in the course of which he said that "science had now come to be regarded as a proper part of the education of every man, in whatever class he might be and in whatever position of life." He added also, among other pregnant remarks, that "it was the new knowledge in science that paid. It was the new knowledge that preserved the nation that produced it in the forefront of commercial and industrial supremacy." The Earl of Warwick, chairman of the board of managers, presided at the meeting, and gave in his opening remarks a brief account of the history of the School and the origin of the present development. The expense of building the new laboratories, &c., has been partly met by a contribution from Sir Thomas White's Charity and partly by a grant from the County Council. Among other speakers who addressed words of encouragement to the managers and scholars were the Countess of Warwick, Dr. Oliver Lodge, representing the nearest University (Birmingham), with which he hoped to see the school hereafter affiliated, Prof. Meldola, Mr. Bolton King, chairman of the Warwickshire Technical Instruction Committee, the Mayor of Warwick, Mr. Alderman Glover and others. The head-master is Mr. H. S. Pyne, who in organising the curriculum hopes to include the scientific subjects bearing upon agriculture, this being the predominant industry in the districts immediately contiguous to the ancient county town. The mining industry is already provided for by a mining school, established elsewhere by the County Council.

THE conversazione of the Society of Arts will be held this year at the Royal Botanic Gardens, Regent's Park, on June 28.

MR. REGINALD SMITH, of the British Museum, has just conducted a second excavation on the Winklebury Estate, Basingstoke. He found fragments of pottery, which he said undoubtedly belonged to the ancient British period, *i.e.* before the Roman invasion of Britain.

THE eighty-fourth annual meeting of the Swiss Natural History Association will be held at Zofingen on August 4–6. At the same time and place, the Swiss Geological, Botanical and Zoological Societies will hold their meetings. Intending visitors should send their names before July 15 to Herr Ulr. Ammann, Zofingen.

THE death is announced, on April 8, of Giulio Bizzozero, professor of pathological anatomy of the University of Turin. Bizzozero was born on March 20, 1846, and was elected a fellow of the Accademia dei Lincei on November 12, 1883, and became a senator of the Italian Government in 1890. His best known discoveries refer to the spinous cells of the epidermis, the functions of the medulla of the bones, the intestinal epithelium, and the morphological elements of blood. He founded a school of histology for Italy, and included Golgi among his pupils.

A FEW days earlier, on April 5, the Accademia dei Lincei was bereft of its president, Signor Angelo Messedaglia, who was born on November 2, 1820, and obtained the fellowship of the Accademia in 1875. Messedaglia's speciality was political economy and statistics, but his knowledge also embraced modern and ancient literature, history, mathematics, astronomy, geography and physics. His last work on Homeric uranology bears abundant testimony to his wide range of study and careful reasoning. He preserved his full activity and intellect nearly till his death.

THE steps taken to provide a memorial of Dr. Walter Myers, who lost his life at Para on January 20 from yellow fever, caught while investigating that malady for the Liverpool School of Tropical Medicine, were explained at the last meeting of the committee of the School. The committee has offered to erect memorial brasses in University College, Liverpool, and in Birmingham University, and the offers have been accepted. The School has also erected a tombstone over the grave of Dr. Myers at Para. It has been resolved to found, as a permanency in the School, the Walter Myers Chair of Tropical Medicine, besides a supplementary fellowship for the next five years, to be called the Walter Myers Fellowship of Tropical Medicine.

THE Whitsuntide excursion arranged by the Geologists' Association is to the new line of the Great Western Railway from Wooton Bassett to Filton, and the district around Bristol. The party will leave Paddington Station on Saturday, May 25, and return in the following week. Many sections, beds, and other features of geological interest will be examined, and the excursion will be enjoyed by all who take part in it. The Yorkshire Naturalists' Union have arranged an excursion to Brough on Whit-Monday for the investigation of Welton, Elloughton and Brantingham Dales, and the southern extremity of the Yorkshire Wolds.

WE are pleased to learn from *Science* that the Legislature of the State of Wisconsin has presented to Dr. S. M. Babcock, of the University of Wisconsin, a fine bronze medal "recognising the great value to the people of this State and the whole world" of his inventions and discoveries, "and his unselfish dedication of these inventions to the public service." Scientific work is so often overlooked by the State that it is pleasing to record the recognition of it. Dr. Babcock's renown rests largely upon his milk test, which has proved of immense value in the dairy industry, but to men of science, who are familiar with dairy and agricultural investigations, his many discoveries in these fields are regarded as even more brilliant and of more value to science than the invention for which he has now been honoured.

THE educational and scientific sides of war will receive special attention at the Naval and Military Exhibition shortly to be opened at the Crystal Palace. Demonstrations will be given of wireless telegraphy, the Röntgen rays and other scientific experiments applied to the uses of war in the Army and Navy. The use of the balloon in military operations will be demonstrated; and a special interest attaches to this section, as Sir Redvers Buller is lending the balloon employed by him during the siege of Ladysmith. In connection with this

section, and naturally forming part of it, will be an exhibition of war kites, the uses of which will be shown. In an "Arctic" section there will be, not only a large collection of Arctic relics and pictures, but also a tableau illustrating Nansen's polar expedition. In the inventions section a series of the latest and most valuable applications of mechanical science to the needs of the Army and Navy will be on view.

A CHRISTIANIA correspondent of the *Times* reports that the second international Hydrographic Conference held its final meeting on Saturday. The object of the Conference was to complete the international programme of research and the plan of organisation drafted in Stockholm in 1899. The original programme has been revised to meet the wishes of the participating Governments, and it is believed that the new proposals will command such general approval as to permit of the commencement of international investigations at an early date. The Governments of all the countries bordering on the North Sea and the Baltic were represented at the Conference, except France, the geographical position of which gives her less practical interest in the area of research. The Norwegians and Russians have already provided themselves with special steamers adapted to the proposed investigations, and a German steamer is now being built. The arrangements of most of the smaller States are well advanced. It is believed that it now rests with the British Government to decide whether the international programme shall be carried out or not.

THE *Revue Scientifique* contains an account of the first meeting of the "Association Internationale de la Marine," held from April 12 to 15 in the building of the oceanographical museum at Monaco. Amongst the more important communications received was one by H.S.H. the Prince of Monaco on the meteorological service of the Azores, which has recently been actively taken up by the Portuguese Government and is now to be carried on on a very adequate scale at an annual cost of 45,000 francs. M. Charles Bénard, president of the Société d'Océanographie du Golfe de Gascogne, contributed a paper on improvements in the equipment of vessels in case of shipwreck, his proposals embodying, in particular, the suggestions of the Prince of Monaco with regard to proper fishing appliances in ships' boats. M. Thoulet's lithological map of the coasts of the Seine Inferieure was presented, and a resolution urging the need for preparing such maps of all frequented coasts, in the interest both of navigators and fishermen, was adopted. The Congress also declared itself in favour of the establishment of a permanent Bureau Maritime Internationale, which should concern itself with all maritime affairs of international interest, lighting and buoyage, regulation of fisheries, assistance of sailors and the like. The Prince of Monaco, at the earnest invitation of the Congress, agreed to take the initiative in attempting to bring about the formation of the proposed organisation.

THIS year's Deutscher Geographentag will open at Breslau on Monday, May 27. On the morning of May 28 Prof. Neumayer will present the report of a committee upon Antarctic exploration, and will speak upon magnetic investigations in polar regions. Dr. E. Philippi will deal with the geological problems of the German Antarctic expedition, and Prof. A. Supan with the Antarctic climate. At the second sitting the subject to be discussed is the organisation of geographical instruction, the speakers being Prof. H. Wagner, Dr. Auler and Herr H. Fischer. On Wednesday morning, May 29, the subjects to be brought before the meeting relate to the scientific study of lands and native races of German colonies. The speakers will include Prof. F. v. Richthofen, Prof. G. Volkens, Dr. E. Kohlschütter, Prof. K. Dove and Prof. Schenck. The methods of geographical instruction will be discussed in the afternoon of the same day by Dr. A. Becker, Prof. A. Fischer, Prof. A. Kirchhoff, Prof. Langenbeck and Prof. A. Bludau; demonstrations will also be given by Prof. K. Dove and Dr. M. Ebeling. In the evening an illustrated lecture will be given on glacier markings in Montenegro, by Prof. K. Hassert, and one on the volcanoes of central France by Dr. M. Friederichsen. At the fifth sitting, on May 30, the papers will deal with various aspects of glaciers and glaciation, and the speakers will include Profs. Finsterwalder, H. Meyer, S. Günther, A. Penck, W. Goetz and Dr. W. Halbfass. On the afternoon of the same day, reports and papers will be received from Prof. A. Kirchhoff and C. M. Kan, and Dr. K. Sapper; and the general business of the association will be transacted. Excursions have been arranged for a few days at the end of the meeting, and exhibits of geographical interest will be on view in two museums in Breslau. The general secretary, with whom intending visitors should communicate, is Dr. R. Leonhard, Schillerstr. 28, Breslau.

IN the *Journal* of the Quekett Microscopical Club Mr. J. Rheinberg describes a simple contrivance for viewing, under the microscope, the diffraction patterns of diatoms and other objects of similar structure. The method adopted by Dr. Johnstone Stoney is to look at the objective through a small hole fixed near the usual place of the eyepiece. Mr. Rheinberg finds that the diffraction patterns can be better seen above the eyepiece by fixing in a short tube the objective of one of the 7*s*. 6*d*. toy microscopes, which is a lens of about ¼-inch focus, stopped down to an aperture of about 1 mm. This arrangement, placed over the ordinary eyepiece, shows the diffraction patterns magnified, and, further, it gives plenty of light, and the patterns cannot shift.

A VERY convenient addition to the laboratory or workshop equipment is the rosin-cored solder recently introduced by the Patent Solder Co., Ltd. This commodity is guaranteed to consist of pure metals mixed in the most efficient ratio, and, as its name implies, has incorporated with it the requisite amount of rosin so that no additional flux is necessary. This is attained by making the solder in the form of a tube with narrow bore, the central cavity being occupied by the flux. The two ingredients being together will facilitate work in difficult positions, and the cleanliness in working will be found a special recommendation for electrical work. The solder is made in four sizes, each of three qualities. The sizes vary from 1/16th to ¼-inch diameter.

THE *Physical Review* for March contains an article by Prof. Carhart on the various determinations of the E.M.F. of the Clark cell. The value originally obtained by Clark reduced to present units at 15° C. is 1·4378 volts, but subsequent research has shown that this is somewhat too high. Prof. Carhart summarises the results of eight other determinations of this constant, in five of which the value was obtained by the use of the silver voltameter, the remaining three values being obtained by absolute methods. The mean value calculated from the whole eight determinations is 1·4335 volts at 15° C., and the mean of the three absolute determinations is 1·4333 volts. Prof. Carhart concludes that the true value is nearer 1·433 volts than the generally accepted value of 1·434 volts. This conclusion is borne out by the results of two determinations of the mechanical equivalent of heat by electrical methods, in both of which the values obtained are higher than those given by direct mechanical methods; if the E.M.F. of the Clark cell is taken as 1·433 volts instead of 1·434, the discrepancies almost disappear.

THE same journal contains an interesting article by Mr. Carl Kinsley on the measurement of the sensitiveness of coherers for wireless telegraphy. Mr. Kinsley urges the desirability of some

standard method of comparing coherers so that the work of different experimenters may be compared, and suggests two ways in which this may be done. Coherers may either be compared relatively by measuring the height of vertical wire necessary for them to respond to signals sent by a given transmitting apparatus at a given distance, or, absolutely, by measuring the voltage at which their initial resistance breaks down. The two methods, it is pointed out, always give the same relative results; the latter appears to be preferable as it is more easily carried out, and, moreover, eliminates all errors which might arise through differences in the transmitters, which is especially advantageous in the case in which the work of different persons is being compared. Mr. Kinsley rightly insists that the absolute value of the resistance after the breakdown, whether high or low, is not of much importance, as the relay can always be designed to work well with the particular coherer with which it is intended to use it.

WE have received from the Rev. J. Coronas, S.J., of the Manila Observatory, a discussion of a cyclone (*El baguio del 8 de Septiembre*, 1900) which traversed the centre of the island of Luzon and is said to have been the most severe storm experienced during the previous six years. It is satisfactory to note that, notwithstanding the paucity of observations from other stations owing to the disturbed condition of the island, the observatory was able to give notice of the existence of the disturbance in the Pacific three days before its arrival on the coast. The observations are insufficient to determine the track of the storm across the Pacific, but after leaving the west coast of Luzon it took a north-westerly course and, crossing the China Sea, reached the mainland near the north of Hainan on September 11. The fall of the barometer was greatest, and the winds the most violent, in the rear of the cyclone; a considerable rise of the barometer was observed at all stations in the front of the disturbance, and was correctly interpreted as a bad sign. The rise was much more rapid than the subsequent fall. The author discusses at some length the premonitory signs of such disturbances, particularly convergence of cirrus clouds and the swell of the sea; the latter is at times observed some 500 miles in advance of the approaching storm.

IT is reported that an American citizen and a member of the Roman Catholic Church has offered to present to the Pope a telescope larger than that shown at the Paris Exhibition of last year. His Holiness is stated to have accepted the gift, which is now destined to find a prominent place amongst the many valuable instruments of research of the Vatican Observatory, which was presented, just over a century ago, by Cardinal Zelada with the then famous Dollond's telescope. Referring to this gift, the *Lancet* gives some interesting particulars concerning the Vatican Observatory. There seems to be scarcely any doubt that an observatory tower was erected in Rome so far back as some time previous to 1582, and, as it would appear, chiefly in connection with the reform of the Calendar. According to B. Crescenzi, Pope Gregory XIII. was mainly responsible for its erection. It is recorded that the tower was intended exclusively for astronomical observations and researches, and there is, from an historical point of view, every reason to suppose that it was the first celestial watch-tower ever built in Rome. Since its erection, however, and partial endowment by Pope Gregory XIII., it has passed through many and highly complicated vicissitudes. It became of world-wide renown at the beginning of the last century, chiefly on account of the scientific labours and able management of Philip Gili, who, for a period extending over thirty years, was its director. After the death, however, of Gili, which occurred in 1821, it again became quite disorganised. In 1888 the Vatican Observatory commenced a new epoch in its history. In that year the commemoration of the fiftieth anniversary of the priesthood of Pope Leo XIII. took place, and on that occasion all the instruments and apparatus given by members of the Roman Catholic Church interested in celestial and terrestrial physics were brought together, and it then occurred to the organisers of the science section of the Vatican Exposition that they would find a suitable home in the old Gregorian tower. The suggestion was warmly approved and soon carried into effect, and the Observatory has since then taken a place in the first rank.

THE new number of the *Mitteilungen aus den deutschen Schutzgebieten* is, as usual, largely devoted to statistics of meteorological observations and astronomical determinations of positions. A map of East Usambara, on a scale of 1 : 50,000, based on trigonometrical and topographic surveys, accompanies the number, also sketch-maps from surveys of the Kirunga volcano region, and of the Ramu river in New Guinea. There are short articles referring to the maps, and Count Zech contributes an illustrated paper on the production of kola in West Africa.

THE *U.S. Experiment Station Record* states that the agricultural council of the Russian Ministry of Agriculture and Imperial Estates has taken steps in the direction of improving the character of the live stock and the live-stock industry in general of that country. At present this industry is said to be far behind that of other countries, the animals kept being inferior and stock raising receiving comparatively small attention from the farmers. The council has recommended the holding of live-stock shows, with prizes for excellence, the establishment of breeding farms and furnishing of expert assistance in purchasing good breeding animals, the maintenance of local breeding establishments where the service of pure-bred animals can be secured, and loans to municipalities and societies for the purpose of purchasing pure-bred animals and providing for their care. In order to carry out the above measures the Ministry of Agriculture, with the concurrence of the Minister of Finance, has recommended a grant of 5,000,000 roubles (about 500,000*l.*) to begin this work and a quadrennial grant of about 112,500*l.*

THE *Bollettino* of the Italian Geographical Society contains part of a paper by Prof. Gabriele Grasso on the distribution of place-names in the Italian communes, dealing specially with those names which have the word "monte" either as prefix or suffix. Dr. Cosimo de Giorgi contributes an elaborate discussion of the physical geography and geology of the port of Brindisi, and Dr. Giuseppe Stegagno a note on the lakes of the Euganean Hills. With this number is issued the part of the *Bibliografia geografica della regione Italiana*, by L. F. de Magistris, for 1899.

IN his Annual Progress Report of the Geological Survey for the year 1899 (1900) Mr. A. Gibb Maitland points out that the field-work has been carried on in areas occupied by the ancient crystalline rocks, presumably Archæan, where the work has had a direct bearing on economic questions. The Kanowna mining district to the north-east of Coolgardie was reported on by Mr. T. Blatchford. Here the schists, which are much decomposed, are in places highly auriferous, the granitic rocks and the interlacing quartz veins are also auriferous, as well as the alluvial deposits. The parent sources of the gold are the quartz veins and lodes which traverse the crystalline rocks, but there is much gold of secondary origin filling fissures or diffused over cleavage planes. It is remarked that what may be called secondary gold has been deposited from solution, not only in the alluvium and other superficial deposits, but also in the zone of decomposition of the bed rock.

MR. C. S. MINOT has sent us a paper, reprinted from *Science*, in which he describes and illustrates the unit system of laboratory

construction. The idea is that the essential requirement of a building intended for laboratory work is a number of rooms of uniform and moderate size, abundantly lighted and conveniently accessible. The size proposed is 23 × 30 feet, and a room of these dimensions will provide working space of 3 feet 6 inches × 5 feet for each of twenty-four students, as well as sufficient space for general use. The only exceptions to the unit-rooms would be the lecture-rooms. It is evident that if an architect has merely to fit rooms of uniform size in a building his designs need only be of a very simple character, and he is, at the same time, given great freedom as to the exterior, which, as Mr. Minot remarks, seems as important to him as the interior is to the users of a building. Many advantages are attached to the unit system of laboratory construction, among them being adaptability and seclusion; and with regard to the construction Mr. Minot states that the cost of a building on the unit plan would be less than for one of equal capacity, but with rooms of the customary irregularity of size.

IN the *Irish Naturalist* for May Dr. R. F. Scharff records from Sligo a woodlouse (*Armadillidium pulchellum*) new to the British fauna. It is typically a northern form, ranging from Scandinavia to Belgium.

NUMBERS 1 and 2 of the fifteenth volume of the *Memorias* of the Society "Antonio Alzate" contain a continuation of the "Alphabetical Cross-reference Catalogue" of the works of the late Prof. Cope. The disadvantage of the mode of quotation adopted is that it is exceedingly difficult to find out which items are the original titles of the papers mentioned. Misprints are also noticeable.

TO the April number of the Johns Hopkins *University Circulars* Dr. C. Grave communicates an important geological and economical study of the oyster-reefs of North Carolina. The author describes the manner in which the oyster-banks of the district in question become, like coral-reefs, gradually converted into islands; and points out that some of the islands in Newport River still display their foundation of oyster-shells, while others exhibit the gradual transformation of an oyster-bank into an island. It is also shown that the history of these reefs affords indications of the proper mode of establishing new oyster-beds for economic purposes. Practical application of these principles has been made, with the result that oyster-culture is now successful in localities where previous attempts to start it had resulted in failure.

IN the *Revue Scientifique* of May 4, M. H. Coupin continues his essay on bird-song, dealing in this section chiefly with birds that imitate sounds other than their own. Very remarkable is the instance of a sparrow imitating the stridulation of the grasshopper. One spring a cage containing a sparrow was hung side by side with another in which were grasshoppers. No notice was taken by the sparrow of his neighbours, but next year, when he was again in the same society, he essayed the grasshoppers' chant. And for the rest of his life, when the grasshoppers had long been dead, the sparrow was accustomed to utter a polyglot song combining the notes of the insect with those of other birds. The fact that young linnets will sometimes learn the song of the nightingale instead of their own is mentioned. And it is also stated that several kinds of birds in Thuringia sing much better than the members of their own species dwelling in the Hartz Mountains.

THE *Zeitschrift* of the Berlin Gesellschaft für Erdkunde devotes the whole of the sixth number of the present volume to a paper on the climatology of Morocco, by Dr. Theobald Fischer. In this paper, which is the completion of the work recently published by the author in an Erganzungsheft of *Petermann's Mitteilungen*, the meagre data available for the region are discussed with great skill and made the foundation of a quite satisfactory outline of its climate. A rainfall map forms an important feature. The seventh number of the same volume contains a short paper, with some good illustrations, on the Rocky Mountains and the Sierra Nevada, by Dr. Emil Deckert, and Dr. S. Passarge contributes a valuable account, with maps, of his geological work in British Bechuanaland.

PROF. W. C. M'INTOSH sends us a copy of his article on the coloration of marine animals which appeared in the *Annals and Magazine of Natural History* for March. While admitting that in certain instances the coloration is for the purpose of protection, the author shows that in many cases it is very difficult to accept such an interpretation as the true reason. In the case of pelagic organisms, for example, where the transparency or faint coloration is assumed to be for protective purposes, he points out "that many of the surface-animals are there only for a limited period during fine weather, and disappear into the depths on the advent of storms and cold." The dog-whelk and the cowry (especially when the soft parts are extruded) are cited as creatures that are fairly conspicuous between tide-marks, and it has yet to be proved that they possess "warning colours." The fact that some cetaceans have their flippers or areas on their bodies white, while others are wholly black, seems to demonstrate that their coloration is not protective, this being supported by the conspicuous nature of a black mass exposed above the surface of the sea. The whole subject, in the author's opinion, demands careful revision.

WE have received vol. xxxii. of the *Proceedings* of the London Mathematical Society, containing papers read at meetings during the first half of last year. The publisher is Mr. Francis Hodgson, Farringdon Street, E.C.

THE Priestley Club, Leeds, has published a list of papers read at its meetings from November 1887 to April 23 of this year. The list shows that many subjects of great scientific importance have been brought before the Club, but we are not able to find whether the papers have been published, and if so, where they can be found.

MESSRS. CASSELL AND CO. have published a new edition (the ninth) of "The North-West Passage by Land," by Viscount Milton and Dr. W. B. Cheadle. The book contains the narrative of an expedition across North America, through the Hudson's Bay Territories, into British Columbia, by one of the northern passes in the Rocky Mountains. It originally appeared in 1865, and gives an interesting description of scenes and adventures in the great country of the Canadian North-West nearly forty years ago.

THE additions to the Zoological Society's Gardens during the past week include two Verreauxi's Guinea-fowl (*Guttera edouardi*) from East Africa, presented by Mr. W. L. Sclater; a Polecat (*Mustela putorius*), British, presented by Mr. F. D. Lea Smith; a Slowworm (*Anguis fragilis*), British, presented by Mr. H. J. M. von Löhr; a Black-handed Spider Monkey (*Ateles geoffroyi*) from Central America, a Kinkajou (*Cercoleptes caudivolvulus*) from South America, a Nylghaie (*Boselaphus tragocamelus*, ♂) from India, a White-browed Amazon (*Chrysotis albifrons*) from Honduras, a Tuberculated Iguana (*Iguana tuberculata*) from Tropical America, twenty-nine Barbadian Anolis (*Anolis alligator*) from the West Indies, four Hybrid Macaws (between *Ara macao* and *A. militaris*), bred in Italy, two Dark Green Snakes (*Zamenis gemonensis*), an Undulated Lizard (*Sceloporus undulatus*), three Brown Newts (*Spelerpes fuscus*), two Spectacled Salamanders (*Salamandrina perspicillata*), European, deposited; two Pintails (*Dafila acuta*), European, purchased; a Japanese Deer (*Cervus sika*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET *a* (1901).—A circular from the Centralstelle at Kiel furnishes the elements and a short ephemeris of the comet computed by Prof. Kreutz from the Cape observations.

Elements.

$T = 1901$ April $24{\cdot}2614$ Berlin M.T.
$\omega = 202^\circ\ 50'{\cdot}0$
$\Omega = 109\ \ 57{\cdot}2$ } 1901·0
$i = 131\ \ 26{\cdot}0$
$\log q = 9{\cdot}38848.$

Ephemeris for 12h. Berlin Mean Time.

1901.	R.A. h. m. s.	Decl. ° ′	Br.
May 16 ...	5 43 53 ...	+4 7·0 ...	0·07
20 ...	6 4 2 ...	5 20·0 ...	0·04
24 ...	6 20 18 ...	+6 21·2 ...	0·03

The comet is rapidly diminishing in brightness, and is following a north-easterly path through the northern part of Orion. On the 16th it will be a short distance below Betelgeuse at sunset, and on the 24th near the Eye of Monoceros.

VARIABILITY OF EROS.—A telegram from Prof. E. C. Pickering, through the Centralstelle at Kiel, announces that on May 8 the variation in the light of the minor planet Eros was zero. The determination was made by Prof. O. C. Wendell.

WASHINGTON OBSERVATIONS, 1891–92.—The astronomical, magnetic and meteorological observations made at the United States Naval Observatory at Washington during the years 1891 and 1892 have recently been issued in one volume. After detailed descriptions of the instruments employed, the observations and reductions are given for each of the chief instruments, the transit circle, 26-inch equatorial, and 9·6-inch equatorial. The meteorological observations include those of pressure, temperature, wind, clouds, rain and snow.

An appendix is added containing the second Washington Catalogue of Stars, with the annual results upon which its compilation is based. The star places are all reduced to epoch 1875·0.

STELLAR PHOTOMETRY.—In *Comptes rendus* (vol. cxxxii. pp. 1091–1094) M. B. Baillaud, of the Toulouse Observatory, outlines a method he has recently developed for determining the magnitudes of stars from the measurement of photographs by means of a standard wedge photometer. Of course in this case the images are black on a luminous background, and the law governing the action of the wedge in the ordinary case of extinction of bright points on a dark background is not applicable here. Using a series of determinations on stars of known magnitude for the calibration and determination of constants, M. Baillaud develops the formula necessary for computing magnitudes by the method. On account of the spreading of the images of the brighter stars, producing definite sized discs, the method is less precise than for fainter objects, but it is hoped that much of the uncertainty in these cases may be removed by special expedients, and observations are in progress for fully testing the possibilities of the method.

NEW NEBULÆ.—M. G. Bigourdan gives, in *Comptes rendus* (vol. cxxxii. pp. 1094–1097), a list of fifteen new nebulæ observed by him with the west equatorial at the Paris Observatory (aperture 0·31 metre), during the period 1897–1900.

MUSK-OX AND BISON AT WOBURN ABBEY.

BY the kind favour of the Duchess of Bedford we are enabled to present our readers with a portrait of the young bull musk-ox now living at Woburn Abbey, in its present condition. The specimen is the survivor of a pair of yearling calves from Clavering Island, East Greenland, purchased by the Duke of Bedford in the autumn of 1899. They are believed to have been the first of their kind ever introduced into this country, and although one of the pair survived its arrival only for a very brief period, the other has continued to flourish and there is every hope that it will reach maturity. It is now considerably more than two years old, but although the horns are strongly curved they are still confined to the sides of the head and display no signs of growing on to the forehead, in the middle line of which their expanded bases should almost meet in the fully adult bull. At the time when the photograph was taken the animal was just beginning to shed its winter coat, the hair hanging in fleecy rags on the sides of the face. The great hump of hair on the withers forms a very noticeable feature in the general aspect of the animal.

The white patches on the face of the Woburn musk-ox forms the chief distinctive feature of the Greenland race of the species, which, it will be remembered, was named in this journal for December 13 last *Ovibos moschatus wardi*. It was at that time considered probable that the white-faced form of the musk-ox might be restricted to East Greenland; but specimens brought to the United States by Lieut. Peary from Grinnell Land and Ellesmere Land have enabled Dr. J. A. Allen, in a recent issue of the *Bulletin* of the American Museum of Natural History (vol. xiv. art. 7), to show that it has a much wider range, embracing apparently the whole of such parts of Greenland as are inhabited by these animals, together with the two countries above named. In addition to the difference in colour, Dr. Allen points out that the Greenland musk-ox differs from the typical *Ovibos moschatus* of Arctic America by the form of the horns and fore-hoofs. And he considers that it should be regarded as a species rather than a race; for this he takes the name *Ovibos wardi*, adding that if the Grinnell Land and Ellesmere Land animal should prove distinct it might be named after the intrepid

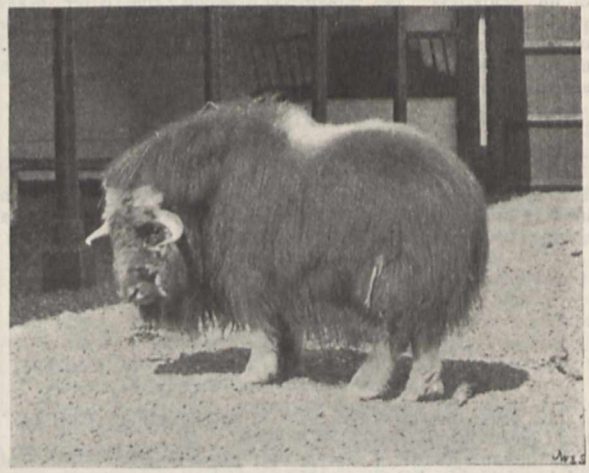

FIG. 1.—Young male Greenland Musk-ox at Woburn Abbey, photographed by the Duchess of Bedford.

American explorer by whom its skins were sent home. For our own part we see no reason to depart from the view that the Greenland and American musk-oxen are local races of one and the same species.

Another feature of special interest in the magnificent collection of animals at Woburn Abbey is the presence of representatives of both the European and American bison. It is now many years since these two splendid animals were seen side by side in the Zoological Gardens in the Regent's Park, and even then they were not shown in such favourable circumstances as are those at Woburn Abbey, which occupy adjacent paddocks of very large acreage. Of the American bison there is now a small herd, including a magnificent old bull as well as several calves, all of which are in splendid condition. When received, rather more than a year ago, the European bison, of which there were a bull and two cows, were very thin after their long journey from Lithuania; and one of the cows (whose skin is now mounted in the Museum of Science and Art at Edinburgh) did not long survive. The other cow and the bull have, however, greatly improved in condition during the last few months, and it is hoped that they may breed before long. The bull serves to show that, although in regard to its head and shoulders the American bison is the finer animal of the two, yet that its miserably weak hind-quarters render its whole appearance far inferior to that of its European cousin. R. L.

RESEARCHES ON ORGANIC PEROXIDES.

IN the latest number of the *Berichte*, v. Baeyer and Villiger have a number of interesting communications. The preparation of ethyl hydrogen peroxide, $C_2H_5O.OH$ is described. It is obtained by treating diethylsulphate with a solution of hydrogen peroxide in alkaline solution. The liquid is then acidified and distilled, when the new compound passes over between 90° and 100° mixed with alcohol and water. By further treatment a solution may be obtained boiling at 47–49° at 100 mm. and containing 80 per cent. of the peroxide. At the ordinary pressure it boils about 95°. It is soluble in water, alcohol and ether. It has a smell of both bleaching powder and acetaldehyde. A drop on the skin produces inflammation. It is relatively stable and may be kept for many weeks with very slight alteration. By superheating the vapour in a test-tube, a moderate detonation occurs. Dropped on finely divided silver it decomposes with a sharp explosion. It is a weak acid of about the strength of a phenol and gives salts with alkalis and alkaline earths. It is a strong oxidising agent. In studying the action of ethyl hydrogen peroxide with different reagents, the authors find that whereas nitrous acid yields nitric acid with hydrogen peroxide, alkyl nitrites do not give alkyl nitrates, but nitric acid and alcohol. On the other hand, ethyl hydrogen peroxide and nitrous acid or ethyl hydrogen peroxides and alkyl nitrites give in both cases the alkyl nitrate. These reactions are explained on the assumption that an additive compound is first formed from which either water or alcohol is subsequently removed. Moreover, where there is a choice between the removal of an "alkoxyl" or "hydroxyl" group, the latter takes precedence. This alone would not explain the behaviour of ethyl nitrite and hydrogen peroxide, on the one hand, and nitrous acid and ethyl hydrogen peroxide on the other, which should yield the same product, viz., ethyl nitrate.

$$O{:}N.OC_2H_5 + H_2O_2 = O{:}N(OH)_2OC_2H_5 = O_2N.OC_2H_5 + H_2O$$

$$O{:}N.OH + C_2H_5O.OH = O{:}N(OH)_2OC_2H_5 = O_2N.OC_2H_5 + H_2O.$$

But if the peroxides form additive compounds by separation into H and O_2H or $O_2C_2H_5$ ions, the apparently anomalous changes are readily explained.

$$O{:}N.OC_2H_5 + H_2O_2 = O{:}N\begin{cases}OC_2H_5\\H\\O.OH\end{cases}$$

$$O{:}N.OH + C_2H_5O.OH = O{:}N\begin{cases}OH\\H\\O.OC_2H_5\end{cases}$$

The nitrosoperoxide acid then by intramolecular rearrangement passes into nitric acid or its ester.

In the same journal, v. Baeyer and Villiger describe a hydrate of sulphurylchoride, $SO_2Cl_2 + 15H_2O$, which they prepare by pouring the acid chloride on ice. The hydrate has the appearance of camphor and remains undecomposed by ice-cold water for hours at a time.

The disputed question as to whether hydrogen peroxide and silver oxide, when brought into contact, yield the oxygen of the metallic oxide as well as an atom of oxygen of the peroxide, which is Thénard's view, or whether, according to Berthelot, the silver oxide acts as a catalysator by reducing the peroxide of hydrogen to water, is determined by v. Baeyer and Villiger in favour of Thénard.

IRON AND STEEL INSTITUTE.

THE annual general meeting of the Iron and Steel Institute was held on May 8 and 9. Sir William Roberts-Austen, K.C.B., the retiring president, announced that Andrew Carnegie Research Scholarships, each of the value of 100*l.*, had been awarded to Dr. A. Stansfield (London), to Dr. J. A. Mathews (New York) and to Mr. J. Goldberg (Leoben, Austria). Mr. Carnegie announced his intention of doubling his original donation for the purpose of founding these scholarships. Mr. William Whitwell was then inducted into the presidential chair. Having presented the Bessemer Gold Medal for 1901 to Mr. John Edward Stead, in recognition of the value of his investigations of the physical and chemical properties of iron and steel, the president delivered his inaugural address, in which he reviewed the scientific and industrial achievements of the past reign, and enumerated some of the most important problems in metallurgy that still await solution. A vote of thanks to the president for his admirable address was proposed by Mr. Carnegie and seconded by Sir Lowthian Bell.

The first paper read was by Mr. A. Greiner, of Seraing, Belgium, on dust in blast-furnace gases, in which he described the methods adopted to get rid of the dust in blast-furnace gases used as motive power for blowing-engines.

Mr. J. E. Stead then described some clearly defined idiomorphic crystals recently discovered in the hearth of a blast furnace at Blaina, Monmouthshire. They were found in a cavity of the sandstone foundation of a furnace, in which spiegeleisen and ferromanganese had been made. The crystals yielded on analysis: manganese, 51·75; iron, 35·76; silicon, 3·62; carbon, 3·71; oxygen, &c., 5·16. They belong to the orthorhombic system, and the results of measurements by Mr. H. Bauerman and by Mr. L. J. Spencer are given in the paper. The compound is described as a carbo-silicide of manganese and iron.

Mr. J. E. Stead and Mr. John Evans next read an important paper on the influence of copper on steel rails and plates. It is generally thought that copper has a very deleterious effect, and engineers, when buying steel, frequently specify that it must be absent. The authors clearly show, however, that the general opinion is erroneous. They prove that between 0·5 and 1·3 per cent. copper has no deleterious effect on either the hot or cold property of steel; that a very large amount (2 per cent.) makes the steel more liable to be over-heated; and that in small quantities it slightly raises the tenacity and the elastic limit, but, unlike phosphorus, does not sensibly make the steel liable to fracture under sudden shock. Like carbon, it reduces the power of the steel to extend under stress, but this is not pronounced when the quantity is small. The effect is more marked when large quantities are present. Lastly they prove that if the evidence of the open-hearth steel trial can be confirmed, copper, instead of producing redshortness, has the contrary effect of changing redshort steel into steel which will roll without cracking.

Mr. William Garrett, of Cleveland, Ohio, submitted a comparison between American and British rolling-mill practice. The paper was followed by an animated discussion, which was resumed on Thursday.

Mr. R. M. Daelen (Düsseldorf) described some recent developments of the use of hydraulic power in the manufacture of iron and steel.

Mr. Axel Sahlin discussed the economic significance of a high percentage of silicon in pig iron for the acid steel processes. The demand for high silicon in pig iron is, he considers, doing much to hamper progress in a certain branch of the British iron industry.

The paper by Prof. J. O. Arnold on the properties of steel castings embodied research work extending over six years. The lessons taught by the data set forth in the preliminary experiments detailed in this paper show that pure iron and carbon steel is not a suitable material for fulfilling the modern specifications drafted by engineers for steel castings. With iron and carbon castings the ductility demanded can be ensured with ease, but with such ductility it is impossible to correlate the required tenacity. The latter property, it is true, can be obtained from iron and carbon castings, but at the expense of an almost complete loss of ductility. Therefore, as has already been remarked, excepting the nearly pure iron the series of castings described have small manufacturing interests. Nevertheless they form the basis upon which the mechanical influence of silicon and manganese can alone be scientifically measured.

The remaining papers were taken as read. Among these the paper by Mr. Axel Wahlberg, of Stockholm, on Brinell's method of determining hardness and other properties of iron and steel was an elaborate memoir of great importance. The method consists in forcing, by means of pressure, a hardened steel ball into the material to be tested so as to cause an impression, the diameter of which is then to be measured, in order to obtain the spherical area of the concavity. The quotient resulting from dividing the maximum pressure by this area will then represent what is called by Brinell a *hardness number*, indicating, according to him, the amount of pressure (kilograms per square millimetre) to which the material so tested has been subjected. With this method a number of researches have been carried out, detailed particulars of which were given. They relate to the determination of hardness of various metals, to

controlling forging tests, and to the hardening of iron and steel. Under the last head experiments were made to ascertain the influence of the percentage of carbon on the hardening capacity, the hardening effect of different quenching liquids, the influence of the temperature of the quenching liquid on the hardening result, the influence of different hardening temperatures. Other researches described dealt with an attempt to ascertain the homogeneity of iron and steel, the degree of annealing, the influence of cold-working, determination of the yield point, ultimate stress and elongation, and tests of blanks for gun barrels.

Prof. E. D. Campbell gave the results obtained at the University of Michigan during the past three years in investigating the heat of formation of the compounds of iron with carbon and silicon.

Mr. Axel Sahlin described a water-cooling device introduced by himself for protecting the walls of the lower part of the blast furnace.

Mr. J. M. While submitted a description of the new Bessemer shop and heating pits at the Barrow Hæmatite Steel Company's works. The results obtained are of interest as showing that the faster working in vogue in the United States cannot be introduced into England with advantage, for the same conditions do not apply in each country.

Mr. H. E. Wimperis, acting on a suggestion from Prof. Ewing, measured Young's modulus for a long rod by tension in an ordinary testing machine, and compared the value thus obtained with that found by experiments on pure bending. The two values differ slightly from each other, but such differences as are found may be regarded as indicating that there is no internal sliding due to layers of any impurity that may be contained in the metal.

Mr. Bennett H. Brough, the secretary, described a medal presented to the Institute by Mr. E. J. Ljungberg. It was struck in steel from the Domnarfvet Steelworks, Sweden, and is the first medal that has ever been struck in that metal. The soft basic Bessemer steel of which the medal is made contained: carbon, 0·05; manganese, 0·19; silicon, 0·007; phosphorus, 0·002; sulphur, 0·005.

Baron H. von Jüptner submitted a paper on iron and steel from the point of view of the phase-doctrine, in which he controverted some of the views elicited by the publication of the paper by Bakhuis-Roozeboom last autumn. He deals chiefly with the state of equilibrium between martensite and graphite.

The next meeting of the Institute will be held in Glasgow in September.

VITRIFIED QUARTZ.[1]

ALTHOUGH the great improvements introduced into the art of glass making by Abbe and Schott have led to marked advances in microscopy, in thermometry and in other departments during the last quarter of a century, glass is still unsuitable for many of the purposes to which we put it, and there remains a real need for some plastic material more infusible, more insoluble, more fully transparent, more elastic and more stable under changes of temperature than glass.

Such a substance exists in the form of vitrified quartz, or vitrified silica as I shall prefer to call it. Vitrified silica was first made in 1839 (*Comptes rendus*, viii. 678, 711) by M. Gaudin, who spun threads of it by hand and noticed their flexibility; and made small, very hard pellets of it by dropping fused quartz into cold water, and observed that in this form it was inactive to polarised light.[2] It was rediscovered in 1869 by M. Gautier (*Comptes rendus*, cxxx. 816), who made capillary tubes and spirals of vitreous silica and exhibited them at the Paris Exhibition in 1878, but who failed to obtain larger objects even with the aid of the electric furnace. Finally it was discovered yet once again, in 1889, by Prof. C. V. Boys, who used the torsion of "quartz fibres" for measuring small forces and produced fine tubes and small bulbs of the same material, and who was the first to fully recognise the great value of this remarkable substance.

As all who are here to-night are not chemists, I may remind you that quartz or rock crystal has for some time past been used by spectacle makers and in the construction of optical instruments; and that it is a form of oxide of silicon[1] which is very familiar to us all in the forms of sand and flint. Quartz is occasionally found in magnificent masses, but our chief source of supply is Brazil, where it occurs in large fragments like those before us on the table.

Quartz itself exhibits many of the desirable qualities enumerated above. It is hard, transparent to the ultra-violet rays, difficult to melt, a good insulator, and insoluble in most solvents, but it bears sudden changes of temperature very badly, and therefore it is not easy to manipulate quartz at high temperatures. When it has been vitrified by heat, however, it becomes much more tractable, and in the vitrified state (vitrified silica) it is not very difficult to deal with.

It is about this "vitrified silica," how to prepare it and fashion it into apparatus when plastic, and about its properties and uses that I am about to address you to-night.

The first obstacle met by those who wish to obtain vitrified silica is caused by the tendency of quartz to splinter. It will not bear contact with a flame. As you see, when a piece of quartz is thrust into a flame it cracks and falls to pieces, and the fragments again break up when similarly treated. Consequently, it was very difficult for the pioneer workers to soften their quartz in the flame. It is true that if the quartz be broken small and heated to redness in a crucible it becomes more easy to manage, but even then it gives trouble, and I should not like to say how much my first silica tube, which held about 5 c.c., had cost me for oxygen and labour when it was finished.

Fortunately we have found that we can prevent the splintering of quartz by heating it in small fragments to about 1000° C. and throwing it quickly into cold water. As you see, when this is done the quartz becomes white and enamel like, and after the treatment has been repeated the product, though still in masses, will not splinter to the slightest extent if it be thrust suddenly into the hottest part of an oxy-hydrogen flame. The preparation of this non-splintering silica constitutes the first stage of the process we are about to show you.

Another difficulty is connected with the oxy-gas burner. Vitrified silica only becomes sufficiently plastic for our purpose when it is above the melting point of platinum; and it cannot be heated sufficiently in all parts of an oxy-gas flame. What is wanted is not so much a very large flame as one which presents a very hot spot (this is situated just beyond the inner blue cone of the flame). After trying all sorts of burners I have concluded that the "mixed gas" jets give the best results, and of the burners I have tried the injector burner of Mr. Jackson, of Manchester, is decidedly the best I have met with.

The first step in the process of converting the white enamel like non-splintering silica into tubes and other vessels consists in pressing together the ends of two small fragments of the solid held in platinum forceps till they adhere, adding a third lump, then a fourth, and so on until a rough rod has been made. This rod is afterwards reheated and drawn out into finer rods about 1 mm. in diameter. In doing this care must be taken to heat each fresh mass of material slowly and from below upward in order that there may be as few bubbles as possible in the product.

A few of the fine rods of silica are next bound round a stout platinum wire, or twisted into a spiral while soft (Boys' and Dufour's method), and heated in the flame till their sides adhere. The uncouth tube thus produced is reheated, drawn out and closed at one end, a bulb is blown on the closed end in the usual manner, and this, when again drawn out, gives us a fine and fairly regular tube which can be lengthened by adding silica to one end of it, blowing a new bulb from this and drawing it out as before.

The enlargement of the small bulbs was rather difficult at first. My earliest attempts consisted in adding small lumps of silica to one end of a bulb, softening them in the flame and expanding the bulb by blowing. It is not impossible to succeed in this way, though the vessels so produced are apt to be uncouth in appearance. But the process is unsatisfactory owing to the fact that often the thinner parts of a bulb immediately surrounding the mass to be expanded become hotter and softer than the latter. When this happens the bulb bursts, and as it can only be repaired by the addition of fresh lumps of silica the process is apt to be tedious and expensive. After many failures, it occurred to me that I might develop the bulbs by applying thin rings of silica as shown in Fig. 1, heating them until the silica begins to spread

[1] A discourse delivered at the Royal Institution, on March 8, by W. A. Shenstone, F.R.S.

[2] A recent observation made by Prof. S. P. Thompson confirms this.

[1] Silicon was discovered by Berzelius in 1823.

and then expanding them by blowing. This method gave satisfactory results at once. By it we can produce long tubes and other apparatus like those exhibited to-night, if not at a very quick rate or very low cost, yet with certainty and very much more quickly than before.

When a tube of silica has been made it can be worked in the flame as easily, though not as inexpensively, as glass. Such a tube can be thickened readily by adding fresh rings of silica; it can be drawn out to various degrees of fineness and sealed hermetically; whilst all kinds of joints can be made easily. In one respect silica is easier to work than glass. It never breaks when thrust into the flame, and finished apparatus needs no annealing.

One precaution must be taken. The eyes must be protected by black spectacles. The glass of which these are made must

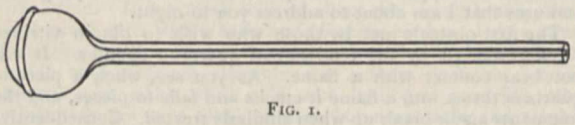

FIG. 1.

be very dark; so dark that white hot silica does not look very bright when viewed through it.

I have spoken of silica as being easy to work. I do not mean you to understand, however, that it is easy to do what you see Mr. Lacell doing to-night. It is not easy to perform any operation of this sort with his wonderful precision, and especially it is not easy to work under the conditions enforced upon him to-night, for he can see nothing of the effects he produces and must adapt his manipulations to my remarks although he can hear the latter only very imperfectly.

The Properties and Applications of Silica.

Vitrified quartz is harder than felspar, but less hard than chalcedony. When cut with a file it breaks like glass. Its conducting power for heat is about equal to that of glass. Mr. Boys has shown that, even in an atmosphere saturated with moisture, it is a very good insulator. Its density (2·21)[1] is decidedly less than that of quartz (2·66). Its optical properties have not yet been fully studied, but its approximate index of refraction has been determined by Prof. S. P. Thompson by means of a small prism cut for the purpose by Mr. Hilger. It is decidedly less than that of quartz.

The melting point of silica is not known and it is plastic over a considerable range of temperature. When a platinum wire embedded in a thick tube of silica is heated from without by means of an oxy-gas flame, the platinum melts and runs at a temperature at which the silica retains its shape.

Its rate of expansion has been studied first, by H. Le Chatelier (*Comptes rendus*, cxxx. 1703) and more recently by Prof. Callendar. The former finds its mean coefficient of expansion between 0° and 1000° to be 0·0000007, but from the manner in which his material was prepared I think it is probable that it was not quite pure. Prof. Callendar has, within the last few days, examined the behaviour of a rod of pure vitrified silica prepared by my method. He finds its mean coefficient of expansion to be only 0·00000059, which is only $\frac{1}{17}$ as great as that of platinum, and much smaller than that of any other similar substance that has hitherto been studied. He finds also that the expansion of vitrified silica is exceedingly regular up to 1000°, and that if not heated above 1000° the rod returns very exactly to its original length when cold. Beyond 1000° he found a slight permanent elongation, although the rod was under compression. Prof. Callendar was able to carry his experiments up to 1500°, which is very satisfactory, for it shows that vitrified silica remains solid, or practically solid, at this very high temperature. This is an important observation, as less carefully conducted experiments had led us to fear that it became slightly plastic even at as low a temperature as 1000°. Above 1000° the rate of expansion diminishes rapidly, changing to a contraction at about 1200°.[1] On cooling from 1500° to 1200° it expands.

Fine rods of silica and also quartz fibres are apt to become rather brittle after being heated to redness. But we have not at present detected this defect in the case of thick tubes or rods.

The transparancy of vitrified silica to the ultra-violet rays has been carefully examined by Dr. A. Wynter Blyth, to whom I am greatly indebted.

The following figure (Fig. 2) illustrates very well the character of the results he has obtained. This figure gives the results of photographing electric sparks taken between electrodes made of an alloy of mercury, tin, zinc and cadmium after passing the light through sheets of quartz, vitrified silica, soda glass and flint glass. The plates of the last three substances were of equal thickness and were carefully prepared for me by Mr. Hilger.

The results show, as indeed we have found by actual experiment, that silica tubes are much more suitable than glass ones for use in studying the spectra of electric discharges.

The most remarkable property of vitreous silica is its behaviour under sudden changes of temperature. We have seen already that tubes of it may be plunged suddenly into an oxy-gas flame without injury, and I have mentioned the fact that apparatus made of silica needs no annealing. But this is not all; we may drop water on a white hot vitrified silica rod, or plunge white hot silica into cold water, or even, by Prof. Dewar's kind aid, into liquid air without injuring it in any way whatever; indeed, experiments seem to show that the material gains very distinctly in regard to its elasticity when it is thus treated. I need hardly point out how convenient tubes of such a material will be to

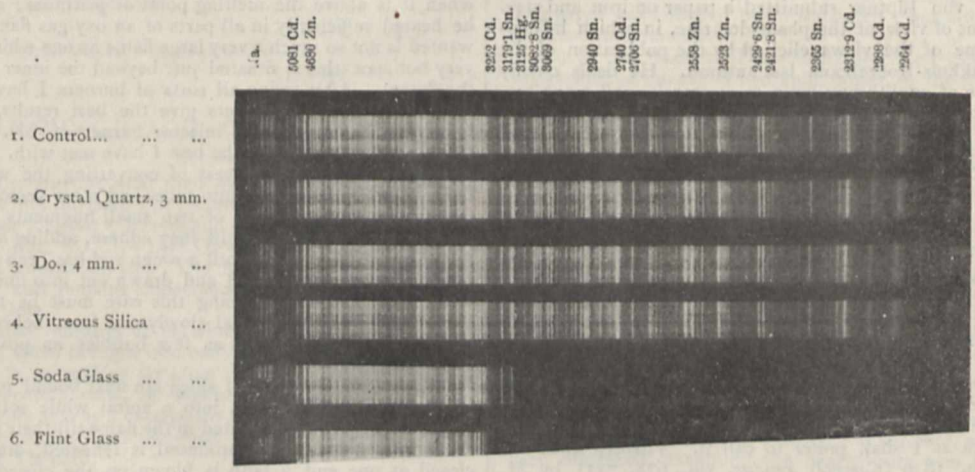

FIG. 2.

[1] This was determined by my pupil, Mr. T. Pears, the silica used contained a few minute bubbles.

[1] Le Chatelier's curve, see Fig. 3, shows a similar contraction, but commencing at a somewhat lower temperature.

chemists, or how many spoilt lecture experiments may be avoided in future by those who possess a silica tube.

This last property of silica and the splintering of quartz find an explanation in the results obtained by Le Chatelier (*Comptes rendus*, cviii. 1046, and cxxx. 1703) and by Callendar. These, as already explained (Fig. 3), show that its rate of expansion is exceedingly low, and, moreover, that at temperatures much above 1000° it contracts when heated. In these circumstances it follows, first, that the strains set up in silica when it is suddenly heated or cooled are comparatively small in amount, and, secondly, that if, for example, vitrified silica be suddenly cooled from 1500° to temperatures below 1000°, the strains set up at the earlier stages of the change must tend to neutralise those produced subsequently. These facts enabled Le Chatelier to predict, a little while ago, the indifference of vitrified silica to sudden change of temperature. But the phenomena had been observed previously and exhibited in this country.

The behaviour of quartz under changes of temperature is also peculiar. This was studied by Le Chatelier in 1889 (*Comptes rendus*, cviii. 1046). From his curves, which are given in Fig. 3, it may be seen that this form of silica expands quite regularly, and much more rapidly than vitreous silica up to 570°, but that at that temperature a sudden expansion takes place which is followed by a steady contraction on further heating.

One of the most important fields in which vitrified silica is likely to be useful is that of thermometry.

Owing to the small coefficient of expansion of vitrified silica the degrees of silica-mercury thermometers will be of greater length in proportion to the volumes of the bulbs than those of

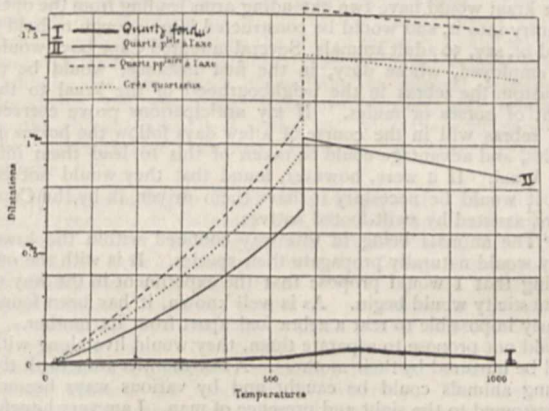

FIG. 3.

glass instruments. Owing to its high melting point it should be possible to employ it with advantage for measuring high temperatures by replacing the mercury by tin or some other metal, as has been done by M. Dufour (*Comptes rendus*, cxxx. 775). And whilst the great elasticity of vitrified silica suggests that the zero points of silica-mercury thermometers will be much more stable than those of glass instruments, the impunity with which it may be suddenly cooled from high temperatures promises obvious advantages.

Finally, the high melting point of silica should make it very valuable for use in platinum thermometers, and I exhibit such a thermometer to-night which has been fitted up for Dr. R. T. Glazebrook. But as the applications of vitreous silica to thermometry are still under investigation I will not dwell on this part of the subject except to add that, as glass reservoirs for air thermometers have proved disappointing, I am not without hopes that the new material may prove helpful in that department also.

We have not yet had time to examine the behaviour of silica with solvents, but if it acts like other forms of the same compound, it may be expected to replace platinum for some purposes, as, for example, for condensers for the preparation of pure water, and vessels of silica probably would be much more suitable for use in exact experiments on the freezing points and boiling points of many dilute solutions than the glass tubes now often used for such work. But, of course, silica vessels would be very susceptible to the action of alkalis. Finally, silica may be expected to prove superior to glass for use in researches on pure gases, owing to the qualities of its surface, and in experiments concerning the behaviour of gases at high temperatures. We have already one small application of silica to research in this latter field to put upon record. It is well known that nitrogen and oxygen enter into combination under the influence of the silent discharge, and Sir William Crookes (*Chem. News*, lxv. 301) has shown that oxides of nitrogen are present in considerable quantities in the flames which accompany the electric discharges of large induction coils; but although various observers have reported indications of the presence of nitrous fumes in the neighbourhood of flames, the forming of an oxide of nitrogen from oxygen and nitrogen alone, and without the intervention of electricity, has not, so far as I am aware, been unmistakably established. Therefore it is interesting to record the fact, first observed by Mr. Lacell, that nitric peroxide may be produced by heating a mixture of oxygen and nitrogen above the melting point of platinum in tubes of silica. It is easy to obtain a gas showing a distinctly yellow colour and exhibiting the reactions of nitric peroxide in this way.

Of course vitreous silica is not entirely without defects. Unfortunately it becomes slightly permeable to hydrogen, as platinum does, though to a less extent (Villard, *Comptes rendus*, cxxx. 1752), at about 1000°. It is attacked when hot by alkaline oxides. It may be heated to about 960° in contact with copper oxide without injury, but at higher temperatures it is attacked. It may be heated more strongly with ferric oxide, but quicklime attacks it at a bright red heat. It is evident that caution must be exercised when it is employed with basic oxides or alkaline solutions. When one first fashions vessels of silica before the flame the vessels exhibit to a greater or less extent a phenomenon resembling devitrification. They become covered with a white opaque crust. This is easily removed by reheating, provided that the tube has been kept scrupulously free from dust and dirt during the process of making it. If this be not done the appearance of the vessel may be spoilt permanently. The earlier observers attributed this phenomenon to the volatility of silica. My impression is that it is connected with the minute traces of alkaline metals present in most Brazil pebble which are usually burnt off in the processes I have described. From what I have told you to-night you will see that in several respects vitrified silica is as much superior to the best glass as Jena glass is superior to more ordinary specimens, and that the progress made in the last few years will make it possible for investigators to employ vitreous silica much more widely in the future than has been possible in the past. At the same time it is evident that the processes for producing vitreous silica are still in their infancy, that there is much more to be done and that further progress can only be made at considerable expense.

In concluding my remarks I wish to express the great obligation I am under to my friend Mr. Lacell. You will have discovered for yourselves that the chief burden has been upon his shoulders to-night, and that without the illumination provided by his precise and beautiful manipulation my discourse would have been but a dry affair. Also I must add that the cost of the work at its later stages has been aided by a subsidy from the Government Grant Fund of the Royal Society.

NOTES FROM RECENT CONSULAR REPORTS.

A REPORT on German East Africa, by Mr. A. C. Hollis, acting vice-consul at Dar-es-Salaam, and one on Veterinary Work in British East Africa and Uganda Protectorates, by Mr. R. J. Stordy, have recently been published as Nos. 2568 and 551 of the Foreign Office Series. The following notes from the reports refer to matters of scientific interest:—

GERMAN EAST AFRICA.

Locusts.—Great interest was shown in the success of the discoveries made at the Grahamstown Bacteriological Institute in the destruction of these insects, and a small quantity of "locust fungus" was imported, and has since been used on Kilima Njaro and in Usambara with success.

Caoutchouc.—There are numerous sorts of caoutchouc creepers and trees indigenous to German East Africa, but the only kinds which are of value are *Landolphia Kirkii* (Kiswahili, *Mohango*), and *Mascarenhasia elastica* (Kiswahili, *Mgora*). Until quite lately it was believed that the best rubber was the product of *Landolphia florida* var. *Comorensis* (Kiswahili, *Mbungo*), but it has now been proved that this creeper is practically worthless.

Samples of the milky juice of the wild fig tree have been sent

to Europe on several occasions, but the price obtained has always been so low as not to repay the cost of transport.

Several trials have been made with other kinds of rubber. *Hevea Brasiliensis* (Para rubber) has been planted repeatedly, but without success, the climate being too dry. *Ficus elastica*, *L. Madagascariensis*, and an *Euphorbia sp.* (from Madagascar) have done fairly well. *Castilloa elastica*, *Hancornia speciosa*, and *Willoughbeia* were each tried once, but the seed did not germinate. *Manihot Glaziovii* (Ceara rubber) was first planted at Tanga in 1891. There are at present about 20,000 trees, but it is feared that it will not pay as the atmosphere is too moist. It is thought probable that Ceara rubber will do better in Donde-Barikiwa (Kilwa district), where a small experimental plantation has lately been opened.

Forestry.—The numerous rivulets and creeks, which form the mouths of the Rufiji River, and which cover an area of 100,000 acres, are lined by extensive mangrove swamps producing the timber known as *boriti*, or Zanzibar rafters. It is the opinion of various botanists that when traders—both European and native—are allowed to cut *boritis* at will, the mangroves in course of time die out, as large numbers of big trees are usually cleared from one spot, thus exposing the young plants to the direct rays of the sun, which is said to kill them. In consequence, the only trees now to be found in various parts of the Rufiji Delta are *Phoenix reclinata Osmunda sp.*, and *Barringtonia racemosa.*

In order to preserve and, if possible, to increase the present supply of *boritis*, a forest officer and three wood-rangers have been stationed in the Rufiji sub-district. The trees are felled under their supervision, and the timber is sold by the German Government.

The custom of systematically stripping a part of the bark from the mangroves, as sometimes practised in the East and West Indies, is not permitted, as it is held that such a course must be injurious to the trees. After the timber has been felled, the bark is stripped and sold.

The regulations issued for the preservation of the woods in the Usambara Hills have done much to prevent the needless felling of valuable timber. Oaks, firs and other European trees are now being planted under the auspices of the Woods and Forests Commission. Similar regulations will shortly be issued for other parts of the colony.

Roads.—Broad roads have been made all over the colony, and it is now possible to drive from Dar-es-Salaam to Lakes Victoria Nyanza and Tanganyika, from Tanga to Kilima Njaro, and from Kilwa and Lindi to Lake Nyasa.

Surveys.—A trigonometrical survey of East and West Usambara has been made, and a map of the former (Handei) is about to be printed. Much topographical work has also been done in various parts of the colony, notably in Uhehe (Hauptmann von Prittwitz), in Usagara (Dr. Stuhlmann), and between the Tanganyika and Nyasa Lakes (Dr. Kohlschüter).

A Commission for the delimitation of the boundary between the Independent State of the Congo and German East Africa left the coast for Lake Kivu in September last. On the completion of the survey of the western frontier, it is hoped that an Anglo-German Commission will be organised to delimit the boundary between the Uganda Protectorate and this colony. The frontier between the British East Africa Protectorate and German East Africa has now been finally settled. An interesting book on the geology of portions of German East Africa, by Dr. Bornhard, was published during the course of the year.

Valuable work is at present being done by Drs. Busse and Kandt. The former is making a study of all the plants indigenous to the country, whilst the latter is exploring the little-known regions between the Tanganyika and Victoria Nyanza Lakes. To him belongs the honour of having discovered the sources of the Kagera-Nile.

Dr. Maurer, after spending three years in German East Africa, has written a lengthy report on the result of his observations, which is being published by the Hamburg Marine Observatory. A successor to Dr. Maurer was appointed in October last. Meteorological observations are regularly taken at a number of places.

Museums.—A museum of products, plants and minerals was established at Dar-es-Salaam in 1899, and has since been increased in size. A collection of the lepidoptera and coleoptera of German East Africa is also being made. The ethnographical museum in Berlin has been greatly enriched by collections received from the colony.

British East Africa and Uganda Protectorates.

Tsetse Fly Disease (*Ngana*).—Mr. Stordy reports that the extent of the tsetse fly belt may be said to be from Mtoto Andei to Simba, a distance of, roughly, 90 miles. The fly is migratory in tendency, so that no well-defined line on the map can be drawn which could safely exclude the possibility of its presence. The fly, however, has never been located further inland than Muani (a halting station in the Kiu Hills on the old caravan route). When studying the causes which rendered the island of Mombasa uninhabitable for horses, Mr. Stordy ascertained that an organism, the morphology of which was identical with that found in animals suffering from tsetse fly disease, was found in donkeys which had been working for some time on the island. The disease has been practically eradicated by the advent of the Uganda Railway, with its excellent service of horse-boxes and fly-proof gauze windows.

Domestication of the Zebra.—Mr. Stordy urges the advisability of utilising for purposes of transport an animal which is naturally immuned against the ravages of the tsetse fly disease and horse sickness, such, for instance, as the zebra, of which there is an enormous number. He adds:—

"I am convinced that, should the Government enter upon a scheme for its domestication, it would prove one of great value, and that at no very distant date a supply of animals would be available, not only for African service, but also for army transport work at home or in India. The great difficulty so far has been the domestication of the adult animal. I have, however, to suggest the following plan for obtaining a possible way out of the difficulty: I would propose that a kraal be formed within a district where firearms are non-existent, as in the case of a preserve. The kraal would have two extending arms leading from the open country into it, and would be constructed large enough to hold a herd of, say, 50 adult animals. Several mounted Cape boys would be employed, whose duty, in the first instance, would be to accustom the zebras in the neighbourhood of the kraal to the sight of horses or mules. If my anticipations prove correct, the zebras will in the course of a few days follow the horses or mules, and advantage could be taken of this to lead them into the kraal. If it were, however, found that they would not be led it would be necessary to have them driven in by the Cape boys, assisted by swift-footed natives.

"The animals being in this way confined within the kraal they would naturally propagate their species. It is with the offspring that I would propose that the experiment in the way of domesticity would begin. As is well known, it has been found nearly impossible to rear a zebra foal apart from its mother. I would not propose to separate them, they would live along with and be nurtured by their mothers. A few months after birth the young animals could be caught and by various ways become accustomed to the sight and presence of man. I am very hopeful that in this way a number of young animals of both sexes would become domesticated and prove useful for transport service, and also in propagating their species. The second generation, if my experiment prove in any way successful, would be even more domesticated than their parents, and I am sure that in course of time a large supply of the domesticated zebra would be forthcoming for the future use of transport work at home and abroad. The initial cost might be a little more than the first results might justify, but there is no reason to doubt that in the long run the ultimate results would far more than compensate for the initial expenditure."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The John Lucas Walker Studentship in Pathology has been awarded to Mr. H. C. Haslam. Dr. E. S. Sladen, who has recently been serving in the Ashanti war, has been reinstated as a second student.

The board for moral science propose the assignment of certain rooms connected with the temporary pathological laboratory for practical work in experimental psychology, under the direction of Dr. Rivers.

A syndicate is to be appointed to consider the question of affording official recognition and support to the work now carried on by the Cambridge Appointments Association.

Mr. W. Bateson, F.R.S., of St. John's College, is to be reappointed deputy for the professor of zoology and comparative anatomy during the ensuing academical year.

WE are glad to see that the London County Council has this year again arranged special beds of plants in Battersea, Ravenscourt and Victoria Parks, with a view to encourage the study of botany among pupils in elementary and secondary schools. At each of these parks about twenty beds are arranged near the paths, each bed containing specimens of a distinct order of plant, and each plant being labelled with its common name and its Latin name. In order to further assist the teaching and study of plants, arrangements have been made by which teachers may obtain orders from the Council's Technical Education Board which will enable them to secure specimens suitable for teaching purposes.

OUTDOOR work by students appears to be carried on in connection with several institutions on the other side of the Atlantic. We notice in *Science*, for instance, that the biological department of the University of California has just commenced a systematic biological survey of the coast of that state. Temporary headquarters are established at San Pedro, and the work during this summer will be carried south from Pt. Conception toward San Diego. A gasoline launch, which has been obtained for the season, will be fitted out with apparatus for dredging, sounding and making observations on temperature, salinity, specific gravity, &c. The work will be carried on by the members of the department and graduate students, together with a number of investigators who have already interested themselves especially in the west coast faunas. A party of students from Harvard University will undertake, this summer, an expedition to Venezuela for botanical and zoological research. We see also that the Mining School of McGill University will this year carry on its summer work in British Columbia. The class has just left Montreal to go out to the Pacific coast, visiting the various collieries along the line of the railway and on Vancouver Island. The party will then go into southern British Columbia for the purpose of studying the mineral deposits of the Slocan, Trail Creek and Boundary Districts, and, returning by the Crows' Nest Pass route, will visit the coal mines at Fernie Hethbridge, reaching Montreal again about the middle of June.

AT a meeting of the Court of Governors of University College, Liverpool, on Saturday last, the following resolution was passed :—"That, while gratefully acknowledging the advantages which have accrued to University College, Liverpool, by its association with the Victoria University, this Court is of opinion that a University should be established in the city of Liverpool, and will welcome a scheme with this object upon an adequate basis." In moving this resolution, Mr. Robert Gladstone, who presided, remarked that the success of the college showed the need for a University. The fees from students had increased from 700*l.* in its first year to 9500*l.* this year. Within the last few years 22,000,000*l.* sterling had been given by private individuals in the United States towards founding Universities and colleges. Was it not the duty of the wealthy people of this country to follow that excellent example? If they did not they could hardly complain if trade passed away and our prosperity diminished. We had already had a blow from German chemists. The great indigo industry in India, which had made the fortunes of many people and been a great source of trade, was threatened with extinction by chemical discoveries made in Germany. It was a misfortune they were not made in this country, as they might have been if we had been better provided with means of investigation. He hoped that the people of Liverpool who had been indifferent to the progress of the college would awake to a better state of mind, and that by their assistance they might succeed in putting Liverpool in as pre-eminent a place with regard to learning as she now enjoyed with reference to commerce.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 28.—"Further Observations on Nova Persei, No. 2." By Sir Norman Lockyer, K.C.B., F.R.S.

In continuation of previous papers, the observations of the Nova made at Kensington are brought to midnight of March 25. Since the last paper of March 7, estimates of the magnitude of the Nova have been made on ten evenings, visual observations of the spectrum on eight evenings, and photographs of the spectrum on four evenings.

Since March 5 the magnitude of the star has been gradually decreasing, but between the nights of the 24th and 25th the light of the Nova decreased very suddenly, dropping from 4·2 to 5·5 in twenty-four hours, and becoming only just visible as a naked-eye star.

The colour of the Nova has undergone some distinct changes since the observation on March 5 last, when it was shining with a clarety-red hue. On the 9th and 10th it was observed to be much redder, due probably to the great development of the red C line of hydrogen.

On the 23rd and 24th the star was noted as yellowish-red, while on the 25th (after the sudden drop in magnitude) it was very red, with, perhaps, a yellow tinge.

On March 6 the photographs were very similar to those obtained in the earlier stages, the only apparent difference being in the relative intensity of the bright hydrogen lines as opposed to those having other origins, most of which have been shown to be probably due to iron and calcium. The hydrogen lines have sensibly brightened, while the others have become much feebler.

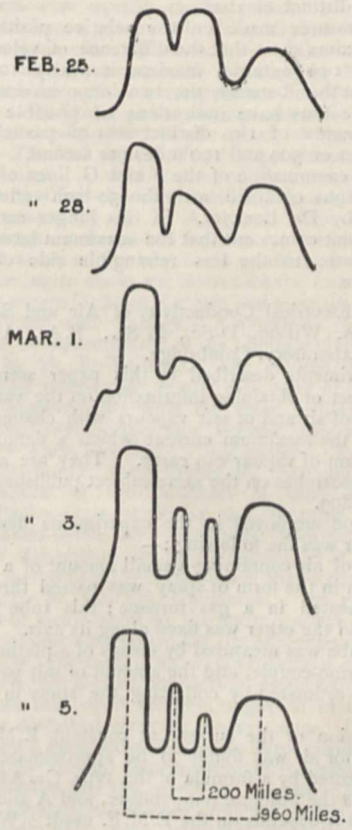

FIG. 1.—Light curve of Hβ (6-inch objective prism).

The photograph of March 10 shows a further dimming of the bright lines other than those of hydrogen.

On March 25, when the next good photograph was taken, the spectrum had undergone great modifications. The hydrogen lines are still very bright, though they do not show the structure which they did in the photographs taken between February 25 and March 10. The bright lines other than those of hydrogen, which are seen in the earlier photographs, have now disappeared, and other lines become visible. The continuous spectrum has also greatly diminished.

Approximate determinations of the wave-length of these new lines have been made by Mr. Baxandall by comparison with lines of known wave-length in the spectra of α and ε Persei photographed with the same instrument.

The lines at λ 3870 and 4650 are perhaps identical with those observed by von Gothard[1] in the spectrum of Nova Aurigæ

[1] *Ast. Phys. Jour.*, vol. xii., 1893, p. 51.]

after it had become nebular, but associated with these lines in his record is the chief nebular line at 5007, no trace of which is yet visible in the photographs of the spectrum of Nova Persei. On the other hand, Hβ, which is the brightest line in the present spectrum of Nova Persei, does not appear at all in von Gothard's spectrum of Nova Aurigæ.

In the former paper the structure of the broad bright lines of hydrogen was referred to. A more detailed examination of the lines as photographed on several evenings shows that this structure has been undergoing changes.

The annexed figure (Fig. 1) gives light curves showing the variation in the loci of intensity of the line Hβ, as photographed with the 6-inch prismatic camera. These curves were plotted by Messrs. Baxandall and Shaw independently of each other, and I have satisfied myself of their accuracy. It will be seen that on February 25 there were three points of maximum luminosity, the two maxima on the blue side being of equal intensity, and greater than the third on the red side. By March 1 the centre one had greatly been reduced in intensity, and on the 3rd it had been broken up into two portions, thus making four distinct maxima.

Rough measures made on the relative positions of these points of maxima show that the difference of velocity indicated between the two external maxima is nearly 1000 miles per second, while that between the two inner maxima is 200 per second. We thus have indications of possible rotations or spiral movements of two distinct sets of particles travelling with velocities of 500 and 100 miles per second.

A similar examination of the F and G lines of hydrogen in the photographs obtained with the 30-inch reflector has also been made by Dr. Lockyer. In this longer series the most important point comes out that the maximum intensity changes from the more to the less refrangible side of the bright hydrogen line.

"On the Electrical Conductivity of Air and Salt Vapours." By Harold A. Wilson, D.Sc., M.Sc., B.A., Allen Scholar, Cavendish Laboratory, Cambridge.

The experiments described in this paper were undertaken with the object of obtaining information on the variation of the conductivity of air and of salt vapours with change of temperature, and on the maximum current which a definite amount of salt in the form of vapour can carry. They are a continuation of the two researches on the same subject published in the *Phil. Trans.* for 1899.

The method employed in the experiments described in the present paper was the following :—

A current of air containing a small amount of a salt solution in suspension in the form of spray was passed through a platinum tube heated in a gas furnace; this tube served as an electrode, and the other was fixed along its axis. The temperature of the tube was measured by means of a platinum platinum-rhodium thermo-couple, and the amount of salt passing through the tube was estimated by collecting the spray in a glass-wool plug.

The variation of the current at constant E.M.F. with the temperature for air was found to be approximately capable of being represented by a formula of the type $C = A\theta^n$, where C is the current, θ the absolute temperature, and A and n constants. The constant n depends on the E.M.F. used. With 240 volts it was 17, and with 40 volts 13. The current, therefore, does not begin suddenly when the temperature is raised, but always increases regularly with the temperature, so that the lowest temperature at which the current can be detected depends entirely on the sensitiveness of the galvanometer.

The relation between the current and temperature for salt vapours was found to be rather complicated. With KI, using an E.M.F. of 800 volts, the current had the following values ($1 = 10^{-4}$ amperes).

Temp.	500°	600°	700°	800°	900°	1000°	1100°	1150°	1200°	1300°
Current	0·7	1·8	3·0	4·0	4·5	4·0	3·5	3·6	7·0	7·0

Thus the current has a maximum value near 900° C., and rises very rapidly near 1150°. Similar results were obtained with other salts.

The maximum current carried by the salt vapour (at 1300° with 800° volts) was found to be nearly equal to that required to electrolyse the same amount of salt in a solution. This fact must be regarded as considerable evidence in favour of the view that the ions are of the same nature in the two cases.

Linnean Society, April 18.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. Harting exhibited and made remarks upon a mummified hawk from an Egyptian tomb, pointing out the difference between mummies made at Memphis, which are black, dry and brittle, from the bitumen employed in the embalming process, and those from Thebes, which, like the specimen exhibited, are of a yellowish colour, more flexible, and were prepared with natron, or neutral carbonate of sodium, Na_2CO_3, brought from the natron lakes in the Lybian desert. Colonel Swinhoe confirmed the statement that our word "mummy," Fr. *momie*, Sp. *momia*, was derived from the Arabic *moum*, wax, the most expensive process of embalming known to the Egyptians being that in which wax and bitumen were the chief ingredients.—Mr. Charles Dawson exhibited a hollow flint nodule which had been picked up on the downs at Lewes, and which on fracture was found to contain the desiccated body of a toad. The flint measured 5½ inches in length and 12 inches in circumference, and a small hole at one end indicated the point of ingress for the toad, which must have entered in a very immature condition, and died there after having attained a size too great to permit of its escape. In the discussion which followed, remarks were made by Mr. E. T. Newton, F.R.S., Mr. John Lewis, and others, the general opinion being that a modern toad had crept into an ancient flint, and, having lived for a time on such insects as found their way into the cavity, had died there.—Mr. S. Pace exhibited specimens of *Moseleya latistellata*, Quelch, the so-called "rugose coral" from Torres Strait. The specimens shown were obtained from the backs of pearl-shells collected in Friday Island passage at a depth of three to four fathoms. In the opinion of Mr. Pace they showed that the so-called coral was really a species of *Lithophyllia*.—Mr. W. B. Hemsley, F.R.S., exhibited the leaves and flowers of two new genera of Chinese trees: (1) Bretschneideria, discovered by Dr. Henry in the province of Yunnan, lat. 23° N., in forests at an elevation of 5000 feet, and bearing pink and white flowers like the horse chestnut, to which it is related; and (2) Itoa, also a native of Yunnan, growing at a similar elevation and to a height of about twenty feet. The genus, named in honour of a famous Japanese botanist, was stated to be allied to Idesia, Maxim., Poliothyrsus, Oliver, and Carrierea, Franch., all monotypic genera inhabiting China, but differing from them in certain respects which Mr. Hemsley indicated.—Mr. S. Pace read a paper on the formation and variation of the remarkable cup-shaped corallum of Turbinaria, on which no observations appeared to have been recorded. This was supplemented by a letter from Mr. H. M. Bernard, in which he offered some critical remarks on the paper which the author had previously submitted to him. Further observations on the bearing of the facts described were made by Prof. Howes.—Messrs. W. B. Hemsley, F.R.S., and H. H. Pearson communicated a paper on the flora of Tibet, based on various collections of high-level plants received at the Kew Herbarium. The country dealt with was described as lying between 80° and 102° lat. and 28° and 29° long., and having an average altitude of 15,000 feet. Within this area 360 species of vascular plants had been collected, and were referred to 144 genera and 46 natural orders. Almost all the orders represented were nearly of world-wide distribution, and none were really local. Of the 360 species only 30 appeared to be peculiar to Tibet. In illustration of the paper a selection of the plants was exhibited; most of them dwarf deep-rooted herbs, very few annual or monocarpic, and the only woody plant, *Ephedra gerardiana*, was described as scarcely rising above the surface of the ground. The majority had been collected at altitudes varying between 15,000 and 18,000 feet. Mr. C. B. Clarke, F.R.S., in making some observations on the paper, pointed out that the name "Thibet" or "Tibet" was quite unknown to the people who dwelt in the country so-called, and its precise boundaries were even still imperfectly defined. It was convenient, however, to retain a name by which it was known to so many European travellers, and the explorations and collections were making us better acquainted with the country every day.

Zoological Society, May 7.—Prof. G. B. Howes, F.R.S., vice-president, in the chair.—Mr. Sclater exhibited and made remarks on an original water-colour drawing by Sir Harry Johnston, K.C.B., of the remarkable new Mammal from the Semliki Forest in Uganda, which had been described (from fragments of skin only) under the name *Equus johnstoni*, and announced that the complete skin and two skulls from which

it had been prepared were now on their way home. There could be no doubt that the animal was not an Equus, and could not be placed satisfactorily in any known genus of recent Mammals.—Dr. W. G. Ridewood exhibited and made remarks on a series of microscopic preparations of the hairs of Antelopes, Giraffe, Zebra, and the so-called *Equus johnstoni*, pointing out that the hairs of the last-named animal were similar to those of the Giraffe as well as those of the Zebra, but different from those of the Antelopes.—Mr. R. I. Pocock communicated a paper, by Mr. G. W. Peckham and Mrs. E. G. Peckham, on the spiders of the family Attidæ found in Jamaica, West Indies. It contained descriptions of thirteen new species, of which one was made the type of a new genus—Nilakantha.—Dr. David Sharp, F.R.S., communicated a paper by Mr. Peter Cameron, containing an account of the Hymenoptera collected during the "Skeat Expedition" to the Malay Peninsula. Fifty-four species were enumerated in the paper, of which thirty-one were described as new.—Dr. David Sharp also communicated a paper by Mons. Eugène Simon on the Arachnida collected during the "Skeat Expedition." It consisted of a list of the 131 species represented in the collection and descriptions of forty-eight new species and four new subspecies.

Royal Astronomical Society, May 10.—Mr. Hinks exhibited and described a new machine for measuring celestial photographs, made for the Cambridge Observatory under his superintendence, in the construction of which several improvements had been effected.—Dr. Lockyer showed slides from photographs of Nova Persei, and curves exhibiting its changes of magnitude.—Father Sidgreaves gave further results of the Stonyhurst observations of the spectrum of the Nova, which distinctly varied with the variations of its light.—Father Cortie read a paper on its visual spectrum, showing that the D lines came out strongly at a minimum, and that the spectrum resembled that of the solar chromosphere.—Prof. Turner communicated Mr. Bellamy's observations of the magnitude of the Nova and the neighbouring stars.—Mr. Wickham read the observations for magnitude made at the Radcliffe Observatory, Oxford, which supplemented and confirmed the observations made at South Kensington.—A curve made by Mr. Child was shown, exhibiting the variations in the brightness of the new star from the time of its discovery.—Observations of magnitude by Mr. Sharp and Mr. Stanley Williams were also read.—Father Sidgreaves suggested an explanation of the fact that the displacement of the lines in the spectra of new stars always indicated a rapid motion of approach.—Prof. Turner read a paper by Mr. H. C. Plummer on the geometry of the siderostat.—A paper by Mr. Franklin Adams was read on an observation of the "green flash" at sunset, a phenomenon which he considered similar to that of "Baily's beads" seen during a total solar eclipse.—Mr. Crommelin gave approximate elements of the orbit of the new comet, from which it appeared that it is moving rapidly from the sun and more slowly from the earth, and that its brightness is rapidly diminishing. Although it should shortly be visible in the evening sky it is improbable that it will be a conspicuous object.

DUBLIN.

Royal Irish Academy, May 13.—Prof. R. Atkinson, president, in the chair.—Hipparchus and the precession of the equinoxes, by Rev. M. H. Close. Hipparchus discovered the increase of the longitudes of the fixed stars, which produces the precession of the equinoxes, as we term it. That increase might be due to (*a*) the eastward progression of the stars; or to (*b*) the westward retrogression of the equinoctial points, from one of which the longitudes are reckoned; or to (*c*) both these movements existing together. We may dismiss *c* at once. Did Hipparchus believe in *a* or in *b*? Laplace, Lalande, and many others declare that he believed in *a*; Delambre, Bailly, and many others that he believed in *b*. None give any arguments for their opinions. Which are right? The former, as would appear thus: (1) Hipparchus admittedly shared the general belief of his times in the immobility of the earth. He had therefore a predisposition against *b*, which involves a movement of the earth. (2) Ptolemy's treatment in the *Almagest* of certain apparently (only) inconsistent expressions of Hipparchus on the present subject shows that he (Ptolemy), who ought to know, held that Hipparchus believed in the progression of the stars. Besides which, we have, in two places in the same work, Ptolemy's direct statement to the same effect. (3) At first, when Hipparchus had examined only certain zodiacal stars, and had observed their apparent progression, he supposed that the extra-zodiacal stars did not participate therein. But he could not have supposed this had he believed in the retrogression of the equinoctial points, for that would give an apparent progression to all the stars. He found afterwards, however, that the stars outside the zodiac preserved their positions relatively to those within, which, from his above-mentioned predisposition, would mean for him that all the stars progressed together.

PARIS.

Academy of Sciences, May 6.—M. Fouqué in the chair.—The influence of feeding, temperature, work and dust upon the evolution of tuberculosis, by MM. Lannelongue, Achard and Gaillard. A series of guinea-pigs, artificially infected with tuberculosis, were submitted to varying external conditions. If compelled to do a certain amount of mechanical work each day, the mortality increased with the amount of work done, those remaining at rest showing the most survivors. With insufficient food the effects were equally marked, those on full rations having the best chance of survival. The inhalation of dust had the same prejudicial effect as in man.—On the fourth volume of the *Annales de l'Observatoire de Toulouse*, by M. Lœwy.—M. Zeuner was elected a correspondant for the section of mechanics, and M. Oudemans a correspondant for the section of geography and navigation in the place of the late M. de Serpa Pinto.—The last sign of life; its application to man, by Dr. A. D. Waller. A modification of the method previously described, but in which the skin remains intact.—The thermal variations of waters, by M. F. A. Forel. The amplitude of the annual thermal variation is a function of the latitude. The depth of penetration of the heat is also a direct function of the latitude, amounting to about 100 metres for the Lake of Geneva, more than 150 metres for Loch Katrine, and more than 200 metres for Lakes Mjösen and Ladoga.—Application of the wedge photometer to the measurement of the photographic magnitudes of the stars, by M. B. Baillaud. The method would appear to give the most trustworthy results with stars of higher magnitudes, the measurements with the more brilliant stars not being so satisfactory.—Some new nebulæ discovered at the Observatory of Paris, by M. G. Bigourdan. A list of new nebulæ, mostly fainter than thirteenth magnitude, together with rectifications of the positions of some nebulæ previously described.—On a particular class of ruled surfaces, by M. A. Demoulin.—On the continuous deformation of surfaces, by M. G. Tzitzeica.—On Taylor's series, by M. L. Desaint.—A practical method for the correction of the secondary error of chronometers, by M. Ch. Ed. Guillaume. An application of the properties of nickel steel to the more perfect temperature compensation of chronometers.—On the existence of open currents, by M. V. Crémieu. As a consequence of the proof previously given that electric convection produces no magnetic effect, it follows that open currents ought to exist. Experiments are now described verifying the existence of these.—On osmosis through a membrane of copper ferrocyanide, by M. G. Flusin. An experimental determination of the relation between the osmotic pressure and the speed of osmosis. For solutions of saccharose, amygdalin and antipyrine the observed pressures agree satisfactorily with those calculated theoretically, none of the substance passing through the membrane. With a 1 per cent. solution of urea the observed pressure was far lower than that calculated, and in this case it was found that urea had passed through the membrane. The velocity of osmosis depends upon the thickness of the membrane, but for a given porous pot the velocities are proportional to the osmotic pressures, and hence inversely proportional to the molecular weights.—On the aluminium alloys. Combinations of aluminium with tungsten, by M. Léon Guillet. By the reduction of tungstic anhydride with an excess of aluminium a tungstide of aluminium can be isolated in the crystalline state, possessing the formula AlW_2.—On an iodoantimonide of mercury, by M. Albert Granger.—On a specimen of crystallised lime, by M. Ad. Jouve. In the preparation of calcium carbide, if the mass be cooled at the moment that the carbide commences to form, transparent prismatic needles of lime are obtained.—On the chemistry of methylene, by M. V. Thomas.—On the hydration of amylpropiolic acid with the formation of caproylacetic acid, by MM. Ch. Moureu and R. Delange. Amylpropiolic acid cannot be hydrolysed by sulphuric acid, but the reaction can be effected

by boiling with caustic alkalis the β-ketonic acid, caproylacetic acid being formed.—On dimethyl-pyruvic acid, by M. A. Wahl. Of the various methods attempted to prove the constitution of this acid, the only one meeting with success was the reduction to α-oxy-isovalerianic acid by sodium amalgam.—On the anhydride of the supposed binaphthyleneglycol, by M. R. Fosse.—Action of the acid chlorides upon the ether oxides in the presence of chloride of zinc, by M. Marcèl Descudé. In presence of anhydrous zinc chloride acetyl chloride reacts violently upon ordinary ether, giving ethyl acetate and ethyl chloride.—On the migration of the ternary materials in annual plants, by M. G. André. On the evolution of immature eggs of *Rana fusca*, by M. E. Bataillon.—On the development of the sole in the laboratory of Concarneau, by MM. Fabre-Domergue and Eugène Biétrix. The authors have been successful in developing soles from the eggs in an aquarium, with a mortality of only 50 per cent. They consider that their results open up the possibility of a culture of the sole commercially.—Chlorophyllian assimilation realised outside the living organism, by M. Jean Friedel.—On the movements of the soil and the formation of the valleys in Walachia, by M. E. de Martonne.—On the law of the electrical stimulation of nerves, by M. Georges Weiss. For an electrical stimulation of the nerve lasting t seconds, it is necessary and sufficient that it puts into play a quantity of electricity given by the formula $Q=a+bt$, a and b being two coefficients depending on the nerve and the distance of the electrodes. This includes the empirical formula of Hoorweg.—Researches on the injection of blood and of nephrotoxic serum in the dog, by M. Bierry.—Researches on the diseases of dogs. Vaccination of the dog against experimental infection, by M. C. Phisalix.—General characters of the teratogenous process, by M. Etienne Rabaud.—On the atmospheric dust observed at Tunis on March 10, by M. E. Bertainchand. An analysis of the red rain showed that it was essentially siliceous in character, containing only 6 per cent. of organic matter.—The movement in each synodic day of the instantaneous axis of symmetry of the barometric deviations, by M. A. Poincaré.

ST. LOUIS.

Academy of Science, April 1.—Mr. John S. Thurman delivered an address on the many industrial uses now made of compressed air, illustrating his remarks by apparatus in operation, including electric motor air compressor, compressed air auger, drill, disinfecting atomizer, sculptors' and stonecutters' tools, carpet renovators, &c., and a set of lantern slides showing the practical uses made of these and other implements and machines operated by means of compressed air.—Dr. Theodore Kodis exhibited, under the microscope, slides illustrating a new method of staining brain tissue, whereby, in four or five days, it has proved possible to prepare single or double stained preparations containing nerve cells with the dendrides of the latter brought out by a direct stain, instead of being differentiated merely as amorphous silhouettes, as is the case with the much slower Golgi process commonly employed. It was stated that the material is treated before sectioning, for about twenty-four hours, with cyanide of mercury, followed for approximately the same length of time by a formaldehyde solution, after which sections are cut, stained with phosphomolybdate hæmatoxylin and, if desired, a contrasting stain, such as one of the aniline greens, and mounted in the usual way.

DIARY OF SOCIETIES.

THURSDAY, MAY 16.

CHEMICAL SOCIETY, at 8.—The Nutrition of Yeast, Part III.: Dr. A. L. Stern.—Derivatives of Methylfurfural: H. J. H. Fenton and Miss Mildred Gostling.—The Preparation and Optical Inversion of Optically Active Nitrogen Compounds, dextro- and Lævo-α-benzylphenyl-allylmethylammonium Salts: W. J. Pope and A. W. Harvey.

FRIDAY, MAY 17.

ROYAL INSTITUTION, at 9.—Turkish Kurdistan: Earl Percy.
SOCIETY OF ARTS, at 8.—Polyphase Electric Working: A. C. Eborall.
EPIDEMIOLOGICAL SOCIETY, at 8.30.—What is Plague: Dr. Klein, F.R.S.

SATURDAY, MAY 18.

ROYAL INSTITUTION, at 3.—Rise of Civilisation in Egypt: Prof. W. M. Flinders Petrie.

MONDAY, MAY 20.

ROYAL GEOGRAPHICAL SOCIETY.—Anniversary Meeting.
VICTORIA INSTITUTE, at 4.30.

TUESDAY, MAY 21.

ROYAL INSTITUTION, at 3.—Cellular Physiology: Dr. A. Macfadyen.
ZOOLOGICAL SOCIETY, at 8.30.—On the more noticeable mammals obtained by Sir Harry Johnston, K.C.B., during his Recent Expedition to Mount Ruwenzori: Oldfield Thomas.—On some Arctic Nemerteans: R. C. Punnett.—On the Anatomy of *Cogia breviceps*: Prof. W. B. Benham.
SOCIETY OF ARTS, at 8.—The Rise and Development of Egyptian Art: Prof. W. M. Flinders Petrie.
ROYAL STATISTICAL SOCIETY, at 5.—Calculation of National Resources: V. V. Branford.

WEDNESDAY, MAY 22.

GEOLOGICAL SOCIETY, at 8.—On the Skull of a Chiru-like Antelope from the Ossiferous Deposits of Hunder, Tibet: R. Lydekker, F.R.S.—On the Occurrence of Silurian (?) Rocks in Forfarshire and Kincardineshire along the Eastern Border of the Highlands: George Barrow.—The Crush-Conglomerates of Argyllshire: J. B. Hill.
SOCIETY OF ARTS, at 8.—Testing and Training Distant Vision: R. Brudenell Carter.

THURSDAY, MAY 23.

ROYAL SOCIETY, at 4.30.—*Probable papers*: On the Presence of a Glycolytic Enzyme in Muscle: Sir Lauder Brunton and Herbert Rhodes.—On Negative After-Images and their Relation to certain other Visual Phenomena: S. Bidwell, F.R.S.—The Solar Activity, 1833-1900: Dr. W. J. S. Lockyer.—A Comparative Crystallographical Study of the Double Selenates of the Series $R_2M(SeO_4)_2, 6H_2O$.—Salts in which M is Magnesium: A. E. Tutton, F.R.S.—On the Intimate Structure of Crystals. Part V. Cubic Crystals with Octahedral Cleavage: Prof. W. J. Sollas, F.R.S.
ROYAL INSTITUTION, at 3.—The Chemistry of Carbon: Prof. J. Dewar, F.R.S.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

FRIDAY, MAY 24.

ROYAL INSTITUTION, at 9.—The Aims of the National Physical Laboratory: Dr. R. T. Glazebrook, F.R.S.

SATURDAY, MAY 25.

ROYAL INSTITUTION, at 3.—The Rise of Civilisation in Egypt: Prof. W. M. Flinders Petrie.

CONTENTS.

	PAGE
The Significance and Scope of Natural Selection. By **F. A. D.**	49
A Text-Book of Electricity	50
An Essay in Critical Bibliography. By **A. F. W.**	51
Our Book Shelf:—	
Häcker: "Der Gesang der Vögel."—**W. P. P.**	52
Griesbach: "Physikalisch-chemische Propädeutik"	53
Gooch: "Annals of Politics and Culture (1492-1899)."—**R. M.**	53
Drummond: "The Child: His Nature and Nurture"	53
Letters to the Editor:—	
The Smithsonian Solar Eclipse Expedition.—**Prof. S. P. Langley**	53
The Persistence of the Spectrum of Carbon Monoxide.—**Prof. W. N. Hartley, F.R.S.**	54
The Use of "Axis-vectors."—**Prof. F. Slate**	54
The New Comet.—**E. C. Willis**	55
Blood-Rain.—**F. H. Perry-Coste**	55
The Anti-Vivisection Society and Lord Lister	55
The Army Education Committee	55
Studies on the Structure of the Universe. By **Howard Payn**	56
The Geological Society and its Museum	57
The Royal Society Conversazione	57
The National Antarctic Expedition	58
Notes	58
Our Astronomical Column:—	
Comet *a* (1901)	63
Variability of Eros	63
Washington Observations, 1891-92	63
Stellar Photometry	63
New Nebulæ	63
Musk-Ox and Bison at Woburn Abbey. (*Illustrated.*) By **R. L.**	63
Researches on Organic Peroxides	64
Iron and Steel Institute	64
Vitrified Quartz. (*Illustrated.*) By **W. A. Shenstone, F.R.S.**	65
Notes from Recent Consular Reports	67
University and Educational Intelligence	68
Societies and Academies. (*With Diagram.*)	69
Diary of Societies	72