THURSDAY, JUNE 19, 1902.

THE PLACE OF LAMARCK IN THE HISTORY OF EVOLUTION.

Lamarck, the Founder of Evolution; his Life and Work. With Translations of his Writings on Organic Evolution. By Alpheus S. Packard, M.D., LL.D., Professor of Zoology and Geology in Brown University, &c. Pp. xiv + 451. (London and New York: Longmans, Green and Co., 1901.) Price 9s. net.

THE name of Lamarck has of late been much in people's mouths. Now that the doctrine of organic evolution has secured acceptance from all those who are qualified to form an opinion on the subject, an attempt is being made in some quarters to deprive Darwin, the real hero of the campaign, of at least a portion of his laurels, and to bestow them on a leader of inferior rank and far lower achievement. It cannot be doubted that this attempt is, in the long run, doomed to failure; but in the meantime there is considerable danger of an unwholesome reaction among those who have not perfectly comprehended the points at issue.

It is often forgotten that the idea of "special creation," or, as we should rather say, of the "immutability of species," is one of comparatively recent growth. Before the seventeenth century the current notions on this subject were by no means rigid, while the terms "genus" and "species," in their technical use, were the exclusive property of logicians. It is not until the time of Ray that we find the latter term borrowed by a naturalist in order to give precision to a conception which was then a novelty to the scientific mind. The definition of natural species in the Linnæan sense would have sounded as strange in the ears of Francis Bacon as would the denial of spontaneous generation. The work of Ray, Linnæus and Cuvier, greatly as it assisted the cause of science, carried with it a fatal defect. It left order where it had found confusion, but in substituting exactness of definition for the vague conceptions of a former age, it did much to obscure the rudimentary notions of organic evolution which had influenced naturalists and philosophers from Aristotle downwards.

Nevertheless, the old transformist beliefs, though no longer popular, were not left quite without a witness. Buffon, being possibly influenced by considerations other than scientific, vacillated, as is well known, between the theories of mutability and fixity of species. Erasmus Darwin, on the other hand, was a vigorous and outspoken upholder of the transformist opinion, shorn of some, but not all, of its former crudities. Geoffroy St. Hilaire declared in favour of the derivation of different species from the same type; and six years later Lamarck, who had previously taught the fixity of species, announced his adherence to the evolutionary view. The author of the "Vestiges of Creation" and Herbert Spencer may be said in some sort to have carried on the transformist succession, but it was reserved for Charles Darwin and Alfred Russel Wallace to import into the problem an entirely fresh set of considerations, and by means of a new and illuminating theory, supported on a secure basis of fact, to win universal acceptance for a doctrine which all the skill and eloquence of its former advocates had failed to commend to the scientific world.

Prof. Packard, on the title-page of the present work, calls Lamarck "the founder of evolution." If the foregoing may be taken as a not unfair presentment of the course of opinion on the subject of transformism, it is difficult to see how such a claim can be justified. It is idle to discuss whether or not Lamarck was acquainted with the works of Erasmus Darwin. Transformism was in the air, and it is impossible to credit Lamarck with the origination of a view which had been present to the minds of Geoffroy St. Hilaire and of Buffon. Neither can it be said that Lamarck's advocacy won general approval for a doctrine that was previously discredited. The strength of his own convictions and the persistence with which he urged them are not in question; but the fact that he failed to convert either his contemporaries or his successors is equally indisputable. The only ground on which, if on any, the claim advanced on behalf of Lamarck can be sustained is the allegation that he was the first to render the doctrine of transmutation credible by pointing out the methods on which organic evolution has proceeded. Much, no doubt, depends on the acceptance or rejection of the so-called "Lamarckian factors." In the earlier stages of the present phase of the evolutionary controversy, these factors were somewhat uncritically accepted as adjuvants to the theory of natural selection propounded by Darwin and Wallace. But when the belief in the inheritance of acquired characters had once been seriously called in question, it was speedily perceived that no logical necessity existed for evolutionists to accept these factors at all. The question became clearly one of evidence; and in the opinion of many, if not most, of the leaders of scientific thought, the upholders of the Lamarckian view have so far failed to deal successfully with the burden of proof that undoubtedly rests upon them. The hereditary transmission of individually acquired characters is a necessary part of the Lamarckian system, and until this point is established to the satisfaction of scientific opinion, it is at least premature to hail Lamarck as in any sense the founder of organic evolution. And even should the proof be forthcoming, the facts would still remain that many of Lamarck's views had been already foreshadowed, that his system contains much speculation unsupported by adequate evidence, and much that is demonstrably erroneous; moreover, that it failed in any appreciable degree to influence his contemporaries.

It is hardly necessary to point out how complete a contrast to this is afforded by the history of Darwinism. Founded on a basis of observation and experiment to which the Lamarckian speculations can lay no claim, and calling in the aid of a principle—that of natural selection—which, given the observed facts of variation, actually showed how the adaptation everywhere manifest in nature might have been brought about, the Darwinian system supplied an element of rationality which had hitherto been absent, and compelled the attention of those to whom the unsupported hypotheses of previous transformists had failed to appeal. The importance of Darwin's work is seen in its results. Under the influence of the "Origin of Species," Huxley, Lyell, Hooker and Asa Gray ranged themselves on the side of evolution;

the whole of the scientific world, with few exceptions, followed their example, and before his death Darwin had the satisfaction of knowing that the doctrine of evolution had become almost a commonplace in the minds of the reflecting and cultivated portion of the community.

Lamarck was unquestionably a capable, industrious and enthusiastic naturalist. He possesses the merit of having grasped the truth of organic evolution, though his views as to its methods were crude and his arguments in its favour unsubstantial. He also carried out the principle on a far larger scale and with greater amplification of detail than did any of his transformist predecessors, and to him we owe the first attempt at the construction of a scheme of phylogeny. But while we readily allow all this, it seems to us, for the reasons above given, that in the present work the importance of Lamarck and of his contribution to the progress of evolutionary theory is greatly over-estimated. Nevertheless, in putting before us within reasonable compass a careful and critical account of the little that is known of the life and circumstances of Lamarck, and of his relations with the leaders of scientific thought in France during a period which is full of interest, Dr. Packard has done real service. He seems inclined to complain that writers on evolution "do not know their Lamarck." Whether this be true or not, the extracts from Lamarck's writings here given are so representative and so copious that there will in future be no excuse for ignorance as to what Lamarck's tenets really were. It may be doubted whether the well-known chapters in Lyell's "Principles" do not really contain all that is requisite for forming a working estimate of the Lamarckian doctrine. But there are some to whom, for various reasons, a more extended acquaintance with this doctrine will be necessary, and who yet possess neither the time nor the opportunity for attacking the works of Lamarck in their original form. To such readers, if they are willing to show indulgence towards a certain amount of needless repetition and some occasional inaccuracy in translation and other matters, Dr. Packard's interesting and thorough-going volume may be recommended with confidence. F. A. D.

ELEMENTARY CHEMISTRY.

Elementary Inorganic Chemistry. By James Walker, D.Sc., Ph.D., F.R.S. Pp. 265. (London: George Bell and Sons, 1901.) Price 3*s.* 6*d.*

Experimental Chemistry. By Lyman C. Newell, Ph.D., State Normal School, Lowell, Mass. Pp. xv + 410. (London: D. C. Heath and Co., 1902.) Price 5*s.*

Elementary Experimental Chemistry. By W. F. Watson, A.M., Furman University, South Carolina. Pp. 320. (New York: A. S. Barnes and Co., 1901.) Price 7*s.* net.

THE first of these books may be said to meet a distinct want, felt in this case by others than the author, and to meet it extremely well. It is an elementary treatise on chemistry imbued with the spirit of the times, but written with restraint and marked by the lucid and philosophic style characteristic of the best class of scientific writing. It is not an ancient garment embroidered with new ions, nor is it an aggravated *bouleversement* of the chemistry that was presented to us twenty years ago. It would probably do most chemists good to read it, and it is admirably adapted as a first college book for students. It contains the essentials of chemical theory and a really judicious selection of chemical facts, and it is to be commended, perhaps, most of all to examiners, whose sins in asking for unimportant facts abate but slowly. It is no book for those who have to charge their memories with Dutch liquid, puce-coloured oxide of lead and powder of Algaroth; yet it does not relegate the conception of mass action and reversible changes to a period of grave and senior study. It is, in fact, a book which can be unreservedly recommended, and Prof. Walker deserves our thanks for having written it.

Dr. Newell's book is a thoughtful and interesting attempt to improve upon the older kind of text-book, and the author endeavours to interweave a laboratory course with adequate descriptive matter. It is difficult to judge such a book fairly without putting it to practical use, but there seems every prospect that by using it as the author intends it to be used the student would be brought to the right view of chemical science and to a sound knowledge of the leading principles and facts. The book abounds in practical and theoretical problems, and encouragement is given to the discussion of laboratory results in class—a most valuable form of teaching. There is a tendency in books of this kind for some of the statements, questions and injunctions to become a little puerile, and to conjure up a picture of ingenuousness which, in the present writer's experience, is not often found in real life, at least among male students. However, there is not very much to complain of in this way. The book has obvious merits, and the author may fairly claim that it deserves a trial.

The third work under review is intended especially for students who only take one short course of chemistry. A reviewer will, according to his disposition, be either intimidated or exasperated by the author's statement that he is "profoundly grateful to ten different educators for reading the proof sheets and making valuable suggestions." To make any objections after this announcement seems perhaps rash; but at whatever cost, the author and the ten educators must be faced with the statement that to an eleventh educator the book has proved disappointing. The introduction to the work comprises ten pages, and it consists of a series of statements defining matter, chemical compounds and mechanical mixtures, atoms, molecules, indestructibility of matter and conservation of energy. It is difficult to know what purpose is served by confronting the student at the very outset of chemical study with a series of dogmas such as are found here. The idea of the atom, for instance, is introduced by the statement that "a single symbol as C and Cl indicates *one atom* of the element." Immediately upon this comes "An atom is the smallest portion of matter that can take part in a chemical change. It is indivisible."

The atom being thus disposed of, the molecule is dealt with in like fashion. It is really astonishing to find this kind of thing in a book with such pretensions as are set forth in the preface. The rest of the book is of the same mould; there is nothing to distinguish it from dozens of other elementary chemical books of the kind that in this country have had their day and are happily ceasing to be. A careful perusal has disclosed nothing that can give a well-intentioned critic occasion to say "this is a happy idea—that is capitally put—this is something to help us." On the contrary, if this book were to be reviewed in detail, it would be necessary to write columns of complaint. One feature of novelty appears in the book in the form of full-page illustrations of apparatus and materials used in all the experiments. These pictures are reproduced from photographs, and show three tiers of apparatus arranged as if for sale. In many cases it is not easy for an experienced chemist to recognise the individual pieces, and in plate xx. we reach a climax. It represents on the top shelf two tin canisters, a stoppered bottle, a Bunsen burner, a beaker, a tin dish, a blowpipe and another stoppered bottle. On the next shelf are three stoppered bottles, a hammer, four tin canisters, a small structure like a dog kennel, and a rack of twelve test-tubes. On the bottom shelf are two developing trays, a beaker, a stoppered bottle, a sugar basin, a stone gingerbeer bottle, a pocket handkerchief and apparently a bank-note or a shirt cuff. The plate bears the legend "The Metals." By the use of a lens one word of two of the labels can be deciphered.

A. S.

SOLID GEOMETRY.

The Elements of Euclid, Book XI. By R. Lachlan, Sc.D. Pp. 51. (London: Edward Arnold, n.d.) Price 1*s.*

IT is to be hoped that some of the scientific committees which are now dealing with the improvement of mathematical teaching, and more especially with that of the teaching of elementary geometry, will, in the process of pruning Euclid, direct attention to this little-read Book xi. As in other books of the Elements, many of the propositions are of the trivial, or even ludicrous, character, while some of the definitions lack precision. For example, can prop. 1—"one part of a straight line cannot lie in a plane and another part without the plane"—be seriously regarded as necessary? Indeed, the proof assumes the thing which it seeks to prove: let A B C be the given straight line; let a part of it, A B, lie in the plane, and a part, B C (if possible), out of the plane; produce A B *in the plane* to any point, D, &c. To this several other instances might be added.

Then as regards definition, the descriptions of dihedral, trihedral and (generally) polyhedral angles leave something to be desired. Possibly some better term than *angle* can be found in such cases. We are told that "when two planes meet and are terminated at their line of intersection, they are said to form a dihedral angle"; "when several planes meet in a point, they are said to form a polyhedral angle." All that such planes visibly "form" is a certain figure; the "angle" which they form (as it is employed in subsequent mathematics) is, in reality, an *area* on a sphere of unit radius. It is true that Book xi. is not concerned with this precise quantitative definition of (so-called) *solid angles*—better called *conical angles*—but merely with certain plane, or face, angles connected with them; nevertheless, it may be desirable to give the student, who when he reaches Book xi. can scarcely be called a *beginner*, this quantitative notion.

In the small compass of this book there is little opportunity for anything strikingly original or novel. Dr. Lachlan finishes it with an appendix which contains a large number of propositions, examples, &c., and this appendix will be found much more valuable than Book xi. itself.

A few criticisms of a minor character may not be out of place. We notice that in the enunciation of each proposition, Dr. Lachlan always uses the simple word "is" or "are" when the proposition states a fact which can be proved; thus, "if two planes intersect, their line of intersection is a straight line." The typical editor of a modern Euclid would say "their line of intersection *shall be* a straight line," employing a ridiculous compulsory form of expression. There is now the beginning of a revulsion against this style, which has been considered for some curious reason to be appropriate and essential to Euclid, but to no other subject of study or conversation. So far, Dr. Lachlan is in agreement with common sense; but why does he, when setting out on the proof of the proposition, re-state the fact with a "shall be"? Twice he forgot his rule—in prop. 1, where "must be" is employed, and prop. 14, where the simple and sensible "are" of the formal enunciation remains "are" in the re-statement.

The proof of prop. 20 would avoid a tendency to mislead the student if it stated that the point C is first taken (arbitrarily), then E, and finally B and D by drawing *any* line, E B D, through E.

In the third line of the proof of prop. 21, the proof is rendered very much more clear by the insertion of the word "all" before the words "the ∠s," the statement then being the very obvious one that if there are two sets of fifty plane triangles, the sum of all the angles in the first set is equal to the sum of all those in the second set.

Finally, the employment of the word "power" in the definition (p. 536) "the square on the distance between a point and the centre of a sphere less the square on the radius of the sphere is called the power of the point with respect to the sphere" does not seem justifiable or necessary, although it has been employed by a geometer of high repute. The word *power* is already employed in science for something quite different from the square of a tangent. Indeed, a student of electricity might be tempted to think that this geometrical "power of points" is a mere pun on the well-known term used in connection with frictional machines. Everything must not be sacrificed to brevity; if new terms are wanted in science, they should be appropriate and expressive.

BELGIAN BOTANICAL INVESTIGATIONS.

Recueil de l'Institut Botanique (Université de Bruxelles). Par L. Errera. Tome v. Pp. xii + 357. (Bruxelles: Henri Lamertin, 1902.)

IN this book there are brought together recent papers by botanists of the Royal Academy of Belgium, which have already been published in different journals during the last two years. Although this is the first volume to be published, it appears as vol. v., since the first four volumes will be given up to earlier papers. Thus the five volumes will provide a systematic record of various lines of research, mainly physiological, which have been the subjects of investigation in the Botanical Institute of Brussels.

The nature of the alkaloids found in plants and the methods of localising them is one of these subjects, and in the present volume there are two papers dealing with those bodies, the one by the late M. George Clautriau, on "The Nature and Significance of Alkaloids in Plants," the other by E. Vanderlinden, treating of alkaloids in the Ranunculaceæ. A considerable part of Clautriau's paper is historical, the present research being confined to caffeine obtained from coffee and tea plants. Having previously studied the alkaloids in various other plants, he is well qualified to summarise our present knowledge of them. Although alkaloids have only been located in a limited number of plants, Clautriau considers that they are probably formed in all plants, but not always in sufficient quantity to be stored up. Alkaloids derived from purine bases are found throughout the whole range of plants, while those derived from a pyridine base are confined almost exclusively to Angiosperms. Definite microchemical tests for alkaloids are wanting; thus Clautriau was unable to obtain any which would enable him to detect caffeine *in situ*. He concludes that alkaloids are decomposition products formed in the breaking down of proteids; that they can be worked up again, but this requires a considerable expenditure of energy, and that generally their function is to protect the plant. Vanderlinden's results are quite in harmony with Clautriau's views. He finds that the amount of alkaloid present in a plant is liable to fluctuations, these depending upon the phase of vegetation and the nature of the soil. Curiously, Ranunculus and Clematis, two genera well known to possess toxic properties, yield no alkaloid.

In a second paper, Clautriau describes his experiments on pitcher-plants, some of which were performed on plants in their natural habitat in Java, others after his return to Brussels. Vines, who has reinvestigated the subject on the strength of Clautriau's results, does not confirm them, but decides that the ferment is tryptic, not peptic.

In the course of his experiments on the permeability of protoplasm to liquids at different temperatures, van Rysselburgh disproves the view held by Schwendener and others that protoplasm is not permeable to water at 0° C.; in fact, he finds that it is permeable to potassium nitrate, urea, methylene-blue, &c., at the same temperature. Another important observation was made that the sap in a cell if isotonic with a certain solution at any temperature will be isotonic with it for all temperatures.

M. Jean Massart advances some decidedly unconventional ideas on the phylogeny of the lower organisms, which presumably have originated during his investigation of the protoplasm of the Schizophyta. His deductions as to the nature of the central body in the Schizophyceæ and the stainable bodies in Bacteria are somewhat convincing, but at present many problems of the nucleus seem to be beyond our powers of solution. The last few pages of the publication are devoted to the description of a gigantic Bacterium, *Spirillum colossus*, obtained by Prof. Errera from an ancient moat.

OUR BOOK SHELF.

Dynamos, Alternators and Transformers. By Gisbert Kapp. Translated from the third German edition by H. H. Simmons, A.M.I.E.E. Pp. v + 503. (London: Biggs and Co.) Price 10*s*. 6*d*.

Étude Pratique sur les Différents Systèmes d'Éclairage. By J. Defays and H. Pittet. Pp. 168. (Paris: Gauthier-Villars, n.d.) Price fr. 3.

MR. KAPP'S book has passed through a somewhat curious development. Originally written in English, it first appeared in German as a translation; subsequently Mr. Kapp revised, and to a large extent re-wrote, the German translation, the revised book appearing as the third German edition in 1899. It is this work which has now been translated by Mr. Simmons. The general merits of the book are probably known to most electrical engineers; those who are only familiar with the earlier English edition will find much that is new and valuable in the one now before us. After some opening chapters on the electric and magnetic theory underlying the design of dynamos, the winding of armatures is considered in detail in a couple of chapters well illustrated by diagrams. The next chapter deals with field magnets, after which armature reaction, commutation and sparkless collection are considered at some length. Some typical examples of direct-current machines are described, but at no great length, as this ground has already been covered by Mr. Kapp in his "Dynamo Construction: Electrical and Mechanical." The remainder of the book deals in a similar manner with alternators, synchronous and asynchronous motors, and rotary converters. Graphical methods are employed in this part to a considerable extent; the mathematical treatment throughout the book is clear and concise, a certain familiarity with the differential and integral calculus being assumed in the reader. As a whole the work forms a most valuable text-book for the student of this branch of electrical engineering.

It will be noticed that the book does not deal at all with transformers; this is because a separate work on this subject has been published by the author, a fact which is stated in the preface. Yet in spite of this, the title as it appears on the cover and page headings is "Dynamos, Alternators and Transformers," which is, to say the least, misleading. On the title-page a different, and more accurate, name is given to the book. This defect is to be regretted, as it mars an otherwise excellent work.

MM. Defays and Pittet's volume cannot fail to prove attractive to those who are interested in the problems of artificial lighting. The authors have aimed at providing a practical guide to those who are called upon to select, as, for example, for lighting a factory, a suitable system of illumination. Naturally, in such a case, the question of relative cost is of prime importance; the authors have, however, rightly abstained from dwelling too strongly on this point, as not only is the price so largely a question of locality, but it is often very difficult, if not impossible, to decide what is the monetary equivalent of the advantages which one illuminant possesses over another. The whole subject of artificial illumination is first dealt with in a general manner, the considerations of importance in relation to different conditions of use being pointed out. After this, separate chapters are devoted to a detailed examination of lighting by gas, acetylene, oil, alcohol and electricity. The principles underlying each system are expounded clearly and not too technically, and its security, healthiness and efficiency are discussed. From the hygienic point of view there can be no question as to the superiority of electric light; it is also more convenient, and probably safer, than any other method; but unfortunately it is considerably dearer, unless regarded from the enlightened standpoint which takes into account the value of health and convenience. Second in healthiness, probably, comes incandescent gas lighting, and this is also the cheapest. For comparative figures we must refer readers to the book itself, in which many useful and interesting tables are given. The book would be improved by the addition of illustrations, which are more especially needed to accompany the descriptions of different forms of gas burners and lamps. We also think that it would be advantageous if the very short chapter on the distribution of light, and the use of shades, &c., were expanded, as this is a subject on which the public more especially needs instruction, since it is that which, more than any other, they have under their own control. M. S.

Sanitary Engineering. A Practical Manual of Town Drainage and Sewage and Refuse Disposal. By Francis Wood, A.M. Inst. C.E., F.G.S. With numerous illustrations. Pp. xi + 304. (London: Charles Griffin and Co., Ltd., 1902.) Price 8*s*. 6*d*. net.

SANITARY engineering is a comprehensive and difficult science, yet the author states in his preface that he himself "felt the want of a work which would in one small volume deal with the science in a comprehensive, concise and easily intelligible form." It is fair to infer from this statement that he considers the want has been met by the compilation of the present work. Yet in his introductory remarks (chapter i.) he adds that the student "will know only a small part of this vast subject when he has read and learned the contents of the present volume." We concur with the writer in the latter statement. The work contains a great deal of information upon sanitary engineering which will be useful to municipal engineers and students, medical officers of health, sanitary inspectors and members of local authorities; but the subject is of course not dealt with comprehensively. The general correctness of the statements and views expressed leave little to be desired, but while in a scientific text-book there is no occasion to be hypercritical on the subject of literary style, there are so many instances in this work where the meaning is obscured or the sense is lost by the slovenly construction of sentences that the pleasure and satisfaction of perusing it are somewhat marred. To give one or two instances:—

"The student must therefore take and make the most of the opportunities which he now has—and never will have again" (p. 5).

"The engineer is a born geologist; his work is connected with the earth and its composition" (p. 5).

"Since the system of bacteriology has been brought forward" (p. 227).

"The formation of Urban, Rural District, and Parish Councils are doing a great work in abolishing these abominations; and it is pleasing to note that in almost every district and village sanitary inspectors are being appointed, who with the powers they possess are rapidly converting these anomalies, which soon must become things of the past" (p. 49).

The author is inclined to conclude that the explanation why sewer air may at times be quite sweet is "that micro-organisms also act on the foul atmosphere and consume each other, together with the foul matter in the gases which must prevade it" (p. 124).

We read with some curiosity and misgivings the statement that a chapter had been allotted to bacteriolysis —but, as we suspected, the chapter deals with the bacteriological purification of sewage. On pp. 170–180, an article which appeared in *The Engineer* about four years ago is inserted, and the writer advises that "the paragraphs under their different headings should be read in conjunction with the same subjects, which are to be found elsewhere" in the book. One need hardly point out that this is not the most convenient way in which the subject-matter can be presented to the student. The author would have done well if he had himself selected the different paragraphs contained in the article and put them under their proper headings. The work, however, in addition to containing much valuable information, is very well illustrated, and the subject-matter dealt with comprises a fairly wide survey of the more important matters of practical sanitary engineering.

The Story of Animal Life. By B. Lindsay. The Library of Useful Stories. Pp. viii + 208. (London: George Newnes, Ltd., 1901.) Price 1*s*.

TO try to tell the story of animal life within the compass of one of Messrs. Newnes' well-known shilling series of "Useful Stories" seems almost irreverent. Even Prof. Macalister required two primers, and the result was somewhat indigestible pemmican. Perhaps Huxley's educational genius might have achieved what must seem to most naturalists impossible. We therefore admire Miss Lindsay's courage, and while we think that she has attempted too much, we willingly recognise that her little book is good value for a shilling—a *multum in parvo*, packed with interesting information and illumined with big ideas. It is perhaps unduly handicapped with technicalities and zoological subtleties, for when we read of "diploblastic," "apopyles," "metamerism," "Archiannelida," "Euthyneura," "Adelochorda," and so on, we wonder what these abstruse terms are doing in this shilling gallery. On the other hand, the booklet is interesting, and it has the two-fold merit of refusing to give a false simplicity to the subject, and of clearly indicating that zoology is not remote from human life. We regret to notice some inaccuracies of spelling and grammar which might have been readily avoided in so small a book. We regret still more to have to point out that many of the figures are so roughly reproduced that they recall the earliest stages of book illustration. Some of them, *e.g.* the tadpoles, are worse than mediæval, and if they were not so dull might be referred to as beacons warning us of the dangers of cheapness.

Municipal Engineering and Sanitation. By M. M. Baker, Ph.D., C.E. Pp. viii + 317. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1902.) Price 5*s*. net.

THE author intends this small volume for that large and rapidly growing class of persons who, either as officials or citizens, are striving to improve municipal conditions. It is a short review of the whole field of engineering and municipal sanitation, and no claim is made that it is an exhaustive study of any one of the branches with which it deals.

Although engineers and sanitarians will not find in the book much that is new to them, yet it contains matter of a trustworthy and up-to-date nature which will make the book interesting and helpful even to professional men. In addition to the treatment of the subjects of water-supply, sewage and sewerage, general scavenging and the making and keeping of streets and pavements, the following matters are also dealt with:—subways for pipes and wires; urban and inter-urban transportation; bridges, ferries and ice boats; docks and harbour facilities; telegraph, telephone and messenger service; ice; milk; markets; slaughter-houses; lighting; cemeteries; crematoria; fire; smoke; noises; disinfection; parks; playgrounds; baths and lavatories; public offices; and the administration, finance and public policy of municipal authorities.

Having regard to the extensive range of subjects dealt with, it follows that in such a small volume the treatment of each subject must be, generally speaking, sketchy. For instance, the chapter upon disinfecting methods and apparatus consists of three small pages containing some 750 words only. The book is of a handy size, well printed and bound, but without illustrations.

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.*]

Astronomy in the University of London.

IT seems desirable to call special attention to the change which has recently been made in the conditions with regard to astronomy for the B.Sc. Pass and Honours degrees of the University of London. This is the more important as, owing to an unfortunate slip of the much-overworked academic Registrar, the point was omitted from the published examination schedules, and has only been corrected by an attached slip in recent issues.

The point is this, that in future astronomy is to be counted as an independent subject for the B.Sc. degree. It will rank equally with geology, botany or zoology. It is true that the Faculty of Arts has retained a certain amount of astronomy in its mathematical syllabus—in my opinion a very poor syllabus—which represents, not modern astronomy, but the condition of affairs in "three day papers" at Cambridge fifty years ago, when the University of London was founded. Why the Faculty of Arts does not insist also on a little antiquated geology and a little pre-Darwinian biology is cause for wonder. At any rate, the Faculty of Science has recognised that astronomy is a suitable subject for graduation, and we may hope that students of astronomical physics and theoretical and observational astronomy will realise that they can now specialise in London before graduating. A Pass student will be able to graduate by studying mathematics, physics and astronomy, and an Honours student by taking astronomy and *either* mathematics *or* physics. We may hope that a school of astronomy will form itself in London free from the traditions of the Cambridge Mathematical Tripos, and recognising mathematics for the astronomer as ancillary only to observational and physical work. KARL PEARSON.

University College, London, June 15.

De Vriesian Species.

THE recent work of Prof. H. de Vries on the origin of species by mutation has attracted a great deal of attention, although it cannot be said that the facts he presents are of a new kind, or that, taken by themselves, they prove anything about the origin of species. The great merit of the work is to be found in its clear presentation of the subject, with carefully worked out examples, at an opportune time. In former years botanists were not so ready as they are to-day to recognise apparently minor characters as specific, and the great variety of slightly modified plant forms passed almost unnoticed. It was not considered worth while to investigate the polymorphism of the old specific aggregates, and men like Jordan, who did so, were not regarded altogether favourably. The old conception of species seemed to give us a superabundance of plant types, taking the world over; and many botanists thought, as one recently said to me, that it was impossible to catalogue and name the minor forms, *because they were infinitely numerous.* However, there has arisen a new school, especially dominant in America, which recognises the fact that many of the old specific names cover a number of types which are readily distinguishable from one another. These may intergrade, but in many cases they do not seem to do so, and though the distinctions may seem small, they are perfectly constant. The result of the new investigations is in many cases to increase the number of recognised species four-fold, ten-fold, or more. Now when one comes to study these numerous species, it is evident that much of the difference is not absolute, but consists in different combinations of the same or similar characters, like the patterns of a kaleidoscope. With a little ingenuity, one could almost predict the characters of undiscovered forms. Heredity seems every now and then to take a new throw of the dice, with results exactly such as de Vries has described. The successful throws are those which give results adapted to the environment, and these, under the laws governing the survival of the fittest, give us what we proceed to describe as new species.

The proof that species do thus originate is not to be found in garden experiments alone, but must be confirmed by field observations. Unfortunately, the average systematic botanist seems to be much more interested in defending his "new species" than in asking whether they may not be "new" in a more literal sense than he imagines. Nevertheless, search will be made for "de Vriesian species," and thereby the true status of many described plants may be revealed. Two instances of such which have lately come to my notice may be worth recording.

(1) *Helianthus petiolaris phenax* (new variety). Rays 13, mustard yellow, 11 mm. diameter; corollas and stigmas yellow, giving the flower a yellow disc. Found at Boulder, Colorado, August, 1901, growing in a field full of normal *H. petiolaris*, with deep saffron-yellow rays about 8 mm. diameter, and corolla and stigmas a very dark wine red. I took both plants to the meeting of the American Association for the Advancement of Science at Denver, and showed them to an eminent botanist who knows the flora of Colorado well, and is not regarded as a "splitter." I said, "these appear to be forms of one species." "Oh, no," he replied, "one is a Helianthus, the other a Rudbeckia!" However, the flowers were carefully examined in company with Prof. Pammel, and were also shown to Miss Eastwood, and no doubt remained that the new variety was really an offshoot from *H. petiolaris*, which had probably originated where it was found. The variation is the more interesting because in the sunflowers (Helianthus) the colour of the disc is used as a character to separate groups of species.

(2) *Ribes cereum viridior* (new variety). Plant perhaps more resinous; tube of calyx shorter, pale greenish, stigma exserted beyond petals. Fruit deep red, small, perfectly spherical. Found (first by my wife) between San Ignacio and Las Vegas, New Mexico. A clump of bushes presenting these characters (observed in two seasons) grows only a few yards away from plenty of what Mr. Coville considers genuine *R. cereum*, with a longer calyx-tube, streaked with purplish pink, and fruit a little larger and more inclined to be oblong. I was at first quite sure I had a valid species in this *viridior* variety, and Mr. Coville, before we got the fruit, thought the specimens might be his *R. mescalerium*, which has black fruit. Now, however, it appears reasonably certain that the plant represents a de Vriesian "species" or mutation. Miss Eastwood has lately described a somewhat similar mutation of a Californian species, under the name *Ribes sericeum viridescens*. T. D. A. COCKERELL.

East Las Vegas, New Mexico, U.S.A., May 22.

Formula for the Perimeter of an Ellipse.

THE formula given by your Queensland correspondent (NATURE of April 10, p. 536) for the perimeter of an ellipse is not at all objectionable on the score of degree of approximation. It leads, however, to another, which for practical purposes is much preferable. If for shortness' sake λ be written for $\log 2/\log \frac{1}{2}\pi$, he says in effect that the perimeter of an ellipse with semi-axes a and b is approximately equal to the circumference of a circle of radius

$$\left(\frac{a^\lambda + b^\lambda}{2}\right)^{\frac{1}{\lambda}}.$$

Now $\lambda = \cdot 3010300/\cdot 1961199$, two convergents to which are 3/2 and 20/13. Taking the former of these—a course which entails the extraction of no roots other than the square and the cube—we obtain the following result:—The perimeter of an ellipse is approximately equal to the circumference of a circle the radius of which is the semi-cubic mean of the semi-axes of the ellipse (see *Messenger of Math.*, xii. pp. 149–151; *Proc.* Manchester Lit. and Phil. Soc., February 1, 1901).

But by far the best result of this kind known to me may be put in the shape of a rule as follows:—To obtain the radius of a circle the circumference of which will be a close approximation to the perimeter of a given ellipse, diminish twenty-one times the arithmetic mean of the semi-axes of the ellipse by twice the geometric mean and thrice the harmonic mean and divide the remainder by 16. As an illustration of the value of this, we may take the classical example where $a = 1$ and $b = \cdot 8$. The three means A, G, H, referred to in the rule are then $\cdot 9$, $\sqrt{\cdot 8}$, 8/9 and

$$\begin{aligned}\frac{21A - 2G - 3H}{16} &= \frac{18\cdot 9 - \frac{4}{5}\sqrt{5} - 2\frac{2}{3}}{16},\\ &= \frac{18\cdot 9 - (1\cdot 7888544 - 2\cdot 6666666)}{16},\\ &= \frac{18\cdot 9 - 4\cdot 4555210}{16},\\ &= \frac{14\cdot 4444790}{16},\\ &= \cdot 90277993 \ldots\end{aligned}$$

Now, according to Legendre, the perimeter in this case is $2\pi(\cdot 90277992)$, so that the rule gives the desired result correct to within one hundred-millionth of 2π. THOMAS MUIR.

Cape Town, South Africa, May 19.

The "Armorl" Electro-Capillary Relay.

IN reply to your correspondent "J.-S." (p. 151), I may say that the model which I saw did actually work; it illustrated the flow of mercury from a fine jet when subjected to the influence of a small electromotive force, in the same way as described with reference to Fig. 1 of my article. I think your correspondent slightly misunderstands the principle of the instrument; it is not the small movement of the mercury, such as is used in the ordinary capillary electrometer, which works the relay lever; this movement merely serves to force some of the mercury out of the jet, and the *falling mercury* then moves the lever.

The inventors claimed that they had succeeded in effecting so nice a balance of forces that the mercury flowed from the jet under a very small influence. I join with your correspondent in the desire (which I expressed also in my article) that some trustworthy data concerning the instrument should be published.

June 13. THE WRITER OF THE ARTICLE.

SCIENCE AND MILITARY EDUCATION.

THE report of the Military Education Committee was issued to the public on Saturday, June 7, and has been the subject of much comment in the Press. The conclusions and recommendations of the Committee have been well received on the whole, though there are some exceptions, as in the case of the *Spectator*, which would wish to see Sandhurst done away with, or rather used in an entirely different manner and at a later stage in the officer's career, and in that of the military correspondent of the *Times*, who, in the course of a long article, falls foul of an important passage relating to science, and in effect advises the War Office not to accept or act upon the recommendations of the Committee on this subject. The writer of the article goes so far, indeed, as to suggest that the Committee has not sufficiently considered the evidence, quoting Sir George Clarke in support of the merits of Latin in such a way that we were not a little surprised on turning to Sir George's evidence to find that, when questioned as to the proper preliminary training of cadets (Question 839), he expressed the opinion that they should have a "broad, liberal education," adding that "the broader it is and the wider its scope, and the sounder generally, the better it will fit them for the special training they receive afterwards."

The passage objected to by the *Times* correspondent (20) will be found on p. 5, and, appearing as it does over the signatures of two such eminent representatives of classical training as the head masters of Eton and St. Paul's, is so important that we print it in full. It is as follows:—

"The fifth subject which may be considered as an essential part of a sound general education is experimental science, that is to say, the science of physics and chemistry treated experimentally. As a means of mental training, and also viewed as useful knowledge, this may be considered a necessary part of the intellectual equipment of every educated man, and especially so of the officer, whose profession in all its branches is daily becoming more and more dependent on science."

Considering the uncompromising terms of this statement, it is disappointing to find that a committee holding such clear and strong views should have found itself, in the event, unable to agree upon a scheme which would ensure that this "necessary part of the intellectual equipment of every educated man" should be provided for each and all our future officers. For it cannot be denied that the actual position proposed for science in the scheme recommended, viz. that it should be alternative in Class I. with Latin, will put it in the power of opponents of science to prevent candidates who may come under their influence from having the opportunity of securing this "essential part of a sound general education."

In saying this we do not overlook the fact, as some are disposed to do, that the proposed arrangements will allow those who select Latin as their subject in Class I. to offer science as a Class II. subject, and that, consequently, neither of these two necessary subjects need be neglected. But after making all allowance for the manner in which the scheme as a whole will qualify the effect of the relations of Latin and science in Class I., we think the Committee has not sufficiently regarded the fact that as Latin is begun at a very early age, but chemistry and physics much later, candidates choosing their subjects at about fifteen, as many, and perhaps most, of them must do, will be much more likely to select the former than the latter from Class I. (see Questions 8630, 8631, 8632), leaving science for Group II., where, however, it becomes an alternative with several other subjects, and so is very likely to be squeezed out.

It is a striking illustration of the effects of the neglect of science in our educational system, which even now is being remedied but slowly in some of our schools, that so many soldiers and others still make the mistake of supposing that as regards science the Army only needs "a proportion of scientific experts among military officers for suggesting and following up improvements in *matériel*," and that "the majority of such experts can be better obtained from civilian sources outside the Army than from within its ranks." The last part of this statement is, indeed, in spite of all the fine qualities of our officers, only too sadly true. But it is just because the basis of military education (and indeed of nearly all English education in the case of the abler members of the higher classes) has been too narrow in the past that the Army has failed to throw up a sufficient supply, we will not say of trained scientific specialists, but of officers capable of understanding the specialists, of absorbing their ideas, mastering their methods and applying these in the operations of war. How can we expect average men whose training has been mainly in language and mathematics to be resourceful and confident when brought face to face with the problems created for their profession by the revolutions of the last half century? Every question, said Liebig, one of the creators of much that is strongest in modern Germany, put to science clearly and definitely has been satisfactorily answered before long. Only when the inquirer has no precise idea of the problem to be solved does he remain unsatisfied for long. It is just because the majority of our officers have not had the broadest training possible, that so many are unable to make use of the new powers that science holds out to them, and are still under the mistaken impression that the main use of science in education lies in the facts which it provides.

It is clear that even now many educators and soldiers have not grasped the real elements of this great problem, and that they still fail to see that the object with which science is now taught is, not to convey a few more facts or a few facts of a new kind, but to preserve those habits of mind and that fertility of resource which daily become more important in face of the problems of modern life, and which are not to be gained by a purely literary and mathematical training. All will agree that faculties which must especially be cultivated in our officers "are power of command, habits of leadership, and the ability to act decisively and correctly at the right time and place." But when it is contended, as it often is, that "study in a chemical laboratory does not make for this kind of fitness," it is forgotten that laboratory work properly done will certainly develop these qualities at least as well, and probably better, than any study in which books only are concerned, and that we do not teach either science or Latin, mathematics or modern languages primarily to produce the habit of command, but because the habit of command and the ability to act with decision have a tenfold value in the man who is many-sided in his knowledge and experience and who, in the language of the street, "knows where he is" in many departments of human activity.

The object of a training in experimental science is not to stuff the mind with knowledge, as so many still seem to think, but to open and prepare it to receive and rightly apply knowledge in the after working years of life. Those persons are indeed ignorant who suppose that in a modern course of work, let us say, in physics, a boy's mind is "stuffed with knowledge" or that a course of work in electricity gives less play to the imagination than getting up vocabularies or irregular verbs. But we must not follow a bad example; these things also make for goodness in their degree.

As we have said above, the report of the Committee has, as regards its main features, been received with a chorus of approval, and little remains to be said about it. We think the proposal of an expert educational committee with advisory powers excellent. We are glad that whilst science and Latin are alternative subjects in Class I., the subject not taken as a Class I. subject can be taken as a Class II. subject. At the same time, we regret that Sir Michael Foster did not succeed in prevailing on his colleagues to embody in their final recommendations the admirable opinion which we quote at the beginning of this article.

If we may judge from the tenor of the discussion at the Conference of Science Masters last Christmas, we think the proposed changes in regard to practical work in chemistry will be widely welcomed. But if this reform is to work well, no attempt must be made to *add* the new scheme of practical work to the old requirements in qualitative analysis. The time which did not suffice for the latter alone cannot be sufficient for both together. We believe, too, that many teachers both of chemistry and physics would be most willing to see the scope of the syllabus in their special subject reduced a little, in order to secure that all candidates taking science should include in their work the "pass part" portions of both the chemical and physical divisions of science.

A HOLIDAY CRUISE TO ALASKA.[1]

THESE two handsome and magnificently illustrated volumes should be brought to the notice of every man of wealth as a lesson in the art of spending a holiday. He will learn therefrom how this may be done with permanent satisfaction to himself and permanent advantage to science.

In a pointedly brief and unassuming preface the patron of the expedition explains that, having planned a summer cruise through Alaskan waters for himself and his family, he found that the steamer which he had chartered would accommodate a larger party, and therefore resolved to seek "some guests who, while adding to the interest and pleasure of the expedition, would gather useful information and distribute it for the benefit of others."

By the advice of his physician he obtained the aid of Dr. C. Hart Merriam, chief of the Biological Survey of the U.S. Department of Agriculture, in carrying out this plan.

The outcome is succinctly stated in the introduction (pp. xxv–xxxi) by Dr. Merriam, who has most capably fulfilled his duties as general editor to the records of the cruise:—

"In the early spring of 1899 Mr. Edward H. Harriman of New York, in cooperation with the Washington Academy of Sciences but entirely at his own expense, organised an expedition to Alaska. He invited as his guests three artists and twenty-five men of science, representing various branches of research and including well known professors in universities on both sides of the continent, and leaders in several branches of Government scientific work. . . The expedition sailed from Seattle May 30 . . . and was gone just two months."

The ship threaded the "inside passages" from Puget Sound to Juneau, Skagway and Sitka; thence along the open coast to Cook Inlet and the Alaska Peninsula, and past the Aleutian Islands into Bering Sea, up to the entrance to Bering Strait, touching at Eskimo settlements on both the Asiatic and American coasts, and then turning homeward. The voyage was not in itself in any way remarkable; the interest centres in the personnel and methods of the expedition.

As for the personnel—the following list will show that the selected scientific party was qualified to take advantage of every opportunity. Botany was represented by F. V. Coville and T. H. Kearney, jun., of the U.S. Department of Agriculture, and by Prof. B. E. Fernow, of Cornell, Dr. A. Saunders and Dr. W. Trelease; zoology in its various branches by Dr. W. R. Coe, of Yale, D. G. Elliot, of the Field Columbian Museum, Dr. A. K. Fisher and Dr. C. H. Merriam, of the U.S. Department of Agriculture, R. Ridgway, of the Washington National Museum, C. A. Keeler, of the San Francisco Museum, Prof. W. E. Ritter, of the University of California, Prof. T. Kincaid, of the University of Washington State, and Dr. G. B. Grinnell; geology and geography by Dr. W. H. Dall, G. K. Gilbert and H. Gannett, of the U.S. Geological Survey, and Prof. B. K. Emerson, of Amherst; mineralogy by Dr. C. Palache, of Harvard, and W. B. Devereux; meteorology by Prof. W. H. Brewer, of Yale; and nature-lore in its literary aspect by John Burroughs and John Muir. Of the three artists on the ship Mr. L. A. Fuertes was a specialist in bird-portraiture—sixteen of the many beautiful coloured plates which adorn these volumes attesting his skill. We learn, moreover, that a fourth artist was sent to Alaska in the following year for the special purpose of securing drawings and paintings of Alaskan plants! The expedition also included two photographers, two taxidermists, two stenographers; with a chaplain, two physicians and a trained nurse. The Harriman family party numbered eleven.

As for the methods—these seem to have been in every way admirable. Under unskilful management the scheme would probably have come to nought through the stress of divergent interests. But the patron of the expedition met the occasion like a whole-hearted democrat. His procedure is thus described by Dr. Merriam:—

"The day after leaving New York Mr. Harriman called together the members of the Expedition and announced that it was not his desire to dictate the route to be followed, or to control the details of the work. In accordance with his wishes a business organization was effected, comprising an executive committee, a committee on route and plans, and special committees on the various scientific activities. These committees, throughout the voyage, held frequent meetings and determined from day to day the operations of the expedition. . . .

"Among the unusual features which contributed to the success of the Expedition, three are worthy of special mention:—

"(1) The ship had no business other than to convey the party whithersoever it desired to go. Her route was entrusted to a committee comprising the heads of the various departments of research; so that from day to day and hour to hour her movements were made to subserve the interests of the scientific work.

"(2) The scientific staff represented varied interests and was made up of men trained in special lines of research.

[1] "Alaska. Harriman Alaska Expedition, 1899." 2 vols. Royal 8vo. Pp. xxxvii + 383, with 39 coloured plates, 85 photogravure plates, 240 text figures and 5 maps. Vol. i. Narrative, Glaciers, Natives. Vol. ii. History, Geography, Resources. By many authors. (New York: Doubleday, Page and Co., 1901.)

"(3) The equipment was comprehensive, including naphtha launches, small boats and canoes, camping outfits, stenographers, photographers, and extra men for oarsmen and helpers, thereby reducing to a minimum the time necessary to accomplish material results. . . ."

To indicate what *was* accomplished let us again quote Dr. Merriam :—

"During the two months' cruise a distance of nine thousand miles was traversed. Frequent landings were made, and, no matter how brief, were utilised by the artists, photographers, geologists, botanists, zoologists, and students of glaciers. From time to time longer stops were made and camping parties were put ashore that more thorough work might be done. Thus one or more camping parties operated at Glacier Bay, Yakutat Bay, Prince William Sound, Kadiak Island, the Alaska Peninsula and the Shumagin Islands. Large and important collections were made, including series of the small mammals and birds of the coast-region,"—

and here we may break off to note that Burroughs, in a later part of the volume (p. 62), mentions that one day the ship "made a voyage of sixty miles to enable our collectors to take up some traps, the total catch of which proved to be nine mice,"—

"enormous numbers of marine animals and seaweeds, and by far the largest collections of insects and land-plants ever brought from Alaska. There were also small collections of fossil shells and fossil plants. In working up this material the services of more than fifty specialists have been secured, and although the task is by no means finished, thirteen genera and nearly six hundred species new to science have already been discovered and described. The natural history specimens have not merely enriched our museums, they have increased many fold our knowledge of the fauna and flora of Alaska. . . .

"A number of glaciers not previously known, as well as many others which had been vaguely or imperfectly known, were mapped, photographed and described, and much evidence was gathered of changes that have occurred in their length and size. . . . In Prince William Sound a new fiord fifteen miles in length and abounding in glaciers was discovered, photographed, and mapped. . . . The large number of photographs taken by the professional photographers on board was materially increased by cameras belonging to various members of the Expedition, and in all not less than five thousand photographs were secured. These cover many parts of the coast region from British Columbia to Bering Strait, and constitute incomparably the best series of pictures of the region thus far obtained."

The publication of the results has been undertaken in the same well-ordered and liberal spirit. The two volumes before us

"contain the narrative of the expedition and a few papers on subjects believed to be of general interest. The technical matter, in the fields of geology, palæontology, zoology and botany, will follow in a series of illustrated volumes. Twenty-two special papers, based on collections made by the Expedition, have been already published in the Proceedings of the Washington Academy of Sciences, and others will follow. All this material will be brought together in the volumes of the technical series."

Having dealt somewhat fully with the organisation and methods of this truly exemplary expedition, let us now glance briefly over the principal contents of the book, which constitute the best general description of Alaska hitherto published.

The narrative of the cruise by John Burroughs (pp. 1–118) is a piece of literary workmanship such as only an able and well-practised writer with a keen eye for nature and under the stimulus of scenes new to him could have penned. This part will appeal more strongly to the general reader than to the man of science, for to the latter the blending of emotional sentiment with technical description, however skilfully done, can rarely fail to give a sense of incompatibility and distortion. As literature, however, these word-pictures are excellent; we will quote, as an example, Mr. Burroughs' impression of a distant view of Mount St. Elias (p. 55) :—

"The base and lower ranges had been visible for some time, bathed in clear sunshine, but a heavy canopy of dun-coloured clouds hung above us and stretched away toward the mountain, dropping down there in many curtain-like folds, hiding the peak. But the scene-shifters were at work; slowly the heavy mass of clouds that limited our view yielded and was spun off by the air-currents till at last the veil was completely rent, and there, in the depths of clear air and sunshine, the vast mass soared to heaven.

"There is sublimity in the sight of a summer thunder-head with its great white and dun convolutions rising up for miles against the sky, but there is more in the vision of a jagged mountain crest piercing the blue at even a lesser height. This is partly because it is a much rarer spectacle, but mainly because it is a display of power that takes greater hold of the imagination. That lift heavenward of the solid crust of the earth, that aspiration of the insensate rocks, that effort of the whole range, as it were, to carry one peak into heights where all may not go—every lower summit seeming to second it and shoulder it forward till it stands there in a kind of serene astronomic solitude and remoteness—is a vision that always shakes the heart of the beholder."

The general narrative is succeeded by a series of profusely illustrated articles on special subjects. First we have "Notes on the Pacific Coast Glaciers," by John Muir (pp. 119–135), who was one of the earliest explorers of the Alaskan ice-fields and is able to compare the present limits of some of the glaciers with their extent in 1879, when he first visited them. He states that in Glacier Bay,

"the Hugh Miller and Muir have receded about two miles in the last twenty years, the Grand Pacific about four, and the Geikie, Rendu and Carrol perhaps from seven to ten miles."

The remaining portion of the first volume (pp. 137–183) is occupied by a concise account of the Indians and Eskimo of the Alaska coast region, by Dr. G. B. Grinnell, closing with the usual lament over the destruction of the weaker race by the influx of the horde of gold-seeking white men, "uncontrolled and uncontrollable."

The second volume opens with a history of the discovery and exploration of Alaska by the veteran Dr. W. H. Dall, whose thirteen previous visits to the territory render him thoroughly qualified to deal with the subject. He treats fully of the early period up to the transference of the country by Russia to the United States in 1867, but sums up the subsequent events in a few sentences, remarking (p. 203) that

"a history of conditions in Alaska from 1867 to 1897 is yet to be written, and when written few Americans will be able to read it without indignation. A country of which it could be said with little exaggeration that

'Never a law of God or man
Runs north of fifty-five':

a country where no man could make a legal will, own a homestead or transfer it, or so much as cut wood for his fire without defying a Congressional prohibition: where polygamy and slavery and the lynching of witches prevailed, with no legal authority to stay or punish criminals; such in great part has Alaska been for thirty years."

He notes also :—

"To one conversant with the facts, one of the most amusing things in current literature is the placid innocence of many a casual traveler or gold hunter, who pours out his tale of experiences in the confident belief that nothing of the kind is on record. A bibliography, far from complete, yet with fully 4000 titles, does not cover the publications in books and serials upon the Territory and its adjacent regions."

The next article is on "Days among Alaska Birds," by Mr. Charles Keeler (pp. 205–234), richly illustrated with coloured plates. Many readers will be somewhat astonished to learn that one of the humming-birds is found abundantly as far north as Juneau and Sitka, and will feel with Mr. Keeler that the bird "seemed singularly out of place."

"Indeed, even after reading that the tiny rufous humming-bird journeyed so far into the northern wilds, it was with almost a shock of surprise that we saw the dainty creature, which we instinctively associate with the tropics, contentedly buzzing about the salmon berries and appearing as unconcerned and happy as if his fine wings had not carried him some thousands of miles from his winter quarters in southern California or Mexico. I cannot imagine a more wonderful instance of bird migration than this—one of the smallest known birds, no larger than a fair-sized moth, yet with strength, endurance, and intelligence to travel up and down the greater part of the North American coast line, pressing close upon the train of early spring, awaiting only the blooming of the wild currant in California and the salmon berry farther north, to venture upon his perilous way!"

What erroneous deductions as to the climate of an "inter-glacial period" would probably be drawn if the remains of a humming-bird were found in a peat bed between deposits derived from glaciers!

The "Forests of Alaska" are described by Prof. B. E. Fernow (pp. 235–256), who points out that their economic value has been much over-estimated. He notes "the astonishing indifference to the influence of the near-by ice-masses" shown by the trees growing in close proximity to some of the great glaciers and even upon their surfaces where covered by moraine material. This article contains some interesting observations on the propagation and spread of forest growth.

The general geography and physiography of the territory are the subject of a lucid article by Mr. H. Gannett (pp. 257–277). In mentioning that the present glaciers are "only trifling fragments" of the great glaciers which occupied this region a short time ago, it is remarked that, nevertheless,

"all the glaciers of Switzerland together would form but a few rivulets of ice on the surface of the Muir Glacier, and the Muir is but one of many glaciers of equal magnitude."

All observers of the glacial phenomena of the region will probably agree with Mr. Gannett that the period since the retreat of the ice from the present water-channels of the coast cannot have been long. It is evident that in Alaska, as in several other glacier-fields of the globe, if the existing ice were entirely removed, few of the glaciers could ever regain their present dimensions under the climatal conditions which now prevail. And it seems probable that in some degree the present glaciers represent the lingering remnants of the great ice-fields of the Glacial period.

"The Alaska Atmosphere" is dealt with by Prof. W. H. Brewer (pp. 279–289), who lays especial stress upon the effects produced by the relatively dustless condition of the air.

An article on "Bogoslof, our Newest Volcano," by Dr. C. H. Merriam (pp. 291–336), copiously illustrated with views of the two new volcanic islands at various periods in their history, and provided with a bibliographical appendix, will appeal to every volcanist.

In describing "The Salmon Industry" (pp. 337–355), which has attained such gigantic proportions in Alaska, Dr. G. B. Grinnell once more calls attention to the wretchedly wasteful methods adopted by the salmon canners in defiance of Congressional laws which there is scarcely a pretence of enforcing, and to the consequent extraordinarily rapid depletion of supplies supposed at first to be inexhaustible. It is the common story of the white pioneer in every part of the globe:—

"All these people recognise very well that they are destroying the fishing; and that before very long a time must come when there will be no more salmon to be canned at a profit. But this very knowledge makes them more and more eager to capture the fish and to capture all the fish. This bitter competition sometimes leads to actual fighting—on the water as well as in the courts. A year or two since, one company which was trying to stop another from fishing on ground which it claimed as its own, sent out its boats with immense seines, and dropping them about the steam launches of its rival tried to haul them to the shore. . . . Thus the canners work in a most wasteful and thoughtlessly selfish way, grasping for everything that is within their reach and thinking nothing of the future. Their motto seems to be, 'If I do not take all I can get somebody else will get something.'"

The final article of the book, however, reveals the pioneer in the unaccustomed *rôle* of conservator. It consists of a highly interesting account, by Mr. M. L. Washburn, of "Fox Farming in Alaska" (pp. 357–365), a new industry which in itself is a striking illustration of western resourcefulness and may lead to important future developments.

"Something like fifteen years ago a few men in western Alaska, realizing that fur-bearing animals were doomed, decided to try the experiment of propagating some of the more valuable kinds. Having resided on the Seal or Pribilof Islands and observed that the blue fox became somewhat tame, they resolved to try its domestication by placing a small number on protected islands and caring for them as the stockman cares for his herd of cattle or sheep. About twenty foxes were taken from St. Paul Island of the Pribilof group, and placed on North Semidi, one of the hundreds of unoccupied islands of Alaska, and thus the experiment began. . . . From North Semidi, the original 'fox-ranch,' if one may employ such a term, foxes were taken to other islands along the Alaska coast and the experiments continued. The results though sometimes discouraging and not always financially successful, have shown on the whole that the animal could be raised and its valuable pelt obtained with as much regularity as in the case of the humbler domestic animals. About thirty islands are now stocked with blue foxes—all the outgrowth of the small stock of twenty foxes taken from St. Paul Island fifteen years ago."

A description is given of one of these ranches where there are now 800 to 1000 foxes. The animals soon learn to recognise their keepers and come to know the feeding time, gathering round for their daily allowance, and afterwards scattering about the island until the time for the next day's dinner. In short, the blue fox has been added to the list of domesticated animals. The probable outcome is thus stated:—

"It is believed that the time is not far distant when hundreds of the now useless islands of Alaska will be utilised in the propagation of fur-bearing animals, and that many of the farmers of the Northern States [*let Canadians take note!*] will have wire-fenced enclosures of an acre or two devoted to this industry, from which they will reap a far greater return than from all the rest of their live stock."

For the excellency of the paper, printing, illustrations and binding, as well as for their contents, these volumes are indeed highly to be commended. As an instance of rare unobtrusiveness and good taste we may mention that in spite of its almost immoderate wealth of illustration not a single portrait of Mr. Harriman or of any member of his family party is to be found in the work.

That the literary and scientific members of this summer cruise should have occasionally burst into song causes us no surprise; and the sprinkling of verse in the volumes is distinctly pardonable in the circumstances.

G. W. L.

OBSERVATIONS OF VOLCANIC ACTIVITY IN THE WEST INDIES.

FURTHER details of the recent volcanic eruptions at Martinique and St. Vincent continue to reach us through West Indian and other papers. Though the great eruptions of Mont Pelée and the Soufrière occurred on May 7–8, the *Dominica Guardian* states that shocks of earthquake were felt so far back as February of last year. These disturbances were noticed several times during the year, and were regarded as serious in February of this year. From April 20 also until the eruption, rumbling sounds were frequently heard, especially at Fancy and at Frasers. Nineteen shocks were experienced within half an hour on May 3 at Wallibou, and the disturbances became more noticeable as the days went on, until, on May 5, the Soufrière gave definite warnings of its renewed activity. The Rev. J. H. Darrell, writing from Kingstown, St. Vincent, on May 9, gives, in the *Dominica Guardian*, the following account of the subsequent eruptious of this volcano:—

It was on Tuesday, May 6, at 3 p.m., that the mountain commenced its series of volcanic efforts. A strong shock of earthquake, accompanied by a terrible noise, occurred, and the volcano began to emit steam. At 5 p.m. louder and more frequent explosions were heard, the detonations succeeding each other at rapidly diminishing intervals. At 7.30 p.m. columns of steam issued from the old crater with terrific noise. These lasted until midnight, when another heavy explosion occurred.

At 7 a.m. on Wednesday, May 7, there was another sudden and violent escape of pent-up steam, which continued ascending until 10 a.m., when other material began to be ejected. It would seem that this was the time when the enormous mass of water in the lake of the old crater was emitted in a gaseous condition. By 12 o'clock noon it appeared that there were three craters vomiting lava—the old crater that had contained the lake, the second crater that opened in 1812, and a third crater that had burst open in the present eruption. Six distinct streams of lava were visible, running down the sides of the mountain. The mountain heaved and laboured to rid itself of the burning mass of lava heaving and tossing below. By 12.30 p.m. it was evident that it had begun to disengage itself of its burden by the appearances as of fire flashing now and then around the edge of the crater. There was, however, no visible ascension of flame. These flame-like appearances were, I think, occasioned by the molten lava rising to the neck of the volcano. Being quite luminous, the light emitted was reflected from the banks of steam above, giving them the appearance of flame.

From the time the volcano became fully active, tremendous detonations followed one another so rapidly that they seemed to merge into a continuous roar which lasted all through the night of May 7 and up to 6.30 a.m. on May 9. These detonations and thunderings were heard as far as Barbados, 100 miles distant, as well as in Grenada, Trinidad and the south end of St. Lucia. At 12.10 p.m. I left in company with several gentlemen in a small row boat to go to Chateaubelair, where we hoped to get a better view of the eruption. As we passed Layou, the first town on the leeward coast, the odour of sulphuretted hydrogen was very perceptible. Before we got half way on our journey a vast column of steam, smoke and ashes ascended to a prodigious elevation. The majestic body of curling vapour was sublime beyond imagination. We were about eight miles from the crater, as the crow flies, and the top of the enormous column, eight miles off, reached higher than one-fourth of the segment of the circle. I judge that the awful pillar was fully eight miles in height. We were rapidly proceeding to our point of observation, when an immense cloud, dark, dense, and apparently thick with volcanic material, descended over our pathway, impeding our progress and warning us to proceed no further. This mighty bank of sulphurous vapour and smoke assumed at one time the shape of a gigantic promontory, then appeared as a collection of twirling, revolving cloud-whirls, turning with rapid velocity, now assuming the shape of gigantic cauliflowers, then efflorescing into beautiful flower-shapes, some dark, some effulgent, others pearly white, and all brilliantly illuminated by electric flashes. Darkness, however, soon fell upon us. The sulphurous air was laden with fine dust that fell thickly upon and around us discolouring the sea; a black rain began to fall, followed by another rain of favilla, lapilli and scoriæ.

The electric flashes were marvellously rapid in their motions and numerous beyond all computation. These with the thundering noise of the mountain mingled with the dismal roar of the lava, the shocks of earthquake, the falling of stones, the enormous quantity of material ejected from the belching craters, producing a darkness as dense as a starless midnight, the plutonic energy of the mountain growing greater every moment combined to make up a scene of horrors. It was after five o'clock when we returned to Kingstown, cowed and impressed by the weirdness of the scene we had witnessed, and covered with the still thickly falling grey dust. Of what this material is composed I am unable to give a certain opinion; but it appears to consist of comminuted rock, produced by attrition of the material as in successive outbursts it is hurled aloft and then tumbles back again to the burning crater to be ejected finally as impalpable dust. So minute are the particles that they find their way through the finest chinks of a closed room. Large areas of cultivation have been buried under the fall of the dust. Its effects upon vegetation will probably be beneficial ultimately, but in the meantime great suffering as well as inconvenience is occasioned thereby. The awful scene was renewed yesterday (May 8) and again to-day. At about 8 a.m. the volcano shot out an immense volume of material which was carried in a cloud over Georgetown and its neighbourhood, causing, not only great alarm, but compelling the people by families to seek shelter in other districts.

More than 400 lives have been lost on the windward side of the island, chiefly from lightning, and we have not yet heard from other parts of the island in that neighbourhood. The flowing lava on the leeward side of the mountain has buried up the Wallibou and Richmond villages and estates, while on the windward side of the mountain the estates of Lot Fourteen, Rabacca, Overland, Tourama, Orange Hill, Mount Bentinck, Langely Park and portions of others have been obliterated.

It is now 2 p.m. (May 9). A dense gloom still envelops the mountain, but there has been no further eruption since 8 a.m. Several streams and rivers have dried up in various parts of the island, and we are threatened with a water as well as a food famine.

As already announced, the National Geographic Society of Washington has sent a special expedition to Martinique and St. Vincent to investigate the volcanic conditions of the West Indian regions. The members consist of Mr. Robert T. Hill, of the U.S. Geological Survey; Prof. Israel C. Russell, professor of geology in the University of Michigan, Ann Arbor; Commander C. E. Borchgrevink, the Antarctic explorer; Dr. T. A. Jaggar, of Harvard University; Mr. G. C. Curtis, of Cambridge, U.S.A., and Dr. Angelo Heilprin, president of the Philadelphia Geographical Society.

The expedition is one of the most important and best equipped commissions ever sent out to study actual volcanic action. Results of scientific and practical consequence may therefore be expected from the work of the members of the party. On their return to the United States they will report the results of their observations to the National Geographic Society. This report, forming a series, will be published in full in the journal of the Society, the *National Geographic Magazine*, the June number of which contains a preliminary account of the observations already made.

Upon arriving at Martinique, Dr. Hill embarked on a steamer and examined the coast as far north as Macouba Point, the north end of the island, making frequent landings. After landing at Le Prêcheur, a little village five miles north of St. Pierre, he walked through an area of active volcanism to the destroyed city. Dr. Hill, according to the Associated Press despatches from Fort de France, was the first man to set foot in the active area of craters, fissures and fumaroles.

On his return to Fort de France he issued a brief statement as to his observations to the National Geographic Society, and it is here abriged from the Society's magazine.

The zone of the catastrophe in Martinique forms an elongated oval, containing on land about eight square miles of destruction. This oval is partly over the sea. The land part is bounded by lines running from Le Prêcheur to the peak of Mont Pelée, thence curving around to Carbet. There were three well-marked zones:—

(1) A centre of annihilation, in which all life, vegetable and animal, was utterly destroyed. The greater northern part of St. Pierre was in this zone.

(2) A zone of singeing, blistering flame, which also was fatal to all life, killing all men and animals, burning the leaves on the trees, and scorching, but not utterly destroying, the trees themselves.

(3) A large outer, non-destructive zone of ashes, wherein some vegetation was injured.

The focus of annihilation was the new crater, midway between the sea and the peak of Mont Pelée, where now exists a new area of active volcanism, with hundreds of fumaroles, or miniature volcanoes.

The new crater is now vomiting black, hot mud, which is falling into the sea. Both craters, the old and new, are active. Mushroom-shaped steam explosions constantly ascend from the old crater, while heavy ash-laden clouds float horizontally from the new crater. The old one ejects steam, smoke, mud, pumice and lapilli, but no molten lava.

The salient topography of the region is unaltered. The destruction of St. Pieire was due to the new crater. The explosion had great superficial force, acting in radial directions, as is evidenced by the dismounting and carrying for yards the guns in the battery on the hill south of St. Pierre and the statue of the Virgin in the same locality, and also by the condition of the ruined houses in St. Pierre.

According to the testimony of some persons, there was an accompanying flame. Others think the incandescent cinders and the force of their ejection were sufficient to cause the destruction. This must be investigated.

On Monday, May 26, Dr. Hill started on horseback from Fort de France for Morne Rouge and Mont Pelée. He reached Morne Rouge safely on May 27, where he succeeded in getting a number of photographs. A close approach to Mont Pelée was impossible, so he started back in a southerly direction. During the two nights he was camping out he made some important observations of volcanic action, and on his return issued the following statement :—

My attempt to examine the crater of Mont Pelée has been futile. I succeeded, however, in getting very close to Morne Rouge. At 7 o'clock on Monday evening I witnessed from a point near the ruins of St. Pierre a frightful explosion from Mont Pelée, and noted the accompanying phenomena. While these eruptions continue no sane man should attempt an ascent to the crater of the volcano. Following the salvos of detonations from the mountain, gigantic mushroom-shaped columns of smoke and cinders ascended into the clear, starlit sky, and then spread in a vast black sheet to the south and directly over my head. Through this sheet, which extended a distance of ten miles from the crater, vivid and awful lightning-like bolts flashed with alarming frequency. They followed distinct paths of ignition, but were different from lightning, in that the bolts were horizontal and not perpendicular. This is indisputable evidence of the explosive oxidation of the gases after they left the crater. This is a most important observation, and it explains in part the awful catastrophe. This phenomenon is entirely new in volcanic history.

I took many photographs, but do not hesitate to acknowledge that I was terrified.

Nearly all the phenomena of these volcanic outbreaks are new to science, and many of them have not yet been explained. The volcano is still intensely active, and I cannot make any predictions as to what it will do.

Associated Press messages from Martinique, dated May 31, announced that Prof. Heilprin had succeeded in climbing to the top of the crater of Mont Pelée. The despatch is as follows :—

Prof. Angelo Heilprin this morning ascended to the top of the crater on the summit of Mont Pelée.

The expedition left Fort de France last Thursday, May 29, at noon. Friday was spent in studying the newly formed craters on the north flank of the mountain. Saturday morning Prof. Heilprin determined to attempt the ascent to the top of the crater, and with this purpose in view he set out at five o'clock.

The volcano was very active, but Prof. Heilprin reached the summit and looked down into the huge crater. Here he spent some time in taking careful observations. He saw a huge cinder cone in the centre of the crater. The opening of the crater itself is a vast crevice 500 feet long and 150 feet wide.

While Prof. Heilprin was on the summit of the volcano, several violent explosions of steam and cinder-laden vapour took place, and again and again his life was in danger. Ashes fell about him in such quantities at times as to obscure his vision completely.

Prof. Heilprin found that the crater at the head of the River Fallaise has synchronous eruptions with the crater at the summit of the volcano, and that it ejects precisely the same matter at such times.

On May 31 a party consisting of Prof. Jaggar, of Harvard University, Dr. Hovey, of the American Museum of Natural History of New York, and Mr. George C. Curtis, ascended to the summit of the Soufrière of St. Vincent from the western side.

The ascent was exceedingly difficult, owing to the mud that covered the mountain side, but the ground was cold. After a tiresome scramble up the slippery hill, the rim of the old crater was reached about midday. There was no trace whatever of vegetation, but there had been no change in the topographical outlines of the mountain on that side, and the old crater retained its tragic beauty. The great mass of water that formerly lay serenely about 500 feet below the rim of the crater had disappeared, and the crater appeared to be a dreadful chasm more than 2000 feet deep. With the aid of a glass, water was made out at the bottom of this abyss.

The party did not venture across the summit of the Soufrière to inspect the new crater, which was then emitting a little vapour, for the ground in that direction looked to be dangerous.

Apparently the ridge of the mountain, called "The Saddle," was intact, although the old crater seemed of larger circumference than before the recent eruption. At the western base of the Soufrière a subsidence of a depth of 100 feet occurred for an area of a square mile. The bank of volcanic dust that prevents the sea encroaching farther inland at Wallibou is being gradually washed away. The lava beds on the eastern side of the Soufrière continue to emit steam, despite the protracted and heavy rainfall that has occurred.

Mr. Knight, Senator for Martinique, has arrived in Paris, and a few of his observations of the condition of men and things in that island are given in yesterday's *Times*. He says that the streams of mud which are still flowing do not emerge from the flanks of the volcano, but from the constantly convulsed ground, now opening in large abysses and then closing. Evidence that the death of the victims of the Mont Pelée eruption must have been instantaneous was obtained from the appearance of the bodies discovered.

Thus, persons have been found on the thresholds of their nearly demolished houses in the attitude of gazing at Mont Pelée. Others were found seated at a table. One man, discovered in the middle of the street, had the muscles of his legs and arms fixed in the attitude of a runner. Others were shaking hands.

PROF. ADOLF FICK.[1]

WITH Adolf Fick, the physiologist of Würzburg, whose death took place in the autumn of last year at Blankenberg, there passed away one of the last representatives of the brilliant physiological school by the combined labours and critical acumen of which, during the latter half of the past century, the foundations of modern physiology were established. For the complete appreciation of the man's whole character, however, regard should be had as well to Adolf Fick's energetic and practical support of public, and, in particular, educational questions, as to his distinction as investigator, man of science and teacher. In all matters that he took in hand he made a striking and original appearance, and he merits a special place in the honour roll of history.

Fick, in whom as a youth conspicuous mathematical talent had already displayed itself, sought the university with the intention of studying mathematics. His elder brother, Heinrich, who died a few years ago while professor of Roman law at Zürich, urged him to the study of medicine, and this he pursued at Marburg and Berlin.

[1] Abridged from an obituary notice by Prof. Kunkel.

At the former university he graduated in September 1851. As early as the year 1852 he worked as prosector under C. Ludwig, whose close friendship he retained throughout life.

In 1856 he went into residence at Zürich, and, in succession to Ludwig and Moleschott, obtained in 1862 the full professorship of physiology there, which he retained for six years. In the year 1868, upon Von Bezold's early death, Fick was called to Würzburg, where he filled the chair of physiology for thirty-one years. He resigned his post at the end of the summer term of 1899, not from distaste for work or through the burden of years, but while in full vigour of mind and body, in the strict fulfilment of a long-expressed intention of making way, on the completion of his seventieth year of life, for the energies of a younger man.

At the time when Fick entered upon the study of physiology, modern medicine, as it is now understood and taught in the schools, was still in its infancy. The great strides made by chemistry at the beginning of last century had rendered possible the introduction of exact methods in the investigation of the problems of biology. The first positions securely gained by physical science had been at once utilised to set aside the doctrine of "vital power," and to establish the important principle that we must endeavour to explain the specific phenomena of life as being determined by preceding chemical and physical conditions. Just as the chemists Lavoisier, Liebig and others, with the knowledge that they had won by their special training, addressed themselves at once to the solution of biological questions, so a school of physicists, starting from the basis of its own discoveries, proceeded to the investigation of the physiological problems which appertained to it. The brothers Ernst, Heinrich and Eduard Weber, Helmholtz, Du Bois-Reymond, Ludwig, Brücke, are the most prominent names of this school and already belong to history, and amongst these earlier adaptors of the methods of physical research to the study of biology, Fick must be accorded a place on account both of his conspicuous bent and training as a physicist and of the work accomplished by him. So early as the year 1849, when a nineteen-year-old student, Fick published his first scientific treatise—that on the muscular system of the thigh—an essay which even at the present day forms a very instructive analysis of the mechanical relations of the muscles of the hip joint. For these researches into the mechanism of the human body Fick always retained a liking. He wrote a monograph on the saddle-shaped articulations, gave in his "Medical Physics," the first edition of which appeared in the year 1856, an admirable exposition of the mechanism of the joints generally, and contributed an article on the subject to L. Hermann's great "Handbuch," besides encouraging several of his own pupils to undertake similar investigations.

His scientific work upon the mechanics of the body led Fick to a special line of inquiry—one to which he devoted the working time and energy of his mature years—that respecting the changes of muscle during its contraction. There are about thirty essays by Fick himself, as well as a number of writings by his students, which deal with particular points in the physiology of muscle. Of these one of the most important was the development of heat which attends contraction. With the aid of thermoelectrical apparatus devised by himself, he was enabled to determine approximately the absolute amount of heat that was developed during continuous contraction. He subsequently introduced and defined the important conceptions which are expressed by the terms "isotonic" and "isometric" as applied to contraction, and investigated the nature of the conditions so designated. For the measurement of work, he constructed his "Arbeitssammler."

As the final result of all his muscular studies, he stated his views as to the nature of the process of muscular contraction. These have not escaped criticism. One of his conclusions, however, which in a manner he reached by a process of exclusion in so far as he rendered untenable other possible ways of explaining the contraction of muscle by reference to the second of the laws of the mechanical theory of heat, is, indeed, of quite prime importance.

According to Fick, the kinetic energy generated by chemical reactions in the muscle cannot be accounted for by the hypothesis that the chemical energy consumed is first developed in the form of heat, and this transformed into the coordinated kinetic energy of the contraction. It must rather be supposed that the chemical forces stored up in the muscle are so coordinated that in their transformation into kinetic energy they directly cause the change of form of the muscle; so that we have not to do with a thermodynamic process as in the case of the steam engine, but the chemical energy is converted directly into the coordinated kinetic energy of the contraction. With this notable definition respecting the changes which precede muscular contraction, an important stage is reached in the explanation of the phenomena of contractile substances, and every future discussion of these questions must be referred back to this as a starting point.

Another subject of Fick's repeated investigations was that of the dynamics of the circulation. His first efforts were directed towards improving the methods of obtaining graphic records of the blood-pressure curve, with the result that the manometer and the spring kymograph bearing his name have been adopted into general use. He was the first to analyse by means of an apparatus constructed by him—now called the plethysmograph—and with the greatest clearness and precision, the variations in speed of the flow of blood in artery and vein (Zürich Laboratory Reports, 1868). By means of new methods of investigation and observation he threw valuable light upon the phenomenon of dicrotism and upon the pressure of the blood in the ventricles of the heart and in the great vessels.

Under the head of the physiology of the organs of sense, he paid special attention to the subject of vision. His dissertation "Tractatus de errore optico," &c., Marburg, 1851, deals principally with the phenomena of astigmatism (Helmholtz, "Physiolog. Optik," p. 147). Fick occupied himself repeatedly with speculations as to the explanation of the colour sense. He published a number of critical and experimental studies upon the subject. His last communication to the Society of Medical Physics of Würzburg dealt with Hering's theory of the colour sense. His contributions to the study of the subject of hearing consisted in an experimental investigation upon the mechanism of the tympanum. A paper by Fick, on the sense of touch, is comprised in the volume for 1860 of Moleschott's *Untersuchungen*.

Upon the physiology of the nerve substance Fick published only a few essays. To the issues for the year 1862 and 1864 of the reports of the Vienna Academy and to the E. H. Weber "Festschrift" in the year 1871 he contributed studies upon the sensibility of the spinal chord. The essay upon the different degrees of excitability observable in functionally different parts of the chord deserves special mention.

Of Fick's work on metabolism, and the physiology of the digestive glands, may be mentioned, as particularly well known, the experiment[1] that he made with the

1 *Vide* the *Philosophical Magazine* for June 1866. The late Sir Edward Frankland regarded this as "one of the most important chemico-physiological experiments ever made" (Frankland's "Experimental Researches," p. 918). Although prevented from accompanying his brother-in-law, Fick, on the expedition, Frankland undertook the experimental determination of certain calorimetrical equivalents required as a basis for the conclusions drawn from the Faulhorn experiment. These, it may be added, had a much wider application, and until replaced by more exact determinations they served for years as the only data on which calculations could be founded.

cooperation of J. Wislicenus for estimating the amount of albumin expended in physical work such as mountain climbing. The result, that the material used in muscular work must be free from nitrogen, was at once generally accepted. The results of investigations on the peptones, upon what becomes of them in the circulation of the blood, on the action of pepsin, and on the value of various nutritive substances, were made public from time to time in lectures for which Fick prepared and demonstrated very numerous and laborious experiments.

The students' manuals which Fick wrote are distinguished by their lucid exposition, clear style and critical discussion. His first book, entitled "Die medicinische Physik," was written when he was in his twenty-seventh year, and passed through three editions. This book at once secured for the young author a place in the front rank of the physiologists of the day. Of the "Kompendium der Physiologie" four editions appeared, the last in the year 1892.

As early as 1862 he published a "Lehrbuch der Anatomie und Physiologie der Sinnesorgane" as part of a larger compilation. To Hermann's "Handbuch," already mentioned, he furnished two elaborate articles on physiological optics.

From the physiological laboratory at Zürich in the year 1869, and from the Würzburg Institute in the years 1873 to 1878, there appeared the "Physiologische Untersuchungen" (four issues). From 1852 and onwards for fourteen years he was one of the contributors to Canstatt's "Jahres bericht" on the literature of physiology.

Of the remarkable talents and training that enabled him, for instance, to deliver experimental lectures on physics during the vacancy of the chair of physics, he also gave evidence by his own productions as investigator and writer in this branch of science. Best known is his work on hydro-diffusion in Poggendorff's *Annals*. The fundamental conceptions of mechanics, and the insight gained into these by means of the mechanical theory of heat, were favourite subjects of his speculation. A brief enumeration must suffice here of the titles of the most characteristic of the treatises that fall under this head, and many of which lie in the borderland between physics and pure philosophy:—

"Ueber die der Mechanik zu Grunde liegenden Anschauungen," "Ueber die Zerstreuung der Energie," "Versuch einer physischen Deutung der kritischen Geschwindigkeit in Weber's Gesetz," "Ueber Druck im innern von Flüssigkeiten." The following treatises belong more to the philosophical side:—"Die Naturkräfte in ihrer Wechselwirkung," "Die Welt als Vorstellung," "Philosophischer Versuch ueber die Wahrscheinlichkeit," "Die stetige Raumerfülling durch Masse," &c.

Even this slight sketch of Fick's literary activity will show how comprehensively he mapped out for himself the sphere of his work and how exhaustively he laboured in it. But he was also unusually well equipped in all other departments of human knowledge. He was extraordinarily learned and well read. In accordance with his own definition of an educated man as one who is capable of taking a comprehensive view of the most characteristic results furnished by the intellectual work of the whole of mankind, Fick studied and mastered a very widely embracing province of knowledge. He was assisted in his efforts by a particularly accurate memory, which he retained unimpaired to the last.

Conspicuous among Fick's talents was his critical faculty. He dealt with the first principles of the science of mechanics in an unusually clear and distinct way, and when a series of novel conceptions was put before him he was able to correctly analyse and estimate them. He was recognised by those who knew him as a scientific critic by vocation. He was aided in his experimental work by great manual dexterity. He prided himself upon belonging to the school of Bunsen, and in the construction of the various instruments which he introduced followed Bunsen's method by himself putting together out of simple materials the first models of new scientific apparatus. It is an interesting fact that Fick warmly espoused the cause of total abstinence, and was himself for the last decade of his life a total abstainer.

NOTES.

M. AMAGAT has been elected a member of the section of physics of the Paris Academy of Sciences, in succession to the late Prof. Cornu.

MR. MARCONI brought forward two interesting pieces of information in his lecture at the Royal Institution last Friday. The first relates to the new form of magnetic detector which he has been employing in place of the coherer. The instrument is found to be more sensitive and trustworthy than the coherer, and gives promise of a great increase in the speed of working. Already a speed of thirty words a minute has been attained, and this may possibly be increased to several hundred. The second point relates to the recent Transatlantic signalling. It seems that on the occasion of Mr. Marconi's journey across the Atlantic in the *Philadelphia*, the signals transmitted during the day failed entirely at a distance of 700 miles, although a message was successfully sent at night more than 1550 miles, and a signal more than 2000 miles. This effect Mr. Marconi suggests may be due to the diselectrification of the aërial wires by the daylight. The difficulty can, however, be got over by the use of greater transmitting power—as is evidenced partly by the fact that the signal received at Newfoundland was transmitted during the daytime. The Canadian station, for the erection of which Mr. Marconi was liberally subsidised by the Canadian Government, will be open shortly for experiments. The rest of the lecture gave an interesting *résumé* of the work already accomplished, but contained nothing which will be new to those who have followed its progress.

THE eighty-third meeting of the Société Helvétique des Sciences Naturelles will be held at Geneva on September 7-10. M. E. Sarasin is the president of the society, M. Marc Micheli and Prof. R. Chodat vice-presidents, M. Maurice Gauthier and M. A. de Candolle secretaries, and M. A. Pictet treasurer. Correspondence referring to the forthcoming meeting should be addressed to M. de Candolle, Cour de St. Pierre, 3, Geneva.

IN accordance with previous announcements, the autumn meeting of the Iron and Steel Institute will be held at Düsseldorf on September 3-4. The directors of the Norddeutscher Lloyd have generously offered to the members attending the meeting complimentary first-class passages, including table, to the number of 250, by the s.s. *Kronprinz Wilhelm*, upon that ship's homeward voyage (from New York) to Bremen, on September 1, from Plymouth. The provisional programme of the meeting is as follows:—On Tuesday, September 2, the members will arrive at Düsseldorf. On September 3 the president, council and members will be received by the civic authorities and by the reception committee in the Municipal Concert Hall (Städtische Tonhalle). A selection of papers will subsequently be read and discussed. In the afternoon a visit will be paid to the Düsseldorf Exhibition, for the purpose of examining the various sections of mining, metallurgy and machinery. In the evening the members and ladies accompanying them will be invited by the Mayor and Corporation of Düsseldorf to a conversazione and concert. On September 4 the morning will be devoted to the reading and discussion of papers, and the afternoon to visits to the exhibition and to works in the immediate vicinity. In the evening the reception committee will entertain the visitors at a banquet.

On September 5 the whole day will be devoted to visits to works. In the evening the exhibition grounds will be specially illuminated in honour of the Institute. On September 6 there will be an excursion to the picturesque district of Vohwinkel, to the Elberfeld suspended railway and to the Kaiserbridge, near Müngsten. A detailed programme will be issued when the arrangements are further advanced.

ON June 14 the Essex Field Club visited those portions of the old Lambourne and Hainhault Forests which, according to the scheme proposed by Mr. E. N. Buxton, are to be re-afforested and to become an open space for London second only in importance to Epping Forest. It is proposed to make free some 859 acres, of which seventy are detached from the main portion. These form Grange Hill Forest, and the purchase of them for 7000*l*. is now assured. For the rest, 20,000*l*. is asked. It is hardly necessary to point out the importance from a natural history point of view which the grounds will possess if they become public property. Not only will the naturalist find happy grounds for study, but others who feel the necessary primness of London parks will be able to enjoy nature less adorned.

QUEENWOOD COLLEGE, near Stockbridge, Hants, was destroyed by fire on June 10, Mr. Charles Willmore, the principal, meeting his death in the disaster. Several distinguished men, both in Mr. Willmore's time and in that of his predecessor, Mr. George Edmondson, made their temporary home at Queenwood. Prof. Fawcett, Postmaster-General and political economist, was a scholar there; and in the roll of its science masters we find the names of Tyndall, Frankland, Debus, Field and Hake. There have been few schools in this country in which the pursuit of science was more earnestly and heartily encouraged. It is now about seven years since the college, as such, ceased to exist.

DURING a trial with a French naval balloon off Toulon on June 9, Lieut. Baudic, who was alone in the car, was thrown into the sea and drowned. The object of the ascent was to ascertain whether it is possible, from the car of a balloon, to perceive submarine boats at a distance of a mile or so. The balloon started from the Maritime Aëronautical Works established in 1890 at Garrouban. The Garrouban Aëronautical Station is provided with two balloons, the *Auxiliare*, and a larger one measuring 500 c.m. capable of carrying three persons, called the *Normal*. These marine balloons are intended to be sent up captive from a large war steamer for inspecting the surrounding sea and sending up signals at a distance.

WE learn from *Science* that at the recent annual meeting of the American Academy of Arts and Sciences it was decided to award the "Rumford premium" to Prof. George E. Hale, of the Yerkes Observatory, "for his investigations in solar and stellar physics, and in particular for the invention and perfection of the spectro-heliograph." It was also resolved to grant the sum of 750 dollars from the income of the Rumford fund to be expended for the construction of a mercurial compression pump designed by Prof. Theodore W. Richards and to be used in his research on the Thomson-Joule effect. A grant from the Rumford fund was also made to Prof. Arthur A. Noyes in aid of his research as to the effect of high temperatures upon the electrical conductivity of aqueous solutions.

THE *Times* reports that the jubilee festival of the Germanic Museum at Nuremberg was celebrated on Monday in the presence of the German Emperor and Empress and members of the Royal Houses of Bavaria, Baden and Würtemberg. The collections in the museum illustrate every aspect of the growth of the Germanic peoples; special collections, for example, have been formed to illustrate the development of the trade guilds and of characteristic German industries, such as the Bavarian breweries. From a collection of antiquities in the narrow sense of weapons, heraldic devices and the like, the museum has grown into a complete historical exhibition.

DURING the researches of the seventh expedition of the Liverpool School of Tropical Medicine, which visited the Gambia in the summer and autumn of last year, a new parasite associated with symptoms resembling those occurring in animals suffering from the tse-tse fly disease was found in the blood of a native child. The committee of the school has now resolved to despatch a new expedition to the Gambia and to Senegambia to study the disease further. The expedition, which will start in a few weeks, will, as at present organised, consist of Dr. J. Everett Dutton and Dr. J. L. Todd, of McGill University, Montreal. Its principal object will be to investigate the conditions under which the disease occurs in both Europeans and natives and its distribution, and also to ascertain how it is conveyed from man to man.

AMONG the subjects discussed at the annual meeting of the Sea Fisheries Committees of England held in London on June 10 and presided over by Mr. Gerald Balfour were the establishment and maintenance by the Government of one or more laboratories for carrying on the work of fishery research, or, failing that, the provision from Imperial resources of the funds necessary to render more efficient and useful the laboratories which at present exist. Mr. Gerald Balfour, in welcoming the delegates, said some of the subjects discussed last year, such as the registry, lettering and numbering of fishing boats, had been carried out; and the artificial fertilisation of ova had been referred to the Committee on Ichthyological Research now sitting, as was also the establishment and maintenance of laboratories and hatcheries.

IN the popular mind, the medical and other sciences are regarded as too severely precise to have romantic aspects, yet in the history of scientific discovery records can be found of many noble deeds and sacrifices for the sake of others. Sir Frederick Treves referred to the romance of medicine in an address at the Charing Cross Hospital Medical School on June 11. He remarked that the exploits of discoverers of new countries had always been surrounded with a halo of romance, but the discoveries in medicine had not been less romantic. No story of the past could exceed the romance of the history of the work of Pasteur, Lister and Koch. They had not discovered any new garden of the Hesperides, but they had travelled far into the valley of the shadow of death. He did not think there was anything in the history more tragic than the account of Laënnec holding on the point of a needle a minute scrap of tissue and saying "I have found the seed of tuberculosis." When Koch demonstrated the bacillus of tuberculosis he was practically reaching one of the limits of philosophic inquiry. Could there be anything more profoundly interesting than the way in which malaria was studied and finally explained?

SEVERAL matters of meteorological interest have been recorded during the past few days. The drought in Australia came to an end at the beginning of last week, when good rains occurred in portions of South Australia, New South Wales and Victoria. Less hopeful news comes, however, from India, for an Exchange telegram from Simla states that the official monsoon forecast, which this year for the first time is withheld from the public, foreshadows a deficient rainfall all over India and drought in Gujerat and Western Punjab. At Karachi, however, a terrific storm occurred on Monday. The *Daily Mail* states that the city is half submerged by extraordinarily high tides. Telegraphs and telephones have all been destroyed, and there has been serious loss of life and property. Exceptionally stormy weather is also being experienced in South Africa. At Middleburg, Cape Colony, for the first time for sixteen years, the town was covered with deep snow on June 11. Storm and cold are general throughout the Colony. The cold is unprecedented, and thousands of cattle and sheep have perished. In many places the telegraph poles are buried beneath snowdrifts. A very severe snowstorm swept ever the midland districts of Cape Colony on June 14. Trains were blocked at Naauwpoort by a snowdrift 6 feet in depth, and much difficulty was experienced in clearing the lines. Heavy falls of snow also occurred in other parts of the country.

THE annual report of the Decimal Association records that ately there has been a very decided growth of public opinion in favour of the compulsory adoption of the metric weights and measures throughout the British Empire. There are warm supporters of the reform in Canada, Australia, Cape Colony and India, and efforts will be made to bring the question before the Conference of Colonial Premiers to be held at the time of the Coronation. British consuls abroad, residing in countries where the metric system is in use, continue to dwell upon the importance of the change being made from our present confused and complicated weights and measures to those of the metric system. The Committee on Decimal Coinage appointed by the Federal House of Representatives for Australia issued its report in April recommending the adoption of decimal coinage. The report of this committee concluded with a recommendation that the Commonwealth should cooperate in any movement for the decimalisation of the weights and measures of the Empire. Quite recently the Association of Trade Protection Societies of the United Kingdom passed the following resolution at its annual meeting :—"That this meeting is of opinion that the time has now arrived when the decimal system of coinage and the metric system of weights and measures should be compulsorily adopted throughout the British Empire."

AMERICA has just furnished a new high-speed record, which has been attained on the Burlington and Missouri Railroad. The train (says *Feilden's Magazine* for June) consisted of nine cars, namely, a mail car, a luggage car, two reclining chair cars, three sleeping cars, dining car and a private car, and the engine (B. and M. R. No. 41) was of the ten-wheeled type with 6-feet driving wheels. The section over which the record was taken was between Eckley and Wray, Colorado, separated by a distance of 14·8 miles, which was "covered in exactly nine minutes, that is, the train was travelling at the rate of 98·66 miles per hour for the whole section." It is stated that the time was correctly tallied by five separate chronographs, and may therefore be considered trustworthy.

IN the *Jahrbuch der k.-k. geol. Reichsanstalt* (Band li. Heft 1), Herr Lukas Waagen contributes a detailed account of the Jurassic *Avicula* (*Oxytoma*) *inaequivalvis* and its allies. This paper will be welcomed by all who may have occasion to study this very variable and difficult group of shells. The author supplies a comprehensive synonymic list, and concludes that the numerous specific separations in this group, proposed by various authors, are in reality unwarranted.

A SCORE of new forms of fossil ear-bones of fishes, from the Tertiary strata of Austro-Hungary, have been described by R. J. Schubert (*Jahrbuch der k.-k. geol. Reichsanstalt*, Band li. Heft 2). These otoliths are for the most part referred to Umbrina, Corvina, Sciænidarum and Sciæna, and were obtained in Pliocene deposits at Brunn am Gebirge and in Miocene beds at several other localities. Some appear to indicate relationship with recent Mediterranean forms, while others have their nearest allies in the Oligocene and Miocene of Germany and in the older Tertiaries of North America. The paper is well illustrated.

IN a memoir on the flora of Thibet or high Asia Mr. Botting Hemsley, F.R.S., has compiled an account which brings out vividly the unique conditions of altitude and climate. The data for the subject-matter are obtained from collections deposited in the herbarium at Kew. Amongst the peculiarities of the vegetation may be noted the scarcity of certain types of plants, *e.g.* annuals, succulents and bulbous plants (except *Allium Semenovi*, which is widely distributed). Woody plants, too, are rare and poorly developed.

WE have received the Report of the South London Entomological and Natural History Society for 1901.

THE most interesting item in the Report of the Albany Museum for the year 1901 is the identification among the collection of a pair of horns of the blaauwbok (*Hippotragus leucophoeus*), an antelope formerly found in the neighbourhood of Cape Town which has been extinct for considerably more than a century. The horns were entered in one of the old catalogues as belonging to the animal in question ; assuming the identification to be correct, the specimen appears to be the only known relic of the blaauwbok remaining in South Africa.

IN the *American Naturalist* for May, Prof. H. F. Osborn further elaborates his views as to the "law of adaptive radiation" among mammals. One result of his investigations is to explode the old idea that it is possible to reconstruct an extinct animal from either a claw or a tooth. Correlation is not, as Cuvier supposed, morphological, "but physiological, function always preceding structure. It becomes closest when teeth and feet combine in the same function, as in the prehensile canines and claws of the Felidæ, and most diverse where the functions are most diverse, as in the teeth and paddles of the Pinnipedia."

VOL. liii. of the *Anales* of the Scientific Society of Argentina contains a long memoir, by Señor A. Gallardo, of the late Dr. C. Berg, director of the museum at Buenos Aires. From this it appears that Berg was born at Tuckum, Curlandia, Russia, in 1843, and that, after much good work in his native country, he first visited Argentina in 1873. Here, under the auspices of Burmeister, he worked at the entomology and botany of the country assiduously for nearly two years, when he was appointed professor of zoology at Cordoba. This appointment, however, he held but two months, as in March, 1875, he was elected to the chair of natural history at the National College of Buenos Aires, in succession to Dr. J. Ramorino. In 1890 he was specially entrusted with the reorganisation of the National Museum at Monte Video, and on the death of Burmeister in 1892 he succeeded to the directorship of the National Museum at Buenos Aires, a post which he held until his own death. Berg's work covered a very wild field both in zoology and botany, and an appendix to the memoir before us contains a very long list of papers of which he was the author. One of his latest contributions proved the distinctness of the smaller form of mara, or Patagonian cavy, the *Dolichotis salinicola* of Burmeister. He is succeeded in the directorship of the museum by Dr. Florentino Ameghino, so well known on account of his remarkable contributions to the history of the extinct vertebrate fauna of Patagonia.

CURIOUS if true must be the verdict in regard to a paper contributed by Prof. William Patten to the May issue of the *American Naturalist* on the structure and classification of the Tremataspidæ. This family is represented by a single genus and species (*Tremataspis schrenki*), all the known remains of which have been obtained from the Lower Silurian of a small pit at Rootsikuelle, in the Isle of Oesel, in the Baltic. These remains consist chiefly, if not entirely, of more or less imperfect examples of the dorsal shield. Although Tremataspis has always been classified with primitive vertebrates like

Cephalaspis and Pteraspis, the curious resemblance presented by its shield to the carapace of the modern crustacean commonly known as Apus has long been recognised. This resemblance, the author contends, is not a mere accident, but indicates genetic affinity between the two groups. Accordingly, he proposes to regard Tremataspis, Pteraspis, Cephalaspis and Pterichthys as the representatives of a new class of arthropod-like animals under the title of Peltacephalata. And he urges that the genetic relationship between this group and the arthropods "can mean nothing else than the derivation, through changes in structure and function, of the one group from the other." A further proposal is to group together into one great phylum the vertebrates and the arthropods, under the name of Syncephalata. It will be interesting to note what the authors' fellow-workers have to say in regard to this startling new departure in classification.

To the April number of the *Ibis*, Mr. W. E. Clarke communicates an account of a month spent by himself last autumn on the Eddystone for the purpose of observing bird-migration. On the night of October 12 the author was fortunate enough to witness a great "rush" of emigrating birds, which continued until the early hours of the 13th. Although the majority of the migrants were British, the presence of the redwing and the fieldfare indicated a foreign contingent, and it was also noted that the starlings taken on this occasion belonged to the race characterised by the purple head and green ear-coverts, which is believed to be continental in habitat. "Throughout the movement, and especially when it was at its height in the earliest hours of the morning," writes Mr. Clarke, "the scene presented was singular in the extreme and beyond adequate description. Resplendent, as it were, in burnished gold, hosts of birds were fluttering in, or crossing at all angles, the brilliant revolving beams of light; those which simply traversed the rays were illumined for a moment only, and became mere spectres on passing into the gloom. The migrants which winged their way up the beams—and they were many—resembled balls or streaks of approaching light, and they either struck the lantern, or, being less entranced, passed out of the rays ere the fatal goal was reached. Of those striking, some fell like stones from their violent contact with the glass, while others beat violently against the windows in their wild efforts to reach the focal point of the all-fascinating light."

THE skeleton and skin of the okapi recently received at the Congo Museum, Brussels, add important information to our knowledge of that animal. The specimens have been submitted to Dr. Forsyth Major, who published a preliminary note on the results of his examination in *La Belgique Coloniale* of May 25, and also gives a figure of the male skull in the same journal of June 8. The Brussels specimens comprise the skeleton of a male, unfortunately lacking two of the vertebræ of the neck, and the skin of a female, both belonging to adults. These show that full-grown individuals of both sexes are provided with horns. Those of the female are comparatively small, conical, nearly vertical and completely covered with skin. Those of the male, on the other hand, are larger, subtriangular and inclined somewhat backwards, each being capped with a small polished epiphysis, which appears to have projected through the skin investing the rest of the horn. As regards its general characters, the skull of the okapi appears to be intermediate between that of the giraffe on the one hand and that of the extinct Palæotragus, or Samotherium, on the other. It has, for instance, a greater development of air-cells in the *diploë* than in the latter, but a much smaller one than in the former. Again, in Palæotragus the horns (present only in the male) are situated immediately over the eye-sockets, in Ocapia they are placed just behind the latter, while in Giraffa they are partly on the parietals. In general form, so far as can be judged from the disarticulated skeleton, the okapi was more like an antelope than a giraffe, the fore and hind cannon-bones, and consequently the entire limbs, being of approximately equal length. It is further suggested that, owing to the skin having been unduly stretched in drying, the neck and fore-limbs of the immature mounted specimen in the British Museum may be somewhat too long. From all this it seems probable that Palæotragus and Ocapia indicate the ancestral stock of the giraffe line; while it is further suggested that the apparently hornless Helladotherium of the Grecian Pliocene may occupy a somewhat similar position in regard to the horned Sivatherium of the Indian Siwaliks.

THE second volume of the *Minnesota Botanical Studies* is completed with the issue of the May number. Mr. Bruce Fink contributes an article dealing with the lichens of north-western Minnesota. The *Corallinae verae* of Port Renfrew, Vancouver Island, B.C., form the subject of a short systematic account by Mr. K. Yendo. The concluding paper, by Prof. Conway Macmillan, deals with the anatomical investigation of *Pterygophora californica*, one of the Laminariaceæ.

IN the first quarterly *Bulletin* for this year issued by the Botanical Department at Trinidad will be found an account of some experiments the results of which promise to be of value to cacao planters. Attempts have been made to graft cacao plants on strong stocks, in the hope that liability to the attacks of fungi may be reduced. So far, successful grafts on *Theobroma bicolor* and *Herrania albiflora* have been obtained, and trials are being made with stocks of *Cola acuminata*. Another somewhat novel experiment is in progress of treating the soil with mulchings of vegetable matter during the dry season. This serves to attract earthworms, and they act as carriers of manure to the roots of the cacao plants. Attention is also drawn to the advantages of using chupons or gormandisers on the plantations.

IN the report for last year, issued from the Royal Botanic Gardens, Ceylon, Mr. J. C. Willis, the director, gives further proof of his capability as an organiser and investigator. To aid in purely scientific work he has the assistance of four experts—a mycologist, a chemist, an entomologist and an assistant. Besides investigating the diseases of tea and cacao plants, experiments have been made with other plants which may prove to have an economic value. While so far no industry of a first-class nature has been brought to light, several minor industries which may be undertaken on existing plantations have been instituted. Hevea plants now under cultivation have yielded rubber superior to the best wild Para. Indigenous species of Palaquium were investigated by the assistant, and rubber of fair commercial value was obtained; this, too, without cutting down the tree. Camphor, citronella oil, cinchona, coca have also been brought to the notice of planters. The laboratory at Peradeniya has been well patronised by English and foreign visitors, and with the establishment of a laboratory and rooms at Hagkala facilities are offered for research in the hill country. The director has completed his review of the flora of the Maldive Islands, and has published it in the new journal, the *Annals* of the Royal Botanic Gardens, Peradeniya.

WE have received a copy of the fifth volume of the *Transactions* of the Inverness Scientific Society and Field Club. It embodies the work of four sessions, ending with the summer of 1899, but there is appended a summary of Dr. John Horne's address to the geological section of the British Association in 1901. Some time has therefore elapsed since the reading of the papers now published, which deal with history and archæology as well as natural history, physics and engineering.

There is a suggestive paper by Dr. Mackie, of Elgin, on "The Felspars present in Sedimentary Rocks as Indicators of the Conditions of Contemporaneous Climate."

MESSRS. J. J. GRIFFIN AND SONS, LTD., have issued a new edition of their illustrated catalogue of chemical apparatus and reagents published under the title "Chemical Handicraft." Hints on manipulation of instruments and arrangement of apparatus are occasionally given, and they assist in making the volume a useful catalogue for chemical laboratories and technical schools.

NEW and revised editions have been received of several well-known scientific books. The fourth edition of Prof. Grenville Cole's "Aids to Practical Geology" has been published by Messrs. C. Griffin and Co. The book is the most helpful guide which the student who desires to become intimately acquainted with the characters of rocks and minerals could possess. It is not intended to take the place of a field geology, but to show how every specimen obtained may be minutely examined in the laboratory or study, and its place among rocks or fossils understood. Work of this kind is practical geology in as scientific a sense as observations in the field.—Messrs. Cassell and Co. have published a popular edition of Mr. Richard Kearton's interesting book "With Nature and a Camera." The 180 pictures reproduced from photographs by Mr. Cherry Kearton have given pleasure to many outdoor naturalists.—The valuable text-book of "Agricultural Botany," by Prof. J. Percival, published by Messrs. Duckworth and Co. and reviewed in these columns in October, 1900 (vol. lxii. p. 570), has reached a second edition. It is satisfactory to know that students of agriculture are using a book in which plant structure and growth are dealt with scientifically.—The eighth edition of "Astronomy with an Opera Glass," by Mr. G. P. Serviss, has been published by Messrs. Hirschfeld Brothers, Ltd.—A new edition of Prof. J. G. Macgregor's "Elementary Treatise on Kinematics and Dynamics" has been published by Messrs. Macmillan and Co., Ltd. Few changes have been made, and the book retains its character as a comprehensive treatise in which the whole subject is treated systematically, without reference to the requirements of examining bodies.

THE additions to the Zoological Society's Gardens during the past week include a Dusty Ichneumon (*Herpestes pulverulentus*) from South Africa, presented by Capt. A. Perkins; two Larger Egyptian Gerbilles (*Gerbillus pyramidum*) from North Africa, presented by Col. Momber; a Buffon's Touracou (*Turacus buffoni*) from West Africa, presented by Capt. H. A. Thorne; two Long-tailed Whydah-birds (*Chera progne*) from South Africa, presented by the Rev. R. Armitage; a Richardson's Skua (*Stercorarius crepidatus*) European, presented by Lt.-Col. L. H. Irby; a Sykes's Monkey (*Cercopithecus albigularis*), a Grant's Gazelle (*Gazella granti*), a Banded Ichneumon (*Crossarchus fasciatus*), a Vulturine Guinea Fowl (*Acryllium vulturinum*), a Bateleur Eagle (*Helotarsus ecaudatus*), three White-winged Whydah-birds (*Urobrachya albonotata*) from East Africa, a Buffon's Touracou (*Turacus buffoni*), a Red-faced Weaver-bird (*Foudia erythrops*), seven Orange Weaver-birds (*Euplectes franciscana*), two Pintailed Whydah-birds (*Vidua principalis*), three Paradise Whydah-birds (*Vidua paradisea*) from West Africa, two Maguari Storks (*Dissura maguari*), two Snowy Egrets (*Ardea caudidissima*), four Black-pointed Teguexins (*Tupinambis nigropunctatus*), four South American Rat Snakes (*Spilotes pullatus*) from South America, two Brazilian Cariamas (*Cariama cristata*) from Brazil, deposited; a Black-winged Peafowl (*Pavo nigripennis*) from Cochin China, purchased; a Great Bird of Paradise (*Paradisea apoda*) from the Arrow Islands, received in exchange; a Brindled Gnu (*Connochaetes taurina*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE SUNSPOT CURVE AND EPOCHS.—The great importance of collecting as many facts as possible regarding solar activity, and revising them from time to time as new information is gathered, is clearly shown by the paramount *rôle* that the sun plays in causing the numerous variations in meteorological phenomena. Wolf's relative numbers have been, and are now, so commonly used when reference has to be made to solar activity that it is of the first importance that such a series of values should be as near correct as possible. It is with great satisfaction, therefore, that we note that Wolfer has so diligently continued the useful work, ably begun by Wolf, that he has now published (*Meteorologische Zeitschrift*, May, 1902) a new set of values carefully revised and brought up to date. As he remarks, an examination of the original manuscript at the observatory with various published tables has shown that a great number of differences and printer's errors have crept in, suggesting that it is time that a new edition was published. This reduction has been very carefully made by Wolfer and his assistant, each making the computations twice. In addition to the observed relative numbers, the paper gives smoothed relative numbers, while a third table shows the epochs of maxima and minima with their corresponding weights; the addition of the weights to the dates of these epochs is a very valuable piece of information which will add to the utility of the earlier epochs.

METHOD OF OBSERVING ALTITUDES AT SEA DURING NIGHT-TIME.—In a paper read before the Royal Dublin Society, Prof. Joly introduced recently a method for observing the altitude of a celestial body at sea which may prove extremely useful for taking bearings at night-time or when the horizon is obscured. Assuming that the vessel is provided with the usual Board of Trade rescue signals, one of these is perforated and dropped overboard. This will furnish a bright white light visible in clear weather up to five miles, and burning for about half an hour. To the signal is attached a suitable sinker, so that it will not drift appreciably. Selecting a star, the observer takes its bearing and then alters his course to the opposite bearing, thus bringing the star right astern. The signal is then dropped overboard, and at the same time a reading of the log is taken. After the vessel has travelled a distance of about a mile from the signal, as indicated by the log, the observer takes the angular elevation of the star over the signal, using the sextant in the usual manner. Corrections will have to be applied for the relative motion of the star from east to west at the rate of 1° in four minutes of time, for the larger angle of "dip," and also for the state of the water surface. In very rough water this last correction becomes of special importance, and formulæ with reduction tables are given to show the influence of waves of varying heights. The routine to be followed in observing two altitudes for a "Sumner" position is also described (*Scientific Proceedings* of the Royal Dublin Society, vol. ix., n.s., part v., No. 46, pp. 559-567).

LIQUID FUEL FOR STEAM PURPOSES.

THE possibility of burning a liquid fuel with very great advantage in most circumstances as compared with a solid fuel has been so long recognised that it is astonishing the practice has not been more generally adopted. The success which has been gained in the last few years, however, will undoubtedly lead to a greatly extended use in the near future.

Naturally the choice of a fuel for steam raising is not altogether dependent upon the evaporative efficiency and other advantages which a particular one may possess, but will, of course, be largely influenced by relative market prices, and this, no doubt, has had considerable influence against the adoption of liquid fuel on a large scale in this country. The fuel natural to the locality will always have great advantages over an imported fuel, and England, having such valuable coal supplies to hand, whilst on the other hand having no great natural sources of liquid fuel, gives preference to that material which renders it most independent of outside supplies. Although gas tar and oil gas refuse may be frequently employed in a very economical manner, yet there is little doubt that with a greatly extended use of liquid fuel the prices of suitable bye-products would be so enhanced that imported liquid fuel would remain practically in possession of the field.

For this reason engineers who have perfected the methods of burning liquid fuel have always considered the possibility of its use becoming limited in certain circumstances, and all modern appliances are so constructed that with slight trouble coal alone may be used in them to the best advantage. One of the great claims to be considered in favour of liquid fuel is the ease with which the burners can be extinguished and a coal fire substituted, thus enabling consumers to take every advantage of fluctuations in the prices of both fuels. For marine purposes this is most desirable, since at many ports liquid fuel would be far more economical to ship for boiler use than a suitable steam coal, whilst a vessel trading from a port—such as Cardiff or Newport—would naturally replenish her bunkers with the steam coal at hand.

Any liquid hydrocarbon of sufficiently high flash point may be used as a liquid fuel; thus residues from many manufacturing processes may be utilised in an economical manner. Astatki, the residuum from petroleum distillation, has been extensively used in Eastern Europe, but tar oils and the oils from oil gas plant are frequently employed. These oils are especially suitable for locomotive work, since most large railways make oil gas in considerable quantities for lighting purposes, and, moreover, have exceptional facilities for transporting gas tar from small towns on their lines where it can be obtained at a reasonable cost. On the Great Eastern Railway this form of liquid fuel is largely employed. Crude petroleum, which has been treated to remove the more volatile constituents and so bring its flash point above the imposed limit for use as fuel, is now being imported into this country. The various methods of burning liquid fuel have been classified by Aydon as follows:—

(1) *Injection with compressed air* (W. Bridges Adams, 1863; Tarbutt, 1885.)

(2) *Percolation through a porous bed* (C. J. Richardson, 1864; Weir and Gray; St. Caire Deville), in which the liquid fuel percolates upwards through a porous bed, accompanied by heated air (and sometimes steam also).

(3) *Vaporisation* (Foote; Simm and Barff, 1865-67), the oil being vaporised from a small retort heated in the furnace, or in some cases (Dorsett, 1868-69; Eames, 1875) by a special external heater for the retort.

(4) *Steam spray injection* (Aydon, Wise and Field, 1865-67), in which the oil is sprayed into the combustion chamber by a jet of steam, whilst at the same time the burner is so constructed that air, heated if possible, is drawn in to supply the oxygen necessary for combustion.

Such a classification does not include burning in open troughs, a method first introduced by Wittenström about the year 1884, and which for many purposes in stationary boilers, furnaces, &c., has met with considerable success; or the more recent method of Korting, by direct injection of heated oil at considerable pressure.

Excepting in a few special cases, the steam spray injection method has been universally adopted. Various extravagant claims have been made for the chemical action of the steam, but it is not easy to see from a theoretical standpoint that it has any advantage over injection by compressed air. From a practical point of view, however, the steam spray is the more simple, since it dispenses with the auxiliary apparatus necessary for the supply of the air blast. On a locomotive, where economy of space is of importance and suitable water for the boilers is readily obtainable, steam spray injection is universal. For marine boilers the choice formerly lay between steam and air injection, each having certain advantages. Using steam injection, the auxiliary apparatus necessary for the air-blast is done away with, thus giving economy of space, whilst it has the disadvantage of requiring more condensed water from the evaporators to replace the steam used. On the other hand, the extra steam necessary for the air-blowers can be condensed and returned in the usual way to the feed water-pipe, but of necessity extra machinery has to be employed. With the introduction of the Korting system referred to above, and the success which has attended its use, notably on the Hamburg-American Line steamers, the marine engineer now has the choice of another method, and everything seems favourable to the extensive adoption of this new system in the future.

From the numerous estimations of the calorific value of different liquid fuels, we may approximately state that in centigrade units it has a value of 10,500, whilst for good steam coal a value of 8000 to 8500 may be taken. It will thus be seen that the liquid fuel has a decided advantage. The usual calculations of the theoretical heating value of a fuel fail to take one important factor into consideration, namely, the physical condition of the fuel. Thus the determined calorific value of carbon is always that of solid carbon, the value for hydrogen being obtained experimentally for hydrogen gas; but although in coal the carbon is in the solid form, it is certain that in liquid fuels it has undergone the first change in the passage of a solid to a gaseous condition, and consequently carbon in a liquid fuel will have a higher calorific value by just as much heat as would be required theoretically to raise solid carbon to the liquid condition. Aydon has estimated that this is equivalent to an expenditure of some 3500 calories.

It is, of course, impossible even with the most perfect appliances to obtain anything like the full heating effect of a fuel in any boiler, and the only real test of the value of competing fuels is their performance under similar conditions in practice. One is struck at the outset with the extremely contradictory figures which have been published to show the evaporative duty of liquid fuel, figures ranging from 46 lbs. of water per lb. of fuel burnt to 14 or 16 lbs. per lb. It may be taken, however, that in modern practice an efficiency of 15 lbs. by steam injection is a very fair result. Many comparisons have been made with coal in the same boilers and under the same conditions with results varying from 7 to 8½ lbs. of water evaporated per lb. of coal consumed. A valuable series of tests made by the Engineers' Club of Philadelphia in 1892 gave the following results:—

1 lb. anthracite evaporated	9·7 lbs.	of water.
1 lb. bituminous coal	10·14 ,,	,,
1 lb. oil 36° B.	16 48 ,,	,,
1 cu. ft. of gas 20 C.P.	1·28 ,,	,,

We are indebted to the carefully recorded results obtained by Mr. Urquhart on the Grazi and Tzaritzin Railway for probably the best published figures of the relative merits of solid and liquid fuels. In winter he found that liquid fuel was 41 per cent. in weight and 55 per cent. in cost better than anthracite coal; or, compared with bituminous coal, 49 per cent. by weight and 61 per cent. in cost better. This was under the worst climatic conditions, and, as might be expected, in summer better results still were obtained. It must be borne in mind that these figures were deduced from the work of a large number of engines.

The Canadian Pacific Railway find that liquid fuel in use on their steamers effects a saving of 56 per cent. on the cost of coal firing.

In this country the pioneer of liquid fuel on our railways is Mr. James Holden and his company; the Great Eastern Railway has now more than sixty engines burning it, either alone or in conjunction with coal. In a note presented at the International Railway Congress in 1900, Mr. Holden gives the following particulars of express trains running between Liverpool Street and Cromer. The distance of 138 miles is covered in 175 minutes with a four minutes' stop, on a consumption of 14·4 lbs. of tar residues per train mile, and an equivalent of 5 lbs. per mile of coal, which is used in raising the steam necessary for starting the oil injectors. In the same paper it is stated that on railways working with wood fuel a saving of 50 per cent. has been effected by burning liquid fuel. Through the kindness of Mr. Holden, the writer recently made a long run on an engine burning crude coal tar over a coal fire with the Holden steam injectors, and was impressed with the ease of maintaining a regular steam pressure and the freedom from smoke.

The South Eastern and other railways are now fitting engines for this class of fuel, and an oil-fired engine is used for shunting on the Central London Railway. Boilers are also being fitted for liquid fuel at Woolwich Arsenal, and its use is extending amongst private firms.

In the English shipping trade the pioneers have been Messrs. Samuel and Co., the managers of the Shell Transport Company, and a reference to the excellent performance of their vessel the s.s. *Clam* will be found in a recent number of NATURE. An interesting account of the record voyage under liquid fuel appears in the *Shipping Gazette* of February 13, the vessel being the s.s. *Murex*, also belonging to the Shell Transport Company. This ship arrived at Thames Haven from Borneo *viâ* Singapore and the Cape on March 10, having steamed 11,830 miles on a consumption of 800 tons of prepared fuel.

The average daily consumption was from 17 to 18½ tons, whilst the same vessel when under coal used from 24 to 25 tons.

The economy of cost in liquid fuel does not lie entirely in its superior evaporative value, for several other factors are all in its favour, and probably the greatest of these in the marine service is the reduction in the stokehold staff. Potter states that with fourteen tubular boilers (16 feet × 5 feet) twenty-five men were required for stoking with coal, but on the introduction of liquid fuel six men sufficed. On the s.s. *Murex*, referred to above, whilst more than twenty stokers were required when under coal fires, only three were carried to attend the oil burners. When the cost of wages, food, &c., for the large number of stokers carried on an average liner are taken into consideration, the possibilities for economy by the adoption of liquid fuel, when it can be obtained at a reasonable price, are very great. In the Royal Navy, where the stokers carried on a battleship run into big numbers, not only does liquid fuel tend to economy, but an even more important factor—the number of lives risked in an engagement—would be largely reduced. It is terrible to contemplate the fate of the engine-room staff in the event of one of our big ironclads being sunk by a torpedo or the ram of an adversary's ship.

For storage, liquid fuel has a slight advantage over coal. In general terms it may be said that one ton of liquid fuel will require 36 cubic feet of storage and steam coal from 43 to 45 cubic feet; but it must be remembered that coal bunkers have of necessity to be specially arranged for the easy delivery of the fuel at the stokehold level, whereas liquid fuel may be carried in places where the storage of a solid fuel is quite out of the question. By the adoption of some system of removing water from the oil, such as that of Flannery and Boyd, where two settling tanks are alternately employed, liquid fuel may be stored in water-ballast tanks and the fore and aft peaks of the vessel. Remembering that one ton of oil fuel has such a much larger evaporative efficiency than the same weight of coal, and, further, has advantages in storage, a very much larger cargo space can be reserved in a vessel, or in the case of the belligerent marine, with no greater total weight of fuel on board, a very greatly extended radius of action can be obtained.

A point in connection with coal as a fuel in steamships which is often overlooked is the large amount of inert material which must necessarily be carried in the bunkers; for example, a ship takes into her bunkers 2000 tons of steam coal (H.M.S. *Queen*, which was recently launched, has a coal capacity of 2040 tons), and taking a fair estimate of the ash of this coal at 5 per cent., it means finding space for at least one hundred tons of non-usable mineral matter, even assuming that the ash and clinker do not exceed the ash of the coal. In the case of liquid fuel, the whole amount stored is actually available as fuel, and there is no trouble with ash or clinker in the furnaces, or solid waste of any description to be got rid of.

On any vessel, and especially on a ship carrying passengers, the operation of coaling is a particularly disagreeable one. With liquid fuel there is really no inconvenience, for the oil can be pumped into the tanks in much less time than coal shipment takes, and, further, all the dirt associated with "bunkering" is avoided. At the present time it is well known that the Admiralty is carrying out experiments in coaling war vessels at sea, the collier being made fast astern and the coal hauled along a suitable transport arrangement. It would undoubtedly be a much simpler operation to transfer liquid fuel through a flexible hose of slightly greater length than the cables made fast between the two vessels, providing that an oil of reasonable viscosity was employed.

Even in a country possessing such splendid supplies of steam coal as England, liquid fuel is now making rapid headway, and this is not surprising when one considers the high prices reached for coal of all descriptions during the last two or three years. To be able to fall back on liquid fuel, when it can be obtained at a reasonable price, places the consumer in an independent position as regards the colliery proprietor, and the necessary fittings to enable this to be done are by no means costly. Coal at a fair price will probably always have the advantage over imported liquid fuel, but in countries entirely dependent upon mported fuel, the liquid form must in the future be the main upply, for bulk for bulk it is twice as efficient as any solid fuel, nd, moreover, its transport in suitable vessels is attended with far less risk than with coal cargoes shipped from a great distance.

J. S. S. BRAME.

THE MURCHISON FALLS.

THE new Government road from the capital of Uganda to Butiaba on the Albert Nyanza will shortly cause the existing caravan track, which crosses the Nile at Fajao, to be abandoned. The latter place obtained some notoriety during the Uganda mutiny 1897–8, but, not being exactly a health resort, the station was soon after given up, and a few Sudanese of the Uganda Rifles now guard the ferry.

On an isolated mass of rock overlooking the Nile, the European quarters are (or were when I passed through on my way from East Africa to the Sudan in October last) still marked by a couple of thatched huts in dilapidated condition, a flower-garden, and a flag-staff from which fluttered the remains of a "Union Jack." From the station a beautiful view of the Murchison Falls, about a mile distant, can be obtained.

Close to the station are two more isolated masses of biotite gneiss, and undoubtedly the river, which is here confined in a deep cañon, has carved its way eastward for one-and-a-half miles to the present falls, leaving these masses as "witnesses."

On arrival, I was struck by the peculiarly irregular sound of the falls; at night it is especially noticeable.

The track to the falls, used by native fishers, at the foot of the cliffs on the south side, follows close to the water's edge, and the sight of five crocodiles with wide-opened mouths on the opposite shore suggested unpleasant possibilities. Usually crocodiles can be seen in hundreds.

Scrambling along the slippery track, much overgrown in places, and glittering with disintegrated mica flakes, we passed several naked Wanyoro fishers in their canoes, and the decaying remains of fish, chiefly a species of perch, showed their favourite landing places.

Arriving at the 200-foot basin into which the fall takes its final plunge, one notices how the constant spray from the falls, ascending in clouds like steam, allows the luxuriant vegetation to grow over even the vertical cliffs surrounding the basin on three sides, except where the soft mica schist has caved in by weathering. A double rainbow added to the beauty of the scene, but the near view of the falls is distinctly disappointing.

The peculiar intermittent roar could now be accounted for; a mass of water tumbling headlong into the pool is immediately followed by an enormous broken wave, then comes a lull, and the process is repeated.

As this phenomenon was inexplicable from below, I suggested that a climb to the top of the falls was advisable; and after much discussion our Nubi guide extracted from an airily clad Mnyoro the information that a track did exist to the top of the south cliff. It proved to be a most trying 200-foot climb up a steep slope covered with dense grass, and it could only have been made by an energetic European. A short downward scramble led to a rock plateau with potholes, the largest of which was 15 feet in diameter and 10 feet deep, filled with water, marking the level of the former bed of the river when it swirled round a mass of gneiss in its centre. This being gradually worn away on the south side, apparently exposed a softer vein, and the river has cut its way through, in a deep vertical cleft from 20 to 30 feet wide and of unknown depth. A well-known officer in the Uganda Rifles whom I met two days later informed me that he had measured the narrowest portion accessible and found it only 18 feet wide.

Now the Nile above this is a succession of falls, and, after a sharp bend to the north-west, turns again west when 200 feet wide and, gradually narrowing, tumbles 10 feet over a rock ridge spanning the river and then over a 5-foot ridge. For 50 feet it rushes with increasing velocity and finally enters the extraordinary cleft. Down this, for 150 feet, the river "slithers," a solid mass of water, as if through a sluice. Suddenly it meets with an obstruction, a harder layer of gneiss through which it is undercutting its way, and with terrific force strikes this, and rebounds, sometimes with a huge shower of spray. Meanwhile the body of water behind has to find an outlet, and, still confined between high walls, is forced over the ridge with irresistible force ere, 250 feet further on, it tumbles over the last fall into the large basin below, and the back wave, now a vast boiling mass, follows hard after it. This explains the peculiar sound of this fall.

The pent-up power of the Nile as it leaps the barrier is extremely impressive, but from an engineering point of view it is regrettable that such enormous power is running to waste.

I returned to Fajao at sunset, in time to see the Nile tinged a rich crimson as the sun sank behind the lofty range of mountains west of the Albert Nyanza, and, contrasted with the deep green foliage of the river banks, the scene was striking. But by far the most superb sight was the fall itself under the light of a full moon that night. For the identification of the rock specimens from the falls, consisting of biotite gneiss, mica schist, garnetiferous mica schist, and quartz, I have to thank Mr. G. T. Prior, of the Natural History Section of the British Museum. C. STEUART BETTON.

THE MANUFACTURE AND USES OF SODIUM.

THE manufacture and uses of metallic sodium is the subject of an interesting article by Mr. James D. Darling in the January number of the *Journal* of the Franklin Institute, from which we take the following facts.

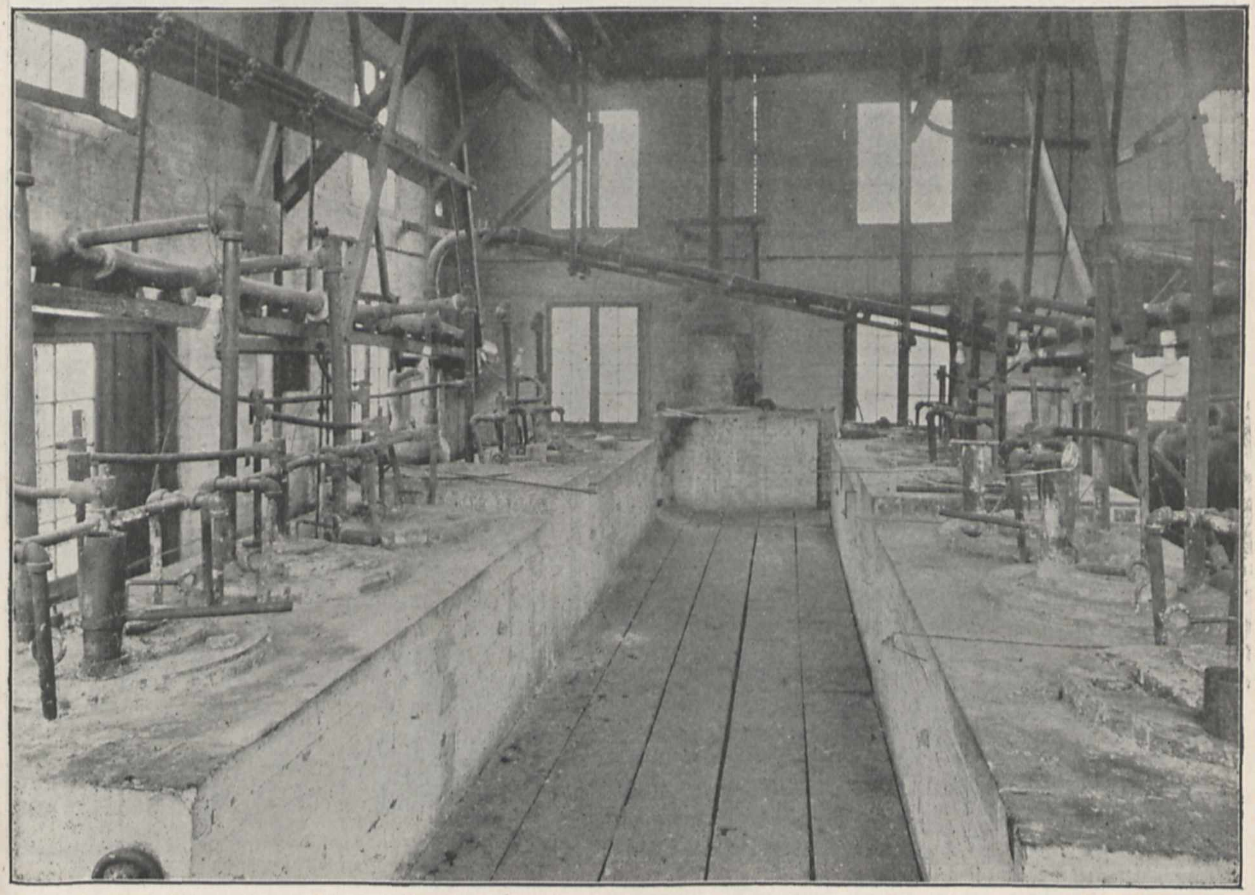

FIG. 1.—General View of Sodium Furnaces.

From the time of its isolation in 1801 until 1858, the cost of sodium was exceedingly high. In 1858, Deville perfected the process of manufacture by heating sodium carbonate, chalk and coal in an iron retort and condensing the sodium vapour thus produced. The price then fell from 2000 francs to 10 francs per kilo. No further important advance in the manufacture was made until the late Mr. Castner took up the subject, and after using with great advantage a modification of Deville's process in which carbon was replaced by a compound of carbon and iron and carbonate of soda by caustic soda, he succeeded in 1890 in making Davy's original method available on the large scale, that is to say, the method of decomposing fused caustic soda by the electric current. Most of the sodium used to-day is made by this process.

Attempts to make sodium from its cheapest compound, the chloride, have so far been unsuccessful, owing chiefly to the high melting point (800° C.) of the chloride and to its corrosive action when in the molten state.

The process introduced by Mr. Darling involves the electrolysis of sodium nitrate with the liberation of sodium and of nitrogen peroxide, which is then converted into nitric acid.

The decomposition cell consists of a cast-iron pot set in a brick furnace. At the bottom of the pot is a 6-inch layer of refractory insulating material, and on this rests a cup 30 inches high, 16 inches outside diameter, with walls 4 inches thick. This cup is made of two sheets of perforated steel, between which is a mixture of ground deadburned magnesite and Portland cement which has been mixed with water and allowed to set hard. The space between the cup and the pot is filled with sodium nitrate (M.P. 313° C.) and the cup itself with melted caustic soda (M.P. 320° C.). The cast-iron pot acts as the anode, and 5 per cent. of the current is advantageously shunted through the metal walls of the cup. The kathode consists of a short length of 4-inch wrought-iron pipe reaching nearly to the bottom of the cup. Each furnace takes a current of about 400 ampères at an average E.M.F. of 15 volts, and external heat is used only when starting up or when changing the cups, which have a life of 425 to 450 hours. When the current is passed, nitrogen peroxide and oxygen are liberated at the anode and escape through a hole in the cover of the pot. Sodium is liberated at the kathode, and rises to the top of the cup, where at intervals of an hour it is dipped off with a spoon and preserved under mineral oil.

The aim of this new process is to decompose sodium nitrate in such a way that the sodium is liberated in a medium which will not oxidise it, and to get the nitrogen peroxide for the manufacture of nitric acid. How this is done will be evident from the description just given; the sodium ions of the fused nitrate travel through the walls of the porous cup to the fused caustic soda; they act upon the caustic soda until it is converted (probably) into the monoxide, hydrogen being liberated, and when this is once achieved the following sodium ions form metallic sodium at the kathode. The use of two electrolytes with a common cation enables the sodium to be liberated in such a way as to escape oxidation by the fused nitrate. It is obvious that the only substance used up is the nitrate. Fig. 1 gives a general view of the sodium furnaces.

The nitrogen peroxide and oxygen evolved at the anode are conducted by earthenware pipes to a number of Woulff's bottles, connected together and containing water. The arrangement is shown in Fig. 2. The action of NO_2 on water is as follows:— $3NO_2 + H_2O = 2HNO_3 + NO$. The NO takes up more oxygen to form NO_2 and more nitric acid is produced. If very strong acid is required, a system of absorbing towers is used.

Sodium is now used on the large scale for making sodium peroxide and sodium cyanide. The peroxide is made by burning sodium in an excess of dry air free from CO_2 in an externally heated retort. It is a valuable oxidising and bleaching agent, replacing the most costly hydrogen peroxide.

Sodium is used in making cyanides by Erlenmeyer's process, in which the metal is heated wirh potassium ferrocyanide, $K_4FeC_6N_6 + 2Na = 4KCN + 2NaCN + Fe$. Potassium carbonate is usually added so as to make the percentage of CN in the mixture equivalent to that of pure KCN.

Another method of using sodium in the manufacture of cyanides is to make sodamide by heating the metal in ammonia gas, $Na + NH_3 = NaNH_2 + H$. The sodamide may then be heated with carbon, $NaNH_2 + C = NaCN + H_2$, or, according to another process, it may be made to first form a cyanamide, $2NaNH_2 + C = Na_2N_2C + 2H_2$. The cyanamide is then treated with more carbon at a higher temperature, $Na_2N_2C + C = 2NaCN$.

Mr. Darling states that he has devised a new method of preparing cyanides in which he avoids using so much sodium in the metallic state.

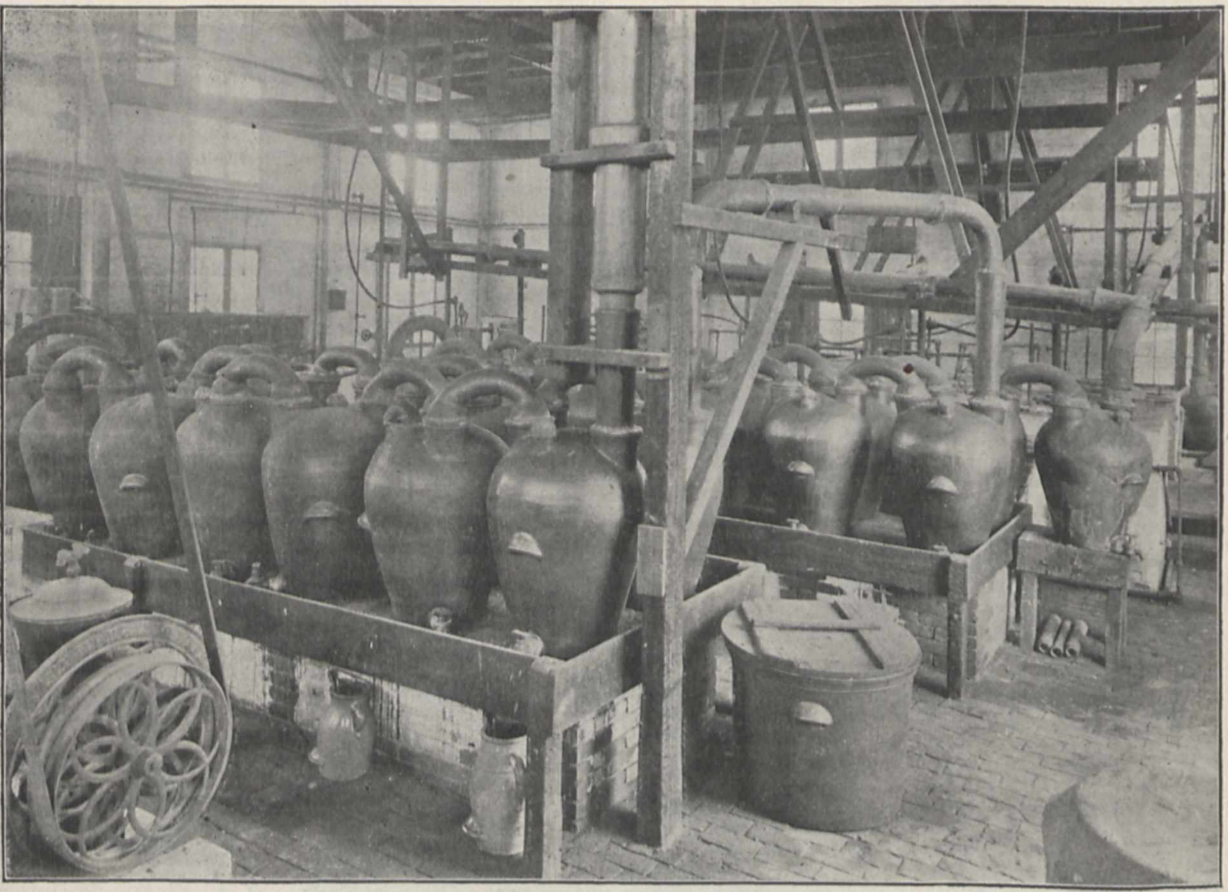

FIG. 2.—Apparatus for converting Nitric Oxide into Nitric Acid.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Considerable changes will be introduced into the examination for Mathematical Honours, Moderations, by a scheme which comes into effect in 1904. The main features of this scheme are (1) the legalising of the use of the infinitesimal calculus in answering questions on mechanics; (2) the abolition of restrictions on the freedom of choice of method, analytical or synthetic, in the treatment of geometry; (3) the introduction of the elements of analytical solid geometry.

CAMBRIDGE.—The following are the speeches delivered by the Public Orator, Dr. Sandys, on June 10, in presenting for the degree of Doctor in Science *honoris causa* (1) Sir Harry Hamilton Johnston, G.C.M.G., K.C.B., Special Commissioner for the Uganda Protectorate, and (2) Dr. A. W. Rücker, F.R.S., Principal of the University of London:—

"Semper aliquid novi Africam adferre" etiam inter antiquos dicebatur. In Africa nuper ab hoc viro, ne plura commemorem, camelopardalis speciem novam repertam esse constat. Idem Africae in regione septentrionali, occidentali, orientali, Africa etiam in media, patriae personam summa cum dignitate gessit; Africae montes, flumina, lacus exploravit; exploratos et pingendi et scribendi arte eximia ante oculos nostros posuit. Quid dicam de libris illis, quorum in uno Livingstonii vitam egregie narravit; in alio colonias omnes ab Europae gentibus in Africam deductas luculenter descripsit; in alio denique Afrorum servitutis imaginem vividam expressit? Talium virorum laboribus indies plura de Africae regione immensa cognovimus, et telluris illius tenebras luce indies maiore illustratas cernimus. Duco ad vos virum a societate zoologica numismate aureo honoris causa donatum, equitem insignem, HARRY HAMILTON JOHNSTON.

Universitatis Londiniensis nuper denuo constitutae praesidem primum ea qua par est observantia salutamus, virum studiis mathematicis olim excultum, Collegii sui inter Oxonienses honoris causa socium; primum in comitatu Eboracensi, deinde inter Londinienses scientiae physicae professorem; Societatis Britannicae scientiarum finibus proferendis nuper praepositum; Regiae denique Societatis inter lumina iamdudum numeratum. Qui insulae Britannicae explorationem magneticam non semel tantum ad finem felicem perduxit, nunc Universitati maximae est praepositus, in qua, animi vi quadam magnetica praeditus, collegarum suorum omnium corda ad se attrahit, et Universitatis totius ad communem fructum Londiniensium liberalitatem allicit. Duco ad vos Universitatis Londiniensis praesidem insignem, ARTHURUM WILLELMUM RÜCKER.

HOLIDAY courses in botany, physics, physiology and zoology will be held at the University of Jena from August 4 to August 16. Particulars and detailed programmes of these and other courses can be obtained from the secretary, Mrs. Dr. Schnetger, 2 Gartenstrasse, Jena.

THE discussion of the Education Bill was resumed in Committee of the House of Commons on Tuesday. An amendment providing that the council of a borough with a population of more than 10,000, or an urban district with a population of more than 20,000, must obtain the consent of the council of the county in order to become the local authority for elementary education was put to the vote and negatived. A proposal to omit the whole of the clause which constitutes the county councils local education authorities was also rejected.

AT a meeting of the council of the Institution of Mining and Metallurgy on Tuesday, it was decided to offer scholarships in mining and metallurgy to the following colleges:—The Royal School of Mines, two scholarships of 50*l.* each; King's College (London), 50*l.*; the Camborne School of Mines (Cornwall), 50*l.*; and the Durham College of Science (Newcastle-on-Tyne), 50*l.* These scholarships will be offered annually for three years. In addition to other work for the advancement of technical education in mining and metallurgy, the Institution has submitted to the Board of Education a comprehensive scheme for affording practical experience in workshops throughout the kingdom to mining and metallurgical students, and it is expected shortly to be put in force.

AT a special meeting of the council of King's College, London, held on Friday last, it was resolved by twenty-two votes to two, "That, in view of the situation created by the University of London Act, 1898, the council, while determined to maintain the connection of the college with the Church of England as set forth in section 5 of King's College, London, Act, 1882, resolves that, so soon as may be, every religious test as a qualification for office, position, or membership in or under the council or college, other than professorships or lectureships in the Faculty of Theology, shall cease to exist, and, further, that all necessary and proper steps be taken to give effect to this resolution." The section referred to in this resolution specifies the following as the purpose of the college:—To give "instruction in the various branches of literature and science and the doctrines and duties of Christianity as the same are inculcated by the Church of England."

A SUCCESSFUL exhibition, designed to show the provision made for science teaching in the secondary and elementary schools of Hampshire and the Isle of Wight, was held at the Hartley College, Southampton, on Saturday last. A well-arranged series of exhibits enabled the visitor to see at a glance the encouragement given by His Majesty's inspectors and others to the construction of simple home-made apparatus to illustrate the principles of physics and chemistry. It was clear from the work of students which was on view that considerable prominence is being given to nature study in these districts; and the collections and drawings of biological subjects of the kind shown should serve to extend and improve the teaching of botany and zoology in schools. The conference of teachers held at the Hartley College in connection with the exhibition, to discuss methods of teaching science, was largely attended and gave evidence of a widespread desire to introduce observational and experimental methods in all scientific instruction.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, May 28.—Prof. Meldola, F.R.S., vice-president, in the chair.—Taxine, the alkaloid of yew, by Dr. Thorpe, C.B., F.R.S., and Mr. G. Stubbs. The authors have confirmed the observations of Hilger and Brande, Marmé and others on the occurrence of an amorphous alkaloid in yew.—The sampling of soils, by Dr. J. W. Leather. Comparative experiments were made in India to determine the possible accuracy of the auger method of sampling soils, the available phosphoric acid and potash being taken as a standard of comparison. The results showed that in most cases the agreement was good between the samples, but that there was occasionally a divergence of about five per cent.—Some excessively saline Indian well waters, by Dr. J. W. Leather. An examination of some well waters collected in the Muttra district, United Provinces, India, showed that they contained from ·2 to 2 per cent. of saline substances consisting of sulphate, nitrate, chloride and carbonate of sodium.—Nitrobromo-derivatives of fluorescein, by Dr. Hewitt and Mr. Woodforde. Several of these substances have been isolated and characterised.—Phosphorus sesquisulphide and its behaviour with Mitscherlich's test, by Mr. F. G. Clayton. Analyses of commercial specimens of this substance have been made, and show that they contain from 83 to 97 per cent. of sesquisulphide.—Atomic and molecular heats of fusion, by Mr. P. W. Robertson. The author finds that for a number of the elements and their binary inorganic derivatives a relation between (atomic or molecular) heat of fusion, absolute melting point and atomic volume exists which is capable of a more or less general representation by an equation of the form $Aw/T^3\sqrt{V} = \kappa$.—The preparation of mixed ketones by heating mixed calcium salts of organic acids, by Mr. E. B. Ludlam. An extension of the method proposed by Young in 1891.—Isomeric additive products of methyl, ethyl and propyl benzyl ketones with benzylidene aniline, part iv., by Dr. Francis and Mr. Ludlam.—The influence of solvents on the rotation of optically active compounds, part iii., influence of benzene, toluene, *o*-xylene, *m*-xylene, *p*-xylene and mesitylene on the rotation of ethyl tartrate, by Dr. T. S. Patterson. The above solvents exert in the order named an increasing influence in diminishing the rotation of ethyl tartrate; in the case of the first four solvents this effect reaches a minimum and a maximum at appropriate concentrations.—iv. Influence of naphthalene on the rotation of ethyl tartrate, by Dr. T. S. Patterson. The effect of this hydrocarbon is to increase the observed rotation.

Geological Society, May 28.—Prof. Charles Lapworth, F.R.S., president, in the chair.—The Red Sandstone-Rocks of Peel (Isle of Man), by Prof. W. Boyd Dawkins, F.R.S. The Red Sandstone series, ranging along the coast from Peel to Will's Strand, is faulted into the Ordovician massif of the Isle of Man. It has been referred to the Old Red Sandstone, the Calciferous Sandstone, the basement Carboniferous, and to the Permian. The series consists of red sandstones containing irregular conglomerates and breccias, more or less chemically altered, known in the lake district as "Brockram." Sections at Ballagnane, Creg Malin, and at the Gob and Traie Fogog, are described in detail; the rocks are classified, and their range to the north-east and inland is described. It is pointed out that the rocks are different in many respects from the basement Carboniferous rocks of Langness and elsewhere, and a list of the materials contained in the "Brockrams" is given. The fossiliferous pebbles in the rocks in question are described, and their fossil contents determined. The whole group of fossils is Lower Carboniferous and Ordovician, and centres mainly in the Carboniferous Limestone. A comparison is instituted with the Permian rocks of Barrowmouth, the Vale of Eden and elsewhere.—The Carboniferous, Permian and Triassic rocks under the glacial drift in the north of the Isle of Man, by Prof. W. Boyd Dawkins, F.R.S.—Note on a preliminary examination of the ash that fell on Barbados, after the eruption at St. Vincent (West Indies), by Dr. J. S. Flett, with an analysis of the dust by Dr. William Pollard (see p. 130).

PARIS.

Academy of Sciences, June 9.—M. Bouquet de la Grye in the chair.—Remarks by M. Hatt on the tidal constants for a certain number of ports in France, the Indian Ocean and China.—A discussion of the magnetic observations made in the central region of Madagascar, by M. P. Colin. A striking anomaly exists at Tsiafajavona, the highest summit of the Ankaratra chain. By reason of its mass and magnitude, this chain exerts a considerable influence in its neighbourhood. A second less-marked centre of disturbance appears in the neighbourhood of Vontovorona. The eastern plateau possesses a more regular magnetic field than the western, the volcanic zones having only a local action of small radius.—On the diabetogenic leucomaines, by MM. R. Lépine and Boulud.—M. Amagat was elected a member in the section of physics in the place of the late M. Cornu.—M. Albert Gaudry announced that M. André Tournouër, who was in charge of the Patagonian expedition, had discovered important remains of Pyrotherium near Rio Deseado. The deposits containing these remains also yielded a large number of fossils of mammalia of great interest.—On functions of infinite species, by M. Émile Borel.—On a remarkable case of rational transformation in space, by M. D. Gravé. On internal combustion motors, by M. L. Lecornu.—On the electric force due to the variation of magnets, by M. E. Carvallo. A discussion of an experiment of M. Cremieu which led to results apparently in contradiction to Maxwell's theory. It is shown that this results from the manner in which M. Cremieu has applied the definition of electric force, and that the results are in complete accord with Maxwell's theory.—On the variations of the zodiacal light, by M. L. Décombe.—The accidental double refraction of liquids mechanically deformed, by M. G. de Metz. A careful study of this property for a considerable number of solutions shows that there is no necessary connection, as has usually been supposed, between the double refraction produced and the viscosity. For certain liquids the optical phenomenon lasted several seconds after the mechanical strain; the effect was especially noticeable with copal and dammar varnish and with collodion.—On a new isomerism in asymmetric nitrogen, by M. E. Wedekind. The presence of two atoms of asymmetric nitrogen in a molecule appears to render possible the existence of stereoisomeric ammonium salts.—On benzene-azobenzoic aldehyde, by M. P. Freundler. Compounds of the type $C_6H_5.N:N.C_6H_4.CO.R$ cannot be obtained by the reaction of Friedel and Crafts, but can be readily prepared by the simultaneous reduction of a mixture of nitro-compounds; thus a mixture of nitrobenzene and nitrobenzoic aldehyde reduced in this way gives benzene-azobenzoic aldehyde, the preparation and properties of which are described.—The oxidation of morphine by the juice of *Russula delica*, by M. J. Bougault. The oxydase present in the plant juice gives the same oxymorphine as is obtained by the oxidation of morphine with potassium ferricyanide.—On the lipase of the blood, by M. Hanriot. The author admits the truth of some criticisms of his former work on this subject by MM. Doyon and Morel, but holds that these experiments furnish no conclusive arguments against the existence of lipase in the blood.—On caryophysema in Euglena, by M. P. A. Dangeard.—On a permanent action which tends to provoke a negative tension in the woody vessels, by M. H. Devaux.—The volcanic rocks of Martinique, by M. A. Lacroix.—The production of a polyvalent preventive serum against pasteurelloses, by MM. Lignières and Spitz.—On the presence of a rennet in plants, by M. Maurice Javillier. The rennet obtained from the juice of rye-grass possesses all the properties of animal rennet. The ferment is met with in many different plants, ten being enumerated in the present paper.—On a qualitative difference between the excito-motor effects of open and closed induced currents, by Mlle. I. Ioteyko.—On the yeasts used for the fermentation of cider, by M. Henri Alliot.—On the bouquet of wines obtained by the fermentation of sterile musts from grapes, by M. A. Rosenstiehl. The conclusion is drawn that the quality of a wine of well-known vintage depends less upon the quality of the grape than upon the nature of the yeast which grows spontaneously upon the grape.—The action of sulphurous acid upon oxydase and on the colouring matter of red wine, by M. A. Bouffard. The protective action of the sulphurous acid acts in two ways; it has a distinctly destructive effect upon the oxydase, and also forms an unstable compound with the colouring matter which protects it from the oxygen of the air.—On the phosphates of the soil which are soluble in water, by M. Th. Schlœsing, fils.—On a new form of collecting bottle for sea-water at great depths, by M. Jules Richard.

DIARY OF SOCIETIES.

THURSDAY, JUNE 19.

ROYAL SOCIETY, at 4.30.—On the Correlation between the Barometric Height at Stations on the Eastern Side of the Atlantic: Miss F. E. Cave-Browne-Cave and Prof. K. Pearson, F.R.S.—Note on the Effect of Mercury Vapour on the Spectrum of Helium: Prof. J. Norman Collie, F.R.S.—The Seed-Fungus of *Lolium temulentum*, L., the Darnel or Poisonous Rye-Grass: E. M. Freeman.—On Methods for the Limitation and Regulation of Chloroform when administered as an Anæsthetic: A. Vernon Harcourt, F.R.S.—On the Measurement of Temperature. Part I. On the Pressure Coefficients of Hydrogen and Helium at Constant Volume, and at different Initial Pressures. Part II. On the Vapour Pressures of Liquid Oxygen at Temperatures below its Boiling Point, on the Constant Volume Hydrogen and Helium Scales. Part III. On the Vapour Pressures of Liquid Hydrogen at Temperatures below its Boiling Point, on the Constant Volume Hydrogen and Helium Scales: Dr. M. W. Travers and others.—On Colour-Physiology of the Higher Crustacea: F. W. Keeble and Dr. F. W. Gamble.—On some Phenomena which suggest a Short Period of Solar and Meteorological Changes: Sir Norman Lockyer, F.R.S., and Dr. W. J. S. Lockyer. And other papers.

LINNEAN SOCIETY, at 8.—On Obesiella, a New Genus of Copepoda: Dr. W. G. Ridewood.—On Modern Methods in Mycology: Mr. G. Massee.—Further Observations on the Owls, especially their Skeleton: W. P. Pycraft.

FRIDAY, JUNE 20.

PHYSICAL SOCIETY, at 5.—Exhibition of a Three-Circle Goniometer: G. F. Herbert Smith.—The Heat Absorbed when a Liquid is brought into Contact with a finely-divided Solid: C. J. Parks.—(1) On the Electrical Resonance of Metal Particles for Light Waves (Second Communication): (2) On a Remarkable case of uneven Distribution of Light in a Diffraction-Grating Spectrum: Prof. R. W. Wood.—Exhibition of a Simple Form of Apparatus for Measuring the Mechanical Equivalent of Heat: Prof. H. L. Callendar.

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