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A MANUAL OF QUATERNIONS.

A Manual of Quaternions. By Prof. Charles Jasper Joly, F.R.S. (London: Macmillan and Co., Ltd., 1905.) Pp. xxvii+320. Price 10*s.* net.

PROF. C. J. JOLY'S "Manual of Quaternions" is an important addition to the literature of the subject. It at once takes rank with Tait's "Treatise" as an eminently serviceable exposition of Hamilton's great calculus.

Hamilton's own works, the "Lectures" and the "Elements," are in their way inimitable. Unfortunately, their style is not suited to the average student eager to acquire a working knowledge of the mathematical method developed in them. Tait alone of the younger contemporaries of Hamilton seemed to have been able to appreciate the "Lectures"; but he himself used to relate how, as he laboriously read through the first six, he began to despair of his own powers. There seemed to be such diffuse discussion, and withal so little apparent progress. But the seventh lecture came like a transformation scene. Every page displayed new beauties, every paragraph disclosed the marvellous power and variety of the method. From it Tait drew his inspiration, and proceeded to enlighten the world as to the meaning and purpose of the quaternion.

To the student who has grasped the essentials of the method Hamilton's second volume, the "Elements," will always prove a happy hunting ground; but experience has shown that its very completeness acts as a deterrent. In the much smaller treatise written by Tait, the important practical aspects of quaternions are more rapidly though less logically developed, and the chief value of Tait's work lies in his characteristic treatment of dynamical and physical problems. It has been long felt, however, that a good working manual of quaternions was needed, by use of which the mathematical student could come quickly into touch with all that is essential in the calculus. This is what Prof. Joly has endeavoured to supply.

For reasons clearly explained in the preface, the author has (reluctantly, he confesses) forsaken the Hamiltonian approach. Instead of developing the calculus logically from the definition of a quaternion as the ratio of two vectors, he defines independently the quantities $S\alpha\beta$ and $V\alpha\beta$, and then writes the product $\alpha\beta$ as equal to the sum of these two. The student must, of course, take on trust that there is some good reason for defining $S\alpha\beta$ as *minus* the product of the length of one vector into the length of the projection of the other upon it. This is, at root, the peculiarity of Hamilton's system which troubled O'Brien nearly sixty years ago, and has not ceased to trouble occasional critics since. There is a kind of notion hovering about in some minds that the positive sign in algebra is more natural than the negative sign, the truth being, of course, that the one necessarily implies the other. It is to be feared, however, that this apparently arbitrary assumption of the negative sign in translating $S\alpha\beta$ into ordinary trigonometrical notation (Clifford calls it a *convention*) will puzzle many a student. Prof. Joly soon gives the reason for the negative sign, though not quite so definitely as might be desirable; but it is questionable if its full significance will be appreciated until considerable progress has been made in acquiring quaternionic skill. The reader is advised to exercise a strong faith, and to proceed nothing fearing. If he persevere he will soon get out of the valley of the shadow of the negative sign.

It is possible that some critic may regard this forsaking of Hamilton's logical basis as a confession of weakness. But this is not so. The weakness is in the average student, for whom a somewhat simple intellectual diet must be prepared in the hope that the mental digestion may be strengthened sufficiently to assimilate the strong Hamiltonian food which Prof. Joly serves up a little later. The truth is that very few students are able to appreciate to the full an absolutely logical argument until they have a certain amount of practical knowledge imparted to them more or less by authority.

So far as the *principle* of the method is concerned, Prof. Joly ranges himself at first on the side of those vector analysts who neglect the quaternion. But it is only for a couple of pages at the beginning of chapter ii. On p. 8 the important formula

$$(\alpha\beta = S\alpha\beta + V\alpha\beta)$$

is introduced as a definition of the quaternion, and the quaternion is never afterwards lost sight of. Its fundamental importance and analytic value are in evidence on every page. It must be admitted that by this line of approach the reader is rapidly brought into touch with the essential elements of the subject. There is, nevertheless, a certain arbitrariness which is not satisfying to the mind, nor is it clear when all is done what is really fundamental. A critically minded student might possibly be inclined to say, Why not define $S\alpha\beta$ as *plus* the product of the lengths of the vectors into the cosine of the angle between them, and then define the quaternion $\alpha\beta$ by the formula $V\alpha\beta - S\alpha\beta$? At first sight it seems to amount to the same thing, and yet, as will be found on trial, it leads to a system clothed in quaternion garments, but more like the fabulous ass in the lion's skin than the real lion.

Having thus established in chapter ii. the fundamental properties of the quaternion, Prof. Joly rapidly runs over certain important transformations of vector products and ratios (chapters iii. and iv.), and simple applications to the geometry of the straight line, plane and circle (chapters v. and vi.). Then follow, treated in separate chapters, differentiation, linear vector functions, quadric surfaces, and the geometry of curves and surfaces. Here the *power* of the calculus asserts itself strongly. Numerous examples are supplied throughout for the student to work upon and develop his analytical skill. In subsequent chapters dynamical problems of various kinds are taken up—such as astatic equilibrium, screws and wrenches, strains, central forces, constrained motion, motion of a rigid body, and the like. A valuable and well arranged chapter on the operator ∇ treats of heterogeneous strain, spherical harmonics, hydrodynamics, elasticity, electromagnetic theory, and wave propagation generally. The

treatment is by no means superficial, and is in many places highly condensed. It is all done in forty-two pages, a remarkable testimony to the compactness of quaternion notation and the brevity of quaternion proofs. In chapter xvii., on projective geometry, Prof. Joly gives his own interesting extension, in which a new interpretation is assigned to the quaternion, and he concludes in chapter xviii. with quaternions generalised so as to be applicable to space of any number of dimensions.

There can be no question as to the high merits of the "Manual of Quaternions." It is a worthy companion volume to the master's own great works. Like the "Elements" of Hamilton and the "Elementary Treatise" of Tait, it is characterised by the extraordinary range of mathematical subjects which come within its scope. It is not merely the substitution of one symbol for three or one for four which makes this condensation possible, for that, after all, is a question simply of notation. But the quaternion calculus rejoices in the possession of two remarkable operators, the linear vector function ϕ and the vector differentiator ∇. They operate singly and in combination according to laws which naturally evolve themselves from the fundamental laws of the calculus. They can be linked together in an endless variety of ways, and go far to give to Hamilton's quaternions a flexibility, power, and pictorial compactness not possessed by any other general method which is directly applicable to problems of mathematics pure and applied. These features are exquisitely brought out in Prof. Joly's "Manual." C. G. K.

SOME MEDICAL WORKS.

(1) *New Methods of Treatment.* By Dr. Laumonier. Translated from the second revised and enlarged French edition, and edited by Dr. H. W. Syers. Pp. xvii+321. (London: Constable and Co., Ltd., 1904.) Price 7*s.* 6*d.* net.

(2) *The Surgery of the Diseases of the Appendix Vermiformis and their Complications.* By W. H. Battle and E. M. Corner. Pp. xi+208. (London: Constable and Co., Ltd., 1904.) Price 7*s.* 6*d.* net.

(3) *Clinical and Pathological Observations on Acute Abdominal Diseases.* (The Erasmus Wilson Lectures, 1904.) By E. M. Corner. Pp. 98. (London: Constable and Co., Ltd., 1904.) Price 3*s.* 6*d.* net.

(4) *A Short Treatise on Anti-Typhoid Inoculation.* By Dr. A. E. Wright. Pp. x+76. (London: Constable and Co., Ltd., 1904.) Price 3*s.* 6*d.* net.

(5) *The Suppression of Tuberculosis.* By Prof. E. von Behring. Authorised translation by Dr. Charles Bolduan. Pp. v+85. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 4*s.* 6*d.* net.

(1) EVERY year a multitude of substances, chiefly synthetic, is introduced, every one being extolled as a certain cure for this or that ailment. By good fortune one of them is now and then found to be of real value, and for a time at least finds a place in the "aramentaria medica," but the majority in a year or two pass into oblivion. Similarly new modes of treatment come and go, most of them being of little worth. But the medical practitioner is expected to know of all these medicinal substances and vagaries of treatment, and must be prepared to employ any one of them at the suggestion of some faddist who happens to consult him. From this point of view the first book on our list may be a useful guide, but otherwise one would be inclined to ask, *cui bono?* Some of the substances included in the volume are by no means new, *e.g.* thyroid, guaiacol, and the antitoxic sera, while others which have a greater claim to novelty, and are, moreover, of real value, such as aspirin, acetozone, urotropine and cystamine, and purgen, are omitted. In dealing with tetanus antitoxin, no mention is made of injection into the spinal cord or nerve trunks. As regards phosphorised principles, lecithin, glycerophosphates, &c., which have of late been extolled in wasting diseases and nervous affections, the administration of a couple of eggs a day would probably be of far greater benefit than any of the medicinal preparations of these substances.

(2) Messrs. Battle and Corner give a succinct account of the anatomy, pathology, symptoms, and treatment of that common and fashionable malady appendicitis which may be safely recommended as a guide for the medical practitioner. The origin and function of the vermiform appendix are discussed, that little blind tubular appendage of the bowel inflammation of which gives rise to so much trouble. The appendix has usually been regarded as a vestigial structure and useless in function, but the researches of Mr. R. Y. A. Berry, of Edinburgh, suggest that it is a specialised mass of lymphoid tissue which the authors conceive may serve as a defensive mechanism against bacterial invasion in a portion of the bowel where, for anatomical and other reasons, there is a delay in the passage of the intestinal contents onwards, and special protection is therefore required against the absorption of bacterial products.

(3) This work is based on material collected in compilation of the Erasmus Wilson lectures, 1904. The author states that the main object of his lectures was to direct attention to the identity of the pathological changes concerned in the production of all acute perforative and gangrenous processes of the alimentary tract. He suggests that two extremes of tissue death or necrosis may be recognised, viz. that due to deprivation of blood and that caused by the action of micro-organisms. Between these two there are various grades and admixtures; the former is slow in action, the latter very rapid, and it is this which plays so important a part in abdominal necrosis. The work is practically a collection of notes, but is interesting reading.

(4) Prof. Wright has done well to collect into a single volume the various papers, with amplifications, he has from time to time contributed to various journals on the subject of anti-typhoid vaccination. The method of preparation of the vaccine, theoretical and practical considerations as to its use, and statistics of its value are all considered. With regard to the last named, it must be mentioned that some controversy has taken place in the medical Press as to

the validity of Prof. Wright's conclusions from the statistical evidence.

(5) This little book should be in the hands of every hygienist, and, since it deals largely with bovine tuberculosis, of every scientific stock owner. Behring is one of those who not only disbelieves the dictum of Koch of the essential distinction between human and bovine tuberculosis, but goes to the other extreme, and asserts that "the milk fed to infants is the chief cause of consumption," and he would insist on the pasteurisation of all milk. He asserts that pulmonary tuberculosis (phthisis or consumption of the lungs) is not an infection from inhaled tubercle bacilli. Besides pasteurisation, Behring also recommends the use of formalin as a preservative of milk, a procedure which will probably not commend itself to the authorities here, though there is a good deal to be said in its favour. Finally, he describes a method of vaccinating cattle against the tubercle bacillus by the aid of which he hopes eventually to stamp out bovine tuberculosis, and as a consequence human tuberculosis, a consummation devoutly to be hoped for. R. T. H.

THE PIONEERS OF GEOLOGICAL THOUGHT.

Karl Ernst Adolf von Hoff, der Bahnbrecher moderner Geologie. By Dr. Otto Reich. Pp. xvi+144. (Leipzig: Veit and Co., 1905.) Price 4 marks.

THIS clearly written work, undertaken with a just enthusiasm, is a welcome and permanent contribution to the biography of scientific men. Von Hoff's position as an original thinker is at least equal to that of Lyell, though both writers, of course, found notable *Bahnbrecher* before them, in Hutton, Desmarest, and others. Karl von Zittel, in his "Geschichte der Geologie," held the balance very wisely between von Hoff and Lyell when he wrote, "The third volume (of von Hoff's "Geschichte der . . . natürlichen Veränderungen der Erdoberfläche") is clearly influenced by Charles Lyell's first volume of the 'Principles of Geology,' which had appeared in the meantime. Von Hoff unreservedly adopts the point of view of the great British investigator; yet Lyell's views corresponded on the whole with what von Hoff had put forward ten years before as the result of his historical researches. The fact that von Hoff's meritorious work was not properly valued, and was put in the shade by Lyell's epoch-making book, which appeared almost simultaneously, is easily explained by the circumstance that the modest German man of science derived his material mainly from books, that his position did not allow him to examine in the field the questions which he discussed, and that he enriched science by no new facts; he faced his problem as a historian, and not as an observer."

Let us frankly admit, on the British side, that Lyell was not among the great original observers, and that his eminence rests on his brilliant perception of the meaning of correlated facts; yet his energy of movement and his frequent travels gave him an immense advantage over his contemporary. Dr. Reich shows us how von Hoff was occupied in many other affairs while preparing himself for his "Geschichte," a work of immense originality, and free indeed from the prejudices of his day.

In 1788 von Hoff entered the University of Jena, in his native region of Thüringia, and proceeded after two years to Göttingen. Here he found inspiration in the character and friendly help of Blumenbach; but his professional work lay in diplomacy, and in 1791 he was appointed Secretary of Legation under his own Government of Gotha, where his father was already a Privy Councillor. As in France, the scientific renaissance was accompanied by national movements that might well have extinguished private calm and study. Von Hoff was one of the delegates who, in 1806, pursued Napoleon's court from Berlin to Posen, and who secured the entry of Gotha into the saving grace of the Confederation of the Rhine. True to the interests of his State, he bore greetings to Jerome of Westphalia two years later, and helped to steer Gotha again into safe waters, this time under a German ægis, when Leipzig had seen the downfall of his alien suzerain. Yet, amid all the excitement of the times, when princes scampered rabbit-like from hole to hole, von Hoff founded a geological journal in 1801, met Werner in Gotha, and was struck by his mental limitations, spoke and corresponded heartily with Goethe, and explored the Thüringian Forest in a number of geological excursions. In the sanguinary year of 1806 he encountered Humboldt in Berlin, and the diplomat of Gotha was describing his native woodlands when the echoes of Friedland spread dismay through Germany.

In 1822 the first volume of his famous "Geschichte der durch Überlieferung nachgewiesenen natürlichen Veränderungen der Erdoberfläche" appeared from the house of Justus Perthes in Gotha; and Dr. Reich does well to press the claims of this work as the foremost and most rational attempt to free geologists from their popular catastrophic school. Dr. Reich (p. 107) quotes from Blumenbach to show that Hutton's views had spread to Germany in 1790, and that Voigt of Jena had already prepared the way by prior and independent conceptions of his own. Von Hoff surpassed Hutton in urging the power of existing causes working through long periods of time. This position had been reached by him as early as 1801 (p. 111), and his biographer is inclined on this account to accuse Lyell of overshadowing wilfully his predecessor. It is idle, however, to quote from the edition of the "Principles of Geology" issued in 1872 (p 131), in which numerous alterations and additions had led to much excision. Instead of the solitary quotation from von Hoff referred to by Dr. Reich in support of his contention, we find five references in the first edition of vol. i. (1830), and two more in the second edition of vol. ii. (1833). Five references, moreover, to von Hoff remain in the eighth edition of the "Principles," issued in one volume in 1850. Since Lyell in his first edition devoted nine pages to the views of Hutton, out of the seventy given to the history of geology, he can hardly be said, as Dr. Reich would have us believe, to have shown ingratitude to Hutton also.

In 1826, in a memorial notice of Blumenbach, von

Hoff proved how far he was prepared to go in accepting organic changes as the result of changes of the earth's surface. Side by side with a progressive development of the surface-features, he saw the necessity for a transformation in the nature of the organic world. The quotation given on p. 134 may not imply so much as Dr. Reich reads into it; but we are grateful to him for setting before us the absolute mental pre-eminence of von Hoff in the world of Continental geologists of his day, and the fact that, from one cause or another, no conception of his greatness and originality can be gained from the historical *résumé* of Lyell, with which all English readers are familiar. G. A. J. C.

MINE AIR.

The Investigation of Mine Air. By Sir C. Le Neve Foster, F.R.S., and Dr. J. S. Haldane, F.R.S. Pp. xii+191; illustrated. (London: Charles Griffin and Co., Ltd., 1905.) Price 6*s*. net.

SINCE the Hon. Robert Boyle published in 1671 his essays on "The Temperature of the Subterraneall Regions" and on "The Strange Subtilty of Effluviums," and Athanasius Kirscher devoted a chapter of his "Mundus Subterraneus" (1678) to the occurrence of inflammable gas in the Herrengrund copper mines, there has been a constant succession of memoirs dealing with the gases met with in mines. The latest addition to the series, by making accessible the results of German, French, and British investigations, should do much to add to the knowledge of the composition of mine gases and of their influence on human life. A large portion of the work was left in manuscript by Sir Clement Le Neve Foster at the time of his death, and such revision as was necessary has been undertaken by Dr. J. S. Haldane, who has added a section of great value, embodying a description of rapid methods of analysis that he himself has devised and an essay on the interpretation of mine-air analyses in the light of recent investigations.

The book is of a composite nature. The first section is a translation of the introductory treatise on mine-air analysis by Prof. O. Brunck, of the Freiberg School of Mines. The second section is a translation of a paper by Mr. Léon Poussigue on the measurement of air currents and fire damp at the fiery Ronchamp collieries, the deepest mines in France. The third and longest part contains a summary of Dr. Haldane's work on the examination of mine air. As an appendix is added a detailed account, from Sir Clement Le Neve Foster's reports to the Home Secretary, of the effects of carbonic oxide in connection with the Snaefell mine disaster in the Isle of Man in 1897. Sir Clement's exposure to carbonic oxide during the recovery of the bodies of the miners killed was the starting-point of the illness that ultimately proved fatal.

The methods of analysis for mine gases described by Prof. Brunck are simple, and in no respect less accurate than the most delicate methods of exact gas analysis. The fulness of the instructions and the simplicity of the methods should induce mining engineers to practise gas analysis and to regard it as an important guide to the safety of the workings placed under their charge.

Since November, 1891, a special department has been organised at the Ronchamp collieries for the purpose of determining the proportion of fire-damp in the workings. The Le Chatelier combustion apparatus is employed, and an assistant makes two hundred determinations a day.

In the third section the methods of determining oxygen, carbonic anhydride, nitrogen, and fire damp described by Dr. Haldane well fulfil the practical requirements of being very accurate and rapid. His method of obtaining and transporting samples of mine air in two-ounce stoppered bottles is trustworthy and much more convenient than Poussigue's method of using a 1½-litre bottle, or Winkler's method of using a 10-litre sheet-zinc vessel recommended by Brunck. One cannot help thinking that in the latter case prolonged storage in a zinc vessel would have an effect on the composition of the gas. In Dr. Haldane's dry bottles no sensible alteration of the contained sample occurs within a fortnight or more. His method of gas analysis is similar to that originally described by him in the *Journal of Physiology* in 1898; and he now describes for the first time a portable apparatus, enclosed in a wooden case measuring 7 by 12 by 2½ inches and weighing 5½lb., by means of which accurate determinations may be made, on the spot underground, of various impurities in the air. He also describes a convenient method of determining the quantity of stone-dust in the air of working places in metalliferous mines. The disastrous effects produced by the habitual inhalation of air containing stone-dust are now generally recognised. The air of an "end" or "rise" just after blasting contains large quantities of dust, and the men ought not to return until there is less than 1 milligram in 10 litres of air. The average air of a "stope" where men are working should not yield any weighable dust in that quantity of air.

Obviously a complete analysis of mine air is useless unless the significance of the results is understood. The chapter on the interpretation of mine-air analyses is consequently of far-reaching importance. Dr. Haldane advocates the use of the convenient term "black damp" for the nitrogen and carbonic anhydride. It is the gaseous residue resulting from the slow oxidising action of air on oxidisable substances in a mine. It is very commonly confused with carbonic anhydride, but it really consists chiefly of nitrogen. Black-damp, which was nothing but pure nitrogen, was described by Mr. H. A. Lee (*Proc. Colorado Scientific Society*, vol. vii., p. 163, 1904) as occurring in a metalliferous mine in Colorado. A useful section on the effects of air impurities on men concludes part iii. Much of the information in this part has already been published by Dr. Haldane in Home Office reports and in papers read before the Institution of Mining Engineers; but an authoritative summary of the results arrived at is a welcome addition to technical literature.

The book, which was originally intended for Le Neve Foster's students at the Royal School of Mines, should prove invaluable, not only to mining engineers at collieries, but also to those engaged in metalliferous mines. B. H. B.

AN INDIAN GARDEN.

An Indian Garden. By Mrs. Henry Cooper Eggar. Pp. viii+181; illustrated. (London: John Murray, 1904.) Price 7*s.* 6*d.* net.

AN unpretentious little book, written in an easy vein, printed on very light paper and in the best of type, "An Indian Garden" might well be suited to while away pleasantly an idle hour. There is so much freshness about the book, so much enthusiasm for the author's garden, such a lovable unconsciousness of the inward triviality of the hundred and one little incidents, servant, cobra, and dog stories and harmless gossip woven into this tale of amateur gardening, that one would fain make the personal acquaintance of the writer. As we read on, our interest centres more and more in the healthy, vigorous, and amiable personality that sways this old Indian Garden of 5½ acres, whilst the garden itself, with its old trees, its amaryllis and caladium beds, its fernery, its obstreperous lawn of "Dooba" grass (*Cynodon Dactylon*), and its general propensity to run back to jungle, becomes so much background.

In those circumstances one forgets to look out for any systematic information on the conditions of gardening in India, nor is there any room for criticising seriously the author's botany. One does not stop, for instance, to ponder over the curious "almond tree" (p. 43) with the convolute embryo, or mind that the lycopodium (p. 50) "that turns a beautiful electric blue in the shade" is in reality a Selaginella (*S. uncinata*), or that the deodars (p. 141) which ripen their berries in July are evidently the debdars (*Polyalthia longifolia*) mentioned repeatedly in the earlier pages. It must all be beautiful, and one longs to see it.

We are not told where the garden is. Its whereabouts, like other things in the book, are hidden under a delightful incognito. It is just a few feet above the sea in a vast plain "with never a rise, sufficient to be called a hill anywhere near for 100 miles." It may be, and very likely it is, in Bengal, as the locality from which the preface is dated and other indications suggest; but that, again, matters very little. It is in keeping with the light, playful humour which pervades the whole book. Still, it would be unfair to pass over the fact that there are passages in it which for keenness of observation, terseness and descriptive power, rise high above the average level of the book. Thus on p. 41, "I like the Casuarinas, though they are bad gardeners, and suck up all the moisture in the earth for some long distance round their roots, so that nothing can possibly live near them; sometimes in the early morning they weep it all back copiously like rain"; or on p. 145, "If one wanted to photograph the movements of an opening blossom, one should select the *Crinum augustum*. It is a noble plant, this lily; about 4 feet high, with scented flowers, numbering 22 in a bunch at the end of a long stalk as thick as a ruler. I passed by one just after a shower of rain this evening, and noticed that four or five of the 4 inch long, pink-striped buds were just ready to open. I came by again shortly after, and lo! and behold! they *were* open, quite wide open, too. In my next turn, 20 minutes after, the long petals had entirely curled themselves backwards like rams' horns. One could see them all a-quiver with the intensity of the movement still. In one hour the points of those petals must have described an arc of 8 or 9 inches or more!"

There is a dainty coloured frontispiece representing a branch of an Antigonon (evidently *A. leptopus*)—though it is difficult to see why a representative of an exclusively American genus should usher in "An Indian Garden"—and eighteen illustrations, photographic prints, some of them veritable gems for their general beauty and exquisite clearness.

OTTO STAPF.

OUR BOOK SHELF.

Animals I Have Known. By A. H. Beavan. Pp. 304; illustrated. (London: T. Fisher Unwin, 1905.) Price 5*s.*

IF the present rate of issue be much longer maintained, popular books on mammals (or "animals," as they are still called by the man in the street) will soon begin to rival in number those devoted to birds. In the volume before us the author, without having anything specially new to communicate, discourses pleasantly enough on the mammals (both wild and domesticated) of our own islands, as well as on those of two other countries, namely, Australia and South America, with which he is personally familiar. His anecdotes and descriptions are emphasised by the numerous reproductions from photographs with which the work is illustrated. Most of these are first rate, the one of the thylacine, or Tasmanian wolf, showing to perfection that gradual merging of the tail in the body to which the author specially alludes, and which so markedly distinguishes many of the lower mammals from their more specialised relatives.

Unfortunately, the text is marred by a number of more or less inexcusable blunders and errors, which cannot but deceive the class of readers for whom the book is intended. On the very first page we are told, for instance, that there lived in Britain during the mammoth period "tapir-like three-hoofed creatures with long snouts." This can evidently be nothing else than the Oligocene palæotherium, an animal to which reference is again made on p. 279, where the author observes that he has momentarily forgotten its name—a nice admission to make in print! A similar "muddle" in regard to palæontological chronology is made on p 16, where we find opossums included among the British Pleistocene fauna. Even more serious is the deliberate statement on p. 222 that the duckbill, or platypus, is the only known oviparous animal—more especially in view of certain doubts that have been expressed of late years as to whether this species does actually lay eggs. Again, on p. 291 we are told that all South American monkeys are furnished with prehensile tails, while ten pages later we are informed that the vampire bat taps the blood of its victims with its canine (instead of incisor) teeth. Moreover, in the plate on p. 299 the author figures as that of the true blood-sucking vampire the head of a javelin-bat (Phyllostoma) or a nearly allied species. Possibly the latter species may occasionally suck blood, but it is not the vampire *par excellence*. In the figures of a bat on p. 91, which

may be presumed to be intended for the pipistrelle, the tail is entirely omitted, so that there is nothing to support the median extension of the interfemoral membrane! The following remarkable sentence (p. 202), we are glad to acknowledge, is not typical of the author's style:—"The koala's habits are sluggish, and though able to climb well, moves about the trees in a most deliberate manner." R. L.

Queen-Rearing in England, and Notes on a Scent-producing Organ in the Abdomen of the Worker-Bee, the Honey-Bees of India, and Enemies of the Bee in South Africa. By F. W. L. Sladen. (Houlston and Sons, 1905.)

THE scope of this little work by a practical bee-keeper is sufficiently indicated by its title, and the bulk of its contents has already appeared in the British *Bee Journal* and the *Entomologist's Monthly Magazine*. There is a coloured frontispiece representing the queen and worker of the Golden Italian bee, and there are numerous text-illustrations of no remarkable excellence After a chapter on queen-rearing in nature, several chapters are devoted to the best artificial means of securing a supply of queens for multiplying or improving bee-colonies; and a brief account is given of different races called the Italian (or Ligurian) Bee, the Golden Italian Bee, and Carniolan Bee, and the Cyprian Bee. In a later chapter Mr. Sladen remarks that when vibrating their wings, and especially when swarming, bees produce a peculiar tune which has been supposed to attract their comrades; but the author thinks the attraction is at least partly due to a powerful scent emitted when a membrane situated between the fifth and sixth dorsal segments of the abdomen is exposed. This is fully described and figured. Short chapters on the honey bees of India (*Apis dorsata, florea,* and *indica*), and on enemies of bees in South Africa; "Bee Pirates" (sandwasps belonging to the genera Palarus and Philanthus), a Tachinide parasite in the abdomen; and a species of Chelifer conclude the work.

Physical Experiments. By N. R. Carmichael. Pp. xi+127; with diagrams. (Kingston, Ontario: R. Uglow and Co., 1904.)

ANYONE drawing up an elementary course of mechanical and physical experiments, and wishing for a manual to accompany it so as to make the preparation of a special volume unnecessary, could hardly do better than adapt his course to the manual before us. It contains just the short description which would otherwise be produced by some copying process for distribution to a class, or, failing this, would probably be written on a blackboard. That is to say, there is just enough description to indicate to a pupil what he is expected to do, and which would be copied by him into his notebook. A teacher will require to amplify the book verbally, either in the course of a short demonstration at the beginning of the class, or, if his lectures and the practical work run together very well, this might sometimes be done in the course of the lectures. The aim that Mr. Carmichael has had before him has been to state concisely the nature of the quantity to be measured in each experiment and the theory underlying the method suggested. Descriptions of instruments are entirely omitted, as the students are expected to have the apparatus given them by an instructor.

With regard to the selection of experiments, the object has been to give students who have but a limited time for laboratory work a practical acquaintance with as many physical quantities as possible. The fact that the author is a teacher in a school of mining is a guarantee that the technical student is intended to be served; but it is the more academic, but equally necessary, side of his training that is here catered for.

An Introduction to Elementary Statics (Treated Graphically). By R. Nettell. Pp. 64. (London: Edward Arnold, 1905.) Price 2*s*.

THIS book consists of a set of graduated exercises in graphical statics. The first seventy, about half the total number, are restricted to problems on the equilibrium of three forces at a point, and are intended to be worked by means of the parallelogram of forces. In succeeding problems the triangle of forces and the polygon of forces are introduced. The principle of moments is also employed. A few examples are given of the determination of the centre of gravity of simple plane figures, and in the final examples the subject is carried as far as the equilibrium of four non-concurrent forces in one plane. The link polygon is not used, so that parallel forces are scarcely referred to. It will be seen how extremely limited is the ground covered by this book. The constructions are not founded on or verified by experimental work of any kind. No vectors other than force vectors are introduced. Trigonometrical calculations, even of the simplest kind, are rigidly excluded. The book is intended to be used by classes of young boys, but its scheme does not harmonise with the ideas now prevalent as to the way in which elementary mathematics should be taught to youths.

The Elements of the Differential and Integral Calculus. By D. F. Campbell. Pp. x+364. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1904.) Price 7*s*. 6*d*.

THIS book seems well adapted to serve as a text-book for a first course in the differential and integral calculus. Fourteen chapters deal with the differential calculus and its applications to maxima and minima values, expansions in series, and the geometry of plane curves. The fundamental ideas of integration are very fully explained, the second fourteen chapters being devoted to the integral calculus and its application to finding plane areas, lengths of curves, areas of surfaces, and volumes. In a short chapter dealing with approximate integration, the first and second elliptic integrals are introduced, and three-figure tables for $F(k, \phi)$ and $E(k, \phi)$ are given. A few elementary chapters on mechanics have been introduced, so that the student may be able to view from the mechanical, rather than from the purely mathematical, side the principles of attraction, centre of gravity, and moment of inertia. Numerous exercises, with answers, are given with each chapter. The diagrams are clear, and the type is excellent.

Völkerpsychologie. By Wilhelm Wundt. Vol. i. Die Sprache. Second revised edition. 2 parts. Pp. xv+667, x+673. (Leipzig: Wilhelm Engelmann; London: Williams and Norgate, 1904.) Price 14*s*. net and 15*s*. net; bound, 17*s*. net and 18*s*. net.

THE first volume of this monumental work has reached a second edition, some sixty or seventy pages bulkier than its predecessor (reviewed in NATURE on January 16, 1902). The most important changes affect the fourth chapter, *Der Lautwandel*, the sixth, *Die Wortformen*, and some parts of the theory of the sentence. A first edition of the other volumes, dealing with myth and custom, has not yet appeared; it is to be hoped that it will not be unduly delayed by the necessity of revising the present instalment, and that in any parts still to appear the wood will be less closely concealed by the trees.

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.]*

History of a White Rhinoceros Skull.

IN his interesting "Natural History Essays," in which occurs the description of the white rhinoceros, Mr. Graham Renshaw makes the following reference to the first skull of this animal which was brought to England :—

"It would be interesting to know if the white rhinoceros head brought to England by the Rev. John Campbell, about 1815, is still in existence. It appears to have been preserved as late as 1867 in the Museum of the London Missionary Society at Finsbury, but there seems to be no mention of it during recent years in zoological literature. In a figure now before me the artist has absurdly furnished the open jaws with an imaginary series of perfectly regular pseudomolar teeth: the square mouth has been distorted to resemble the prehensile lip of the black species, though the slit-like nostrils, position of the eye and semi-tubular ears are delineated with fair correctness. The anterior horn of this individual is said to have been 3 ft. long: and, *as figured*, from its slender-

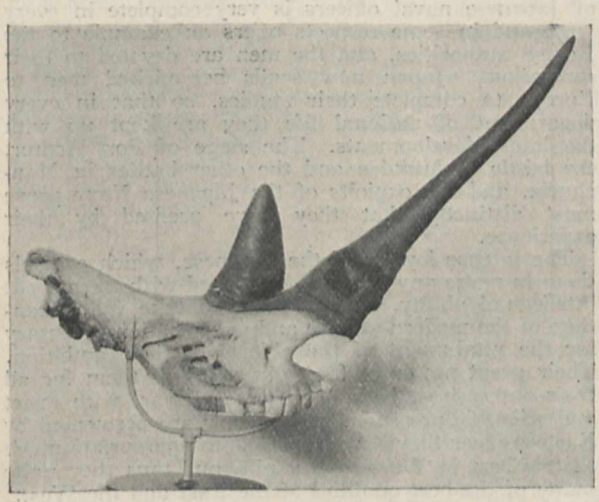

FIG. 1.—Skull of the White Rhinoceros in the American Museum of Natural History.

ness recalls Col. Hamilton Smith's description of the mysterious horn, brought from Africa, from which he sought to deduce the existence of a true unicorn in the interior of that Continent" (p. 146).

In 1902 this very skull was purchased from Mr. Cecil Graham for the American Museum of Natural History by Mr. J. Pierpont Morgan. Mr. Graham has made a large and valuable collection of rhinoceros horn weapons, clubs, knob-kerries, and battle axes, and in course of correspondence he wrote of his discovery of the skull as follows :—"There is no record as to how or when the specimen was first brought to England. I found it by chance a few years ago in the City, lying neglected and dirty on the floor of a back room of the London Missionary Society. No doubt it was presented by a missionary before 1821. I especially value the letter dated 1821."

The letter referred to by Mr. Graham is from William Cooke, of the Royal College of Surgeons. It is dated November 20, 1821, and addressed to William Alers Hankey, Esq., Fenchurch Street. It reads as follows :—

"My dear Sir,

"The head in the missionary museum supposed to be the head of the unicorn, appears to belong to a species of Rhinoceros previously unknown in this country, at least, there is no such specimen in the Hunterian Museum which may be regarded as the National Depository for comparative anatomy. In that grand collection there are heads which nearly resemble it, but there are points in which the diversity of conformation indicates a decided *specific* difference.

"Permit me to suggest to you, and through you to the Directors of the Missionary Society, that a rare specimen of that nature is entitled to a place where it can be more justly appreciated than it ever will be in their collection. I need not suggest to you the advantages which result from a concentration of the different productions of nature —from bringing under one view the genera and species of the various natural sciences—especially when they are not only rendered available for minute distinction, but by a liberal policy are accessible to men of science from all parts of the world. I can have no selfish motive in suggesting that the head possessed by the Missionary Society would become much more an object of interest if deposited in the Hunterian Museum, than it ever will be should it remain in the Old Invry. If deposited at the College of Surgeons it will not only fall under the notice of Naturalists from all quarters, but it will likewise be a subject of reference in the lectures on comparative anatomy annually delivered at that Institution.

"The Missionary directors unquestionably will consider the advantages which may result to their own Society, as well as the promulgation of scientific knowledge; and if I might presume to express an opinion on this subject, it would be in favour of the head being presented to the College. It would there be preserved as a testimony of praiseworthy liberality—it would soften prejudice, where perhaps there is a deep-rooted antipathy to religion, but where conciliation is of great importance; and if it remain in its present situation for a few years it will be liable to destruction, or to essential injury at least.

"If you have never seen the Museum of the College of Surgeons it would afford me great pleasure to accompany you thither any Friday.

"I feel assured, my dear Sir, that you will excuse the liberty I have taken in addressing you on this topic;—and believe me to be

"Yours most obediently and
"respectfully
"(signed) WILLIAM COOKE."

In spite of this appeal, the skull evidently remained in the possession of the Missionary Society until Mr. Graham rescued it from oblivion. Although the occipital portion has been sawn off, it is a remarkably fine specimen, as shown by the accompanying photograph. The nasal horn is firmly attached to the skull; the frontal horn is detachable, but readily fits in place. The principal measurements are as follows :—

Total length of skull, along top	.. 778 mm.	= 30⅝ inches
Length of grinding series	287 ,,	= 11¼ ,,
,, frontal horn	280 ,,	= 11 ,,
,, nasal horn	890 ,,	= 35 ,,

(Measured on a straight line.)

The skull is now exhibited with two war clubs manufactured from the nasal frontal horns of the white rhinoceros, with a skull of the related woolly rhinoceros from Siberia, presented by the Moscow Museum, through Madame Pavloff, also with a skull of the *Rhinoceros pachygnathus*, a related or ancestral form, from Pikermi, presented by the Munich Museum through Prof. von Zittel.

HENRY FAIRFIELD OSBORN.

American Museum of Natural History, New York, April 24.

Fictitious Problems in Mathematics.

YOUR reviewer gives a new definition of "a perfectly rough body" (NATURE, June 1), which he says is that of the mathematician. The definition appears to me to contradict what he has elsewhere said. But I need not enlarge on this point, for his criticism of a problem should be tried, not by his definition, but by that given in the book in which the problem occurs.

The reviewer accuses Cambridge examiners "of endowing bodies with the most inconsistent properties in the matter of perfect roughness and perfect smoothness"

(NATURE, April 27). He adds, as an explanation, that "the average college don" forgets an elementary law of friction. But the proper inference is that the definition of the reviewer is different from that in common use. It is difficult to believe in this general forgetfulness.

The various letters sent to NATURE sufficiently show what meaning is usually attached to the words.

June 3. E. J. ROUTH.

WHY JAPAN IS VICTORIOUS.

TEN years ago, after the conclusion of the war between Japan and China, it was remarked that the sound of the Japanese cannon at the mouth of the Yalu River awoke the nations of the world to the fact that a new Power had arisen in the Far East which in future would require to be taken into account when any political problems arose. It is, of course, recognised by all who know modern Japan that the most important factor in the making of new Japan has been the applications of science to the arts both of peace and war. Without these, even the spirit of the samurai would have been as powerless before the attacks of Western Powers armed with all the latest warlike appliances, as were the dervishes at the battle of Omdurman. Spectators speak with admiration of the bravery of these men and with pity that their lives were thrown away in a vain resistance. Without the help of science and its applications it is very certain that, before this time, Japan would have been overrun by a European Power after immense slaughter, for the last man would have died, fighting with his primitive weapons, rather than recognise a foreign domination.

A careful study of the evolution of modern Japan shows plans founded on enlightened principles and carried out in every detail. In fact, one of the secrets of the success of the Japanese in the present war is that nothing is left to chance; every detail is worked out and carefully provided for. They soon recognised that their national ideals would never be realised without a system of education, complete in every department, which would supply the men who were required to guide the nation under the new conditions which had emerged. Elementary education was organised all over the country, secondary education in central districts, and technical education wherever it seemed to be required. Above all, there are two national universities which in equipment and quality of work done will bear favourable comparison with similar institutions in any other country in the world.

The educational work of the country was directed not simply to personal or sectional purposes, as is unfortunately too often the case in the West; it was also consciously directed to the attainment of great national ends. Every department of the national life was organised in a rational manner, and, therefore, on scientific principles. In many departments there is still much to be done, but past achievements promise well for the future.

Special attention has been paid by the Government to the applications of science. Without the railways, the telegraphs and telephones, the dockyards, the shipbuilding yards, the mines, and the engineering establishments, the existence of the army and navy would have been impossible; at least, if they did exist they would have been nearly powerless. The operations of the present war with Russia have clearly demonstrated the importance of the introduction of the scientific spirit into all the national activities. The railways which have been built in Japan have been fully utilised to convey men and materials and the ships to transport them oversea. The telegraphs have been used to communicate instructions and to keep the authorities informed regarding movements and requirements. The dockyards and shipbuilding yards have been ready to undertake repairs, and the arsenals and machine shops to turn out war material of all kinds, as well as appliances which aid operations in the field. Light railways have been laid down on the way to battlefields, and wireless telegraphy and telephones to convey instructions to the soldiers; in short, all the latest applications of mechanical, electrical, and chemical science have been freely and intelligently used.

The Japanese have not only modified Western appliances to suit their conditions, but they have also made numerous distinct advances. The ships of their navy are probably the best illustration of the Japanese method of procedure. In naval matters they accepted all the guidance the Western world could give them, but at the same time they struck out a line of their own, and the fleet which they have created is unique in the character of its units. British designs have in many respects been improved upon, with the result that they have obtained in their latest ships many features which have won the admiration of the world. The training of Japanese naval officers is very complete in every way, and in some respects offers an example to the British authorities, and the men are devoted to their profession. Japan now sends her picked men to Europe to complete their studies, so that in every department of national life they are kept up with the latest developments. The siege of Port Arthur, the battle of Mukden and the other battles in Manchuria, and the exploits of the Japanese Navy prove most distinctly that they have profited by their experience.

The intense loyalty of the Japanese, which compels them to make any sacrifice, combined with their great intellectual ability, enables them to take full advantage of the modern science and organisation necessary for the attainment of the objects of their ambition. Their great power of foresight prepares them for all their enterprises, both of peace and war, with exact and scientific precision. While they are permeated by Eastern ideas they have been able to appropriate much that is best in Western thought, and thus they unite many of the best qualities of the East and the West.

The lesson which our educationists and statesmen have to learn from Japan is that the life of a modern nation requires to be organised on scientific lines in all its departments, and that it must not be directed chiefly to personal ends, the attainment of which may, to a large extent, intensify many of our problems, but that it be consciously used for the promotion of national welfare.

But though the lesson is plain enough, apparently it is not understood by those whose business it is to promote national welfare by guidance or counsel. With one consent our newspapers have attributed Japanese success to all reasons except the right one; and, instead of opening the eyes of the nation to our pressing needs and deficiencies, they have been blind leaders of the blind. Our public men and our Press will not see that scientific education has brought Japan to her present position in thirty years, and that, if we choose to educate ourselves, we may arrive at the Japanese standard of national efficiency. The progress which this country has made since the Middle Ages is due to the discoveries of men of science, whose work has been done in spite of discouragement or national indifference. In the new atmosphere of Japan a scientific spirit prevails, which encourages development, with the result that the nation has in a generation arrived at a position which has taken us centuries to reach. It is not compli-

mentary to us as a nation to say that our patriotism, fear of death, or nerves compare unfavourably with similar attributes of the Japanese; and, after all, this is a matter of opinion. The fact to face is the transformation which science has effected in Japan, and the sooner our statesmen are educated to see it, the more promising will be the outlook for the British nation.

SOLAR CHANGES AND WEATHER.

DURING the last few years more than usual attention has been paid to the question of the relationship between sun-spots or prominences and "weather," and to the possibility of being able in the near future to forecast the characters of approaching seasons. Quite recently in this Journal (vol. lxxi. p. 493, March 23) we referred briefly to a pamphlet published by the United States Department of Agriculture, Weather Bureau, summing up the general state of the problem of long-range weather forecasting. In this it was stated that advances in the period and accuracy of weather forecasts depend upon a more exact study and understanding of atmospheric pressure over large areas, and a determination of the influences, probably solar, that are responsible for normal and abnormal distributions of atmospheric pressure over the earth's surface.

In the April number of the *Popular Science Monthly* the question of the relationship between sun-spots and weather is summarised in an article by Prof. Ernest W. Brown, of Haverford College. In this we have an interesting account of the problems waiting solution, and he brings together in a very clear manner a general survey of the relationship, or rather non-relationship, as he concludes to be the case. Thus he says, "it is highly probable that the direct effect of the spotted area is unimportant compared with the effects produced in our atmosphere by other causes." In his final summing up he remarks that his opinion is expressed by Prof. Cleveland Abbe, who stated that:—"The key to the weather problem is not to be found in the sun or indeed in any external influence, but that the solution is to be worked out by the conditions which hold in the atmosphere itself—conditions which can only be discovered by a thorough examination of the internal laws of motion, quite apart from any external forces which may modify the results."

In referring to the difficulties which are met with in examining the meteorological conditions on the earth's surface, Prof. Brown points out that observations made "at one place should be kept separate from those at other places, for it is theoretically possible and even probable that a maximum at one place of observation may occur at the same time as a minimum at another place. For example, the yearly averages might show that a maximum rainfall in one place always occurred with a minimum rainfall in another and *vice versâ*."

In the last quotation Prof. Brown makes a suggestive remark which recent work has shown to be an actual meteorological fact; it has already been completely established for pressure, and must therefore hold good as regards rainfall, since the latter depends on the former.

In the case of these variations of barometric pressure it has been shown, and referred to at some length in this Journal (vol. lxx. p. 177, June, 1904), that there exists a barometric see-saw on a large scale the presence of which has been amply corroborated by Prof. Bigelow, of the United States Weather Bureau. There seems little doubt that it is this pressure change that will eventually prove the "key" to the situation, and its solar origin has already been suggested in the changes in the frequency of prominences, which are, after all, allied to sun-spots.

Up to the present time those who have been attempting to explain variations of weather on the supposition of solar changes have been looking for the effect of solar action as either increasing or decreasing simultaneously the rainfall over the whole earth. The consequence has been that a study of a great number of statistics has shown that in some regions the rainfall varies directly with the number of sun-spots, and that in others the variation is inverse, while, again, in other parts there seems to be no apparent relation at all. In fact, these deductions, though quite correct, have led to the conclusion that the solar connection is of a very questionable character, as it was considered impossible for such opposite results as the first two just named to have their origin in one solar change.

It is the employment of this incorrect working hypothesis that has probably retarded the progress of the study of the connection between solar and meteorological changes.

The now recognised existence of this barometric see-saw shows that the sun's action must have a *double* effect on our atmosphere, and this of an opposite nature. Such a result is quite natural, and it is curious that use has not been made of it before.

When it be considered that the amount of air in our atmosphere is a constant quantity, a greater piling up of it on one side of the earth must necessarily mean a diminution in the antipodal regions. If greater heating power of the sun takes place, then the atmosphere must also be heated to a greater extent, and consequently more intense up-currents of warm air are formed, resulting in more pronounced low-pressure areas. There must, however, be a compensating effect somewhere, and this is found on the opposite side of the earth when the previously heated air arrives, descends, and creates an area of excess pressure.

This backward and forward transference of air becomes, therefore, of great importance in studying the weather changes in any one region, because the rainfall phenomena are so closely related to the pressure changes.

Away from the middle portions of those two large areas which behave in this see-saw manner, the variations of pressure should, and actually do, have a different periodic nature. It is of extreme importance, therefore, when trying to trace the sun's action on our atmosphere, to separate the regions over which the variations may be truly solar from those which exhibit variations modified by the mechanism of the atmosphere itself.

There is therefore no reason why we should take a pessimistic view of the attempts made to solve this fascinating riddle of the relationship between changes of solar activity and the vagaries of the weather. An enormous amount of accumulated material is ready for discussion, and efforts should be made to secure the continuity of these observations and at the same time to coordinate the data along lines most suitable for this particular research.

WILLIAM J. S. LOCKYER.

THE SURVEY OF INDIA.[1]

THE extracts from the narrative reports of the Survey of India for the years 1902–3 are contained in a thin and attenuated volume of some eighty pages, which, as compared with previous reports, represents the effects of Indian financial economy applied to one of its most interesting departments.

1 "Extracts from the Narrative Reports of the Survey of India for the Season 1902–3." (Calcutta: Government Printing Office, 1905.) Price 2*s*. 3*d*.

A committee is now sitting somewhere in India to decide on the best method of increasing the efficiency of the Indian survey department from the point of view (amongst others) of the English expert. It may be doubted whether the Indian surveyor has much to learn from the English expert, excepting in the science of map reproduction; but it may be that the Indian financier will learn therefrom that the way to improve and develop a department is not to starve it under the pressure of each successive spasm of financial depression, but to give consistent support to its work in the field and encourage the publication of such results as are of world-wide interest. Compare this half-starved production with the survey reports of North America, of Canada, of any Continental country, or even with the intermittent publications of South America, and it would really appear as if India offered no field for scientific research that was worth a descriptive record. The report is unworthy of the Government of India.

There is apparently but one triangulation party now existing in India which works on geodetic principles, and this is gradually pushing its network of triangles through Burma, giving a good basis for two topographical surveys to extend their minor triangulations and lay out a framework for detailed mapping. Only these two topographical parties figure in the report, and the narrative of their progress is confined to the dullest of all dull statistics. Yet one of them is working in the Shan States on the Chinese frontier, where, if anywhere in the eastern world, there must be a most delightful field for new experiences and original observation.

Of geographical exploration on or beyond the Indian frontier, or of scientific investigations in the Himalayas, there is not a word in the report; nor, for that matter, is there the faintest reference to the solid work of the revenue and forest surveys which are spread in more prosaic form over half the continent. Possibly there may be much of really stirring narrative rendered by the officers concerned in trans-frontier work to which it is not deemed well to make any allusion. This is comprehensible on the grounds of political prudence, but the worst feature of this form of suppression is that it is apt to be permanent. A report once pigeon-holed in an Indian office might almost as well be solemnly committed to the earth with a spade. The man who wrote it, and who knew what he wrote about, leaves India at the mature age of fifty-five, and thereafter has nothing further to say to it. His opinion is never consulted, and it becomes merely a matter of academic interest to him to watch a new generation of frontier administrators floundering along by the light of experiences gained, let us say, in South Africa or in Egypt. He faintly wonders what has become of all the detailed information of the Indian frontier gathered in his time at the cost of so much labour and expense.

There is, however, doubtless much to be learnt from the series of tidal, levelling, and magnetic tables which take up nearly fifty of the eighty pages of the report, although it is not easy to recognise their claim to be considered narrative. Presumably these tables are published for the benefit of the comparatively few men of science who are interested in these special classes of investigation, but they hardly seem to justify the title of the report, and should certainly be preserved (as they probably are) in other forms more readily accessible for purposes of reference.

There is an account of a local survey (including levelling operations) which was undertaken for the benefit of the salt revenue department in order to ascertain the source of the Sambhar Salt Lake water supply. The result of the investigation would have been interesting had it been stated. The lake was surveyed thirty-eight years ago, and the source of supply carefully examined then. Probably the report was pigeon-holed.

It would be pleasant to congratulate Colonel Longe on the success of his first administrative report as Surveyor-General of India, but, as a matter of fact, it is obvious that hardly even the skirts of narrative have been touched so far as the Survey of India is concerned, and we can only hope that there may be another and a more comprehensive report issued hereafter in some other form. T. H. H.

NOTES.

IT cannot be too often emphasised that Japan owes its triumphs chiefly to the adoption of the scientific spirit as the essential principle of national progress. The State that accepts this axiom of practical politics secures for itself a place among leading nations; while, on the other hand, the country that gives little or no encouragement to science must fall behind in the future. The Paris correspondent of the *Times* states that this view is taken by M. Ludovic Naudeau, who, in the course of a telegram from Tokio on the causes of the Russian defeat, remarks:—"It is now idle to attempt to hide the fact that never was the Russian lack of science, of the modern spirit, or, to speak frankly, of intelligence—never was the absence of training and of enthusiasm which retards the efforts of the whole Empire displayed in a more melancholy fashion than in the Sea of Japan. All the Russian inferiority is in the intellectual sphere." We understand that even in the midst of the war, the subject of education is being keenly discussed in Japan. In our own country it is necessary to urge that satisfactory provision for the future can only be made by taking a wide view of scientific education, and by insisting that all who have the affairs of State under their control should possess such a knowledge of the methods of science as will enable them to understand that the most potent factors of success in the arts of peace or of war are scientific education and research.

UNDER the name of the Potentia Organisation, an international association has been formed with the object of establishing among nations a mutual relationship and cooperation for the diffusion of accurate information and unbiased opinion concerning international events and movements, and to combat narrow, prejudiced, and often interested views and news that contribute so much to international mistrust and misunderstanding. It is proposed to publish throughout the world, through the medium of newspapers and reviews, statements of simple fact and expressions of opinion by eminent public men of all nations on all important political, social, philosophical, economic, scientific, and artistic questions, to present the sincere views of experts on all current international events, and to refute false or biased news and views calculated to spread error and to endanger the peace and progress of the world. A cosmopolitan alliance of this kind should meet with many adherents in the world of science, in which the sole aims are the discovery of truth and the extension of natural knowledge. We trust that the organisation will do something to show that scientific culture is at the foundation of all national progress.

MR. STANLEY GARDINER, leader of the Sladen Trust Expedition for the exploration of the Indian Ocean between Ceylon and the Seychelles in H.M.S. *Sealark*, has sent Prof. Herdman a letter from Colombo (May 7) in which he gives the following provisional programme:—Leave

Colombo May 8, arrive Chagos Archipelago about May 20, and work there until about July 15; arrive Mauritius about August 1, and stay until about August 15; arrive Seychelles about September 8, leave about September 15, and return there on October 15 after visiting the various Amirante Islands. A second steam-launch has been acquired, and Mr. Stanley Gardiner considers that he is now fully equipped for work. The expedition will probably be next heard of from Peros Banhos, which ought to be reached early in June.

A REUTER telegram of June 1 states that a severe earthquake shock was felt in the morning of that day throughout the whole of Montenegro.

WE regret to see the announcement of the death of Mrs. Emma Hubbard, who at various times contributed to our correspondence columns interesting observations on natural history, more particularly on the subject of birds and their ways. Mrs. Hubbard also did useful service to science by indexing scientific works, among them being Sir Michael Foster's "Physiology" and her brother's "Ancient Stone Implements."

THE first International Congress of Anatomists will be held at Geneva, Switzerland, on August 7 to 10. The following national societies are to participate in this congress:—the Anatomical Society of Great Britain, the Anatomische Gesellschaft, the Association des Anatomistes, the Association of American Anatomists, and the Unione Zoologica Italiana. The organisation of the congress has been entrusted to a committee representing these societies, and consisting of Profs. Minot, Nicolas, Romiti, Symington, and Waldeyer. The presidents thus far named are Prof. Sabatier, of Montpellier; Prof. Romiti, of Pisa; and Prof. Minot, of Harvard. The congress owes its successful initiation largely to Prof. Nicolas, of the University of Nancy, to whom inquiries may be addressed.

ON June 1 the Prince of Wales paid a private visit to the Cotton Exhibition at the Imperial Institute, which is being held by the Board of Trade in conjunction with the British Cotton-growing Association. The exhibition, which has been arranged by the scientific staff of the Imperial Institute under the direction of Prof. Wyndham Dunstan, F.R.S., in consultation with Sir Alfred Bateman and Sir Cecil Clementi-Smith, the managing committee of the institute, is intended to show not only the progress of cotton cultivation on British soil, but also to indicate the stages in the conversion of the raw material into the manufactured fabric. Bulk samples of commercial cottons grown in different parts of the Empire are supplemented with small specimens arranged to show the length of staple, and are accompanied by photographs of cotton fields, ginneries, &c., and statistical diagrams and maps. The British Cotton-growing Association, in addition to their raw cottons, exhibit a unique collection of native textiles. The machinery section includes models of Arkwright's machines, a power-loom in operation, and several testing machines. Manufacturing processes are illustrated by specimens and explained by means of diagrams, and samples of goods produced by special processes, including the making of "selvyt," are on view.

THE weather report issued by the Meteorological Office for the week ended on June 3 showed that the rainfall since the beginning of the year had only exceeded the average in the north of Scotland (excess 5·4 inches) and in the north of Ireland (excess 0·8 inch). The greatest deficiency was in north-east England (3·2 inches) and in the midland and southern counties (2 to 2·6 inches). The heavy downpours in the early part of this week will have contributed something towards making up the deficiency, especially in the eastern and southern parts of the kingdom. The *Daily Weather Report* of Monday last showed a great change in the distribution of barometric pressure, there being a steady increase over the northern and north-western districts, and a shallow depression having formed over France. During the twenty-four hours ending at 8h. a.m. on Tuesday, the rainfall was continuous and heavy over the south and south-east of England, amounting to nearly 2 inches at Dungeness, 1·5 inches at Clacton-on-Sea, and to an inch in London, the rain still continuing, practically without cessation, during the whole of Tuesday. The heaviest falls reported for the twenty-four hours ending 8h. a.m. on Wednesday were 0.57 inch in London and nearly half an inch at Oxford and Bath.

THE *Engineering and Mining Journal* records that payable ore has been reached at the New Chum Railway Mine, at Bendigo, Victoria, at a depth of 4262 feet. This is the greatest depth at which gold mining has been carried on. It has, however, been exceeded at the Lake Superior copper mines.

THE plans have been completed for the fifteen-story building, to cost 195,000*l.*, which Mr. Andrew Carnegie is to present to the engineering societies of New York. Adjoining it in the rear will be a thirteen-story house for the Engineers' Club, which is to cost an additional 75,000*l.*, and is also part of Mr. Carnegie's gift.

IN the *Engineer* there is a long and interesting description of the instructive case of models showing the construction of the leading types of expansion and plain slide-valves lately placed on view in the Victoria and Albert Museum. The collection forms a complete record of the progress made in this important branch of steam engineering.

IT is reported in *Engineering* that the world's copper production in 1904 amounted to 613,125 tons, the United States furnishing more than half the total. Great things in the way of copper production are expected from Alaska, where development is being carried on rapidly, especially in Tanana County. In the same journal, attention is directed to an important discovery of tin ore in the Vlaglaagte district of the Transvaal. The world's sources of tin supply are so few that interest must always attach to reported new finds.

WE have received a copy of a paper reprinted from the *Transactions of the Institution of Mining Engineers*, read on January 10, by Mr. James Ashworth, on outbursts of gas and coal at the Morrissey collieries, in the Crow's Nest Pass Coalfield, British Columbia. A huge outburst on November 18, 1904, caused the death of fourteen miners, and it is estimated that some 3,000,000 cubic feet of gas, at atmospheric pressure, were set free by the outburst in thirty-five minutes. Mr. Ashworth suggests that these unusually large outbursts may have some connection with the petroleum occurring in the district.

AT the forty-second general meeting of the Institution of Mining Engineers, held in London on June 2 and 3, several interesting papers were read. Mr. T. Y. Greener dealt with the firing of boilers by waste heat from coke ovens. Mr. M. R. Kirby described the compound winding engine at Lumpsey iron mine. Its steam consumption is only 38 lb. to 40 lb. per indicated horse-power hour. Mr. F. Hird gave the results of tests of the electric winding engine at Friedrichshall, and Mr. E. Lozé described electric winding engines installed at French collieries. Mining

education in the United States was discussed by Prof. H. Eckfeldt, and in New Zealand by Prof. J. Park. Coal mining in India was dealt with by Mr. T. Adamson. Mr. J. Jeffries described the occurrence of underground fires at the Greta colliery, New South Wales. Mr. W. C. Blackett and Mr. R. G. Ware described a striking innovation in mining practice, the use of electrically driven mechanical conveyors for filling at the coal-face. Two years' experience has shown a saving of 48 per cent. over the ordinary pick and shovel method. Lastly, Mr. A. R. Sawyer gave an account of the geology of Chunies Poort, Zoutpansberg, Transvaal. Incidentally, he mentioned some old copper workings where native copper occurs in some abundance in dolomite. The proceedings terminated with a vote of thanks, proposed by Mr. Bennett H. Brough, to the Geological Society and to the Royal Astronomical Society for the use of their rooms for the meeting.

IN the *Biologisches Centralblatt* of May 15 Dr. O. Zacharias brings to a conclusion his article on the relations of modern hydrobiology to fish culture and fisheries. Dr. G. Schneider also discusses the origin of species among cestode worms. He concludes that morphological variation in union with biological isolation through parasitism are insufficient to form species unless aided by physiological, that is, sexual, isolation.

IN the *Nouveaux Mémoires* of the Moscow Academy, vol. xvi., parts ii. and iv., the well known Russian ornithologist, Dr. P. Suschkin, commences an important work on the osteology of the avian skeleton, the second part, which is alone before us, dealing with the osteology and classification of the diurnal birds of prey (Accipitres). This part is illustrated with four plates of various parts of the skeleton.

DURING a recent visit to the Victoria Falls of the Zambezi, Mr. W. L. Sclater, director of the South African Museum, obtained three fishes from that river which were sent to the British Museum for examination. One of these proved to be new, and is described by Mr. G. A. Boulenger in vol. iii., part vii., of the *Annals of the South African Museum* under the name of *Paratilapia carlottae*. The genus is widely spread.

WE have received from the author, Mr. C. C. Hurst, a copy of his paper on experimental studies on heredity in rabbits, published in vol. xxix. of the *Journal of the Linnean Society*. The experiments were commenced in 1902, with the object of ascertaining whether the Mendelian principles of heredity were applicable to animals as well as plants, the animals selected being the white Angora rabbit and the Belgian hare. The results confirm, and extend to rabbits, those already obtained by Prof. Cuénot in the case of mice, though it would appear that the heredity of Dutch markings in rabbits differs in some respects from that of the "panachure" in mice.

IN the *Zoologist* for May, Mr. J. H. Gurney records the early history of a young cuckoo. On May 22 last year a hedge-sparrow's nest was found containing three eggs laid by the owner, and one egg deposited by a cuckoo. The cuckoo's egg was of the ordinary brown type, presenting no resemblance to the hedge-sparrow's eggs. On June 2 the young cuckoo and two hedge-sparrows were hatched, the third young hedge-sparrow, which had been hatched earlier, having previously disappeared. The next day the two nestling hedge-sparrows were found lying dead outside the nest. When one was replaced, no attempt was made to eject it by the cuckoo. The same result happened when a young wagtail was put into the nest; but when this was replaced by a young wren, the latter was ejected under the eyes of the observer in the usual manner. On June 22 the young cuckoo left the nest.

IN discussing certain habits of British bats in the eighth article of vol. xlix. of the *Memoirs of the Manchester Literary and Philosophical Society*, Mr. C. Oldham refers in the first place to the winter sleep, and points out that, from observations made in the disused copper mines of Alderley Edge, in the case of the long-eared bat this sleep is interrupted, the bats probably feeding at intervals on the insects which abound in the tunnels in winter, even if they do not venture forth into the open. The same is probably true of Daubenton's bat, the whiskered bat, and the lesser horse-shoe bat. There appears to be nothing to show that the bats occasionally seen abroad on mild days in winter are pipistrelles. Two popular fallacies are contradicted, firstly, that bats cannot walk, or can only shuffle awkwardly, along a flat surface, and secondly, that they cannot take flight from such a surface. The different

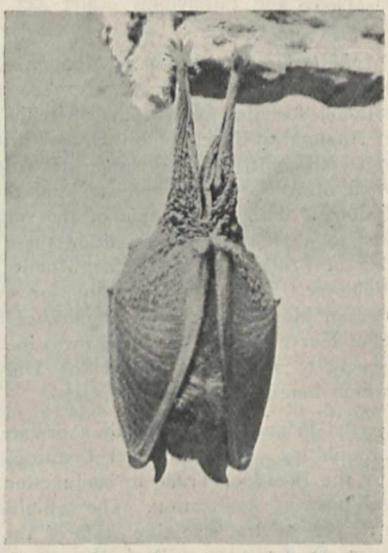

FIG. 1.—Lesser Horseshoe Bat in Repose.

postures assumed by British bats in repose form the subject of the plate illustrating Mr. Oldham's paper. The lesser horse-shoe bat, of which one of the figures is reproduced, recalls the posture assumed by the fox-bats, or flying-foxes, when at rest. The posture of ordinary bats is quite different, and it is a curious fact that while the lesser horse-shoe alights from the air in an inverted position, other bats, on first coming to rest, do so with the head upwards, and then reverse their position.

THE foregoing paper is supplemented by the observations of Mr. C. B. Moffat on the duration of flight among bats, published in the May number of the *Irish Naturalist*. In this communication it is shown that while the long-eared bat and the pipistrelle are all-night fliers, the hairy-armed bat only ventures forth for a short flight in the evening, and again shortly before dawn. The hairy-armed bat thus enjoys a daily rest of 21½ hours, taking all its exercise and its food in two periods (which in summer may be very close together) of one and a quarter hours each. There is a suggestion that the great bat, or noctule, indulges only in an evening flight, but additional evidence is required before this can be definitely accepted, and it appears to be contradicted by certain observations which the author did not see soon enough to incorporate in his text.

No. 1402 (vol. xxviii.), pp. 425–460, of the *Proceedings of the U.S. National Museum* contains descriptions by Mr. E. A. Mearns of new mammals from the Philippine Islands. The most interesting of these is a new genus of insectivore represented by *Podogymnura truei*. It is allied to Gymnura and Hylomys, and has a long hind-foot and a stout tail rather more than a third the length of head and body. Two tupaias are likewise referred to a new genus, Urogale, one of these having been previously described by Mr. O. Thomas as *Tupaia everetti*. They are characterised by the round tail. Several new genera of rats are likewise described, for one of which the author proposes the name Bullimus, a term, in our opinion, too like the familiar Bulimus. In vol. i., No. 6, of the *Bulletin of the Brooklyn Institute*, Dr. J. A. Allen describes a collection of mammals from Beaver County, Utah. Copies of three other American papers have been received during the current week. In the first, *Bulletin of the Brooklyn Institute*, vol. i., No. 6, Mr. C. Schaeffer records additions to the beetle fauna of the United States, with notes on some previously known species. In the second, *Proceedings of the U.S. National Museum*, No. 1400, Miss Richardson describes two new isopod crustaceans from California. In the third, *op. cit.* No. 1401, Mr. T. W. Vaughan gives a critical review of the genera of the fungoid corals, with a tentative classification.

WHEN the "Book of Antelopes" was concluded in 1900 the authors were unable to give any satisfactory account of Heuglin's "giant eland" of the Bahr-el-Ghazal from the want of accessible specimens. Heuglin had described it in 1863, but had based his description on a single pair of horns, and Schweinfurth, who had subsequently met with the same animal in Bongoland, had given very little further information about it except that it had stripes on its body. In these circumstances Messrs. Sclater and Thomas classed the giant eland of Central Africa as a subspecies of the common eland (*Taurotragus oryx*) under the name *Taurotragus oryx gigas* ("Book of Antelopes," iv., p. 208). This splendid animal, which may be fairly called "the grandest of all the African antelopes," has lately been re-discovered by Mr. A. L. Butler, the superintendent of game preservation in the Anglo-Egyptian Sudan, who communicated a full description of it to the Zoological Society at a recent meeting. It appears, from the evidence given by Mr. Butler, that its nearest ally is the Derbian eland (*Taurotragus derbianus*) of Senegal, and not the typical *T. oryx*, and he therefore proposes to call it *Taurotragus derbianus gigas* instead of *T. oryx gigas*. This is probably correct, as the description given by Mr. Butler agrees very fairly in most points with the Derbian eland. But the giant eland appears to be a still larger and finer animal, with much stronger horns; its height at the withers is stated to be 68 inches. On this question we may shortly have an opportunity of forming an opinion, as Bimbashi Collins, of the Egyptian Army, who has himself shot two specimens of the animal, has sent the heads and skins to Mr. Butler to be forwarded to England, where they will probably go to the Natural History Museum at South Kensington.

THE question of the sleep of fishes was referred to (p. 104) last week in our notice of the last volume of the "Cambridge Natural History." Mr. F. Davis, writing from 49 and 51 Imperial Buildings, Ludgate Circus, E.C., says that observations of many varieties kept by him in aquaria extending over a period of twenty years show that fishes do sleep. He has also observed what appeared to be the play or sports of fishes, which probably serves the same biological ends as in the higher vertebrates. He remarks:—"Apparently when kept in aquaria fishes only sleep during the hours of darkness. If an artificial light be thrown upon them they quickly regain consciousness."

WE have received the annual report for 1903 of the Government bacteriologist and director of the laboratory (Mr. H. Watkins-Pitchford), Pietermaritzburg, showing that much good work is being done in the colony. It contains a valuable bacteriological report on the plague in Natal in 1902–3.

THE "Nervous Diseases Research Fund" has just issued its first annual report. The object of the fund is to promote and carry on research into the origin and cure of diseases of the nervous system. The work is carried on at the National Hospital, Queen's Square, W.C., and is under the direct supervision of the medical staff of the hospital. During 1904, forty-eight autopsies were performed and the pathological condition investigated. Special attention has been directed to the study of a disease known as myasthenia gravis, which is almost invariably fatal, and about which little is known at present.

THE development of lenticels at points where the stress is small is discussed by Mr. J. A. Terras in an article in the *Transactions and Proceedings of the Botanical Society of Edinburgh* (vol. xxii., part iv.), and the origin of lenticels on roots is described in some detail. A first account of new species of flowering plants from the Republic of Colombia, mostly collected by the writer, who accompanied Captain Dowding's expedition in 1898–9, is contributed by Mr. T. A. Sprague to the same number.

A RECENT leaflet issued by the Board of Agriculture and Fisheries furnishes an account of the life-history of the pine sawfly, *Lophyrus pini*, which attacks more especially the Scots pine and the black Austrian pine. Two broods develop in the year, the first in May and the second in August. The larvæ are the source of damage, as they devour the pine needles. Amongst the animals which feed on the larvæ are mice, squirrels, goatsuckers, and starlings, also numerous ichneumon flies. In plantations the best remedy is to kill the larvæ by hand, but as a spray for ornamental trees in parks and gardens, hellebore essence or arsenate of lead is recommended.

ALTHOUGH the investigation of the gametophytes and embryo of the gymnospermous genus Torreya has not yielded the critical results which had been expected, several interesting taxonomic characters were observed by Dr. J. M. Coulter and Mr. W. J. G. Land, and are described in their account of *Torreya taxifolia* in the *Botanical Gazette* (March). The archegonium initial is differentiated very early, while most of the endosperm develops after fertilisation. A pro-embryo of twelve to eighteen cells completely fills the egg and persists through the winter, until in the spring the suspensor elongates, and later the ruminated appearance of the endosperm becomes apparent. Rumination is shown to be due to the unequal resistance offered by the perisperm in different parts of the seed to the encroaching endosperm.

THE report of the Meteorological Commission of Cape Colony for the half-year ending June 30, 1904, has been received. The usual tables of rainfall, temperature, &c., at various stations will not be published until the issue of the next half-yearly report, so that the data may be comparable with the information contained in previous yearly reports. But in lieu of the usual tables above referred to,

the present issue contains a very valuable series of twenty-three tables prepared by the secretary (Mr. C. M. Stewart) showing the characteristic features of the winds at the Cape Observatory during the five years 1896–1900, arranged under sixteen points of the compass, and referred to various elements, *e.g.* temperature, humidity, &c., and giving the percentage of relative wind-frequency and wind-force at various hours.

WE have received a copy of the report of the director of the Philippine Weather Bureau for the year ending August 31, 1904 (reprinted from the report of the Philippine Commission, part ii.). We have frequently had occasion to refer to the useful work of this organisation, and the valuable researches and publications of the Rev. J. Algué, S.J., particularly in respect of the cyclones in the Far East. The central office performs a large amount of work gratuitously for observers on land and sea, by adjusting and comparing instruments; this is generally only known to those benefited. The director states that the weather bureau is never closed; the chief officials live at the observatory, and are ready to attend any call at all hours, especially inquiries by officers of ships, if they wish for information as to the conditions of weather. In addition to the regular work, telegrams are constantly exchanged between the provinces, China, Formosa, and Japan, and when bad weather is impending special warnings are dispatched to the points threatened.

THE annual summary of the Monthly Weather Review of the U.S. Weather Bureau for 1904, containing a useful subject, author, and title index of the papers published in the monthly parts, and an annual climatological summary of the observations made at the Weather Bureau stations, has just reached us. Weather forecasts for thirty-six and forty-eight hours in advance have been made daily throughout the year for each State, and special warnings of gales on the sea coasts have been issued when necessary. In a number of instances, the chief of the Weather Bureau states, European shipping interests were notified of the character and probable course of severe storms that were passing eastward from the American coast. The warnings and indications of the movements of West India hurricanes have evidently been the means of saving a large amount of property and a number of lives, and their value has been acknowledged by the Press, and also by the President of the Jacksonville Board of Trade, who states that the warnings to vessels not to leave port prevented serious disasters. Prof. W. L. Moore expresses the hope that the time will come when it will be possible to forecast the weather generally for coming seasons, but that time has not yet arrived. Valuable researches are being made at Mount Weather Observatory, Virginia, where it is proposed, *inter alia*, to discuss meteorological observations from the point of view of their relations to solar physics, and to select meteorological and magnetic elements and compare them with solar observations.

IN the current number of the *Comptes rendus* of the Paris Academy of Sciences M. Guyou gives an interesting account of the utilisation of the telephone system for the exact transmission of time. The experiments were undertaken by the Observatory of the Bureau des Longitudes at the request of the Chambre syndicale de l'Horlogerie, and after a preliminary trial in the Paris area were extended to the whole French system. The transmission of the time by a verbal signal not being sufficiently exact for the purpose, by means of a specially arranged microphone each beat of the pendulum of the standard clock in the observatory could be heard in the telephone receiver, the operator at the sending end merely counting one or two beats. On May 25 the destroyer *Escopette*, whilst at Brest, was able to regulate its chronometers directly against the standard clock of the Observatory of Montsouris with an accuracy of about 0·1 to 0·2 second. As M. Guyou points out, owing to the wide extent of the telephone system at the present time, this mode of transmitting the time ought to be of considerable service.

IN *Kungl. Svenska Vetensk. Akad. Handl.* (Band 38, No. 5) Dr. Hasselberg gives the results of an investigation of the arc spectrum of tungsten. The region he has studied extends from λ 3477 to λ 5892. This is a continuation of the very useful series of publications by the same spectroscopist relating to the arc spectra of metals. The elimination of lines due to impurities was done by comparing the tungsten spectrum with those of other metals taken under similar conditions. In cases of close agreement between tungsten lines and those of other metals a special study was made of the lines with the object of establishing their coincidence or non-coincidence, and in the former case the probable origin of the common line was determined from a consideration of the relative intensities in the two spectra. In a comparison column are given the lines recorded by Messrs. Exner and Haschek for the same element. The strongest lines of this metal have been carefully compared with the Fraunhoferic lines, and cases of coincidence and probable identity noted.

IN our issue of July 28, 1904, we noted that Dr. H. M. Reese, of Yerkes Observatory, had published the results of some observations of "enhanced" lines in the Fe, Ti, and Ni spectra, wherein he supposed that he had discovered some enhanced lines not included in Sir Norman Lockyer's lists. In the current number of the *Astrophysical Journal* Mr. F. E. Baxandall comments on Dr. Reese's results, and shows that in a great number of cases there is no evidence of enhancement in the Kensington photographs. For example, the comparative tables given show for each element that of the seventy enhanced lines discovered by Dr. Reese for iron, fifteen are actually stronger in the arc than in the spark spectrum, twenty-five are equally strong in both spectra, twenty do not occur in either spectra on the Kensington grating spectrograms, whilst six are so slightly "enhanced" as to leave it doubtful as to whether they should be included in this category. It seems probable that Dr. Reese was misled by comparing two spectra of which the spark was generally the stronger, for he especially remarked that only one line was stronger in his arc than in his spark spectrum.

WE have received from the Bureau of Mines of Ontario an interesting memoir on the limestones of the province by Mr. Willet G. Miller, the provincial geologist. It covers 143 pages, and contains a number of excellent photographs of the principal quarries. It shows clearly where limestones of various chemical compositions are to be found, and gives a concise account of the uses of limestone and lime at the present time. Hitherto it has hardly been realised that limestones form an important part of the mineral resources of Ontario, and this well arranged collection of analyses of limestone and of descriptions of quarries cannot fail to prove of value to all interested in the important industries that depend upon limestone as a base.

MESSRS. ILIFFE AND SONS, LTD., have published a little book on practical frame-making by Colonel W. L. Noverre; the price is 1*s.* net.

OUR ASTRONOMICAL COLUMN.

PHOTOGRAPHIC REALITY OF THE MARTIAN CANALS.—No. 4021 of the *Astronomische Nachrichten* contains a telegram dated May 28 from Mr. Lowell to Prof. Pickering in which the former states that several of the canals on Mars have been photographed by Mr. Lampland. Amongst others, Nilo Syrtis, Casius, Vexillum, Thoth, Cerberus, Helicon, Styx, Chaos, and Liedeus (? Libneus) are shown on the negatives, some appearing on more than twenty plates.

DISCOVERY OF SATURN'S TENTH SATELLITE.—A brief note in No. 4015 of the *Astronomische Nachrichten* states that Saturn's tenth satellite was discovered from an examination of several plates taken with the 24-inch Bruce telescope which were selected from those used in the determination of the orbit of Phœbe.

The new satellite appears on thirteen plates. The orbital motion is direct and the period is twenty-one days, therefore the satellite is apparently a little nearer to Saturn than is Hyperion.

JUPITER'S SIXTH AND SEVENTH SATELLITES.—An abstract from vol. xvii. of the *Publications of the Astronomical Society of the Pacific*, appearing in No. 4015 of the *Astronomische Nachrichten*, contains an account by Prof. Perrine of the observations so far made of Jupiter's sixth and seventh satellites.

The former can be photographed in ten minutes with the Crossley reflector, and thirty-six plates have been obtained. A preliminary investigation of the orbit shows that the inclination to the ecliptic and the planet's equator is about 30°, and that the satellite has a period of about 250 days, with a mean distance from the planet of 7,000,000 miles. The direction of the orbital motion still remains uncertain. The brightness of the satellite indicates a diameter of about 100 miles, or less.

On examining the plates taken for the sixth satellite on January 2, 3, and 4, a much fainter object, also apparently belonging to Jupiter, was discovered, which was then situated N. and W. of, and was moving towards, the planet. Subsequent observations, which, owing to the satellite's faintness, were much more difficult to make than in the case of the sixth satellite, confirmed its dependence upon Jupiter. This object was not shown on the negatives taken for the sixth satellite during December, being just outside their field, but altogether twenty observations have been made, the last on March 9.

Apparently the orbit of the seventh satellite is quite eccentric, with a mean distance from the planet of about 6,000,000 miles and a period of about 200 days. The inclination of the orbit to the plane of Jupiter's equator is about 30°, but the direction of the orbital motion is as yet undetermined. The photographic magnitude of the seventh satellite is not brighter than the sixteenth, and on comparing this with the magnitudes of other satellites and of asteroids a diameter of about 35 miles is deduced.

Prof. Perrine suggests that the large inclination of their orbits indicates that neither of these bodies were originally members of Jupiter's family, but have been "captured" by the planet.

STARS WITH SPECTRA OF THE ORION TYPE.—In No. 2, vol. lvi., of the *Annals of the Harvard College Observatory*, the distribution of stars having class B or Orion-type spectra is discussed, and all known stars of this type placed in a catalogue, in order of R.A., the position (1900·0), magnitude, exact type of spectrum, and the galactic longitude and latitude being given for each star. Considerably more than 30,000 spectra have been examined by Mrs. Fleming in connection with the Henry Draper memorial work, and of these 803 are included in the present catalogue.

As a distinctive feature of these stars is the helium indicated in their spectra, the allocation of them with regard to galactic longitude and latitude really indicates the distribution of helium in the universe. On thus classifying them, it is found that on dividing the sky into equal areas the galactic latitudes of which are included between +90° and +30°, +30° and 0°, 0° and −30°, and −30° and −90°, the numbers of well marked helium stars in these divisions are 22, 219, 509, and 53, or 3, 27, 63, and 7 per cent. of the total respectively, nine-tenths of them being within 30° of the galactic equator. A congregation in certain galactic longitudes is also indicated. Thus between 160° and 340° there are 613, or 78 per cent. of the total, of these stars. About one-quarter of the whole number are contained in four regions having a total area of 790 square degrees, or less than one-fiftieth of the sky. One of these four regions is near to the variable star I Carinæ, and lies almost wholly within the constellation Argus. As this Argus region contains nearly three times as many "Orion" stars as does the Orion region, Prof. Pickering suggests that "Argus" stars would have been a more suitable generic name for the class of stars having spectra of this (B) type. He states, however, that the nebula of Orion appears to be the starting point, or origin, of class B stars, twenty of which are situated within 1° of θ Orionis, that is to say, nearly as many as are contained in the region between galactic latitudes +30° and +90°, although the area of the latter region is three thousand times as great.

Arranging them according to magnitude, it is found that most of this class are bright stars, only 1 in 20 being of the sixth or fainter magnitudes.

THE MOTION OF THE TAIL OF BORRELLY'S COMET (1903 iv).—From the examination of a number of photographs obtained by different observers during July, 1903, Prof. Jaegermann, Moscow, has compared the relative motions of the different sections of the tail of comet 1903 iv in regard to the movements of the comet's nucleus and to the sun. After analysing the velocities and movements determined, he has arrived at the conclusion that in this case light-pressure, acting in the sense of Arrhenius's hypothesis, was not the determining factor in the formation of the several tails, for a pressure sixty times greater than gravity would have to be assumed. If the light-pressure hypothesis be retained, the assumption must be made, according to Bredichin's idea, that the tail-matter consisted of gaseous molecules, and that its illumination was due to the fluorescence of highly illuminated gases, such as has been experimentally demonstrated by Lommel, Wiedemann, and Schmidt.

The existence of a repulsive force, other than light-pressure, was demonstrated by Bredichin in comet Rordame (1893 ii), by Prof. W. H. Pickering in comet Swift, and was confirmed by Prof. Jaegermann in a preliminary investigation concerning the denser parts of the tail of comet Swift, 1892 i.

DOUBLE STAR OBSERVATIONS.—The results of a series of observations of double stars made at Kirkwood (Indiana) Observatory are given in No. 4022 of the *Astronomische Nachrichten*. The observations were made by Mr. J. A. Miller and Prof. W. A. Cogshall with a 12-inch refractor, and the B.D. and A.G. numbers, the 1875 position, the magnitudes, and the measured position-angle and distance are given for each of 114 double stars.

The objects observed were selected from those noted as double by the Leipzig observers when preparing the A.G. catalogue for the zone +10° to +15°, and, with few exceptions, they have not been measured elsewhere. Some few stars suspected by the Leipzig observers as duplicate could not be seen as such by the Kirkwood observers, and one or two of the sets of measures refer to newly discovered double stars.

THE ROYAL OBSERVATORY, GREENWICH.

ON Saturday last, June 3, the Board of Visitors made their annual inspection of the Royal Observatory, Greenwich, but unfortunately, through ill-health, the Astronomer Royal was not able to be present. The following is a brief abstract of the report which was submitted to the visitors.

Very great progress has been made in the observation of the reference stars for the Greenwich section of the Astrographic Catalogue, about 9500 observations of R.A. and N.P.D. having been added during the year. The comparatively few observations required to secure five observations of each of the reference stars (more than 10,000 in number) will easily be obtained by the end of the year, as there are only 5 stars requiring three observ-

ations, 100 requiring two, and 1500 requiring one observation only in order to carry out the programme. In fact, it may be taken that the observations for this catalogue are practically completed. The catalogue, which will be terminated this year, will contain, besides the reference stars for the Astrographic Catalogue, the 834 zodiacal stars given in the Nautical Almanac for 1897.

It is proposed to begin next year a new nine-year catalogue of the stars of magnitude 9·0 and brighter between the limits +24° to +32° of N. declination, this being the Oxford astrographic zone, for which they serve as reference stars. The re-observation of these stars, which for the most part fall within the Cambridge zone of the Astronomische Gesellschaft Catalogue, will afford valuable data for their proper motions, besides giving fundamental positions for the Oxford astrographic plates.

The comparison between theory and the Greenwich meridian observations of the moon from 1750 to the present time, undertaken by Mr. Cowell, has been completed for the longitudes, and the discussion from 1847 to 1901 is completed for the latitudes. The only point left outstanding is the motion of the node, for which it is necessary to discuss as long a series of observations as possible. The results obtained for the longitudes are summarised in a series of papers in the *Monthly Notices of the Royal Astronomical Society*. In particular, the paper in vol. lxv., No. 2 (1904 December), gives the coefficients of 145 terms as obtained directly from observation, with a comparison with the theoretical coefficients given by Hansen, Delaunay, M. Radau, and Dr. Hill. The publication of the details of the whole investigation will be shortly proceeded with.

The re-reduction of Groombridge's observations was completed at the date of the last report, and during this year the printing of the results has been pushed on. The introduction has also been prepared for press. A discussion of the proper motions determined by comparison with modern Greenwich observations, and a determination of the constant of precession and of the direction of the solar motion by Mr. Dyson and Mr. Thackeray, are given in the *Monthly Notices of the Royal Astronomical Society*, March.

The altazimuth has been in regular use throughout the year, and a second determination of the pivot errors has been made, and also observations for obtaining the value of one revolution and errors of the screw of the telescope-micrometer have been completed.

The observations of the moon, both in and out of the meridian, seem very satisfactory as shown by the agreement between the two instruments, the transit circle and the altazimuth.

The 28-inch refractor has been employed, as was the case last year, for micrometric measurements of double stars, the total number measured being 603. Of these, 143 have their components less than 1″·0 apart, and 60 less than 0″·5. A marked deterioration of the images of the stars led to an examination of the lenses, and the suspected tilt between the components was corroborated and remedied.

Sixty-five photographs of Neptune and its satellite have been secured with the 26-inch refractor, while, with the 30-inch reflector, numerous photographs of minor planets and comets *a*, *b*, *c* 1904, and *a* 1905, have been obtained.

At the date of the last report, 119 plates taken of Eros with the astrographic equatorial, and 55 taken with the Thompson equatorial, had been measured. During this year the remainder of the photographs have been measured, making in all 198 with the astrographic equatorial and 152 with the Thompson instrument. The reduction of the measures is in a satisfactory state, and it is expected that it will be completed in two months for both sets of photographs.

The astrographic equatorial has been employed mainly to obtain photographs to replace chart plates which show slight photographic defects unsuitable for production of enlarged prints.

The measurement of the catalogue plates for the Greenwich section is now completed. Since the last report 47,200 measures of pairs of images (6m. and 3m.) have been made. The number of plates measured in the year is 102, covering 128 square degrees between declination 83° and the pole. The number of plates measured up to the date of last year's report was 1051. Adding the 102 plates measured this year, the total number of plates measured is 1153, being the 1149 of the Greenwich section + 4 additional photographs of the polar field.

For the year ending 1904 December 31, Greenwich photographs of the sun have been selected for measurement on 209 days, and photographs from India and Mauritius (to fill up the gaps in the series) on 151 days, making a total of 360 days out of 366 on which photographs are at present available. Photographs were taken in Mauritius for three of the six days yet unrepresented, and may be received in due course.

The solar activity has shown a great increase during the year ending 1905 May 10, and the sun has not been free from spots on a single day during that period. The mean daily spotted area for 1904 was more than half as great again as that for 1903, and early in the present year a number of exceptionally large groups was observed. The group which was seen first on the east limb on 1905 January 28 had a greater total area than any other group which has been photographed at the Royal Observatory.

The principal results of the magnetic elements for 1904 are as follows:—

Mean declination	16° 15′·0 West.	
Mean horizontal force	4·0166 (in British Units).	
	1·8520 (in Metric Units).	
Mean dip (with 3 needles) ...	66° 57′ 11″.	

In 1904 there were no days of great magnetic disturbance and eight of lesser disturbance.

The mean temperature for the year 1904 was 49°·8, or 0°·3 above the average for the fifty years 1841–90. During the twelve months ending 1905 April 30 the highest temperature in the shade (recorded on the open stand in the magnetic pavilion enclosure) was 91°·0, on August 4. On the same day the highest temperature in the Stevenson screen in the magnetic pavilion enclosure was 89°·5, and in the observatory grounds 89°·7. The lowest temperature of the air recorded in the year was 19°·5, on January 1. During the winter there were thirty-nine days on which the temperature fell below 32°·0, being seventeen less than the average number.

The mean daily horizontal movement of the air in the year ending 1905 April 30 was 280 miles, which is 2 miles below the average of the preceding thirty-seven years. The greatest recorded daily movement was 867 miles, on November 9, and the least 49 miles, on December 22. The greatest recorded pressure of the wind was 23·5 lb. on the square foot, on March 12, and the greatest hourly velocity 45 miles, on December 30.

The number of hours of bright sunshine recorded during the twelve months ending 1905 April 30, by the Campbell-Stokes instrument, was 1486 out of 4457 hours during which the sun was above the horizon, so that the mean proportion of sunshine for the year was 0·333, constant sunshine being represented by 1.

The rainfall for the year ending 1905 April 30 was 20·21 inches, being 4·33 inches less than the average of the fifty years 1841–90. The number of rainy days was 153. This small rainfall may be contrasted with the heavy rainfall of 35·42 inches in the corresponding period last year. The most striking contrast is obtained by comparing the rainfall for the year commencing 1903 March 1, which was more than 37 inches, with that for the year commencing 1904 March 1, which was less than 17½ inches. This dry period of twelve months was followed by a heavy rainfall in 1905 March, which exceeded 3½ inches, and is the greatest amount recorded in March since 1851.

The printing of the Paris-Greenwich longitude determination, 1902, is practically complete. The Killorglin longitude is the only determination which still requires to be printed to complete the volume of longitude determinations, which will contain the determinations Paris-Greenwich made in 1888, 1892, and 1902, of Greenwich-Waterville-Canso-Montreal made in 1892, and of Greenwich-Killorglin made in 1898.

The re-reduced Groombridge Catalogue is nearly completely printed, with the exception of the introduction, which is ready for the press.

Provision has been made in the Navy Estimates for the observation of the total solar eclipse of 1905 August 30 by a party of three observers on the coast of Tunis, where the weather conditions are promising. It is proposed to take photographs of the corona for detail and extension with the Thompson 9-inch coronagraph, the 13-inch astrographic refractor, and the 4-inch Dallmeyer rapid rectilinear lens, and also photographs of the spectrum with the two spectroscopes lent by Major Hills, R.E., as in 1900 and 1901.

THE OPTICAL CONVENTION.

THE optical convention has just concluded a very successful meeting extending over four days; the exhibition and the papers attracted numerous visitors from all parts of the country. The papers led to much valuable discussion. An account of the exhibition and the president's address appeared in last week's NATURE.

The first group of papers dealt with the design of optical and scientific instruments. The Gauss theory was entrusted to Mr. Conrad Beck, who considered the theory of the equivalent planes of complete optical instruments; he dealt more particularly with the complete microscope in relation to its "working distance."

Dr. Drysdale gave a general account of the aberrations of lens systems, submitting a classification and specification of the various aberrations to obtain an expression of opinion from those working at the subject. Mr. Chalmers gave a graphical method of representing the results of calculations of lens systems, and a modification of the Hartmann system of testing to permit of measuring and expressing aberrations in exactly the same form. This should make it possible to obtain the relation between the definition and the measured or calculated aberrations. In the discussion Mr. Carson pointed out the importance of the relative intensity of the image disc and the aberration patch in estimating the performance of lenses.

Mr. Walter Rosenhain criticised the mechanical design of certain types of instruments; he showed that, in many cases, the ideals of the instrument maker were in conflict with sound engineering principles, and suggested directions in which improvements might be looked for.

Diffraction in optical instruments was discussed by Mr. J. W. Gordon in an important theoretical paper; his conclusions, which would modify many of our ideas on optical systems, are now being submitted to a definite experimental test.

A group of papers related to interference phenomena. Mr. J. Rheinberg exhibited a method of producing achromatic interference bands which is likely to have numerous applications. Mr. Stansfield described a simple form of Michelson interferometer specially suitable for demonstration. Prof. Watkin and Mr. Morrow exhibited their apparatus for calibrating extensometers by observing the displacement of interference bands.

Mr. Twyman described the manufacture of the Echelon spectroscope, stating the accuracy required in the plates and the precautions used to obtain it. This apparatus was exhibited and compared with the Lummer "parallel plate" arrangement for obtaining resolution of spectrum lines. Mr. Blakesley discussed the various forms of prism which could be used in constant deviation spectroscopes and some of their applications. Mr. Newall dealt with astronomical spectroscopes, demonstrating that the limits of usefulness of the present type of spectroscope were almost reached in the case of faint stars, as the intensity of light necessary for photographing their spectra can only be obtained at the sacrifice of the purity of the spectrum or the certainty of identification of the lines, and that no very marked improvement is likely to be obtained from the use of larger objectives, on account of the increased absorption in the prisms required. He suggested the use of gratings.

Lord Rayleigh dealt with the subject of polish, pointing out the distinction between the process of grinding, which consists of the removal of comparatively large flakes, and that of polishing, which he regards as molecular, the roughnesses of the surface being reduced to dimensions smaller than the wave-length of light. Experiments on the thickness of glass removed by polishing and by etching with hydrofluoric acid under various conditions were illustrated. In the discussion Mr. Walter Rosenhain cited evidence to show that the surface flow which has been recognised in the polishing of metals also occurs in glass.

Mr. Walter Rosenhain dealt with the possibilities of progress in optical glass; he described the limitations to the production of vitreous fluxes of extreme properties, and advanced the view that media of widely different optical properties could only be obtained by the production of large homogeneous crystals. Physicochemical considerations were cited to indicate lines upon which this difficult problem might be solved.

A number of instruments for optical measurements were described, Prof. Poynting exhibiting his form of parallel plate micrometer. Mr. Blakesley described his apparatus for the measurement of focal length of lenses, with applications to other optical measurements. Mr. Chalmers described a new form of refractometer for obtaining the refractive index of glass in lens form. The lens is inserted in a trough containing a suitable transparent liquid, and the difference of the refractive indices is deduced from the approximate curvatures of the lens and its power in the liquid, with an accuracy comparable with that of the best refractometers.

Mr. Baugh described the use of invar tapes for base-line measurements.

Dr. Drysdale discussed the requirements of small telescopes and binoculars, with special reference to the field of view and illumination of the image. He indicated the method he had employed in calculations for prism binoculars, showing how he had been led to use glass of high refractive index for the prisms. He described a special form of photometer for determining the absorption in binoculars.

Mr. A. C. Jolley gave a critical review of photometric standards and apparatus; he described a modification of the Violle platinum standard, and discussed the difficult problems connected with heterochromatic photometry; his results indicate that the accuracy claimed by Sir W. Abney is far too high, especially when readings by different observers are compared. He concludes that a discrimination photometer is the most trustworthy instrument for comparing different colours.

Mr. Milne exhibited his new form of spectrophotometer. The apparatus is especially suitable for determinations of the absorption of light of specified wave-length by liquids.

Mr. Bull discussed the theory of tricolour filters, plates, and inks. He concluded that it was most satisfactory to adjust each independently of errors in the adjustment of the others. The filters should have a certain amount of overlap, the colour of the overlap of two filters being the colour of the printing ink corresponding to the other filter.

Mr. Crawley discussed the limits of stereoscopic vision; the results of his measurements point to a much greater accuracy in judging distances by stereoscopic effect than is generally admitted.

Mr. H. L. Taylor discussed the effects of astigmatism on the accommodation of the eye. Two new forms of ophthalmometer were demonstrated, one being the Ettles-Curties, which is valuable for the perfection of its mechanical adjustments, and the use of complementary colours for the mires; it is so arranged that the corneal microscope can be readily attached. The ophthalmometer shown by Mr. Sutcliffe contains a number of variations from ordinary forms; the mire is an almost complete ring illuminated by a special lamp, and the method of doubling the image is novel.

Dr. Walmsley gave an account of the attempts which have been made to provide technical education for those engaged in the optical industry, and the existing facilities; he outlined the scheme for the establishment of a British Institute of Technical Optics. The convention decided to memorialise the London County Council to support the scheme.

Major-General Waterhouse gave an account of the history of telephotography.

In the evening lecture, Prof. Silvanus P. Thompson gave a most interesting account of the various forms of Nicol's prism and its modern equivalents.

AGRICULTURAL NOTES.

THE annual report of the Transvaal Department of Agriculture for 1903–4 is a volume of more than 400 pages, which contains, in addition to an introduction by the director, reports on the fourteen sections into which the work of the department falls. In discussing the *personnel* of the department, the director refers to the difficulty of obtaining expert assistants, a difficulty which, so far as agriculture is concerned, exists in all countries supplied from Britain, and even in such countries as the United States, where the training of the expert receives more attention than it does here. Many of the chief positions in the Transvaal department have now been filled up, but assistants are still required, and as the work expands it is probable that a considerable number will be engaged. The report states that men for scientific work "will doubtless best be obtained from amongst students who have had good careers at one or other of the universities, and who have done a certain amount of research after taking their degree. A thorough grounding in pure science is a *sine qua non*, and if they are not acquainted with the applied side of Science, this knowledge will have to be acquired in our laboratories whilst acting as assistants to the Chief of their particular Division."

The above named report contains many interesting paragraphs. Here is one that appears under the heading "Farmers' Cooperative Experiment Reports":—From General Louis Botha, Pretoria, "They (mangels from England sent for trial by the Department) do not grow so quickly as other sorts of root-crops, but if sown early they will grow splendidly and give a good winter crop in May; therefore I ordered a big quantity which I intend to use this year."

In papers contributed to the first four parts of the *Agricultural Journal of the Cape of Good Hope* for the current year, Mr. D. E. Hutchins, conservator of forests at Cape Town, makes out a strong case for the extension of tree planting in South Africa. The coast districts have a very favourable climate, growth is rapid, and the quality of the timber produced is good; but while native resources have not been developed, timber to the value of 1½ millions is imported annually. There is no reason why most of the wood required for building and mining purposes should not be grown in the country, and it is estimated that every 1*l.* spent in afforesting suitable land would bring in an annual revenue of 1*l.* in thirty-five years' time! If Mr. Hutchins can convince the financier that this estimate is correct, South Africa should soon grow its own timber; but in this branch of agriculture the sower seldom reaps, and the investor is not easily convinced. It is likely, therefore, that in South Africa, as elsewhere, the lack of capital will prove a more serious difficulty to the enthusiastic forester than either soil or climate.

In a recent number of the *Bulletin of the College of Agriculture, Tokyo Imperial University*, there is an article of considerable interest to British agriculturists. The Japanese farmer, like the English farmer of half a century ago, is given to employing lime more freely than is good for his land, and in some districts the injury done by liming has caused the authorities to interfere with the practice. Following up some work by Kellner and Böttcher on the effects of lime on the action of certain phosphates, Nagaoka investigated the results of employing a number of phosphatic fertilisers on limed and on unlimed land. Rice was grown, and it was shown that lime greatly interfered with the action of those phosphatic manures which were of animal origin, such as bone meal or fish bones; on the other hand, when the phosphates were derived from a vegetable source, the effects of lime were not very pronounced. The injury was about twice as great in manures of animal as in those of vegetable origin. The injurious action of lime extended into a second year. Nagaoka's results confirm those obtained by Kellner and Böttcher in Germany, and indicate that such manures as bone meal and fish meal should not be used on recently limed soils.

We have received from the committee of the Lawes Agricultural Trust a copy of the report of the director, Mr. A. D. Hall, on the work done at the Rothamsted Experimental Station for the year ending March 31. The well known experimental fields are still continued without any essential change; in addition, a new field has been laid out to test the residual value of various manures in the second and succeeding years after their application. Other experiments deal with calcium cyanamide, the new manure containing nitrogen derived from the atmosphere, and with the various cultivations of bacteria which have been recently introduced for the inoculation of leguminous crops, with the view of making them more efficient collectors of atmospheric nitrogen. During the year in question seven papers have been issued from the station, all of which deal with investigations on the soil, methods of soil analysis, &c. The annual losses of carbonate of lime in the Rothamsted soil have been determined, both that due to natural agencies and that caused by the use of manures. Certain restorative actions have been investigated which account for the maintenance of the fertility of many soils which are almost devoid of lime. Another of the papers deals with the remarkable accumulations of fertility in certain plots of land which have been allowed to run wild for the last twenty years, and have in that time gained nitrogen to an extent not readily explicable by the accepted theories. The Lawes Trust committee continues to find its income very inadequate to the proper development of the station; only donations and subscriptions from various sources, including 300*l.* from the Goldsmiths' Company, 50*l.* from the Clothworkers' Company, 50*l.* from Lord Rothschild, &c., have prevented a serious deficit on the year's working. Mr. J. F. Mason has also promised to erect and equip a new laboratory for agricultural bacteriology, which will be the first of its kind in this country, as a continuance of the experiments carried on for many years by his father, the late Mr. James Mason, at Eynsham Hall, Oxon.

REPORTS ON SEA FISHERIES.

THE report for 1904 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool and the sea fish hatchery at Piel[1] contains an introduction and general account of the year's work, written, as usual, by Prof. Herdman, the honorary director of the scientific work.

A report upon the sea fish hatchery at Piel, by Mr. Andrew Scott, shows that more than a million plaice fry and more than twelve million flounder fry were liberated, the result of hatching eggs laid by fish caught in the autumn and confined in tanks at the hatchery. The useful results to the fisheries of thus confining spawners and turning out the newly hatched fry have yet to be demonstrated.

A paper upon the tow-nettings collected in the Irish Sea, contributed by Mr. Scott, is of little value, because it is far too general, the contents of the tow-nets not having been identified. Such records as "Copepoda, medusoids, gelatinous algæ, a fish egg," are perhaps of some value, but of very little. It appears to us that had less been attempted, and some one group properly worked, the value of the paper would have been much greater. In referring to the occurrence of pelagic fish eggs, the scientific names of the various species might have been mentioned with advantage.

Bacteriological investigations in relation to shell-fish pollution by sewage matter, by Mr. James Johnstone, is an interesting paper continuing an investigation carried on during the previous year. Mr. Johnstone is also responsible for a paper upon plaice-marking experiments, and for another upon the internal parasites and diseased conditions of fishes. The plaice-marking experiments are upon a small scale, but no doubt will give results of interest in time. Dr. J. Travis Jenkins, recently appointed to the post of superintendent of fisheries of the district, contributes an interesting discussion of official fishery statistics, from which it appears that the Board of Trade returns are not always accurate. Dr. Jenkins's remarks

[1] Report on 1904 on the Lancashire Sea Fisheries Laboratory at the University of Liverpool and the Sea-fish Hatchery at Piel; and Syllabus of Lessons on Marine Biology. (Liverpool, 1905.)

upon the cockle industry are both interesting and important.

The volume contains several plates and woodcuts, and is in paper covers. The education committee of the Lancashire County Council provided funds for the instruction of fishermen at the Piel hatchery, and forty-five fishermen attended the class which was held in the spring by Mr. James Johnstone. A "Syllabus of the Lessons in Marine Biology given in the Practical Classes for Fishermen" has been revised, and is now published as a separate volume. It is difficult to estimate the value to the fishermen of the benefit to be derived from a superficial knowledge of marine biology, but the value to the laboratory no doubt lies in the fact that the men send in specimens of animals and plants taken in the course of their fishing operations.

The Danish fishery and hydrographical contributions to the international North Sea fisheries investigations,[1] lately issued, include two papers dealing with fishery matters, one by Mr. Johs. Schmidt being concerned with the pelagic post-larval stages of the two species of halibut *Hippoglossus vulgaris*, Flem., and *H. hippoglossöides* (Walb.). Mr. Schmidt points out that the best distinction between these two species is not in the number of fin-rays, but in the number of vertebræ, and he found certain post-larval fishes off Iceland and the Færöe Islands which agreed in the number of vertebræ with the adults of *H. vulgaris*. The material from which he determined the young stages of *H. hippoglossöides* was taken by the Danish Ingolf Expedition.

The other fishery paper is by Dr. A. C. Johansen, and is entitled "Contributions to the Biology of the Plaice with Special Regard to the Danish Plaice Fishery," and is the first report published upon the subject. The paper is exceedingly interesting, the results, chiefly in regard to the growth and migrations of the plaice, having been obtained by recording the length of a number of fish, marking them with a label, and returning them to the sea to be caught later on by one of the numerous fishing boats. A fair percentage of the fish have been recovered, and by re-measuring these fish their rate of growth during the time between their marking and re-capture has been determined. An interesting part of this experiment was the transplanting of fish from one ground to another, by which it was found that on some grounds they would grow three or four times as rapidly as upon other grounds. Experiments upon the same lines have been carried out by the English staff with similar results, but the official English report is not yet published. The marking experiments have also shown that in Danish waters there are decided migrations of plaice at different times of the year, the tendency being for the fish to work into shallower water during the spring and into deeper water during the autumn.

Dr. Martin Knudsen contributes a paper upon the hydrography of the North Atlantic Ocean, while Mr. J. N. Nielsen writes upon the hydrography of the waters of the Færöe Islands and Iceland during 1903. In both these papers we should have liked to see either an introduction stating the objects of the investigation or a summary of results, as, to those who are not hydrographers, the results obtained are not very clearly set forth. It is perhaps too early to attempt to connect the observed physical phenomena with the movements of the fish, but no doubt, as more material comes to hand, the biological results of the international investigations will be shown to be closely dependent upon the physical conditions observed by the hydrographical staff.

A paper by Mr. Neils Bjerrum, on the determination of oxygen in sea-water, is bound in with Mr. Nielsen's paper already referred to. Mr. Bjerrum has adopted a method of "preserving" the water samples taken in mid-ocean until they can be accurately analysed on land, and it appears that his method of adding to the water samples a solution of manganous chloride and caustic soda containing iodide of potassium has been very satisfactory.

FRANK BALFOUR BROWNE.

[1] Meddelelser fra Kommissionen for Havundersøgelser. (Copenhagen, 1904-5.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—A statute was brought before Congregation on June 6 to provide a delegacy to superintend the instruction of candidates for the Indian Forest Service, and to grant diplomas in forestry. The proposal to establish a diploma in forestry in the university has arisen from the recent decision of the Secretary of State for India to send the Indian forestry students, hitherto trained at the Coopers Hill Engineering College, to receive their special training in forestry at Oxford. Those students under the regulations just issued by the India Office will be selected by a competitive examination held by the Civil Service examiners every summer. They must be natural born British subjects of not less than eighteen or more than twenty years of age on the January 1 before their selection. They will be required, before becoming candidates, to have passed Responsions or an equivalent examination. The subjects of the competitive examination will be:—(1) mechanics and physics; (2) chemistry; (3) zoology; (4) botany.

After selection the students will be probationers for about three years. For the first two years they will be required to study at Oxford, and their course will include theoretical and practical forestry, and subjects auxiliary to forestry, viz. organic chemistry and the chemistry of soils, geology, forest botany, forest entomology, mathematics, German, and book-keeping. During the third year of probation they will receive practical instruction, visiting Continental forests under suitable supervision. The first competitive examination will be held on August 29 for the selection of not less than nine candidates. Applications for admission must be made to the India Office by July 1.

The Junior Scientific Club gave a conversazione in the museum on Tuesday, May 30, at which more than a thousand visitors were present. Lectures and demonstrations were given by Prof. Poulton, Dr. Tutton, Dr. Brereton Baker, and Mr. E. P. Poulton, and there were a large number of scientific exhibits.

The Robert Boyle lecture for 1905 was given by Sir Victor Horsley on Monday, June 5, in New College Hall. The subject of the lecture was "The Cerebellum."

CAMBRIDGE.—A little pamphlet has just been published on the authority of the Vice-Chancellor containing the names of all those who voted on the report of the examinations and the way they voted. An analysis of the poll shows that amongst the resident members of the university 288 voted in favour of allowing a substitute for Greek in the previous examination and 240 against. Thus the residents had, out of a total of 528 votes, the substantial majority of 48; they were, however, swamped by the non-resident vote. Only four colleges, King's, Christ's, Trinity, and Downing, showed a majority amongst both residents and non-residents in favour of the proposed change.

Prof. Lewis gives notice that a course of lectures and demonstrations in crystallography will be given in the mineralogical lecture-room during the long vacation, beginning at 9 a.m. on Friday, July 7.

The observatory syndicate has reported upon the management of the sum of 5000*l.* bequeathed by the late Mr. Frank McClean for "improving the instrumental equipment of the Newall Observatory." It recommends that the sum be invested, and that the disposal of both the interest and, if advisable, the capital, be in the hands of the syndicate, and that the accounts be annually audited and published with the university accounts.

The special board of medicine has drafted ordinances which, if they pass the Senate, will allow a candidate for the M.B. or M.D., if resident abroad, to take his degree *in absentia*.

THE annual conversazione of University College, London, will be held on the evening of Wednesday, June 28. There will be scientific and other exhibits illustrating the work of the various departments of the college.

MR. E. BROWN, lecturer on applied mechanics at the University of Liverpool, has been appointed assistant professor in civil engineering and applied mechanics in the McGill University at Montreal.

DR. J. E. DUERDEN, of the University of Michigan, formerly curator of the museum, Jamaica, has been appointed professor of zoology at the Rhodes University College, Grahamstown, Cape Colony.

A COURSE of eight lectures in advanced zoology on "The Prosobranchiate Mollusca" is being given in connection with the University of London in the lecture room of the Chelsea Physic Garden by Mr. J. E. S. Moore on Mondays and Thursdays during June. There is no fee for the course; cards of admission and a detailed syllabus may be had on application to the academic registrar, University of London, South Kensington, S.W.

THE King has approved the charter for the constitution of the University of Sheffield. On June 3 the Pro-Chancellor formally handed over the charter to the Vice-Chancellor, Dr. Hicks, F.R.S., and congratulatory speeches were made. The King and Queen have consented to open the new university buildings in July. An endowment fund of about 140,000*l*. has been raised in Sheffield, and the City Council and the councils of neighbouring boroughs and counties have guaranteed annual rate aid equivalent to an even larger capital sum. The first Chancellor of the university is the Duke of Norfolk.

WE learn from *Science* that Prof. Asaph Hall, jun., has resigned the professorship of astronomy and directorship of the observatory at the University of Michigan. Prof. W. T. Hussey, of the Lick Observatory, has been elected his successor. Prof. S. J. Barnett, of Stanford University, has accepted the chair of physics at Tulane University, vacant by the resignation of Dr. Brown Ayres to accept the presidency of the University of Tennessee. At Williams College, Mr. W. E. McElfresh has been promoted to the Thomas T. Reed professorship of physics, and Mr. H. L. Clelland to a professorship in geology. M. Gabriel Bertrand has been appointed to succeed the late M. Duclaux as lecturer on biological chemistry at the Paris Faculty of Science.

IT is announced, *Science* states, that 360,000*l*. has been contributed toward the endowment of 500,000*l*. which is being collected to increase the present amount available for the salaries of the teaching staff of the college of Harvard University. The circular which appeals for additional subscriptions says:—"The position of Harvard to-day among American universities is due not so much to its age, traditions, or able administration as to its noble line of teachers. That the teachers in the college should be the best in the land; that the older professors should be free from the cares of a straitened income; that the younger teachers should be able to give themselves without distraction to their work, and that the best men should not be drawn away to other colleges, but should see before them reasonable promotion in work and salary, is essential to the leadership of Harvard and the culture of her sons." It is pointed out that the total of salaries in Harvard College is about 87,600*l*., and the average per capita allowance for the staff of 279 teachers is only 314*l*.

AN article entitled "Some Candid Impressions of England" is contributed to the current number of the *National Review* by a "German Resident." The first fact which strikes the contributor is the indifference of Englishmen to their individual duties as citizens of a great Empire, and it seems to him, looking at English schools, that the mainspring of German success is here. He says:—"Our youths, like your youths, are human, and would be lazy if there were no penalty for idleness. But the fact that those who are negligent and lazy at school have to put in an extra year of service, acts as a stimulus and compels the German boy to work, where the English boy spends his time in play." In another place:—"I look at England and see the want of such an influence even in your public schools, which are good in a way, so far as they form character, but bad in that they neglect intellect." As for our primary education, its product seems to the critic surprisingly bad. He says the knowledge imparted in our elementary schools does not seem to be such as is required for the making of good citizens. The majority of our workers, he remarks, read little but the sporting Press, and care for little but betting and sport. It is pointed out that the Germans have destroyed in this generation the superstition that Germany makes only poor and cheap articles. "Our Mercedes motors and scientific and optical instruments are the best and most expensive in the world, and no English article of their class can for a moment compete with them."

THE annual report of the council of the City and Guilds of London Institute was adopted at the yearly meeting of the institute held on June 1. The council directs attention to the diminished income of the institute, owing to the fact that the Mercers' Company, the Fishmongers' Company, and the Corporation have made reductions in their contributions. No reason, it is said, has been assigned for these reductions. At the invitation of the Lord Chancellor, a meeting of the representatives of the principal companies has been held to discuss the situation, and a resolution has been passed expressing a hope that the livery companies will increase, rather than diminish, their subscriptions. The total income for the past year, including donations for special purposes, amounted to 43,432*l*., of which the Corporation and the livery companies contributed 23,308*l*., the remainder coming from fees and other receipts. In the previous year the income was 46,829*l*., of which the Corporation and livery companies contributed 29,385*l*. Sir John Wolfe Barry, in his speech moving the adoption of the report, alluded to an interview with the chairman of the Departmental Committee on the Royal College of Science, South Kensington. He gathered that the general idea of the scheme which will be submitted to the council of the institute is a federation or coordination of all the teaching institutions which are gathered round about South Kensington, and when this takes place the institutions will be in intimate connection with the university. It is held that a system of this kind will be a very great benefit, not only to the general teaching given, but also to post-graduate teaching, which will be largely developed, it is hoped, in the future.

THE report of the Commissioner of Education for the year 1903 has now been published by the United States Bureau of Education. It contains in its 1327 pages an abundance of information concerning all grades of American education, and parts of the educational systems of other countries. It is only possible here to refer to a few of its contents. Dr. Charles F. Thwing, president of Western Reserve University, contributes a chapter on the development of American universities, their organisation, conduct, and relations to the life of the nation. The chapter shows that the growth of university endowment funds has kept pace in the United States with that of the wealth of the country at large. For example, the productive funds of Yale College have increased from about 600*l*. in 1830 to more than 1,000,000*l*. at the present time. The growth of libraries also has been significant in particular instances, yet Dr. Thwing says the "libraries of most colleges are inadequately furnished and inefficiently administered." The functions of universities in American communities are considered under various aspects. First, as conserving forces in the presence of a democracy inclined to make all things new; then as inspiring with high moral ideals an age inclined to pursue mere material aims. As an agency to promote systematic research—the seeking after truth as such—the university fulfils an increasingly useful function. It presents, as the chapter points out, materials for the study of all truth, in the world of nature and in the world of man. Another chapter of the report deals with education in France, and includes some interesting statistics concerning French universities. It appears that the registration in State universities has increased by about 60 per cent. since 1887, the total registration for 1901 being 29,931 students. The University of Paris greatly outnumbers all others in this respect, its total registration being 12,289 students. Lyons, with 2458 students, and Bordeaux, with 2119, stand next to Paris. As the distribution by faculties, law leads with 10,152 students, medicine follows with 8627, science comes third with 3910 students, and is closely followed by the faculties of letters with 3723 students.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 30.—"The Theory of Photographic Processes, Part ii. On the Chemical Dynamics of Development, including the Microscopy of the Image." By S. E. **Sheppard** and C. E. K. **Mees.** Communicated by Sir William Ramsay, K.C.B., F.R.S.

This paper forms a continuation of a preceding one on the kinetics of development (*Proc.*, lxxiv. pp. 447–473). By microscopical methods, the growth in the thickness of the reduced layer of silver particles, in their size and their number, under varying conditions of exposure and development, has been studied. For the structure of the developed negative the following facts were ascertained:—

(*a*) With constant development for a short time the depth of the image is independent of the exposure.

(*b*) With increased time the depth increases very rapidly at first, reaching a maximum for each exposure, after which it is constant, while the density of reduced silver still increases.

(*c*) With long development the depth increases somewhat with the exposure, a limit naturally being fixed by that of the film.

Size of the Grain.—This increases with the time of development, the *rate* being a function of the exposure, but the limiting size independent of this, and fixed by the original haloid grain. Thus in the early stages of development the size of the grain increases with exposure, but on ultimate development is independent of it.

Soluble bromides at moderate concentration give a smaller grain for the same time of development, but depending on the exposure. On ultimate development the size becomes the same.

Number of Grains Reduced.—In the surface-area the number is independent of the exposure, but in the volume unit for moderately long development the number increases with the exposure, and is nearly proportional to the density. It increases rapidly with the time of development, more so than the density, and soon reaches a maximum.

When plates are exposed through the glass side, the thickness of the reduced layer is much the same, but the numbers less. Further, the grains nearer the glass are larger, showing that the more exposed grains start development first. Generally, each grain develops as an isolated system, only uniting to form "aggregates" when the packing is close, as in high exposures. The true reaction-layer is in the gelatin skin surrounding the grain, its thickness being of the order 0·0005 mm., and the reaction is similar to the catalysis of H_2O_2 by colloidal metals, with convection excluded.

Early Stages of Development.—From considerations of the order of reactions the validity of the Watkins factorial method of development is discussed, and the "time of appearance" shown to be a measure of the development-velocity for the initial stage of development. For ferrous oxalate this initial velocity is shown to be proportional to the concentration.

Effect of temperature for ferrous oxalate can be represented by the formula of van 't Hoff, $\log K = -A/T + C$, but the temperature-coefficient for 10°, $K + 10°/K$, varies for different developers and emulsions, and cannot serve as a criterion for distinguishing rate of chemical action from diffusion in development.

It is further shown that "tanning" the film with formalin does not alter the development-velocity.

For the "penetration" of the developer, it was found that with plates exposed from the back the image appeared on the glass or film side first according to the exposure. This is explained by consideration of the micro-structure of the exposed film, and the conclusion is again obtained that the "re-activity" or readiness to start development of the individual grain is a steady function of the exposure.

From the absolute "time of appearance" of the image at the back it is concluded that the diffusion-induction is not great, especially since other considerations show that in the early stages of development the chemical reaction has more influence than diffusion.

Chemical Society, May 17.—Prof. R. Meldola, F.R.S., president, in the chair.—The desmotropic form of substances of the ethyl acetoacetate type in the homogeneous state and dissolved in neutral media: J. W. **Brühl** and H. **Schröder.** The authors claim to have established by optical measurements with solutions in various media that both the ethyl acetoacetates and their secondary and tertiary alkyl derivatives, and also the camphorcarboxylic esters and their alkyl derivatives, display a pure uniform ketonic structure, and are free from the enolic forms.—The chlorination of methyl derivatives of pyridine, part i., 2-methylpyridine: W. J. **Sell.** The compound C_6HCl_6N was obtained by chlorinating 2-methylpyridine in hydrochloric acid solution.—The absorption spectra of uric acid, murexide, and the ureides, in relation to colour and their chemical structure: W. N. **Hartley.** The ureides, diureides, and some oxypurin derivatives are divided by the characters of their absorption spectra into two groups, the oximino-ketones with no ethylenic linking associated with the carbonyl groups, and the substances which have one or more such linkings.—Observations on chemical structure and physical properties associated with the theory of colour: W. N. **Hartley.** The main feature in a coloured substance is the occurrence in two parts of the molecule of ethylenic and benzenoid groupings and of ketonic groupings. The explanation of colour, based on the change from a double linking (ketonic) to a single linking (enolic), should, if sound, be capable of explaining the occurrence of six bands in the spectrum of benzene, four in that of naphthalene, and four in that of anthracene. It is shown how this is possible from Kekulé's formula for benzene, and how this formula may be reconciled with the "centric" formula.—Further studies on dihydroxymaleic acid: H. J. H. **Fenton.** This paper describes the results of a study of the condensation of the acid with ammonia, and the behaviour of the acid and its esters towards various hydrazines.—The influence of light on diazo-reactions, preliminary notice: K. J. P. **Orton** and J. E. **Coates,** and (in part) F. **Burdett.**—Behaviour of solutions of propyl alcohol towards semi-permeable membranes: A. **Findlay** and F. C. **Short.** Some years ago Pickering stated that when a porous pot containing a 57 per cent. aqueous solution of propyl alcohol was immersed in either pure water or pure propyl alcohol, the water or the alcohol passed inwards to the solution. The authors have been unable to confirm Pickering's experiments, and suggest that the behaviour observed by him might be temporary and due to differences in the velocity of the diffusion of the pure liquids and the solution.—The thermal decomposition of formaldehyde and acetaldehyde: W. A. **Bone** and H. L. **Smith.** Formaldehyde decomposes at all temperatures between 400° and 1125° in accordance with the equation $CH_2O = CO + H_2$, and acetaldehyde at 400° in accordance with the equation $CH_3.CHO = CH_4 + CO$.—The synthesis of formaldehyde: D. L. **Chapman** and A. **Holt,** jun. The authors have succeeded in synthesising formaldehyde by maintaining a platinum wire at a high temperature in the following mixtures:—(*a*) carbon monoxide and hydrogen; (*b*) carbon monoxide, hydrogen, and steam; (*c*) carbon monoxide and steam; (*d*) carbon dioxide and hydrogen.—Oxymercuric perchlorates and the action of alcohol on mercury perchlorates: M. **Chikashigé.** Three new oxymercuric perchlorates are described.—The constitution of pilocarpine, part v., conversion of *iso*pilocarpine into pilocarpine: H. A. D. **Jowett.**

Royal Meteorological Society, May 17.—Capt D. Wilson-Barker, vice-president, in the chair.—Measurement of evaporation: R. **Strachan.** The author pointed out that the rainfall, evaporation, and percolation are related to each other, and that rainfall is commonly considered to form the sum of evaporation and percolation. If two of these quantities are found by experiment or observation, the other is assumed to be known. This, however, does not always hold good. A month may be very dry, and still evaporation will go on at the expense of previous percolation—and otherwise. A month may be excessively wet, then there may be another item to take into account, viz. overflow. As, unfortunately, it is not possible to make evaporation and percolation the subject of experi-

ment, except at a very few observatories, the author thinks it is desirable to be able to estimate, even empirically, the probable amounts of each. By using the meteorological data published for the Royal Observatory, Greenwich, he has calculated the probable evaporation for the year 1898, which agrees very closely with the observed evaporation at Camden Square and also at Croydon.—On a logarithmic slide-rule for reducing readings of the barometer to sea-level: J. **Ball.** This has been devised for the purpose of saving the time and labour usually occupied in working out the corrections from the international meteorological tables.

Royal Microscopical Society, May 17.—Dr. Dukinfield H. Scott, F.R.S., president, in the chair.—The movements of diatoms and other microscopic plants: D. D. **Jackson.** The author describes the observations and experiments made by him, some with artificial diatoms, which have led him to the conclusion that the movements referred to are caused by the escape of oxygen gas evolved in these organisms.

Faraday Society, May 18.—Dr F. Mollwo Perkin, treasurer, in the chair.—An application to electrolytes of the hydrate theory of solutions: Dr. T. Martin **Lowry.** The object of the paper is to consider the possibility of extending the hydrate theory to electrolytes in such a way as to take account of the observations which form the experimental basis of the theory of electrolytic dissociation. The hydrate theory postulates that an aqueous salt solution consists of a mixture of hydrates in equilibrium with the solvent and with one another. But it must be supposed that even in solution there is a limit to the possibility of hydrate formation, so that ultimately a stage will be reached at which the molecule as such will be unable to combine with any further quantity of water. The ionisation of an aqueous electrolyte consists essentially in a further process of hydration whereby the fully hydrated molecule combines with an additional quantity of water to form two or more hydrated ions. The hydration of the ions is thus conceived to be the primary cause of the ionisation of aqueous electrolytes. It is believed that this extension of the hydrate theory to the phenomena of electrolysis may help to remove the fundamental difficulty of Arrhenius's theory, namely, the absence of a motive for electrolytic dissociation.

Physical Society, May 26.—Meeting at the National Physical Laboratory by invitation of the director, Dr. Glazebrook.—The following special demonstrations were made:—The specific heat of iron at high temperatures: Dr. J. A. **Harker.** A knowledge of the specific heat of iron is important in the determination of high temperatures by calorimetric methods. Dr. Harker has determined the total heat of iron up to temperatures of 900° C. by heating the specimen in an electric furnace, the temperature of which was determined by a resistance thermometer, and dropping the iron into a water calorimeter. Dr. Harker also exhibited some new types of electric furnace for the attainment in absence of noxious gases of temperatures between 800° C. and 2200° C. The conductor conveying the electric current is a tube of solid electrolytes similar in composition to the filament of a Nernst lamp. An essential feature is that, for many purposes, the usefulness and life of a furnace constructed in this way may be much increased by adopting a "cascade" system of heating.—Apparatus for the measurement of small inductances: A. **Campbell.** The method of measurement is that adopted by Max Wien, and described by him in a paper on "Magnetisation by Alternating Currents" (*Wied. Ann.*, xiii., August, 1898). It is a modification of Maxwell's method of comparing two self-inductances, the source of voltage being alternating, and the indicating instrument a tuned optical telephone or vibration galvanometer.—Two new optical benches constructed for the laboratory by Messrs. R. and J. Beck: J. **Selby.** One of these is specially designed for the rapid testing of spherical and cylindrical lenses, such as are found in oculists' trial cases. The second bench is designed for the determination of the loss of light by absorption and reflection in telescopes and binoculars.

CAMBRIDGE.

Philosophical Society, May 1.—Prof. Liveing, vice-president, in the chair.—On the striation of the positive column in electric discharges: Prof. **Thomson.** The author considered the ionisation in a discharge tube by the collision of charged ions as well as of corpuscles against the molecules of a gas, and showed that if the pressure in the tube and the electric current through it had values situated between certain limits, there would be periodic alternations in the positive column analogous to striations.—On the calculation of the coefficient of re-combination of the ions and the size of the ions: Prof. **Thomson.** The re-combination of ions is due to oppositely charged ions attracting each other and forming a single system. When the ions are at a distance r apart the work required to separate them to an infinite distance is e^2/r, hence two ions starting from a distance r apart will not describe closed orbits about each other, *i.e.* will not combine if their kinetic energy is greater than e^2/r. Since the ions behave like the molecules of a gas, their kinetic energy will depend only upon the temperature, and can be calculated when that is known. If T is this kinetic energy, then for combination to take place e^2/r must be greater than T, or r less than e^2/T. Hence to find the number of re-combinations in any time, all we have to do is to find the number of pairs of ions which within that time get within a distance e^2/T of each other. This number, and hence the coefficient of re-combination, is easily calculated. If we assume that the ions in hydrogen are charged molecules of hydrogen, the coefficient of re-combination at 0° C. would be $1{\cdot}5\times10^{-6}$; the value found by experiment is about 10^{-6}, hence we conclude that the hydrogen ion is more complex than the hydrogen molecule. The kinetic energy due to temperature is shown to prevent the ions getting very much larger than the molecules; thus if the radius of the molecule were 10^{-8} cm., the radius of the ion could not exceed 3×10^{-8}.—Some physical properties of sodium vapour: P. V. **Bevan.** The experiments described in this paper were made to investigate the phenomena of the cloud of sodium vapour formed by heating a piece of metallic sodium *in vacuo* or in an atmosphere of hydrogen. In certain circumstances the sodium vapour forms a very sharply defined cloud with apparently a definite surface across which diffusion does not take place. The formation of this cloud, which was discovered by Prof. R. W. Wood, was found to be conditioned by the presence of water vapour in the atmosphere in which the sodium was heated. *In vacuo* the sodium vapour behaves like any other vapour, and in perfectly dry hydrogen there is no definite surface to the vapour observable when the sodium is heated. It was also shown that *in vacuo* the sodium begins to form vapour at the temperature of boiling water. The view is put forward that when the sodium cloud is seen on heating sodium in a vacuum tube the effect is due to the formation of an atmosphere of hydrogen occluded by the sodium and formed by the action of the sodium on sodium hydroxide.—A null method of measuring small ionisations: N. R. **Campbell.** Measurements have been made of spontaneous ionisations by adjusting the pressure of the air in a closed vessel containing a constant amount of uranium until the current through that vessel was equal and opposite to that through the spontaneously ionised gas. By this device certain difficulties connected with the measurement of capacity and the preservation of insulation are avoided.—The reflexion of sound at a paraboloid: Rev. H. J. **Sharpe.**

DUBLIN.

Royal Dublin Society, April 18.—Prof. J. A. McClelland in the chair.—Notes on the constitution of nitric acid and its hydrates: W. Noel **Hartley.** The author referred to a paper by him published in 1903 in the *Chem. Soc. Trans.* on the absorption spectra of nitric acid in various states of concentration. He had assigned the formula H_3NO_4 to normal nitric acid, and suggested that the several hydrates described were hydrates of this acid; but H. Erdmann, also in 1903, having isolated and described five nitric acids, the author was led to revise the formulæ of the hydrates in accordance with the constitution of these

compounds. The normal acid being pentabasic, $N(OH)_5$, there are several hydrates of this extending to

$$N(OH)_5.14H_2O.$$

Ordinary nitric acid of 1·42 sp. gr. consists entirely of the octobasic acid $(HO)_4N.O.N(OH)_4$, and the crystallisation of this was shown to the meeting by cooling the acid in liquid air.—The effect of very low temperature on moist seeds: John **Adams.** Seven species of moist seeds were submitted to the temperature of liquid air, with the result that they were all killed, while dry seeds were not adversely affected. The physiological processes involved were next considered, as well as the various theories put forward to account for death by freezing. An attempt was made to bring the results obtained into line with Macfadyen's experiments on bacteria, and the more recent investigations of Edwin J. Smith and Deane B. Swingle.—Injurious insects and other animals observed in Ireland during the year 1904: Prof. G. H. **Carpenter.** In this paper special attention is paid to Cecidomyiidæ, the pear-midge (*Diplosis pyrivora*, Riley) being recorded, and an account of *Rhabdophaga heterotia*, Loew., very destructive to osier beds in the county of Kilkenny, being given. Further instances are mentioned of Collembola injurious to plant roots and a new species of oribatid mite (*Lohmannia insignis*, Berlese) destructive to bean seedlings is described. The life-history of the well known mangold fly (*Pegomyia betae*, Curtis) is worked out in some detail.—Prof. **McClelland** made an addition to the communication he laid before the society at its February meeting.

EDINBURGH.

Royal Society, May 1.—Prof. Geikie in the chair.—The internal structure of *Sigillaria elegans* of Brongniart's "Histoire des Végétaux fossiles": R. **Kidston.** The primary xylon formed a continuous ring as in *S. elongata*, Bgt., described by Prof. Bertrand, but the protoxylon groups formed rounded projections, not pointed, as in *S. elongata*. The paper concluded with some general remarks on the development of the primary xylon of the Carboniferous lycopods, and the opinion was expressed that the solid stele was the most primitive type, followed by the continuous ring with a medulla, the series ending in that type of structure found in *S. spinulosa*, where the primary xylon assumes the form of a circle of isolated bundles.—The rainfall of the drainage area of the Talla reservoir: B. Hall **Blyth** and W. A. **Tait.** The observations had been carried out in connection with the new Edinburgh Water Works in order to obtain data for fixing an equitable compensation to the Tweed Salmon Fisheries Commissioners and other proprietors in the district. Seven gauges had been established at various levels, and observations had been taken continuously for seven years from 1896. The lowest gauge, at a height of 966 feet, gave an annual average of 61·43 inches, and the highest, at a height of 2627 feet, gave 65·53 inches, or only 0·41 per cent. per 100 feet rise. The greatest average was given by the gauge at the height of 1537 feet, the value being 73·92 inches. These facts showed that the rainfall was greatly affected by the exposure to prevailing winds and the character of these winds, quite apart from the effect of height. The extent of the drainage area was 6180 acres, and the average annual rainfall, as estimated from the observations, was nearly 14,600,000 gallons per day, of which one-third had to be given off as compensation.—The rainfall records in the Talla drainage area from 1896 to 1902: P. D. **Donald.** This contained further discussions of the records. The observations of rainfall were being continued by the Water Trust, and it was hoped that the information so gained would be of special value to all interested in water supply.—Variant forms of vanishing aggregates of minors of axisymmetric determinants: Prof. **Metzler.**

PARIS.

Academy of Sciences, May 29.—M. Troost in the chair.—The exact transmission of time by the telephone: E. **Guyou** (see p. 134).—On cyanocampho-acetic, cyanocampho-α-propionic, cyanocampho-α-butyric acids and their principal derivatives: A. **Haller** and A. **Couréménos.** The sodium derivative of cyanocamphor reacts with the methyl and ethyl esters of the α-monochlor- and monobromo fatty acids similarly to the alkyl iodides and bromides previously studied, the camphor derivative behaving as if it possessed the enolic form. These new compounds can be saponified by alcoholic potash, furnishing the corresponding acids, several esters, salts, and amides being described in detail.—The oscillations of locomotives under the action of various disturbing forces: Georges **Marié.** A study of the conditions under which the oscillations may accumulate to a dangerous amplitude, and of the means of avoiding these conditions in practice.—On the continued algebraical fractions of Laguerre: R. de Montessus **de Ballore.**—On partial differential equations of the elliptic type: S. **Bernstein.**—On the interpolation of continuous functions by polynomials: Martin **Krause.**—The electrolytic production of very fine wires: Henri **Abraham.** Starting with a fine drawn wire of a given material, the metal is removed electrolytically in a suitable bath, the resistance of the wire being measured during the experiment, the increase of the resistance giving an exact measure of the reduction of the diameter. For the production of uniform wires it is necessary that the electrolysis be conducted very slowly, and the method proved very successful for the purpose in view.—On tangential irradiation: A. **Guébhard.** A discussion of the mechanical and electrical theories as to the cause of photographic irradiation.—The examination of phosphorus sulphide for the presence of free white phosphorus: Léo **Vignon.** The Mitscherlich reaction (distillation with water) is useless for detecting free phosphorus in commercial phosphorus sulphide; the removal of the free phosphorus by heating in a current of hydrogen proved more serviceable.—On a reaction with discontinuous velocities of the green sulphate of chromium: Albert **Colson.**—On some physical properties of propane: Paul **Lebeau.** Pure propane was obtained from three sources, normal propyl iodide, isopropyl iodide, and isopropyl chloride, the final purification being effected in all three cases by fractional distillation of the liquefied gas. It remained liquid at the temperature of liquid air (−195°), boiled at −44°·5 C., and had a critical temperature of 97°·5 C., the critical pressure being 45 atmospheres. Propane is soluble in several reagents, its solubility being much greater than either methane or ethane. It is interesting to note that although propane does not solidify at −195° C., methane, its lower homologue, is crystalline at −184° C.—On methyl-acetyl-carbinol: André **Kling.** This acetol can be obtained by the oxidation of 2 : 3-butanediol by the action of the sorbose bacterium and by *Mycoderma aceti*. The resulting keto-alcohol is dextrorotatory, the oxidation proceeding at the expense of the lævo-form. The semicarbazone is well crystallised and readily isolated, and forms the best means of identifying this substance.—On the oxide of methoethenylbenzene: M. **Tiffenau.**—Syntheses in the anthracene series. The condensation of derivatives of benzodihydrofurfurane into γ-substituted anthracene derivatives: A. **Guyot** and J. **Catel.**—On methylnatalœmodine and natalœmodine: E. **Léger.** The name natalœmodine is given to a trioxymethyl-anthraquinone obtained by the action of sodium peroxide upon the aloin from Cape aloes. Details are given of its properties and the preparation of some of its derivatives.—On the acidity of some ethyl alcohols of commerce and on the variations in acidity at the ordinary temperature: René **Duchemin** and Jacques **Dourlen.** Alcohol slowly oxidises in the presence of air at the ordinary temperature, acetic acid being formed. The amount formed depends on the nature of the containing vessel.—The conductivity of colloidal solutions: J. **Duclaux.** A solution of a colloid can be filtered through a collodion film, crystalline substances passing readily through such a filter, the colloid remaining behind. It was found that the conductivity of the concentrated solution of the colloid was appreciably greater than that of the filtrate. From the results of the measurements it was calculated that the electric charge on each particle of colloidal ferric hydrate was about 1/500th of that corresponding to the gram-valence of an ion.—On the presence of noumeite in the detritic state in the neo-Caledonian Eocene: M. **Deprat.**—The wild coffee trees of French Guinea: A.

Chevalier.—On *Oidium lactis* and the ripening of cream and cheese: J. **Arthaud-Berthet.**—On *Stearophora radicicola*, a fungus of the roots of the vine: L. **Mangin** and P. **Viala.**—The pathogenic action of *Stearophora radicicola* on animals: MM. **Charrin** and **Le Play.**—The phenomena of sexuality in the development of the Actinomyxides: M. **Caullery** and F. **Mesnil.**—The histological phenomena of asexual reproduction in Salmacina and Filograna: A. **Malaquin.**—Some variations in the coefficient of demineralisation in animals in a state of acid dyscrasia: A. **Desgrez** and Mlle. Bl. **Guende.**—The experimental reproduction of human cancer: M. **Mayet.**—On distemper in dogs: H. **Carré.**—On the geology of the Piedmont zone: Maurice **Lugeon** and Émile **Argand.**

DIARY OF SOCIETIES.

THURSDAY, JUNE 8.

ROYAL SOCIETY, at 4.30.—Researches on Explosives. Part III.: Sir Andrew Noble, Bart., K.C.B., F.R.S. (1) On the Thermoelectric Junction as a Means of Determining the Lowest Temperatures; (2) Studies with the Liquid Hydrogen and Air Calorimeters: Sir James Dewar, F.R.S.—Colours in Metal Glasses, and in Metallic Films and Metallic Solution: J. C. Maxwell Garnett.—On the Application of Statistical Mechanics to the General Dynamics of Matter and Ether. The General Method of Statistical Mechanics: J. H. Jeans.—On the Magnetic Qualities of some Alloys not containing Iron: Prof. J. A. Fleming, F.R.S., and R. A. Hadfield.—On the Phosphorescent Spectra of Sm and Europium: Sir William Crookes, F.R.S.—On the Perturbations of the Bielid Meteors: Dr. A. M. W. Downing, F.R.S.—The Asymptotic Expansion of Integral Functions defined by Taylor's Series: Rev. E. W. Barnes.—Preliminary Note on Observations made with a Horizontal Pendulum in the Antarctic Regions: Prof. J. Milne, F.R.S.—Note Supplementary to a Paper "On the Radio-active Minerals": Hon. R. J. Strutt, F.R.S.—The Morphology of the Ungulate Placenta, particularly the Development of that Organ in the Sheep, and Notes upon the Placenta of the Elephant and Hyrax: R. Assheton.—A Preliminary Communication on the Life History of *Trypanosoma balbianii*: W. S. Perrin.—On the Effect of Carbon Dioxide on Geotropic Curvature of the Roots of *Pisum Sativum*: E. Drabble and Miss H. Lake.—The Pharmacology of Indaconitine and Bikhaconitine: Prof. J. T. Cash, F.R.S., and Prof. W. R. Dunstan, F.R.S.—Preliminary Note on the Occurrence of Microsporangia in Organic Connection with the Foliage of Lyginodendron: R. Kidston, F.R.S.—Chitin in the Carapace of *Pterygotus Osiliensis* from the Silurian of Oesel: Dr. Otto Rosenheim.—(1) The Synthesis of a Substance allied to Adrenalin; (2) On the Physiological Activity of Substances indirectly allied to Adrenalin: Dr. H. D. Dakin.

ROYAL INSTITUTION, at 5.—Electromagnetic Waves: Prof. J. A. Fleming, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—On a Class of Many-valued Functions Defined by a Definite Integral: G. H. Hardy.—On the Condition of Reducibility of any Group of Linear Substitutions: Prof. W. Burnside. On Criteria for the Finiteness of the Order of a Group of Linear Substitutions: Prof. W. Burnside.

FRIDAY, JUNE 9.

ROYAL INSTITUTION, at 9.—Submarine Navigation: Sir William White, K.C.B., F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Meteors from Biela's Comet: W. F. Denning.—On the Formula for connecting Diameters of Photographic Images with Stellar Magnitude: H. H. Turner.—(1) The Moon's Observed Latitude, 1847–1901; (2) On the Discordant Values of the Principal Elliptic Coefficients in the Moon's Longitude: P. H. Cowell.—Determinations of Stellar Parallax from Photographs taken at the Cambridge Observatory. Introductory Paper: A. R. Hinks and H. N. Russell.—The Most Probable Position of a Point determined from the Intersections of Three Straight Lines: S. A. Saunder.—On the Relative Efficiency of Different Methods of Determining Longitudes on Jupiter: A. Stanley Williams.

SATURDAY, JUNE 10.

ROYAL INSTITUTION, at 3.—Exploration in the Philippines: A. H. Savage Landor.

WEDNESDAY, JUNE 14.

MINERALOGICAL SOCIETY, at 8.—The Chemical Composition of Lengenbachite: Dr. A. Hutchinson.—The Identity of the Ancient Amiantos of Cyprus with Chrysotile: Dr. J. W. Evans.—The Chemical Composition of Hutchinsonite: G. T. Prior.

CHEMICAL SOCIETY, at 5.30.—Influence of Various Sodium Salts on the Solubility of Sparingly Soluble Acids: J. C. Philip.—The Dielectric Constants of Phenols and their Ethers Dissolved in Benzene and *m*-Xylene: J. C. Philip and Miss D. Haynes.—Synthesis by Means of the Silent Electric Discharge: J. N. Collie.—The Ultra-violet Absorption Spectra of Benzene and Certain of the Mono-substituted Derivatives: E. C. C. Baly and J. N. Collie.—Association in Mixed Solvents: G. Barger.—The Ultra-violet Absorption Spectra of Derivatives of Benzene. Part II. The Phenols: E. C. C. Baly and Miss E. K. Ewbank.—The Action of Water on Diazo-salts. A Preliminary Note: J. C. Cain and J. M. Norman.—Synthesis of Substances Allied to Epinephrine: G. Barger and H. A. D. Jowett.—A Precise Method of Determining the Organic Nitrogen in Potable Waters: J. Campbell Brown.—Synthesis of 1:1-Dimethyl-Δ^3-tetrahydrobenzene: A. W. Crossley and Miss N. Renouf.—Bromine in Solutions of Potassium Bromide: F. P. Worley.

THURSDAY, JUNE 15.

LINNEAN SOCIETY, at 8.—Biscayan Plankton. Part VI. Colloid Radiolaria: Dr. R. N. Wolfenden.—Biscayan Plankton. Part VII. Mollusca: Dr. P. Pelsener.—(1) Longitudinal Nerves and Transverse Veins in Bamboos; (2) Some Indian Undershrubs: Sir D. Brandis, K.C.I.E., F.R.S.—Notes on a Skeleton of the Musk-duck, *Bizuria lobata*: W. P. Pycraft.—*Exhibitions: Arum maculatum*, in Relation to Insects (with lantern slides): Rev. J. Gerard, S.J.

FRIDAY, JUNE 16.

PHYSICAL SOCIETY, at 8.—On the Ratio between the Mean Spherical and Mean Horizontal Candle-power of Incandescent Lamps: Prof. J. A. Fleming, F.R.S.—The Electrical Conductivity of Flames: Dr. H. A. Wilson.—Contact with Dielectrics: R. Appleyard.—The Pendulum Accelerometer, an Instrument for the Direct Measurement and Recording of Acceleration: F. Lanchester.—A New Form of Pyknometer: N. V. Stanford.—Exhibition of a Refractometer: R. Appleyard.

MALACOLOGICAL SOCIETY, at 8.—Lecture on the Prosobranchiate Mollusca: J. E. S. Moore.—On the Extension of the Genus Macrochlamys to the Island of Mauritius: Lieut.-Col. H. H. Godwin-Austen.—Mollusca of the Porcupine Expeditions, Supplemental Notes, Part II.: E. R. Sykes.—On a Small Collection of Mollusca from Tierra del Fuego: E. A. Smith.—On two Miocene Gastropods from Roumania: R. Bullen Newton.—Revision of the New Zealand Patellidæ, with Descriptions of a New Species and Subspecies: Henry Suter.—The Conchological Writings of Captain Thomas Brown: C. Davies Sherborn.

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