THURSDAY, MAY 17, 1900.

BIOLOGY AS AN "EXACT" SCIENCE.

The Grammar of Science. By Karl Pearson, M.A., F.R.S., Professor of Applied Mathematics and Mechanics, University College, London. Second Edition, revised and enlarged, with 33 figures in the text. Pp. xviii + 548. (London: Adam and Charles Black, 1900.)

THE sciences of life are marked off for practical purposes from those concerned with inorganic matter by obvious differences in the nature of the material with which they respectively deal. But in addition to distinctions of this kind, it has been customary to look upon biology as having a lower claim to the title of an "exact" science than that enjoyed, for example, by chemistry and physics. This view has been emphasised by the practice of calling biology a merely "descriptive" science, with a kind of implication that other sciences are that and something more. The distinction, however, is at best an artificial one, resting mainly on the fact that the conditions of life are often so complex, and the data so difficult of access, that the use of those quantitative methods of induction which in other sciences have been fruitful of important results, so far as biology is concerned has to a great extent remained in abeyance.

It could not be expected that this state of things should be allowed to continue. "Every science," said Stanley Jevons, "and every question in science, is first a matter of fact only, then a matter of quantity, and by degrees becomes more and more precisely quantitative." In those parts of biology which come into relation with chemistry and physics, the quantitative methods have long since gained a footing. Physiology tends increasingly to become a science of exact measurement, and there is abundant scope for the exercise of mathematical power in the investigation of its present data. With regard, however, to many problems of what is known as "general biology," especially those which gather round the central doctrine of evolution, it is no doubt true that until recently measurements have either not been applied at all, or have been used only in the simplest and crudest form. That general biology has now ceased to deserve the reproach of neglecting quantitative methods is largely due to the labours of Mr. Francis Galton, Prof. Weldon, and Prof. Karl Pearson; the way towards a greater precision of method having also been in some degree prepared by other workers, such as Milne Edwards, J. A. Allen and A. R. Wallace.

In the second edition of his well-known "Grammar of Science," Prof. Pearson has included two new chapters which contain a semi-popular account of his recent work on the mathematical aspects of evolutionary theory. The ground covered is extensive, comprising quantitative investigations of variation, correlation, selection in its various forms, heredity and reversion. Those readers who may be deterred by the length and elaboration of Prof. Pearson's papers in the *Proceedings* and *Philosophical Transactions* of the Royal Society will here find a clear account of the various problems concerned, together with a tolerably easy explanation of the mathematical processes involved in their attempted solution, and a useful summary of the results so far arrived at. The author states his main position as follows:—

"What we need in the theory of evolution is quantitative measurement following upon precise definition of our fundamental conceptions. Biologists, even as physicists have done, must throw aside merely verbal descriptions, and seek in future quantitative precision for their ideas."

In the same spirit, Prof. Weldon remarked in his Presidential Address to Section D at the Bristol meeting of the British Association: "Numerical knowledge of this kind is the only ultimate test of the theory of natural selection, or of any other theory of any natural process whatever." That these dicta are substantially true will hardly be questioned, though it may be objected to Prof. Pearson that he somewhat overstates his case. All concrete science is in its essence descriptive, and it is not improbable that parts at least of biological study will have to remain indefinitely in the condition of "merely verbal description." It would appear, too, that in his eagerness to denounce the putting forward of inadequate hypotheses, the author allows himself to undervalue those rough preliminary generalisations which have frequently formed so useful a step in the completion of a great induction. It is possible to attach too much importance to Faraday's famous saying. If every "suggestive thought" which has eventually turned out to be imperfect, or even erroneous, had been "crushed in silence" instead of being given to the world, the cause of scientific progress would have suffered. We must often, for practical purposes, be content to proceed by the method of successive approximation. The work of Darwin himself was only to a limited extent quantitative.

Evolutionists of what may perhaps without offence be called the "orthodox" type, will find Prof. Pearson's attitude towards most controverted points sufficiently correct. Thus, without denying the possibility of a bathmic element in evolution, he does not countenance the "inherent growth-forces" that find favour with Neo-Lamarckians. Demonstration of the inheritance of acquired characters he holds to be still wanting; tradition, on the other hand, is probably an important factor in what are called the "instincts" of the lower animals. He finds no quantitative evidence for telegony, the occurrence of which alleged phenomenon "seems both mechanically and physiologically inconceivable." The reality of natural selection as a factor in evolution is quantitatively demonstrable, and sexual selection is rehabilitated.

It would be impossible within the limits of a notice like the present to do justice to the lucidity of Prof. Pearson's explanations, the ingenuity of his mathematical devices, and the care with which he has avoided possible sources of error in his calculations. Examples may be found in his exposition of the technical terms "modal value" and "standard deviation"; in his determination of the coefficient of regression; and in his discussion of the relative value of selective and non-selective death-rates for organs of different sizes. Among the most valuable of his suggestions are those on the importance of correlation; on selective mating in its various forms

(including autogamy, endogamy, homogamy, preferential mating or "sexual selection" in Darwin's sense, and heterogamy); and on "genetic selection" or the inheritance of fertility. The last-named principle promises to be of special weight as a factor in evolution, though the proof of definite correlation of other physical characters with that of fertility must still be considered incomplete. The analysis of natural selection into autogeneric, heterogeneric and inorganic selection ("intra-selection" being ignored) is useful, and might have been carried still further.

A contribution to the theory of evolution so original and stimulating as Prof. Pearson's must necessarily run the gauntlet of much adverse criticism. This will probably take the form rather of objection to certain points of detail than to the general drift of his method. Certainly some passages and expressions seem capable of amendment. It is, for instance, scarcely allowable to speak of the approach of the coefficient of correlation to unity as "the transition of correlation into causation." As the author himself elsewhere points out, correlation does not imply causation, though the converse is no doubt true enough. The principle of recognition-marks in their widest sense seems again to deserve more consideration than it receives at his hands. They are requisite to ensure the actual effectiveness of the impulse towards preferential mating. It is worth notice in this connection that the author's view as to the species-forming tendency of differential fertility (which is distinct from "physiological selection," as understood by Romanes) is well exemplified by Dr. Jordan's work on "mechanical selection." In speaking of hybridisation with reference to atavism, the "Grammar" does less than justice to observed facts. The evidence afforded by crosses, such as those so carefully investigated by Standfuss at Zürich and by Prof. Cossar Ewart at Penicuik, has a bearing on heredity and atavism which cannot safely be ignored. Prof. Pearson contents himself with saying that in such cases, "from physiological and mechanical reasons, the gametes produce a zygote which does not give an individual blending the ancestry. Here any singularity almost may be expected." This statement, to say the least, seems wanting in precision. Again, a severe critic might allege that the author is apt to assume theoretical values (as in the case of the resemblance of first cousins) which have not stood the test of rigid proof.

We have not yet learned to like the new term "apolegamy," nor such a phrase as "a comparative few zygotes" (p. 453). The remarkable form of a sentence on p. 461 is probably due to a printer's error, as also the substitution of DAG for FAG at the bottom of p. 447. These, however, are small matters, and do not detract from the value of the book.

We must not be led into a discussion of the earlier chapters, a notice of which appeared in these columns at the time of their original publication. There is, however, one point on which we cannot refrain from joining issue. Prof. Pearson takes biologists to task for the loose way in which they often use such terms as "matter," "force" and "motion," as if no important questions lay behind them. Now it is certain that, in their employment of these expressions, biologists have no desire whatever to prejudice any philosophical problems. When metaphysicians and physicists are agreed about the definition of these terms, the biologist will doubtless be quite ready to follow suit. Meanwhile he must be allowed the use of ordinary language. But Prof. Pearson maintains that if these words are used in their everyday, or, as he calls it, their "figurative" sense, they ought to be defined. Why so? No definition is required for the particular end in view. Supposing an opponent were to say that the "matter" of the argument was not "attractive," and that there was no "force" in this or that contention, would the Professor waste time in making him define his terms? Can we not "beat about the bush" without entering into explanations that would satisfy the schoolmaster and the botanist? It would seem that here the Professor once more overshoots his mark.

It will be convenient to give, in conclusion, a summary of the main contention of these new chapters in the author's own words, as follows:—

"It is not absence of explanations, but rather of the quantitative testing of explanations, which hinders the development of the Darwinian theory." "The problem of the near future is not whether Darwinism is a reality, but what is quantitatively the rate at which it is working and has worked."

It is noteworthy to find him adding:—

"If that problem should be answered in a way that is not in accordance with the age of the earth, as fixed by certain physicists, it by no means follows that it is biology which will have to retrace its steps. When the rate is determined, it will be as exact in its nature as physical appreciations; and it will be a question of superior logic, and not of the superiority of the 'exact' over the 'descriptive' sciences which will have to settle any disagreement of biology and physics." . . . "It is a question of the *rate* of effective change, and when the biologists are in a position to make a definite draft on the bank of time, their credit will be just as substantial as that of the so-called exact sciences."

These last sentences, as coming from a mathematician, are highly significant; and we cannot but admire the courage that has given them expression. F. A. D.

HERTZ'S MECHANICS.

The Principles of Mechanics presented in a New Form. By Heinrich Hertz. Authorised English Translation, by D. E. Jones and J. T. Walley. Pp. xxviii + 276. (London: Macmillan and Co., Ltd., 1899.)

GREAT expectations were aroused by the publication, in 1894, of a book by Heinrich Hertz, with the title, "Die Principien der Mechanik in neuem Zusammenhange dargestellt." Perhaps it would set out the received theory of dynamics in strictly logical sequence; perhaps it would present a complete theory of energy independent of the notion of force; perhaps it would bridge the gap between the molecular and mechanical standpoints. Whether it would do any of these things or not, what Hertz might have to say would certainly be worthy of attention. Hertz died before the work was printed, and the task of seeing it through the Press was entrusted to Dr. P. Lenard. He tells us that the author had devoted the last three years of his life to the book, the last two being spent in perfecting its form; and, although there are indications that he was not even then

completely satisfied, the work may fairly be regarded as the mature expression of his deliberate thought on the subject.

The book opens with a preface by Helmholtz, followed by the author's preface; then there is an introduction, and the author's theory is formulated in two books:—Book i.: Geometry and kinematics of material systems; Book ii.: Mechanics of material systems. Helmholtz's preface contains an account, which might be called an appreciation, of the scientific work of Hertz, and is further remarkable for the statement that, while Kelvin, Maxwell and Hertz appear to have derived fuller satisfaction from explanations of physical facts founded on some simple general conception, such as Hertz's "straightest path," he, for his part, had felt safer in adhering to the representation of physical facts and laws by systems of differential equations. In his own preface the author tells us that his object was "to fill up the existing gaps, and to give a complete and definite presentation of the laws of mechanics which shall be consistent with the state of our present knowledge, being neither too restricted nor too extensive in relation to the scope of this knowledge"; and that what he hoped was new in his work was "the arrangement and collocation of the whole—the logical or philosophical aspect of the matter."

In the introduction the author criticises the received theory of dynamics and the more modern doctrine of energetics, and proceeds to explain the character of the new theory which he proposes. The novelty consists in this: whereas the other two theories started from four fundamental concepts—space, time, mass and force, or energy—he requires only three—space, time and mass—and the hypothesis of concealed masses. In Book i. relations concerning spaces and times are considered, and we have a generalisation of ordinary kinematics, including definitions of the path and velocity of a material system, and its shortest and straightest paths. By a material system is meant what in the ordinary presentation of dynamics would be called a system of particles with invariable connections. Some of the definitions referred to contain arbitrary elements, but they are, at any rate, simple. The definition of *mass* might have been omitted with advantage. In Book ii. the author enunciates his "fundamental law"—that every free system moves in a straightest path. This law may be looked upon as an interpretation of the principle of least action for systems of which all the energy is kinetic, or as an extension of Gauss's principle of least constraint. He proceeds to show how the motions of systems which are not free can be brought under the fundamental law by means of the hypothesis of concealed masses—the visible system is regarded as linked on to another system by invariable connections—and it is proved that the equations of motion of the system contain terms which correspond to the "forces" of ordinary dynamics. It is, perhaps, not remarkable that the dynamics of distant gravitating bodies, which was the immediate object of the received theory, should offer special difficulties from the present point of view (§ 469); on the other hand, it is claimed that the new minimum principle is applicable to invariable connections of the type of pure rolling, in which the velocities are connected by non-integrable equations, and that it thus includes more phenomena than the principle of least action. A considerable portion of Book ii. is taken up with the consideration of cyclical systems. Hertz has here developed important conceptions due to Helmholtz. Throughout both books the "older synthetic method," that of a chain of propositions, has been adopted in order that the logical purity of the theory might be beyond dispute.

Whatever may be the influence exerted on the progress of mechanics by Hertz's kinematical generalisations and fundamental law, there cannot be any doubt of the value of his criticisms of existing dynamical theories. He has explained, in the clearest manner, the object of physical theories, and stated the conditions which such theories must satisfy. He has tested the received theory of dynamics—that which is associated with the names of Galilei, Newton, d'Alembert and Lagrange—in respect of logical permissibility, and in respect of appropriateness as an expression of facts. Concerning this representation of physical experience, he asks: "Is it perfectly distinct? Does it contain all the characteristics which our present knowledge enables us to distinguish in natural motions?" And his answer is "a decided—No." He has put his finger on the weakest part of the theory—the relation of the notion of internal stress to that of equal and opposite distance-actions. He makes the supposition that the theory can, even here, be rendered rigorous, and prefers to base his attack on the complexity of the various actions which the theory needs to assume. In a somewhat similar spirit he discusses the representation of physical facts by means of the theory of energy, although it is rather the logical permissibility than the appropriateness of this representation that is called in question.

The translators have done their work well on the whole. Here and there they have been too literal, or not literal enough; they have left some obvious misprints in the German text, and some in the translation, uncorrected; but these are slight blemishes, and we must be grateful to them for a rendering which admirably conveys the spirit of the original. Their translation should serve to make more widely known a book which certainly ought to be read by all who wish to have clear ideas concerning the most fundamental of the physical subjects. A. E. H. L.

ASSYRIAN AND BABYLONIAN ASTROLOGY.

The Reports of the Magicians and Astrologers of Nineveh and Babylon. By R. C. Thompson. Vol. i. Pp. xviii + 85 plates of cuneiform text. Vol. ii. Pp. xci + 148. (London: Luzac and Co., 1900.)

IT is now about thirty-five years ago since the late Edward Hincks, whose name will be honourably coupled with the history of cuneiform decipherment, astonished many folk by declaring that he had discovered in the British Museum tablets which related to the pseudo science of astrological astronomy. And it is not surprising that such a declaration evoked general interest, because reasonable grounds existed for hoping that when the texts on the tablets had been deciphered, some trustworthy information about Chaldean astronomy might be forthcoming. The labours of Hincks were followed by those of Lenormant and Oppert, but they had little

result, because neither of these scholars was able to devote sufficient time to the study of original texts in the British Museum. Great impetus was given to the study when the late Sir Henry Rawlinson published the third part of the "Cuneiform Inscriptions," and Prof. Sayce found therein material for his paper on the "Astronomy and Astrology of the Babylonians," which appeared in 1873. During the last twenty-five years the astronomy of the Babylonians has been discussed by Strassmaier, Jensen and others, but little has been done for the older, sister subject of astrology. In the two volumes before us Mr. Campbell Thompson gives us the cuneiform text of what is, practically, the complete series of the Astrological Reports of the Royal Library at Nineveh—that is to say, copies of about two hundred and eighty tablets, and transliterations of about two hundred and twenty duplicates, without reckoning the transliterations of the texts of the original series. In addition, we find a translation of the tablets in English, and a vocabulary, with references, and a subject index. The work in each of these sections has been carefully done, and we welome Mr. Thompson in the little band of English Assyriologists, because his pages, somehow, suggest that he intends to try to justify his position as assistant in the British Museum. The study of Biblical parallels and the making of Biblical comparisons are interesting and useful enough in their way, but it is useless to dogmatise about any branch of Assyriology as long as the literature relating to it remains unpublished. Mr. Thompson's book is a good proof of this contention. Many have talked glibly and written vaguely about Chaldean astrologers, but now that we have before us the actual texts of the documents which they drew up, we shall find that most of what has been written on the subject before is incorrect.

The study of astrological astronomy in Western Asia is very ancient, and an old tradition, referred to by Pliny, states that the Babylonians possessed records of calculations which covered a period of 490,000 years; there is no doubt that we now possess texts of this class which are as old as the reign of Sargon of Agadhe (about B.C. 3800); but nothing older than this date has yet been unearthed. The principal astronomical schools in Assyria in the seventh century B.C. were at Ashur, Nineveh, and Arbela, and at a later period Sippar, Borsippa and Orchoe, in Babylonia, were famous for their schools. The chief duty of the astrologer in Assyria was to calculate times and seasons, which he did either by observation or by the help of an instrument called *abkallu shikla—i.e.* "master of measure" (*or* reckoning). This instrument may be the clepsydra, which Sextus Empiricus says was known to the Chaldeans. The time measure was called *kasbu*, and contained two hours; the month was one of thirty days, and the year contained twelve months. The Assyrians employed one intercalary month (second Adar), and the Babylonians two (Elul and Adar). Both nations had a year of lunar months, and much of the time of the Chaldean star-gazer was spent in observing the sun and moon, with the view of determining when the months began and ended. The seven planets were called Sin (moon), Shamash (sun), Umunpauddu (Jupiter), Dilbat (Venus), Kaimânu (Saturn), Gudud (Mercury), and Mushtabarrû-mûtânu (Mars). From these, and the Signs of the Zodiac, and indeed most heavenly bodies, omens were deduced, and from the horns of the moon many portents were derived. Another source of omens were the halos, two of which were known; the one was of 22°, and the other of 46°. Dark halos always portended rain, and were well known, and Mr. Thompson suspects that the astrologers were acquainted with mock suns also. That they were good weather prophets is tolerably clear from many indications; indeed, it would be surprising if they were not. The omens derived from eclipses are very interesting, but the train of reasoning which guided the composition of birth portents cannot always be followed. Thus, in text No. 277, it is related that a certain butcher, called Uddanu, reported to an astrologer that when his sow littered, one of the young pigs had eight legs and two tails, and that he had preserved the animal in brine; from this birth the astrologer deduced the omen that the Crown Prince of the day would "grasp power." But why? Many of the reports sent to the king are interesting, chiefly because of the variety of their contents. When the astrologer had reported the astrological fact asked for, he added any little detail concerning mundane affairs which he might have room for on the tablet, or which he thought it would amuse the king to have knowledge of. Sometimes there is nothing of special astrological importance in the report at all—*e.g.* No. 22, whereon the writer wishes the king power and riches, and says that as the gods Ashur, Shamash, Nebo and Merodach have delivered Kush and Egypt into his hands, even so will they deliver the Cimmerians and the Mannai. Again, in No. 124, more than one-third of the report is occupied with the discussion of some private affair, in which the writer says, "Now the king knows I hold no land in Assyria." From the literal translations which Mr. Thompson gives in the second volume of his book, it is clear that the writers of these reports wilfully obscured their meaning by using obscure and difficult words, and that they intended to make it necessary for their recipients, royal or otherwise, to call in the professional astrologer. If the Assyrians found it difficult to get out a meaning from such documents, there is small wonder that we, in these days, have a difficulty in understanding them also, and as many of the allusions must necessarily be unknown to us, we may have to wait for new texts which will help us to clear them up. Meanwhile, Mr. Thompson has dealt carefully with his texts, and has erred rather on the side of being too literal than too paraphrastic in his translations. It is to be hoped that he will find time to continue his investigations, and to give us accurate editions of original documents, which may serve as the foundation of a superstructure of facts rather than theories.

THE SCIENCE OF NUMBER.

Éléments de la Théorie des Nombres. Par E. Cahen. Pp. viii + 404. (Paris: Gauthier-Villars et Fils, 1900.)

TO the contemplative mind the science of arithmetic offers irresistible, if tantalising, attractions. The abstract notion of number underlies all scientific knowledge and theory whatever; and it is in terms of it alone that we are compelled to seek for the ultimate statement of the facts of the sensible world. It is most unfortunate

that arithmetic should be so often confounded with the vulgar art of logistic—the necessary, but ignoble, reckonings of the exchange and the market-place. Even those who are aware of the distinction often fall into another error, which is almost equally pernicious. To most of them scientific arithmetic means the "Theory of Numbers," a term which they vaguely associate with an unknown, mysterious branch of mathematics with which only a few eccentric specialists have any concern.

The facts of the case are very different. It is true, of course, that the exact and logical foundation of the very rudiments of arithmetic has required the efforts of a series of the greatest intellects ; that in order to follow its numerous ramifications, and appreciate its relation to other parts of analysis, demands a large amount of ability and perseverance ; and that many of its truths have, as yet, only been proved by elaborate, one may even say artificial, methods ; while other theorems, almost certainly true, still baffle all attempts at demonstration. But, in spite of all this, it may be asserted that arithmetic requires less apparatus and less preliminary training than any other branch of mathematics ; and that, whether as a recreation or as a field for research, it amply rewards a very moderate degree of application.

It is not without reason, therefore, that Prof. Cahen addresses himself deliberately to amateur mathematicians ; and, in fact, any one gifted with common sense, unspoiled by a vicious course of school instruction, ought to profit by his lucid and entertaining pages. In six chapters he deals in sufficient detail, and with appropriate numerical illustration (a most important point), with the elementary definitions and laws of operation, with linear and quadratic congruences, and with the elementary theory of binary quadratic forms. After this come a series of notes, ranging from scales of notation to an outline of the properties of Gauss's complex integers and their nearest allies ; and, finally, a very useful set of tables, which afford the reader material for those applications to particular cases, without which the general theory cannot possibly be mastered.

The appearance of this work, as well as of others with a similar object in view (for instance, M. J. Tannery's excellent "Leçons d'Arithmétique"), encourages the hope that some improvement may be effected in the teaching of arithmetic in schools, and that a sound knowledge of its first principles may cease to be the monopoly of a very small minority of University graduates. It is, unfortunately, true that a very large proportion of class-books, both in arithmetic and in algebra, contain half-informed, misleading attempts at expounding theory which are really worse than the old-fashioned bundles of "Rules" ; and unless these are replaced by something better, the efforts of reformers will have the lamentable result of producing a state of things worse than the old routine : a mere jargon of pseudo science, a barbarous patchwork of sham "Principles."

M. Cahen's work will be found of interest, not only by the amateur in search of recreation, but by intelligent teachers and arithmeticians of every degree of proficiency ; while the professed devotees of the science will look with pleased anticipation for the more extended work on the same subject which the author appears to be preparing.

G. B. M.

OUR BOOK SHELF.

Atlas of Urinary Sediments, with special reference to their Clinical Significance. By Dr. Hermann Riedel. Translated by F. C. Moore, M.Sc., M.D. Victoria. Edited and Annotated by Sheridan Delépine, M.B., C.M. Edinburgh, B.Sc. Pp. viii + 111, and 36 plates. (London : C. Griffin and Co., Ltd., 1899.)

THE work before us, as is evident from its title, is an atlas, and will be of interest rather on account of its plates, which are very beautiful, than of its letterpress ; this latter, however, which is situated at the end of the book, covers more than a hundred pages, and is provided with a bibliography and an index of authors and subjects. The text is sub-divided into an introduction and two parts. The introduction deals with methods of collection and examination, &c. Part i. is devoted to unorganised, Part ii. to organised sediments. The editor has added considerably to the original text, his remarks being indicated by parentheses : he occasionally differs with Dr. Riedel concerning fact. The large additions to the text made by the editor have rather altered the character of the work, and have probably increased the sphere of its usefulness.

Under organised sediments bacteria are considered. A useful chapter is to be found at the end concerning the making of permanent specimens of urinary sediments.

The book should be of value to urinologists, and the plates certainly to physicians in general. The thanks of the profession are due to the translator and the editor for making the work available to English readers, and amplifying its contents.

Dante. By Edmund G. Gardner, M.A. "The Temple Primers." Pp. vi + 159. (Dent, 1900.)

A VERY admirable book, by the author of Dante's "Ten Heavens." Dante was a master of the science of his time, and Mr. Gardner has shown that he has not only carefully studied the "Divina Commedia" from the point of view of literature, but has taken pains to carefully annotate all the references to the then *systema mundi* on which so much of the action of the poem depends. Diagrams and explanations are given at the end of the book, which will be found most useful by the student.

The Farmstead. By Prof. J. P. Roberts, Director of the College of Agriculture, Cornell University. Pp. vi + 350. (New York : The Macmillan Company. London : Macmillan and Co., Ltd., 1900.)

THIS is a very readable compendium of suggestions in regard to providing a beautiful, economical, and healthy rural home. Although written for American farmers, it contains much that is of interest to all who are concerned with a country life, and few will peruse the book without gleaning some useful hints. There are special chapters on house-furnishing, decoration, and sanitation by Prof. Mary Roberts Smith, who writes pleasantly on the lighter sides of a farmer's life. A strong case is made out for the educational opportunities of the farm, which are shown to be ample enough to satisfy the most exacting advocate of Nature Study. W. S.

Object Lessons in Botany from Forest, Field, Wayside and Garden. Book ii., for Standards iii., iv. and v. By Edward Snelgrove, B.A. Pp. xviii + 297. (London : Jarrold and Sons.)

THIS is a meritorious little book, and ought to well serve its purpose of inculcating habits of accurate and precise observation in the young pupils for whom it is designed. Although we notice a few slips here and there, they are not serious ones, and are quite eclipsed by the excellent character of the book as a whole. The author is convinced, as he says in the preface, of the value of elementary botany in the education of children, and we think his book justifies his contention.

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.*]

Percussion Caps for Shooting in Schools.

THE extraordinary explosive power of fulminate of mercury is known to all chemists, but it is not generally known that the explosion of a percussion cap on a gun will cause a current of air sufficient to extinguish a candle at a distance of ten or fifteen feet. The distance, of course, varies with the length and bore of the gun, and with the nature and the size of the candle. The gun must be pointed at the lower part of the wick, and in order to blow out the candle the aim at this distance requires to be nearly as accurate as would be required to make a centre with a rifle at a hundred yards. In a speech to the Primrose League on May 9, Lord Salisbury mentioned the expediency of every man having the chance to learn to handle a rifle within reach of his own cottage. By beginning with percussion caps children might be taught to handle a gun at such an early age, that, in case of invasion of this country, boys of fourteen might be able to act as soldiers, as they are said to be doing amongst the Boers at the present time. The objections to training children to handle a rifle are, first of all, the danger of the child shooting either itself or some one else; and secondly, the expense. But the inclination of children to play soldiers might readily be utilised by teaching them to handle first of all a toy gun, and then to practice shooting at a candle with caps. For those who shoot best with caps, the practice with a saloon rifle might be held out as a reward. One single-barrelled old muzzle-loading gun would suffice for many children, and as 240 caps cost a shilling, the expense of providing a gun and material for practice would be very small. LAUDER BRUNTON.

Escape of Gases from Planetary Atmospheres.

IN NATURE of March 29 (p. 515), Dr. Stoney, in referring to a paper by the writer in the January number of the *Astrophysical Journal*, raises the question as to the correctness of the use of Maxwell's distribution of velocities in computing the escape of gases from the earth's atmosphere. He maintains that this distribution does not hold at its attenuated limits. In my paper I have not taken conditions which may exist there, but boundary conditions, which are much more favourable to the escape of the molecules of a gas, and certainly compatible with the kinetic theory, if we are to accept such a theory at all.

Of the four conditions discussed in my paper, I will only refer to the third, the data for which are based on direct observation, namely, $-66°$ C. at a height of 20 kilometres (the mean of several ascensions really giving $-65°$ C. to $-70°$ C. for a height of only 16 kilometres). The pressure is calculated from the usual exponential formula, which agrees closely with observations to this height. At these temperatures and pressures there can be no question as to the validity of the kinetic theory.

Let us assume now that the atmosphere abruptly terminates at this height, and at this temperature the loss would certainly be greater (in fact, very much greater) than under the actual conditions, where the temperature and pressure are much lower. It should also be noticed that in my tables I have assumed the atmosphere to be entirely made up of one gas—for example, helium or hydrogen. Even then only $26{\cdot}73 \times 10^{-23}$ c.c. of helium would escape in 10^7 years. Hence the assumption that helium is now escaping from our atmosphere is without foundation. In the case of a hydrogen atmosphere only 0·54 c.c. will escape in one year. If the total amount of air in the atmosphere be taken approximately at 10^{24} c.c., and if the actual density and temperature at the outer limits of the atmosphere be also considered, it will be evident how baseless the supposition is that either helium or hydrogen is escaping. It should be further noted that Maxwell's distribution of velocities from zero to infinity is the only one giving a sufficient velocity for any escape at all, Clausius' theory not being adequate.

It was the assumption that helium is escaping from the atmosphere—since it had not been detected—that first led me to verify it on the kinetic theory of Maxwell. The discovery, by Ramsay, of helium as a constituent of our atmosphere only tends to confirm the results of my calculations of the impossibility of its escape. S. R. COOK.

Physical Laboratory, University of Nebraska, April 26.

Racket Feathers.

YOUR able reviewer of Meyer and Wiglesworth's "Birds of Celebes" (NATURE, April 26), criticising the arguments used to account for the formation of the racket tail feathers of the parrot, *Prioniturus* (as an inherited effect of mechanical attrition on objects against which the tail is liable to be brushed—boughs, walls of nesting-hole, &c.), asks the pertinent question, why so few exposed feathers, such "as the external rectrices and remiges of all birds, and specially the lengthened feathers of wedge-shaped tails (*Dicrurus*) are neither bare nor racket-shaped nor incipiently so." The insignificant length of the outer rectrices of *Dicrurus* perhaps safeguards them; when these feathers are longer, as in the closely-allied *Bhringa* and *Dissemurus*, they *are* racket-shaped. As to the remiges and rectrices of birds generally, one feather overlies and to a great extent protects the next; but still, the outer webs *are* always very much narrowed in the outermost and most exposed feathers, less narrowed in the next, and so on till in the middle of the wing and tail (where they are well protected on both sides) they are not narrowed at all. But, while normal wing and tail feathers are exposed to attrition on one web only, long feathers standing well out from the rest are liable to have the web frayed on both sides of the shaft as far as they project beyond the other feathers, and to some extent where they rest upon the other feathers through friction against the latter. It is assumed that at some period earlier in the history of the race these elongated feathers were of the usual simple shape, but they are now known to issue from the follicles displaying peculiarities which are often much the same as those obtained by scraping an ordinary feather with a knife—namely, if the shaft is stiff and not very long, a small terminal spatule is formed (as in *Prioniturus*, *Parotia*); if the shaft is long and weak, a large spatule (as in *Tanysiptera*, *Loddigesia*). A difficulty, perhaps, to the acceptance of the theory is its apparent consequence—that epidermal (in a sense, dead) structures, like feathers, possess the power of transmitting mutilations to posterity. For my own part, I think that the modification of shape of the feathers is communicated to the sensitive tissues (much in the same way as the shape of a stick placed in the hand of a blind man is comprehended by him after touching other things with it), and that a corresponding physiological adjustment is made and gradually inherited. The result is probably not an exact recapitulation of the mutilation, but it sometimes appears to be very nearly so.

L. W. WIGLESWORTH.

Castlethorpe, Stony Stratford, April 30.

MR. WIGLESWORTH in the above note hardly does more than recapitulate the (?) arguments advanced in the "Birds of Celebes." He does not offer any explanation of the crucial difficulties indicated in the review; why "mechanical attrition on objects," or by the wind, is effective only in so few cases throughout the class *Aves* when so many species are subject to the necessary conditions; why, for instance, the species of *Palaeornis* (belonging to the same sub-family as *Prioniturus*), or those of the genus *Irissor*, do not conform to the "law"; and why one sex of a species may have "sabre wings," or spatulate ornaments in various situations, and the other sex not.

The question may also be asked *apropos* of Mr. Wigleworth's statement above, why in *Paradisea rubra* the *long* and *weak*-shafted tail feathers have the *small* spatule (which eventually vanishes) instead of a *large* one, if the knife-scraping analogy holds good?

The reasons for the *exceptions* to the author's rule is what chiefly demands an explanation, in the opinion of

THE REVIEWER.

THE APPROACHING TOTAL ECLIPSE OF THE SUN.

THE approaching total solar eclipse, on the 28th of the present month, promises to contribute some valuable additions to our scientific knowledge of the centre of our system, inasmuch that the track of the moon's shadow on the earth's surface passes, to an unusual extent, through regions which are easily accessible. Entering the North American continent near New Orleans, in Louisiana, the central line of eclipse traverses the States of Mississippi, Alabama, Georgia and Carolina,

passing on to the Atlantic from the shore of Virginia, near Norfolk. The track is thus crossed by many of the numerous railway systems of the Southern States, exceptional facilities being thereby offered to observers with large instruments. Information supplied by the U.S. Weather Bureau indicates that stations in Alabama and Georgia are most likely to be favoured with an unclouded sky; hence the expeditions from the chief American observatories will go there. Congress has voted 5000 dollars to the Naval Observatory, and 4000 dollars to the Smithsonian Institution, for the necessary equipment. The Naval Observatory staff will organise two expeditions, one going to North Carolina, the other to Georgia, so that the stations will be some 200 miles apart, and will furnish valuable evidence as to the changes to which the solar surroundings are subject.

The Smithsonian Institution will be represented by Prof. S. P. Langley, and the Princeton Observatory by Prof. Young, who will make a redetermination of the wave-length of the green corona line. Prof. Stone will conduct a party from the University of Pennsylvania, and although details are as yet unknown here, it is expected that expeditions from the Yerkes (Profs. Hale, Barnard and Frost) and Lick (Prof. Campbell) Observatories will endeavour to obtain complete spectroscopic records of the various stages of the eclipse. The latter will again use the 40-foot coronograph, giving a 4-inch disc on plates 14×17 inches. Prof. Pickering, of the Harvard College Observatory, proposes to make a systematic search for an intra-Mercurial planet, and will probably occupy a station in Alabama.

By the kindness of Prof. Young, the Rev. J. M. Bacon has been enabled to organise an expedition to the States, and his observations will be made in the neighbourhood of Wadesborough, near the boundary between North and South Carolina. The party will consist of the Rev. J. M. Bacon, Miss Bacon, and Mr. and Mrs. Maskelyne. The two latter observers will expose a telescopic kinematograph on the corona during totality, and also an ordinary kinematograph on the landscape during and after totality, in the hope of recording the sweep of the moon's shadow. The Rev. J. M. Bacon, using a telescopic camera, will photograph the corona at definite times with respect to mid-totality, for determining the positions of sun and moon, and will expose a long film, continuously driven, to the zenith before, during and after totality, for recording the relative brightness of the sky during and without eclipse. By means of a kite, he will also compare the temperature of the air at an altitude of several hundred feet and at ground-level. Miss Bacon will attempt to photograph the outer corona and extensions, and also a series of landscape photographs showing the gradual diminution of illumination. Special attention will also be devoted to the "shadow bands," and to making standard photographic comparisons of the light of the corona with that of the full moon.

Prof. Burckhalter, of the Charbo Observatory, will photograph the corona by means of a camera provided with revolving screens, so adjusted as to give varying exposures for the different regions.

As the eclipse will occur at the American stations at times from 1h. 30m. to 1h. 50m., we in England will be able to hear of the results obtained there before the observers in Spain have commenced operations.

After leaving the American coast, the moon's shadow crosses the Atlantic in a westerly direction, and reaches the coast of Portugal, near Ovar, about 4.0 p.m. Thence it rapidly passes across the peninsula, leaving the mainland some little distance south of Alicante, and crossing the Mediterranean to Algiers. Most of the European expeditions will have stations along this line, chiefly at Ovar, Santa Pola and Algiers. Taking the stations in the order suggested by the progress of the eclipse, the distribution of the various parties and their plan of operations will be as follows:—

Ovar.—At this place, some twenty miles south of Oporto, and five miles from the coast, will be stationed one of the three official expeditions sent out by the British Government, the observers being the Astronomer Royal and Mr. Dyson, his chief assistant. The former has arranged to take large scale photographs of the corona with the 9-inch object-glass of the Thomson photoheliograph at Greenwich, the primary image being enlarged by a *concave* secondary magnifier to a scale of about 4 inches to the sun's diameter, on plates 15 × 15 inches; and also photographs with the double camera used in previous eclipses, having a 4-inch rapid rectilinear lens of 33 inches focus, and another of 13 inches focus, for recording the extensions of the coronal streamers.

Mr. Dyson's programme is purely spectroscopic. He will have two slit spectroscopes belonging to Captain Hills, and will endeavour to obtain photographs of the spectrum of the "flash" and of the corona.

Prof. Müller, of Potsdam, will from this station determine the albedo of Mercury from direct photometric comparisons with Venus, which will then be near its greatest brilliancy.

Santa Pola.—The second British official expedition will be stationed here, some distance south of the town of Alicante, on the east coast of Spain. The party will be under the direction of Sir Norman Lockyer, who will be primarily assisted by Mr. A. Fowler, Dr. W. J. S. Lockyer and Mr. H. Payn. On their arrival at Gibraltar, they will be taken on board H.M.S. *Theseus*, of the Mediterranean squadron, which will then convey them to their destination. As at Viziadrug in 1898, and Norway in 1896, volunteers will be selected from the ship's company, and parties detailed out for every character of observation it is possible to make during a total solar eclipse; and in the interval between their landing and the final day, besides the erecting and adjusting of the instruments, the principal observers will have their time fully occupied in giving lectures, practical demonstrations, and rehearsals to the host of volunteers who will undoubtedly offer themselves.

Sir Norman Lockyer will make visual observations with a 4-inch Cooke photo-visual telescope equatorially mounted, and will give the signals for the whole of the remaining human and mechanical machinery to be set in motion. The following are the chief sections of the observers:—

20-foot Prismatic Camera.—This will be manipulated by Mr. Fowler, and consists of a Cooke photo-visual triplet lens, of 6 inches aperture and 20 feet 3 inches focal length. Outside this will be placed the objective prism, of 9 inches aperture and 45° angle, which was used at Viziadrug in 1898. The instrument will be fixed horizontally, and fed with light from a 12-inch siderostat. It is proposed to obtain instantaneous photographs of the chromospheric spectrum at both internal contacts, and long-exposure photographs of corona spectrum during totality. It is hoped that the greatly increased dispersion given by this instrument will increase the contrast between the *line* and *continuous* spectra of the corona, and so render more accurate measurements of wave-length possible. The plates used will be 15 × 2½ inches.

6-inch Prismatic Camera.—This is the same instrument which was used with success by Mr. Fowler in 1898, and will be under the charge of Dr. Lockyer. It consists of a 6-inch object-glass by Henry, of 7 ft. 6 in. focus, outside which are adjusted two objective prisms, each of 6 inches aperture and 45° angle. The programme with this instrument is similar to that of the 20-foot.

Coronographs.—Several coronographs of varying power are being taken, the largest being under the charge of Mr. Howard Payn, a gentleman who has generously volunteered his services for the expedition. This instru-

ment has a Cooke photo-visual lens of 4 inches aperture and 16 feet focal length, the primary image being used on plates 12 × 12 inches.

In addition, the De la Rue coronograph (4⅝ inches aperture and 72 inches focal length), Graham coronograph (3 inches aperture, 21 inches focal length), and Dallmeyer coronograph (6-inch aperture rapid rectilinear, 48 inches focal length) will be used. Parties of the volunteers will be engaged in one or other of the following observations :—

Disc drawings of corona ...	about	19 volunteers.
Observations of ring spectra ...	,,	5 ,,
Observations with pocket slit spectroscopes...	,,	4 ,,
Observations of shadow bands...	,,	6 ,,
Observations of stars and other celestial objects visible during totality	,,	20 ,,
Shadow phenomena, both atmospheric and terrestrial ...	,,	6 ,,
Colours of landscape, &c. ...	,,	12 ,,
Meteorology, temperature, pressure, &c.	,,	15 ,,
Photographs of landscape ...	,,	5 ,,
Natural history effects on men and animals	,,	3 ,,

In addition to these instruments, several of the observers will obtain photographs of the eclipse spectra by means of diffraction gratings and prisms fixed in front of their own small cameras. Those with gratings are likely to be specially useful, as the dispersion is sufficiently great to render it possible for the bright line spectra to show up from the continuous spectrum, and there is the further advantage of the large field given by an ordinary rectilinear, so that the spectrum of the streamers may also be obtained.

Prof. Copeland, Astronomer Royal of Scotland, will also occupy a station at Santa Pola, using a telescope of 40 feet focus.

The British Astronomical Association and the French Astronomical Society will each send parties to both Alicante and Algiers. As, however, the former place is so well occupied by Sir Norman Lockyer's party, the third official party from the British Government will occupy a station at Algiers, and will consist of Prof. Turner, Mr. Newall, Mr. Evershed and Mr. Wesley.

Prof. Turner will photograph the corona with one of the double cameras used in previous eclipses, one of which is arranged to polarise the coronal light before it reaches the photographic plate, and thereby determine the extent to which this light is initially polarised. In addition, he also hopes to repeat his work of 1893 and 1898 for determining photometrically the relative brightness of the corona at varying distances from the limb.

Mr. Newall will have three instruments under his charge, viz. :—(1) A four-prism slit spectrograph for obtaining the spectrum of the "flash," and of the corona. In the latter he hopes to obtain material for showing the difference, if any, between the spectrum of the coronal rays and the other portions. (2) An objective grating camera for photographing the spectrum of the corona in monochromatic light. (3) A polariscopic camera for photographing the corona, special attention being devoted to the study of any differences between the darker and brighter rifts.

Mr. Wesley, the assistant secretary of the Royal Astronomical Society, has for many years critically studied the minute structure of the corona, he being the draughtsman who has engraved the reproductions of many of the corona photographs of past eclipses for publication, but has not hitherto had an opportunity of studying it from nature. By the kindness of M. Trépied, the Director of the French Government Observatory at Algiers, Mr. Wesley will be enabled to examine the corona with the powerful "equatorial coudé" (about 8 inches aperture).

Mr. Evershed will not be stationed at Algiers itself, but intends to observe from a place near the limiting line of totality, about twenty miles south of Algiers, so that he may photograph the "flash" spectrum with somewhat longer exposure than near the central line.

Mr. and Mrs. Maunder will repeat at Algiers their programme so successfully carried out at Buxar, India, in 1898, but with larger apparatus. This will include short exposure photographs of the inner corona, and others with long exposure for extensions and streamers.

Mr. and Mrs. Crommelin will go to Algiers, and take photographs of the corona and of the shadow as projected on the atmosphere.

It is also stated that Mr. Percival Lowell, of Arizona, and Prof. Todd, of Amherst College Observatory, U.S.A., will occupy stations near Tripoli, in North Africa. It is to be hoped that favourable weather will enable the latter astronomer to successfully use his electrical control, by means of which he has arranged that a great number of photographic cameras shall be automatically exposed for varying times, all of which are operated from one revolving drum with delicately fitted electrical contacts.

The eclipse occurs at the European stations about 4.0 p.m. Greenwich time, so that it may be possible to communicate the results of the various expeditions to the evening papers of the same day.

Mention should be made of the generous arrangements which have been made by the authorities of all the Governments concerned, whereby the usual customs tariff and examination will be dispensed with, provided the observer is furnished with a certificate showing that his baggage is really for eclipse observation. The railway companies in Spain have also consented to convey passengers at half the usual fares.

CHARLES P. BUTLER.

THE ROYAL SOCIETY SELECTED CANDIDATES.

FIFTEEN candidates were selected by the Council of the Royal Society on Thursday last for election into the Society. The following are the names and qualifications of the new Fellows :—

GEORGE JAMES BURCH,

M.A. (Oxon). Lecturer at the University Extension College, Reading. Author of the following papers :—(1) "Experiments on Flame" (NATURE, 1885-86) ; (2) "A Perspective Microscope" (*Proc. Roy. Soc.*, vol. xiii.) ; (3) "Researches on the Capillary Electrometer" (*Proc. Roy. Soc.*, vol. xlviii., *ibid.*, vol. lix., *Phil. Trans.*, vol. clxxxiii(A)., *The Electrician*, July, 1896). "On a Method of drawing Hyperbolas" (*Phil. Mag.*, Jan., 1896). Also joint author of the following papers :—(1) "Dissociation of Amine Vapours" (with Mr. J. E. Marsh) (*Journ. Chem. Soc.*, 1889) ; (2) "E.M.F. of certain cells containing Nitric Acid" (with Mr. V. H. Veley) (*Phil. Trans.*, vol. clxxxii(A). ; (3) "Effect of Injury in Muscle" (with Prof. Burdon-Sanderson) (*Proc. Physiol. Soc.*, 1893) ; (4) "Action of Concentrated Acids on Metals in contact" (with Mr. S. W. Dodgson) (*Proc. Chem. Soc.*, 1894) ; (5) "D'Arsonval Physical Theory" (with Mr. L. E. Hill) (*Journ. Physiol.*, 1894) ; (6) "The Electromotive Properties of *Malapterurus electricus*" (with Prof. Gotch) (*Phil. Trans.*, 1896).

Supplementary Certificate.

Author of the following scientific papers in addition to those stated in the first certificate :—"On Prof. Hermann's Theory of the Capillary Electrometer" (*Proc. Roy. Soc.*, vol. lx., p. 328) ; "The Tangent Lens-gauge" (*Phil. Mag.*, 1897, p. 256) ; "An Inductor-Alternator for Physiological Experiments" (*Journ. of Physiology*, vol. xxi., 1897 ; "An Account of Certain Phenomena of Colour Vision with Intermittent Light" (*ibid.*) ; "Artificial Colour Blindness, with an Examination of the Colour-Sensations of 109 Persons" (*Phil. Trans.*, vol. clxli., 1899) ; joint author with Prof. Gotch, F.R.S., of the following scientific papers :—"The Electrical Response of

Nerve to a Single Stimulus as investigated by the Capillary Electrometer" (*Proc. Roy. Soc.*, vol. lxiii., 1898, p. 300); "The Electrical Response of Nerve to Two Stimuli" (*Journ. of Physiol.*, vol. xxvi., 1899); "The Electromotive Force of the Organ Shock, &c., in *Malapterurus electricus*" (*Proc. Roy. Soc.*, vol. lxv., p. 434, 1900).

T. W. EDGEWORTH DAVID,

B.A. (Oxon.), F.G.S. Professor of Geology in the University of Sydney, N.S.W. Formerly Senior Geologist to the Geological Survey of New South Wales, and author of many reports and maps issued by the Survey. Has published many papers dealing with Glacial action in recent, as well as ancient, geological periods; among others:—"Evidences of Glacial Action in S. Brecknock and E. Glamorgan" (*Quart. Journ. Geol. Soc.*, vol. xxxix., pp. 39-58, 1882); "On Evidences of Glacial Action in the Carboniferous and Hawkesbury Series, N.S.W." (*ibid.*, vol. xliii., pp. 190-197, 1887); "On Glacial Action in Australia in Permo-Carboniferous Times" (*ibid.*, vol. lii., pp. 289-302, 1896); also many papers and addresses dealing with Petrology, Vulcanology, and Stratigraphical Geology in the Southern Hemisphere, published in the *Journals* of the Royal, Linnean, and the Societies of New South Wales. Has superintenned and conducted to a successful issue the work of boring the Coral Atoll of Funafuti, undertaken by the Royal Society and the Geographical Society of New South Wales, with the assistance of the Admiralty.

JOHN BRETLAND FARMER,

M.A. (Oxon.), F.L.S. Professor of Botany, Royal College of Science, London. Formerly Fellow of Magdalen College, Oxford. Distinguished for his Botanical and Biological researches. Author of the following papers:—"On the Development of the Endocarp in *Samlucus nigra*" (*Ann. of Bot.*, vol. ii.); Contribution to the "Morphology and Physiology of Pulpy Fruits" (*ibid.*, vol. iii.); "The Stomata in the Fruit of *Iris Pseudacorus*" (*ibid.*, vol. iv.); "On *Isoetes lacustris*" (*ibid.*, vol. v.); "On Abnormal Flowers in *Oncidium splendidum*" (*ibid.*, vol. vi.); "On the Occurrence of two Prothallia in an Ovule of *Pinus silvestris*" (*ibid.*); "On the Embryogeny of *Angiopteris evecta*" (*ibid.*); "On Nuclear Division in the Pollen-mother-cells of *Lilium martagon*" (*ibid.*, vii.); "On the Relations of the Nucleus to Spore-formation in certain Liverworts" (*Proc. Roy. Soc.*, vol. liv.); "Studies in Hepaticæ" (*Ann. of Bot.*, vol. viii.); "On Spore-formation and Nuclear Division in the Hepaticæ" (*ibid.*, vol. ix.); "Further Investigations on Spore-formation in *Fegatella conica*" (*ibid.*); "Respiration and Assimilation in Cells containing Chlorophyll" (*ibid.*, vol. x.); "Ueber Kerntheilung in Lilium" ("Flora," 1895); "On the Structure of a Hybrid Fern" (*Ann. of Bot.*, vol. xi.). Joint Author of:—with J. Reeves, "On the Occurrence of Centrospheres in *Pellia epiphylla*" (*ibid.*, vol. viii.); with J. H. Williams, "On Fertilisation and the Segmentation of the Spore of Fucus" (*Proc. Roy. Soc.*, vol. lx.); with T. Waller, "Observations on the Action of Anæsthetics on Vegetable and Animal Protoplasm" (*ibid.*, vol. lxiii.); with J. Brentland, "Contributions to our Knowledge of the Fucaceæ, their Life-History and Cytology" (*Phil. Trans.*, vol. cxc.).

LEONARD HILL,

M.B. Lecturer on Physiology, London Hospital Medical College. Distinguished as a Physiologist. Author of the following works:—"On Poisoning by Phosphorus" (*Lancet*, 1890); "On Intra-Cranial Pressure" (*Roy. Soc. Proc.*, vol. lv.); "On Effects of Compression of the Common Carotid Artery" (with Moore) (*Brit. Med. Journ.*, 1894); "On Formation of Heat in the Salivary Glands" (with Bayliss) (*Journ. of Phys.*, vol. xvi.); "On D'Arsonval's Physical Theory of the Negative Variation" (with Birch) (*ibid.*); "On a Simple Form of Gas Pump" (*ibid.*, xvii.); "Exchange of Blood-Gases" (with Nabarro) (*ibid.*); "On Exchange of Blood-Gases in Brain and Muscle" (*ibid.*, xviii.); "On the Influence of Gravity on the Circulation" (*ibid.*); "On Intra-Cranial Pressure and the Circulation" (with Bayliss) (*ibid.*); "The Physiology and Pathology of the Cerebral Circulation," Hunterian Lectures, Churchill, 1896; "On Nervous Pressure and the Pulse" (with Barnard and Sequeira) (*Journ. Physiol.*, xxi.); "Influence of Gravity on the Circulation" (with Barnard) (*ibid.*); "The Causation of Chloroform Syncope" (*Brit. Med. Journ.*, 1897); "A Simple Form of Sphygmometer" (*ibid.*); "On Arterial Pressure in Man" (*Journ. Phys.*, xxii.); "On Rest, Sleep and Work on Arterial Pressure" (*Lancet*, 1898); "On Syncope and the Influence of Posture on Rabbits" (*Journ. Phys.*, xxii.); "On the Effects of Cerebral Anæmia produced by Ligation of the Cerebral Arteries" (with Mott) (*ibid.*, 1898); "On Human Cerebro-Spinal Fluid" (*Proc. Roy. Soc.*, 1898). In the press:—"Mechanism of the Circulation" (Schäfer, "Text-Book of Phys."); "Cerebral Circulation" (Allbutt's "System of Medicine").

JOHN HORNE,

F.G.S., F.R.S.E. One of the Senior Geologists on the Staff of the Geological Survey of Scotland. Has been engaged for more than thirty years in the Geological Survey. From 1868 to 1876 he personally studied and mapped large areas of the Silurian uplands of Scotland. From 1876 to 1883 he surveyed extensive tracts in the counties of Nairn, Inverness, Banff and Aberdeen. From 1884 till the present time he has taken an important share in the investigation and mapping of the complicated geology of the North-West Highlands. In addition to these official researches he has devoted his intervals of holiday to original exploration, and has made important contributions to our knowledge of the glacial and volcanic geology of the Orkney and Shetland Isles. Among his papers are the following:—"A Sketch of the Geology of the Isle of Man," and the "Post-Pliocene Formation of the Isle of Man" (*Edin. Geol. Soc. Trans.*, ii., 1174, pp. 323, 329); "The Geology of the Island of Unst" (*Edin. Phys. Soc. Proc.*, iv., 1878, p. 274); "The Volcanic History of the Old Red Sandstone Period North of the Grampians" (*Glas. Geol. Soc. Trans.*, vii., 1881, p. 77). Most of his investigations have been worked out in conjunction with Mr. B. N. Peach, F.R.S., but the results have been arranged and described by Mr Horne. Some of this conjoint work has been of the highest value, both in regard to British geology and to the theoretical treatment of the science. Special reference may be made to the "Report on the Recent Work of the Geological Survey in the North-West Highlands of Scotland" (*Quart. Journ. Geol. Soc.*, xliv., 1888, p. 378), in which the detailed structure of one of the most intricate geological regions in Europe was worked out and illustrated; to a paper on "The Olenellus-Zone in the North-West Highlands" (*ibid.*, xlviii., 1892, p. 227), which demonstrated the existence and stratigraphical relations of Lower Cambrian Rocks in Scotland; and to the large volume recently published by the Geographical Survey, on "The Silurian Rocks of Scotland" (p. 749), which gives the detailed results of a prolonged and laborious investigation by Messrs. Peach and Horne of the whole Silurian region of southern Scotland. In 1888 was awarded the Wollaston Fund by the Geological Society, and in 1899 received from the same Society, in association with his friend and colleague, Mr. Peach, a duplicate Murchison medal. Received, in 1893, the Neill medal from the Royal Society of Edinburgh, in recognition of the value of his contributions to Geology.

JOSEPH JACKSON LISTER,

M.A., F.Z.S. Demonstrator of Comparative Anatomy in the University of Cambridge. Distinguished as a Zoologist. Was Naturalist on board H.M.S. *Egeria* in two cruises, one to Christmas Island (Indian Ocean), the fauna of which he was the first to investigate, and another in the Pacific among the Tonga, Union and Phœnix Islands, during which he made himself well acquainted with the fauna of those islands, and of the Seychelles. His researches on the Foraminifera have thrown important light on the life-history and reproduction of that group. Author of the following papers:—"On the Natural History of Christmas Island in the Indian Ocean" (*Proc. Zool. Soc.*, 1888, p. 512); "On some Points in the Natural History of Fungia" (*Quart. Journ. Micros. Soc.*, vol. xxix., p. 359); "A Visit to the Newly-Emerged Falcon Island, Tonga Group, S. Pacific" (*Proc. Roy. Geograph. Soc.*, March 1890); "Notes on the Birds of the Phœnix Islands, Pacific Ocean" (*Proc. Zool. Soc.*, 1891, p. 289); "Notes on the Natives of Fakaofu (Bowditch Island), Union Group" (*Journ. Anthrop. Inst.*, 1891, p. 43); "Notes on the Geology of the Tonga Island" (*Quart. Journ. Geol. Soc.*, vol. xlvii., p. 590); "Contributions to the Life-History of the Foraminifera" (Abstract, *Proc. Roy. Soc.*, vol. lvi., p. 155. Full paper, *Phil Trans.*, vol. clxxxvi., 1895B, p. 401); "A Possible Explanation of the Quinqueloculine Arrangement of the Chambers in the Young of the

Microspheric Forms of Triloculina and Biloculina" (*Proc. Camb. Phil. Soc.*, vol. ix., pt. v.); with J. J. Fletcher, "On the Condition of the Median Portion of the Vaginal Apparatus in the *Macropodidae*" (*Proc. Zool. Soc.*, vol. lxiii., 1881, p. 976).

Supplementary Certificate.

Author of "*Astroclera Willeyana*, the representative of a New Family of recent Sponges," in the Zoological Results of Dr. Willey's Expedition, 1899.

JAMES GORDON MACGREGOR,

D.Sc. (Lond.), 1876. M.A. (Dalh.) Professor of Physics, Dalhousie College, Halifax, N.S. Well known for his long-continued Researches on Electrolytic Conductivity, on Solutions, on Resistance of Metals, and on Thermo-electricity. Author of numerous Memoirs contributed to the Royal Society of Edinburgh, the Royal Society of Canada, the Physical Society, and the British Association, including the following:—"Note on the Electrical Conductivity of Saline Solutions" (*Proc. Roy. Soc.*, Edin., 1875); "On the Electrical Conductivity of Stretched Silver Wires" (*ibid.*, 1878); "On the Variation with Temperature of the Electrical Resistance of certain Alloys" (*Trans. Roy. Soc.*, Edin., 1880); "On the Measurement of the Resistance of Electrolytes by means of Wheatstone's Bridge" (*Trans. Roy. Soc.*, Canada, 1882); "On some Experiments showing that the Electromotive Force of Polarisation is independent of the difference of Potential of the Electrodes" (*ibid.*, 1883); "On a Test of Ewing and MacGregor's Method of Measuring the Electrical Resistances of Electrolytes" (*ibid.*, 1890, with Prof. Ewing); "Note on the Volumes of Solutions" (*Brit. Assoc. Report*, 1877, with Dr. Knott); "On the Thermo-electric Properties of Charcoal and certain Alloys, with a Supplementary Thermoelectric Diagram" (*Edin. Trans.*, 1879, with Dr. Knott and Prof. Michie Smith); "The Thermo-electric Properties of Cobalt" (1876, *Proc. Roy. Soc.*, Edin., 1878); "On the Absorption of Low Radiant Heat by Gaseous Bodies" (*ibid.*, 1882-83); "On the Resistance to the Passage of the Electric Current between Amalgamated Zinc Electrodes and Solutions of Zinc Sulphate" (*Trans. Nov. Scot. Inst. Nat. Sci.*, 1883); "On the Density and the Thermal Expansion of Solutions of Sulphate of Copper" (*Trans. Roy. Soc.*, Canada, 1884); "On the Relative Bulk of certain Aqueous Solutions and their Constituent Water" (*Trans. Nov. Scot. Inst. Nat. Sci.*, 1886); "A Table of Cubicle Expansions" (*Trans. Roy. Soc.*, Canada, 1888); "On the Variation of the Density with the Concentration of Weak Aqueous Solutions of certain Salts" (*ibid.*, 1889, vol. ix., 1891); "On the Calculation of the Conductivity of Electrolytes" (*ibid.*, 1896); "On the Relation of the Physical Properties of Aqueous Solutions to their State of Ionisation" (*Phil. Mag.*, 1897); "On the Hypothesis of Abstract Dynamics and the question of the number of Elastic Constants" (*ibid.*, 1896, with Mr. E. A. Archibald); "On Calculation of Conductivities of Electrolytes" (*ibid.*, February 1898). Author of "An Elementary Treatise on Kinematics and Dynamics" (1887).

PATRICK MANSON,

C.M.G., M.D. (Aberd.). F.R.C.P. (Lond.). LL.D. (Aberd.). Physician and Medical Adviser to the Colonial Office. Lecturer on Tropical Medicine, St. George's Hospital, Charing Cross Hospital and London School of Tropical Medicine. Distinguished as a Physician and Parasitologist. Discoverer of Filarial Periodicity of the *rôle* of the Mosquito in Filarial Metamorphosis; of Filarial Ecdysis; and of many other points in connection with the life-history of the Filaria nocturna. Discoverer of three other blood-worms of man, viz. *Filaria diurna*, *Filaria perstans* and *Filaria Demarquaii*. Discoverer of the disease known as Endemic hæmoptysis and of its Parasitic cause. Discoverer of *Bothriocephalus Mansoni* and of many points in connection with human and animal helminthology. Was the first to describe accurately and to name *Finea imbricata*, and to prove experimentally its dependence on a vegetable parasite. Was the first to point out the significance of the flagellated body as the initial stage of the extra-corporeal cycle of the malaria parasite, and to enunciate the hypothesis that the mosquito was the host of the parasite at this stage, and therefore an active agent in diffusing malaria, an hypothesis since proved by Major Ross to be correct. Author of a work on *Filaria sanguinis hominis* and some Parasitic Diseases of Warm Climates, 1883; of "Tropical Diseases," 1898; of the Goulstonian Lectures on the Life-History of the Malaria Parasite Outside the Human Body, 1896; of Papers on the Metamorphosis of *Filaria sanguinis hominis* in the Mosquito (*Trans. Linn. Soc.*, 1883); "On the Nature and Significance of the Flagellated Body in Malarial Blood" (*Brit. Med. Journ.*, 1894); and of many other papers on the subjects mentioned above and allied matters.

THOMAS MUIR,

LL.D., M.A., F.R.S.E. Superintendent-General of Education in the Cape Colony. Distinguished as a Mathematician and Educationist. Author of "A History of Determinants," and fifty-eight original mathematical papers, including "Continuants: a New Special Class of Determinants" (*Proc. Roy. Soc. Edin.*, 1875); "On the Transformation of Gauss' Hypergeometric Series into a Continued Fraction" (*Lond. Math. Soc.*, 1876); "New General Formulæ for the Transformation of Infinite Series into Continued Fractions" (*Trans. Roy. Soc. Edin.*, 1876); "On Eisenstein's Continued Fractions" (*ibid.*, 1879); "On a Systematic Determinant connected with Lagrange's Interpolation Problem" (*Lond. Math. Soc. Proc.*, 1881-2); "On New and Recently Discovered Properties of certain Symmetric Determinants" (*Quart. Journ. Math.*, 1882); "On the Phenomena of 'Greatest Middle' in the Cycle of a Class of Periodic Continued Fractions" (*Proc. Roy. Soc. Edin.*, 1884); "The Theory of Determinants in the Historical Order of its Development" (*ibid.*, vol. xiii.-xvi.); "On Some Hitherto Unproved Theorems in Determinants" (*ibid.*, 1891); "A Problem of Sylvester's in Elimination" (*ibid.*, vol. xx.); "New Relations between Bipartite Functions and Determinants, with a Proof of Cayley's Theorem in Matrices" (*Lond. Math. Soc. Proc.*, vol. xvi.). Has rendered services of the highest importance to education in the Cape Colony, and in his capacities of trustee of the South African Museum and member of the Geological Commission has greatly promoted original scientific research in South Africa.

ARTHUR ALCOCK RAMBAUT,

M.A., Sc.D. (Dublin). Radcliffe Observer. Late Royal Astronomer of Ireland. Late Andrews Professor of Astronomy in the University of Dublin. Author of the following researches in Astronomy and Physics:—Catalogue of the Mean Places of 1012 Southern Stars" ("Astronomical Observations and Researches of Dunsink," part vi.); "Catalogue of the Mean Places of 717 Stars" (part vii., *ibid.*); "On the Determination of Double Star Orbits from Spectroscopic Observations of the Velocity in the Line of Sight" (*Monthly Notices, Roy. Astron. Soc.*, vol. li., No. 5); "To Adjust the Polar Axis of an Equatorial Telescope for Photographic Purposes" (*ibid.*, liv., No. 2); "On the Inequality in the Apparent Diurnal Movement of Stars due to Refraction, and a Method of Allowing for it in Astronomical Photography" (*ibid.*, vol. lvii., No. 2); "On a Geometrical Method of Finding the most Probable Apparent Orbit of a Double Star" (*Proc. Royl. Dubl. Soc.*, vol. vii., part 2); "On the Distortion of Photographic Star Images due to Refraction" (*ibid.*, vol. viii., part 2); "On the Rotation Period of the 'Garnet' Spot on Jupiter" (*ibid.*, vol. viii., part 5); "On the Relative Positions of 223 Stars in the Cluster χ Persei, as Determined Photographically" (in conjunction with Sir R. Ball) (*Trans. Roy. Irish Acad.*, vol. xxx., part 4); "On the Possibility of Determining the Distance of a Double Star by means of the Relative Velocity of the Components in the Line of Sight" (*ibid.*, 2nd series, vol. iv., No. 6); "The Absorption of Heat in the Solar Atmosphere" (in conjunction with W. E. Wilson) (*ibid.*, 3rd series, vol. iii., No. 4).

WILLIAM JAMES SELL,

M.A. Senior Demonstrator of Chemistry, University of Cambridge. Author of the following papers:—"Volumetric Determination of Chromium" (*Trans. Chem. Soc.*, 1879); "On a Series of Salts of a Base containing Chromium and Urea," Nos. 1 and 2 (*Proc. Roy. Soc.*, 1882 and 1889); "Anhydro-Derivatives of Citric and Aconitic Acids" (*Trans. Chem. Soc.*, 1892); "Salts of a new Platinum Sulphurea Base" (*Brit. Assoc. Rept.*, 1893); "Studies on Citrazinic Acid," Pts. I.-V. (*Trans. Chem. Soc.*, 1893-1897); "Note on the Action of Chlorine on Pyridine" (*Trans. Chem. Soc.*, 1898); "The Chlorine Derivatives of Pyridine," Pts. I.-II. (*ibid.*, 1898); "Interaction of Ammonia and Pentachlorpyridine" (*ibid.*); "Constitution of Glutazine" (*ibid.*).

W. BALDWIN SPENCER,

B.A. (Oxon.), M.A. (Melbourne). Professor of Biology in the Melbourne University; formerly Fellow of Lincoln College, Oxford; Hon. Sec. of the Royal Society of Victoria; Corr. Member Zool. Soc., Lond. Distinguished as an original investigator in Zoology and Comparative Anatomy; and as a teacher and organiser. Graduated at Oxford twelve years ago. Has published more than thirty memoirs, among which are:—"On a New Family of Hydroidea Ceratellidæ" (*Trans. Roy. Soc. Vict.*, 1890); "The Anatomy of *Megascolides Australis*," and other papers on Australian Earthworms and Planarians (*ibid.*); "On New Crustacea and New Mammals," in Report of the Horn Expedition to Central Australia (which he organised); "On the Pineal Eye in Lacertilia" (*Quart. Journ. Micro. Sci.*, 1887); "On the Habits, Blood-vessels and Lungs of *Ceratodus Fosteri*"; "On a New Genus of Marsupials from Central Australia" (*Proc. Roy. Soc. Vict.*, vol. ix.); "On the Cranial Nerves of Scyllium" (*Quart. Journ. Micros. Sci.*, 1881); "On the Early Development of *Rana temporaria* (*ibid.*, 1885); "The Fauna and Zoological Relationships of Tasmania" (Presidential Address to Sect. D., Austr. Assoc. Adv. Sci., 1892).

JAMES WALKER,

D.Sc. (Edin.), Ph.D., Leipzig. Professor of Chemistry, University College, Dundee. An active and successful worker in chemistry, especially physical and organic. Author of numerous papers, of which the following are among the most important:—"Zur Affinitätsbestimmung Organischer Basen" (*Zeit. Physikal. Chem.*, iv.. p. 319, 1889); "Ueber Löslisкkeit und Schmelzwärme" (*ibid.*, v., 193, 1890); "The Dissociation Constants of Organic Acids" (*Journ. Chem. Soc.*, lxi., p. 696, 1892); "The Methyl Salts of Camphoric Acid" (*ibid.*, lxi., p. 1088, 1892); "The Electrolysis of Sodium Ethyl Camphorate (*ibid.*, lxiii., p. 495, 1893); "The Boiling Points of Homologous Compounds" (*ibid.*, part i., lxv., p. 193, 1894; part ii., lxv., p. 725, 1894); "Hydrolysis in some Aqueous Solutions" (*Proc. Roy. Soc. Edin.*, vol. xx., p. 255, 1894). Along with Prof. Crum Brown, "Electrolytic Synthesis of Dibasic Acids" (parts i. and ii. *Trans. Roy. Soc. Edin.*, vol. xxxvi., p. 211, 1891, and vol. xxxvii., p. 361, 1893). Along with J. Henderson, "Electrolysis of Potassium Allo-Camphorate" (parts i. and ii. *Journ. Chem. Soc.*, vol. lxviii.. p. 337, 1895; vol. lxix., p. 748, 1896). Along with F. I. Hambly, "Transformation of Cyanate into Urea" (*Journ. Chem. Soc.*, vol. lxvii., p. 746, 1895). Along with J. R. Appleyard, "Transformation of Methylammonium Cyanates into the Corresponding Ureas" (*Journ. Chem. Soc.*, vol. lxix., p. 193, 1896).

PHILIP WATTS,

Naval Architect and Director of the War-Shipbuilding Department of Sir W. G. Armstrong, Whitworth and Co. Distinguished for his knowledge of the science and practice of Naval Architecture. Responsible designer of a considerable number of the swiftest and most powerful war-ships. Has done much original scientific and experimental work in connection with investigations of the stability of ships and floating bodies; the oscillations of ships in still water and amongst waves; the propulsion and manœuvring powers of ships. Was appointed by the Admiralty and acted for some years as assistant to the late Mr. W. Froude, F.R.S., on the analytical and experimental work carried on by that investigator. In that capacity he took part in the device and application of the process of "graphic integration" by which the oscillations of ships can be approximately determined under assumed conditions of wave motion, including the effect of fluid resistance. Has independently proposed a method of reducing the rolling of ships at sea, by the introduction of free water into a suitably formed chamber. This plan was adopted by the Admiralty for several important ships, after mathematical and experimental demonstration of its efficiency. Was entrusted with the experimental investigation of the turning powers of H.M.S. *Thunderer* made in connection with the work of the *Inflexible* Committee. Devised and applied methods for determining exactly the path traversed by the C.G. of the ship, the rate of acquisition of angular velocity, the angle of heel and other phenomena incidental to turning under the action of the rudder. This investigation led to subsequent modifications in the under-water form of ships, tending to increase their handiness. Is author of the following papers printed in the *Transactions* of the Institution of Naval Architects:—"On a Method of Reducing the Rolling of Ships at Sea" (1883); "The Use of Water Chambers for Reducing the Rolling of Ships at Sea" (1885); "The Italian Cruiser *Piemonte*" (1889); "The Steering Qualities of the *Yashima*" (1898); "Elswick Cruisers Built during the last Ten Years" (1899).

CHARLES THOMSON REES WILSON,

M.A. (Cantab.), B.Sc. (Vict.). At present engaged in Investigations on Atmospheric Electricity on behalf of the Meteorological Council. Author of the following papers:—"On the Formation of Cloud in the absence of Dust" (*Cam. Phil. Soc. Proc.*, vol. viii., p. 306); "The effect of Röntgen's Rays on Cloudy Condensation" (*Roy. Soc. Proc.*, vol. lix., p. 338); "Condensation of Water Vapours in the Presence of Dust-free Air and other Gases" (*Phil. Trans.*, A., (1897), pp. 265-307); "On the Action of Uranium Rays on the Condensation of Water Vapour" (*Camb. Phil. Soc. Proc.*, vol. ix., pp. 333-338); "On the Production of a Cloud by the Action of Ultra-Violet Light on Moist Air" (*ibid.*, vol. ix., p. 392); "Condensation Nuclei produced in Gases by the Action of Röntgen Rays, Uranium Rays, Ultra-Violet Light and other Agents" (*Phil. Trans.*, A., 192, pp. 403-453); "Comparative Efficiency as Condensation Nuclei of positively and negatively charged Ions" (*ibid.*, A., 193, pp. 289-308).

LIEUT.-GENERAL PITT-RIVERS, F.R.S.

BY the death of Lieut.-General Augustus Henry Lane-Fox Pitt-Rivers, F.R.S., on May 4, anthropology has lost one of her most prominent and enthusiastic students, and one whose place it will be impossible to fill.

Augustus Henry Lane-Fox was born in 1827. He served with distinction in the Crimea, at Alma and Sevastopol, being during that campaign an officer in the Grenadier Guards, and on the staff. As Lieut.-Colonel Lane-Fox he was the earliest and principal associate of Colonel, afterwards Lieut.-General, Hay, the first Commandant and Inspector-General of Musketry, and about 1855 he wrote and delivered the series of lectures which then, and since, formed a principal part of the Hythe curriculum. He had thus the honour and distinction of being prominently associated with the inauguration of one of the most important reforms in our military system. He had the unusual reputation in those days of military dandies of being an able, studious and scientific officer; but his career at Hythe was not a long one. While he was there he had the practical training and instruction of those who came to qualify as musketry instructors; and he added to, if he did not originate, the interesting collection of ancient arms and weapons and projectiles in that establishment. General Pitt-Rivers never lost his interest in military matters, and as late as 1893 he was appointed Colonel of the South Lancashire Regiment.

Few men have had the collecting instinct so strongly developed as had General Pitt-Rivers, but in his case not only were his interests extremely wide, but he had always some method in his collecting; there was invariably some principle or theory that the objects were designed to illustrate. Consequently he bought with judgment, and what in most collections are "curios" or trophies, under his arrangement became links in a chain of scientific argument, or clever suggestions of stages in the evolution of human thought or handicraft.

The spoils of over twenty years of intelligent collecting were exhibited, in 1874, in the Bethnal Green Museum, and the catalogue of this collection was published by the Science and Art Department. It is no exaggeration to say that this collection was a revelation to many people, and it and the catalogue initiated a new departure in the study of handicrafts. It was, in fact, the first practical application of the theory of evolution to objects made by man. As Colonel Lane-Fox he was, for

example, the first to demonstrate the evolutionary history of patterns, or of certain decorative features from realistic originals. He placed together, side by side, analogous objects from all parts of the world, and often he was enabled to demonstrate the origin and modifications of modern weapons, utensils, and the like. This system has its dangers; analogy may often be mistaken for homogeny, and it must be admitted that mistakes were occasionally made or wrong inferences suggested; but with care these may be greatly reduced, and this system of studying human productions appeals alike to the general public and to scientific men. We believe that the collections exhibited in 1874 were first offered to the University of Cambridge, but now they find a final resting-place in the museum at Oxford, where they have since been greatly added to and further elaborated.

Owing to the death of the sixth Baron Rivers in 1880, Mr. Lane-Fox succeeded to large estates in Wiltshire and Dorsetshire, and he assumed the name of Pitt-Rivers. This gave him his chance; many years previously his keen eye had noted the numerous earthworks and tumuli on Cranborne Chase, but he little thought that fortune would hand them over to his keeping.

In 1881 the General commenced excavating, and in 1887 he published the first of his four quarto memoirs on the results of his digging. Many burrows had been rifled before by antiquaries, but never had excavations been so systematically and thoroughly studied in this country. These memoirs are monuments to the princely liberality, technical skill, and conscientious attention to details that characterised General Pitt-Rivers.

In order to display the finds obtained in his excavations, Pitt-Rivers built a new museum at Farnham in Dorsetshire, and once more he gave rein to his passion for collecting, and soon an extensive and valuable ethnographical museum sprang up in this remote country village. Here, systematically arranged and described, may be seen models of the sites and excavations, and every specimen and fragment thence obtained. In order to illustrate the pottery which is found in various diggings, a comparative collection of pottery and ceramics was started which now forms a very valuable epitome of this industry in all ages and climes. In the same manner, a large comparative collection of agricultural implements has been collected. Here also is the collection of locks, upon which he based the memoir he published in 1883 The collections of general ethnography are surprisingly rich, and his well selected specimens of Benin metal work constitute perhaps the most representative series extant. Words fail to express one's surprise at finding this wonderful museum buried in the depth of the country.

At Tollard Royal, near Farnham, the General very carefully restored a thirteenth century house, which is known as King John's House—this he converted into a museum mainly designed to illustrate the rise of the art of painting; and with characteristic thoroughness he began with paintings of the twentieth and twenty-sixth dynasties.

Not far off are the Larmer Grounds, a park which has been beautifully laid out and provided with numerous picturesque large summer-houses for the use of excursionists. During the warm weather a band plays on Sunday afternoons, and large numbers of people avail themselves of the General's hospitality. In this effort to provide free and innocent enjoyment to the multitude, General Pitt-Rivers received much opposition from well-meaning but misguided sabbatarians; but in this as in so many other matters, he pursued what he considered to be his duty without being influenced by the opinions or opposition of others. He was very fond of joining the happy throngs, and he was never more pleased than when many thousands assembled on great occasions, such as the annual races. It is gratifying to know that his liberality was never abused by unseemly conduct.

General Pitt Rivers' written contributions to anthropological literature were very numerous, and in his time he took an active part in the work of various societies.

General Pitt-Rivers was a Fellow of the Royal Society; on more than one occasion he was President of the Anthropological Institute; and he was a Vice-President of the Society of Antiquaries. His last public appearance was when he read an address as Vice-President of the Royal Archæological Institute at Dorchester in 1893. He was Inspector under the Ancient Monuments Protection Act of 1882, and in this capacity he visited the scheduled monuments; but even his energy was powerless to counteract the restricted powers and scope of the Act.

It would be difficult to detail the wide range of subjects that interested General Pitt-Rivers, and the remarkable knowledge he had on so many subjects. He was by no means a man whose sympathies narrowed with age. His strong physique, indomitable energy and imperious will enabled him to accomplish an immense amount of work, and his trained mind, combined with wide knowledge and sympathy, rendered that work of especial merit. Possessed of an abundance of means, he spent lavishly on his beloved science. His strenuous life was devoted to the advancement of knowledge and to the instruction and recreation of the populace.

A. C. H.

NOTES.

THE council of the Society of Arts attended at Marlborough House, on May 8, when his Royal Highness the Prince of Wales, K.G., President of the Society, presented the Albert medal of the Society to Sir William Crookes, F.R.S., "for his extensive and laborious researches in chemistry and in physics; researches which have, in many instances, developed into useful practical applications in the arts and manufactures."

THE Paris correspondent of the *Times* states that the committee of the Paris Academy of Sciences has selected as candidates for election as permanent secretary, in place of the late M. Joseph Bertrand, M. Cornu, professor at the École Polytechnique, and M. Darboux Jean, of the Faculty of Sciences in Paris.

BY the will of the late Mr. G. J. Symons, F.R.S., a valuable bequest is made to the Royal Meteorological Society. Mr. Symons was a great lover of old books, and had succeeded in getting together an extensive meteorological library. He bequeathed to the Society all his books, pamphlets, maps and photographs a copy of which is not already in its library. He also bequeathed his Cross of the Legion of Honour, his Albert medal, and other decorations, as well as the testimonial album presented to him by the Fellows of the Society in 1879. In addition to the above he also bequeathed the sum of 200*l*.

MR. GOSCHEN made an important announcement at the annual dinner of the Iron and Steel Institute last week. He said that, with a view to developing the power of English guns by means of improving the propellant agent, a committee has been appointed, with Lord Rayleigh as chairman, to investigate the whole subject. The reference to the committee is to carry out trials to ascertain what are the best smokeless propellants for use in existing guns of all natures and in existing small arms, and to report as to whether any modification in the existing designs of guns is desirable with a view to developing to the full the powers of any propellant which may be proposed.

THE King of the Belgians has created Mr. E. Windsor Richards, past president of the Iron and Steel Institute of Great Britain, a Knight Commander of the Order of Leopold.

THE Royal Commissioners who were recently appointed to inquire into and report upon the condition of the salmon fisheries of England, Wales and Scotland, commenced their inquiry on Tuesday.

FORTY-SIX of the sixty-five automobile vehicles which left London on April 23 for a 1000-mile trial, returned on Saturday last. From a report in the *Times*, we gather that the mechanical results of the trial have been very much what they were expected to be. That is to say, the established type of machine has proved itself entirely trustworthy, and between the Daimler, Napier and Panhard motors there has been, in the matter of "staying power," practically nothing to choose. Of the cars which entered, only four were driven by any other motive power than petroleum spirit, and of these one steamer only survived.

LETTERS received from Mr. Moore and Mr. Fergusson announce that the Tanganyika Expedition arrived at Lake Kivu on December 7, 1899, having left two of their party (Messrs. Berridge and Mathews) at the head of Lake Tanganyika. They had ascended the active volcano of Karunga, north of Lake Kivu (11,350 feet), but found only steam without lava issuing from the orifice. They arrived on the shores of Lake Albert-Edward on January 21, and on February 12 were at Fort Gerry, the English post in Zoru, near Mount Ruwenzori, which they were proposing to ascend.

SOME living specimens of the very curious blind fish of the caves of Kentucky, U.S.A. (*Amblyopsis spelaea*), may now be seen in the Zoological Society's fish-house, where they have been deposited by the Hon. Walter Rothschild. They are of a nearly uniform pale flesh colour. When exposed to the light these creatures hide themselves among the stones in the tank in which they are placed, though when shaded they seem to swim about pretty freely like other fishes, but usually keep near the surface.

THE Ancient Monuments Protection Bill was read a second time in the House of Lords on Tuesday. The measure extends the provisions of the Ancient Monument Act of 1882, and proposes that local authorities should be empowered to take over the charge of national monuments and to receive voluntary contributions towards the cost of maintaining and preserving them. Some of the London open spaces had been preserved in this manner, and there seemed no reason why the same principle should not be applied to monuments of archæological interest.

THE U.S. Congress has under consideration a Bill for the conversion of the present Office of Standard Weights and Measures into a National Standardising Bureau similar to the Reichsanstalt at Charlottenburg, and the National Physical Laboratory. The clause dealing with the work of the bureau reads as follows:—The functions of the bureau shall consist in the custody of the standards; the comparison of the standards used in scientific investigations, engineering, manufacturing, commerce, and educational institutions with the standards adopted or recognised by the Government; the construction when necessary of standards, their multiples and subdivisions; the testing and calibration of standard measuring apparatus; the solution of problems which arise in connection with standards; the determination of physical constants, and the properties of materials when such data are of great importance to scientific or manufacturing interests, and are not to be obtained of sufficient accuracy elsewhere.

THE gold medal of the Linnean Society of London, which is annually presented alternately to a zoologist and to a botanist, has this year been awarded to Prof. Alfred Newton, F.R.S., in recognition of his important contributions to zoological science. To the general public Prof. Newton's name will be best known in connection with the latest addition of Yarrell's "British Birds" (vols. i. and ii. of which were revised and edited by him), and the "Dictionary of Birds," an admirable compendium of ornithology. As editor of the *Ibis* (1865-70), and of the "Zoological Record" (1870-72), to which for some years previously he had supplied the annual record of the literature relating to Aves, he has placed ornithologists of all nations under great obligations to him, as he has done, also, by his publications on the avifauna of Iceland, Greenland, the West Indies, the Mascarene and Sandwich Islands, and by his articles in the "Encyclopædia Britannica" and the "Dictionary of National Biography." As chairman for many years of a committee of the British Association he has been instrumental in securing the publication of valuable reports on the migration of birds and in obtaining legislative protection for the more useful species by the appointment of a close time. The medal will be presented at the Anniversary Meeting of the Linnean Society.

THE Académie Royale de Belgique announces the following prize subjects for 1900:—*Mathematical and Physical Sciences*. A description of researches on critical phenomena in physics, together with new researches upon this subject; new researches on the viscosity of liquids; study of the derived carbonates of an element of which the compounds are still little known; the variation of latitude, together with a discussion of the reasons which have been put forward to account for it; a contribution to the algebraic and geometric study of n linear forms, n being greater than 3; new researches on the thermal conductivities of liquids and solutions. *Natural Sciences*: The determination of the limits of the Comblain-au-Pont formation, and the place it should occupy in geological classification. Is it Devonian or Carboniferous?; researches on the modifications produced in minerals by pressure; researches on the organisation and development of a flat-worm with the object of determining whether there exist any phylogenic relationships between Platyhelminthes and Enterocœla; does a nucleus exist in Schizophytes (Schizomycetes)? if so, what is its structure and mode of division?; researches on Devonian plants of Belgium, from the point of view of description, stratigraphical position, and, if possible, anatomical characters. The value of the gold medal to be awarded for each subject is six hundred francs. Memoirs may be written in French or in Flemish, and must be sent to the secretary of the Academy by August 1.

WE learn from the *Electrician* that an instrument called the telephonograph, which is a modification of the phonograph, was recently inspected and tested by the German Postmaster-General and several engineers. Its inventor, Herr Paulsen, a Dane, has replaced the wax cylinder of the Edison phonograph by a steel band, and the style by a magnet energised by a telephone. Currents transmitted by the telephone pass through the electromagnet and create consequent poles on the steel band, and more or less the converse operation is employed for reproducing the sound. A long line can, of course, intervene between the transmitting telephone and the phonograph itself, and it is suggested that a telephone subscriber on leaving his office can set such a telephonograph to receive telephoned messages during his absence.

EXPERIMENTS on the exposure and development of photographic plates in ordinary light have recently been made by Prof. F. E. Nipher, and are described in *Science*. It appears that if a photographic plate in a camera is greatly over-exposed it may be developed in the light. A plate which should for ordinary work have an exposure of a second and a half for street or outdoor photography, may be exposed for two hours. When developed with weak hydrokinone by the light of a lamp, it gives a good positive. If the plate is held too near the lamp the light will dissolve a picture already appearing. If held too far away the plate begins to fog. By moving toward or from the lamp the proper illumination may be soon secured. It is remarkable that a street scene taken in this way shows not a moving thing on the streets. In Prof. Nipher's pictures, tramcars passing every two minutes, waggons, horses, pedestrians, left no trace upon the plate. But the fixed objects are shown perfectly, with their proper shadows and high lights. Prof. Nipher points out that lantern slides and transparencies may be made directly by this method without re-photographing from a negative. Röntgen ray pictures can also be obtained upon plates which have been exposed to the light of an ordinary room for a few days, by developing in the manner described. Good radiographs have been thus produced upon plates which were uncovered during exposure to the rays.

THE usual proof that the arithmetic mean of any number of positive quantities is greater than their geometric mean consists in showing that if any two of the quantities be replaced by their semi-sum, the new series has the same arithmetic mean and a greater geometric mean. This proof, however, involves the assumption that if this process of substitution be repeated indefinitely, the ultimate result will be a series of quantities each equal to the arithmetic mean of the original series. We have never seen this property proved, and it is certainly by no means an obvious truth in the general case, for the result of the repeated operations is always a fraction whose denominator is a power of 2, while the arithmetic mean of n quantities has n for its denominator. We are glad to see that Mr. G. E. Crawford, writing in the *Proceedings* of the Edinburgh Mathematical Society, recommends an alternative proof in which the number of steps is finite, and the above assumption is not made. Two such proofs are possible, both of which run on somewhat parallel lines, and Mr. Crawford refers to a text-book which appeared a few years ago for the alternative to the proof now given.

WE have received from Prof. A. Klossovsky, the energetic director of the meteorological system of South-west Russia, a very valuable contribution to climatology. The work consists of two volumes, text and charts, and embraces the large area running from about the latitude of London to the northern shores of the Black Sea and the Sea of Azov, and bounded on the east by the River Dnieper. The observations used in the discussion include those made at the stations belonging both to the Central Meteorological Service of St. Petersburg and to the South-west Russian system, and embrace a period of twenty-five years (1871–1895). The tables exhibit monthly, yearly and five-yearly values of all the principal elements, and the distribution of thunderstorms and hail. The charts are coloured, and show very clearly the mean annual distribution of rainfall, the number of days of thunderstorms and hail, mean and extreme temperatures, and the distribution of cloud and humidity. The tables are arranged in various ways, and furnish most useful statistics for agriculturists and for men of science generally.

IN describing some Neocene corals of the United States (*Proc. U.S. National Museum*, vol. xxii. 1900), Dr. H. S. Gane remarks that a majority of the corals in these Eocene, Miocene and Pliocene formations belong to extinct species. They do not, however, present any close kinship with the corals of a like age in the West Indies, but are more nearly related to those now living in the Caribbean Sea and Atlantic Ocean.

MR. CECIL B. CRAMPTON, who has for some time been assistant to Prof. Boyd Dawkins in the museum at Owen's College, Manchester, has been appointed an assistant geologist on the Geological Survey of Scotland.

MR. LESTER F. WARD gives an account of the wonderful "Petrified Forest" or "Chalcedony Park" of Arizona (Report to Department of the Interior, U.S. Geol. Survey, 1900). Countless logs of silicified wood occur over a wide area in Arizona, but they are especially abundant in a particular tract known as the "Petrified Forest," east of Holbrook, between the Little Colorado and Rio Puerco. Here the logs lie in the greatest profusion, "while the ground seems to be everywhere studded with gems, consisting of broken fragments of all shapes and sizes, and exhibiting all the colours of the rainbow." These silicified blocks are not *in situ*, but have been derived from a bed of conglomeratic sandstone of Triassic age, which is exposed on the margin of a high plateau. Mr. Ward refers also to a well-known "Natural Bridge," which consists of a petrified trunk lying across a canyon, and forming a footbridge, and he observes that the trunk here is *in situ*. He advocates that means be taken to preserve these natural phenomena.

A REPORT on the proposed railway from the Commune des Houches, Bonneville, in Haute-Savoie, to the summit of Mont Blanc, has been published by M. Joseph Vallot, Director of the Mont Blanc Observatory, and M. Henri Vallot, engineer. This great undertaking was projected by M. Saturnin Fabre, but various routes have been suggested. These are fully discussed by the authors, who give reasons for recommending a route which starts from the valley of the Arve at an elevation of about 3000 feet, and proceeds by the Aiguille du Goûter and the Dôme du Goûter to a terminus at the Petits Rochers Rouges, where the elevation is about 15,000 feet. The total length ot the railway would be about seven miles, and from an elevation of about 4000 feet to its upward termination, the line would for the most part be subterranean. There would be several openings, and also stations giving access to the mountain, at points of special interest and beauty. M. Joseph Vallot contributes chapters on the geology, including the glacial phenomena, and these are illustrated by a section showing the nature of the solid rocks through which the railway would be carried, and the thickness of the glacier-ice above. For a short distance the tunnelling would be made through Liassic slates and Trias with gypsum, and then wholly through various crystalline schists.

IN his memoir recently published in the *Philosophical Transactions* (see NATURE, April 19, p. 595), Mr. Oldham has shown that, in recording the movements due to distant earthquakes, the heavy vertical pendulums employed in Italy answer most readily to the early tremors, while the light horizontal pendulums of Rebeur-Paschwitz and others are most affected by the later-arriving surface-undulations. Dr. G. Agamennone has discussed the same subject independently in a note read on February 18 before the R. Accademia dei Lincei of Rome. At the Roccadi Papa Observatory, of which he is director, are two horizontal pendulums provided with mechanical registration. It is found that these instruments fail to indicate small local shocks, while in recording distant earthquakes they lag behind the vertical pendulums with stationary masses. But, by increasing the

weight which the horizontal pendulums carry from 25 to 60 kg., this defect almost disappears. Dr. Agamennone therefore proposes to erect an additional pair of horizontal pendulums at Rocca di Papa in which the masses shall be at least 500 kg., the period of oscillation 10 to 15 seconds, and the magnifying ratio of the writing stiles 50, and possibly 100. He also suggests a double system of registration; the stiles at one end are to write in ink on white paper moving with a velocity of about 50 cm. per hour, and at the other end on an endless strip of smoked paper, which, on the occurrence of a shock, will be made to travel still more rapidly. The former record will enable the initial and final epochs to be determined, and the latter the period of the individual oscillations.

WE have received the *Transactions* and *Report* of the Manchester Microscopical Society for 1899, which contains a good account of the late Zoological Congress, and also some well illustrated papers on various biological subjects of current interest.

DR. C. S. MINOT has favoured us with a copy of a paper from vol. xxix. of the *Proc. Boston Soc. Nat. Hist.*, entitled "On a hitherto unrecognised form of blood circulation without capillaries in the organs of Vertebrata." "Sinusoids" is the name proposed for the newly-discovered vessels, which are said to differ in many respects from true capillaries.

THE "Descriptive Guide" to the collection of corals now on view at the South London Art Gallery, Peckham Road, Camberwell, may be described as a wonderful "pennyworth." Not only does it contain two excellent photographic plates of corals, but the text is an excellent popular introduction to the study of these beautiful structures. The collection in question is the property of Mr. J. Morgan, of St. Leonards, who has kindly loaned them for public exhibition.

FROM its last *Report* we are glad to notice that the Felsted School Scientific Society appears in a flourishing condition. Physics and chemistry receive a larger share of attention than is usually the case in school societies, owing, doubtless, to the fact that the president, Mr. A. E. Munby, teaches these subjects in the school. Dr. Charles Hose has kindly offered to present a selection from his Bornean treasures if proper accommodation can be obtained for their display.

"CODIUM" is the title of the fourth issue of the Liverpool Marine Biological Committee's memoirs. The remarkable branching alga originally described as *Fucus tomentosus*, but now designated *Codium tomentosum*, is one of three British representatives of the group *Codiaceae*, but the only one found within the area treated of in this series of memoirs. Although widely distributed, it occurs within the district only in shallow rock-pools at the south end of the Isle of Man. The plants are perennial, and fruit in winter; the season of fructification apparently extending from November till February. The authors of the memoir have worked out the life-history of the organism so far as their materials admitted of this being done; but there are certain problems connected with the reproduction which require further investigation.

DR. R. W. SHUFELDT contributes a paper on the psychology of fishes to the April number of the *American Naturalist*. In general it may be said that fishes possess excellent visual power, even to the exact discrimination between objects; and there is also reason to believe that they are extremely sensitive to any disturbance of their native element, when such disturbance is within the range of appreciation of their nervous organs. Whether, however, any fish has the extreme sensibility of the leech *Clepsine*, which, when the experiment is conducted with proper precautions, will be conscious of the touch of a needle-point on the surface of the water of the dish in which it is placed, is more than doubtful. The peculiar sensitiveness to teasing exhibited by the fish known as the snowy grouper (*Epinephelus niveatus*) is instanced by the author as a phenomenon requiring special explanation. When much disturbed, this fish displays a spasm, or fit, much resembling the contortions of death, eventually floating belly-upwards, and at the same time changing colour. The author suggests that these movements are for the purpose of warning off predatory fish, which prefer to take their prey in a healthy condition after an exciting chase.

A PRELIMINARY REPORT on the Klondike Goldfields, Yukon District, Canada, has been published by Mr. R. G. McConnell. (Printed in advance from the Summary Report, Geol. Surv. Canada for 1899, 1900). The rocks consist of stratified and foliated rocks, mostly Palæozoic, and of granites and other eruptive rocks of Tertiary age. Of the older rocks, the Klondike series constitutes the country rock along the productive portions of all the richer creeks. It mainly comprises micaceous schists, greatly crushed and altered, which pass in places into a granitoid rock. Quartz veins are very abundant, and these occasionally contain free gold. The placer deposits have derived their gold from the quartz veins and silicified schists of the district; and it is considered probable that productive veins, or zones of country rock, will eventually be discovered. A fairly full account is given of the placer deposits, so far as they are known, but the author remarks that the work of the prospector will not be completed for many years. The valleys known to be productive in gold are shown on a map.

"NOTES on the Fossil Flora of South Gippsland," by Mr. James Stirling, Government geologist, have been published by the Department of Mines, Victoria (1900). The plants, which include ferns, cycads and conifers, were obtained from Jurassic strata. They are illustrated in six plates, which accompany the notes, and which were prepared under the direction of the late Sir Frederick McCoy.

MESSRS. ARCHIBALD CONSTABLE AND CO. will publish in a few weeks Mr. W. Worby Beaumont's new and comprehensive work, "Motor Vehicles and Motors: Their Design, Construction and Working by Steam, Oil and Electricity."

PROF. J. A. EWING'S standard work on "Magnetic Induction in Iron and Other Metals" (The *Electrician* Printing and Publishing Co.) has reached a third edition. A chapter has been added on practical magnetic testing, and important advances made since the book was originally published have been taken into consideration.

MESSRS. NEWMAN AND GUARDIA, LIMITED, have just placed a new quarter-plate pocket camera—the "Nydia"—upon the market. The camera is fitted with a special 5½-inch lens, either Zeiss, Wray or Ross make; it carries twelve films or eight plates; when folded it measures only $7\frac{1}{4} \times 4\frac{1}{4} \times 1\frac{3}{4}$ inches, and it only weighs, when loaded, $1\frac{3}{4}$ lbs. Photographers requiring a portable and efficient hand camera at a moderate price should see the "Nydia."

THE fourth edition of "Psycho-therapeutics," by Dr. C. Lloyd Tuckey, has been issued by Messrs. Ballière, Tindall and Cox. The third edition was published nearly ten years ago; and since that time hypnotism and suggestion have become recognised forms of medical treatment. Dr. Tuckey's work is a useful statement of the development of the system of psycho-

therapeutics, both from the theoretical and practical sides, and it will show practitioners what can be accomplished by hypnotic suggestion.

ALTHOUGH a large amount of work has been published upon the physical properties of dilute solutions of single electrolytes, the experimental study of solutions of mixed electrolytes, notwithstanding its great interest from the point of view of the electrolytic theory of dissociation, has not been worked at so extensively. The theoretical discussion of such mixtures leads to a set of equations somewhat difficult to solve; but since Prof. MacGregor, of the Dalhousie College, Halifax, Nova Scotia, showed how to solve these equations by a simple graphical method, systematic researches have been carried on at this college on the properties of such mixed solutions of electrolytes. A recent paper, by Mr. J. Barnes, in the *Transactions* of the Nova Scotian Institute of Science, deals with the depression of the freezing point in salts containing a common ion; and the results show that in the case of mixtures of potassium chloride and sodium chloride, and of sodium chloride and hydrochloric acid, and of all three, it is possible, with the ionisation coefficients obtained by Prof. MacGregor's method, and on the assumption that the molecular depression of an electrolyte in a mixture is the same as it would be in a simple solution of the same total concentration, to predict the depression of the freezing point within the limits of the error involved in observation and calculation.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*, ♂) from India, presented by Lady Malcolm, of Poltalloch; a White-crested Tiger Bittern (*Tigrisoma leucolophum*) from West Africa, presented by Mr. W. F. Marshal; four Chaplin Crows (*Corvus capellanus*) from Southern Persia, presented by Mr. B. T. Ffinch; a Cinereous Vulture (*Vultur monachus*), European, presented by Mr. W. E. Found; a Common Boa (*Boa constrictor*) from South America, presented by Mr. F. H. Preston; two Egyptian Foxes (*Canis niloticus*) from North Africa, two Prevost's Squirrels (*Sciurus prevosti*) from Malacca, a Ring-tailed Coati (*Nasua rufa*) from South America, two Porto Rico Pigeons (*Columba squamosa*) from the West Indies, a Sclater's Cassowary (*Casuarius sclateri*), two Red-sided Eclectus (*Eclectus pectoralis*) from New Guinea, four Loggerhead Turtles (*Thassochelys caretta*) from Tropical seas, twelve Elegant Terrapins (*Chrysemys scripta elegans*), seventeen Lesueur's Terrapins (*Malacoclemmys lesueuri*) from North America, twelve Adorned Terrapins (*Chrysemys ornata*) from Central America, seven Reeves's Terrapins (*Damonia reevesi*) from China, deposited; five Hairy Armadillos (*Dasypus villosus*) from La Plata, four Common Indian Starlings (*Sturnus menzbieri*), a Bengal Fox (*Canis bengalensis*) from India, two Meyer's Parrots (*Poeocephalus meyeri*) from South-east Africa, four Australian Sheldrakes (*Tadorna tadornoides*), five —— Wood Swallows (*Artamus sordidus*) from Australia, six Sulphury Tyrants (*Pitangus sulphuratus*), a Black-pointed Teguexin (*Tupinambis nigropunctatus*) from South America, purchased; a Crowned Lemur (*Lemur coronatus*), six Common Wolves (*Canis lupus*), a Llama (*Lama peruana*) born in the Gardens.

OUR ASTRONOMICAL COLUMN

UNPUBLISHED OBSERVATIONS AT RADCLIFFE OBSERVATORY, 1774–1838.—In a pamphlet containing a reprint of an article in *Monthly Notices*, vol. lx. pp. 265–293, Dr. A. A. Rambaut, Radcliffe observer at Oxford, calls attention to a very valuable collection of astronomical observations which are preserved at the Radcliffe Observatory, but have not been reduced or published. Two of the Oxford astronomers, Profs. Hornsby and Robertson, spent a large amount of labour in reducing Bradley's observations made at Greenwich from 1750–1762, and further continued his work by themselves maintaining a systematic and regular series of observations for sixty-five years, from 1774–1838. These were all made with the instruments supplied by Bird to the Radcliffe Observatory at its installation, consisting of two quadrants each of 8-feet radius, a transit instrument of 8-feet focal length, and a zenith sector of 12-feet focus. The observations have all been methodically copied in a similar form to their printed edition of Bradley's observations, and contain altogether about 130,000 transits and 60,000 zenith distances. Dr. Rambaut states that his staff at present could not undertake the reductions; but, in order to show the extreme importance of the data available, he has made a selection of them, giving the probable errors compared with other observers.

The planets and sun have received considerable attention, there being about 8000 observations of the sun alone, a number little less than that on which Leverrier's tables were founded, and, moreover, covering the period when the corrections to the mean longitude of the sun, as deduced at Greenwich, Paris and Königsberg, are most discordant.

The working list of stars includes about 4870 of those observed by Flamsteed and Bradley, so that direct comparisons could be made in the reductions. Their great value would be specially apparent in the question of proper motions, filling up as they do the long gaps between Bradley and Piazzi, or Bradley and Pond. Specimens of Dr. Rambaut's reductions are given in the paper to show the high degree of accuracy attained by the observations.

MAXIMUM DURATION FOR A TOTAL SOLAR ECLIPSE.—Mr. C. T. Whitmell, president of the Leeds Astronomical Society, recently read a paper showing the results of calculations he had made in the endeavour to ascertain what is the maximum duration possible for a total solar eclipse (*Monthly Notices*, R.A.S., vol. lx. pp. 435–441). After considering the several effects of the varying distances of sun and moon from the earth in determining size of umbra and velocity of shadow, he cites the following five conditions as required for maximum duration of totality:—

(1) The new moon, at or very near a node, must also be at the most favourable perigee possible; (2) the sun must be at apogee; (3) during totality, which should be observed at local noon, the moon's shadow should run along a parallel of latitude, in order that the diurnal movement of the observer may be for the time parallel to the motion of the moon, thereby producing its full effect in detaining him within the umbra; (4) the sun and moon should be in the zenith, so that the umbra may be as large as possible; (5) the observer should be on the equator, so that his linear velocity may be as great as possible.

Of these, owing to the sun and moon *not* moving in the plane of the celestial equator, it is impossible that (4) and (5) can be simultaneously fulfilled; (5) is more favourable than (4).

Taking the moon's horizontal parallax as 61′ 22″,
" " earth's radius as 3963 miles,
" " moon's " 1081·5 miles,

and using the present accepted *eclipse* values of the diameters of the sun and moon, the maximum totality will occur near the middle of July, at noon, in geocentric north latitude about 4° 52′, and will last about 7m. 40s., the sun being at apogee with a parallax of 8″·70. This is on the assumption that the declinations of the two bodies are considered practically constant during totality. The author gives the following list of long duration eclipses, calculated by Mr. Crommelin from Oppolzer's data:—

Date	Duration at noon	Position of noon point	
		Longitude	Latitude
	h. m.	°	°
1901 May 18 ...	6 41·6 ...	97 E. ...	2 S.
1919 May 29 ...	7 5·9 ...	18 W. ...	4 N.
1937 June 8 ...	7 19·9 ...	131 W. ...	10 N.
1955 June 20 ...	7 24·5 ...	117 E. ...	15 N.
1973 June 30 ...	7 19·6 ...	6 E. ...	19 N.
1991 July 11 ...	7 10·7 ...	105 W. ...	22 N.

THE FRESH-WATER LOCHS OF SCOTLAND.[1]

THE introduction to this paper, published in the *Geographical Journal*, includes the correspondence that passed between the Royal Societies of London and Edinburgh and Her Majesty's Treasury in 1883 and 1884, relative to the survey by a Government Department of some of the inland lakes of Scotland.

The weighty arguments brought to bear upon the Government by these learned societies failed in their object, and the Government declined to undertake the proposed surveys. In these circumstances the authors determined a few years ago to make a systematic survey of all the fresh-water lochs of Scotland, and the present paper is the first instalment in the publication of their results, dealing with a compact series of lakes directly or indirectly connected with the water-supply to the city of Glasgow, viz. Lochs Katrine, Arklet, Achray, Vennachar, Drunkie, Voil, Doine and Lubnaig, which form part of one united drainage system having its outflow by the River Teith.

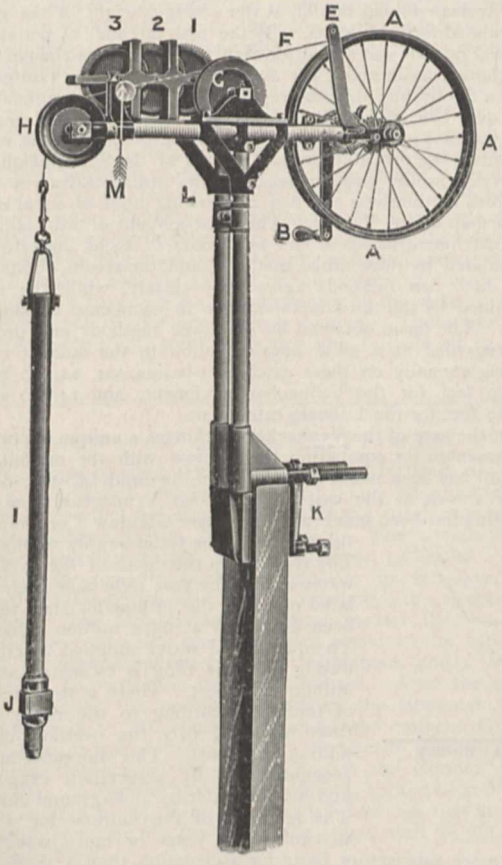


FIG. 1.—F. P. Pullar's sounding machine.

In order to overtake the large amount of work contemplated, involving an immense number of soundings, within a reasonable time, it was necessary to have a portable wire sounding machine adapted for rapid work in small rowing boats. Mr. Pullar designed, and had made, a sounding machine (see Fig. 1), which is described and figured; this apparatus is admirably adapted for the purpose in view, and with it all the soundings in the different lakes were taken.

The total number of soundings recorded in the paper, taken in the eight lochs mentioned, was 2422, the number varying from 775 in the largest (Loch Katrine) to 90 in the smallest (Loch Doine). These soundings were laid down in position on the large scale (six-inch) Ordnance Survey maps, and contour-lines of depth drawn at certain intervals, from which with the aid of the planimeter the cubic mass of water in each loch was calculated. The soundings show that Lochs Katrine, Arklet, Achray, Voil and Doine form each a single basin, while in Lochs Lubnaig, Drunkie and Vennachar the irregularities of the bottom cut up the deep parts of the lochs into separate basins.

The most important of the lakes under consideration is the well-known Loch Katrine, which is eight miles in length, one mile in maximum width, with an area of 4¾ square miles. The greatest depth, 495 feet (82½ fathoms), was found much nearer the eastern than the western end, so that a section drawn down the centre of the loch from west to east (see Fig. 2) shows a gradual increase of depth for nearly four-fifths of the total length, and then a more rapid rise of the bottom towards the eastern end. A section across the loch from north to south (see Fig. 3) shows the deeper part at the point chosen for the section nearer the southern than the northern shore. The mean depth of the loch, *i.e.* the cubic mass of water divided by the area, is 199 feet. The surface of the loch lies at an elevation of 364 feet above the sea, hence a considerable portion of the bottom (over one square mile) falls below the level of the sea; in this respect Loch Katrine differs from all the other lochs treated of. In connection with the water-supply to Glasgow, Loch Katrine was raised four feet above its previous level, and it is now in process of being raised an additional five feet.

Loch Arklet is a small Highland loch situated between Lochs Katrine and Lomond, at an elevation of 455 feet above the sea. It is over a mile in length, nearly half a mile in maximum width, and covers an area of about one-third of a square mile. The greatest depth, 67 feet, was found nearer the western than the eastern end; the mean depth is 24 feet. Loch Arklet at present belongs to the watershed of Loch Lomond, but the Corporation of Glasgow have power to divert its waters into the Loch Katrine watershed, with the view of increasing the supply of water to that city.

Loch Achray is situated between Lochs Katrine and Vennachar, at an elevation of 276 feet above the sea. It receives the outflow from Loch Katrine and flows into Loch Vennachar, the level of which is six feet lower. Loch Achray is about 1¼ miles in length, and one-third of a mile in maximum width, covering an area of about one-third of a square mile. The greatest depth, 97 feet, was recorded in two places approximately in the centre of the loch; the mean depth is 36 feet.

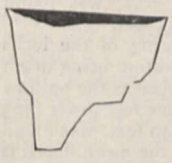


FIG. 3.—Transverse section of Loch Katrine. The black portion shows the true slopes; the outline shows the slopes exaggerated ten times.

Loch Vennachar is about four miles in length, with a maximum breadth of less than three-quarters of a mile, and covers an area of over 1½ square miles. The greatest depth, 111 feet, is situated approximately in the centre of the loch; the mean depth is 42½ feet. Loch Vennachar has been raised five feet nine inches in connection with the Glasgow water-supply, for the purpose of providing compensation water to the River Teith.

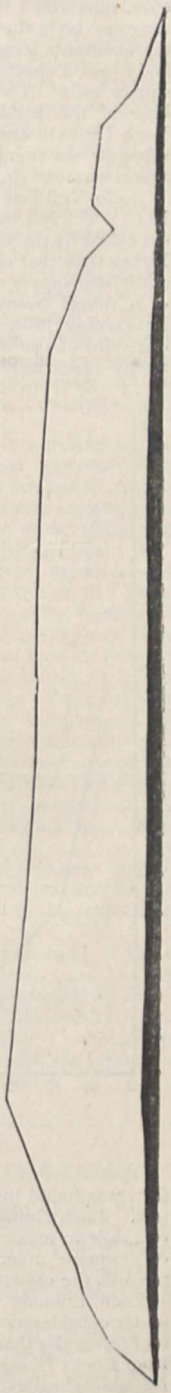


FIG. 2.—Longitudinal section of Loch Katrine along the axis of maximum depth. The black portion shows the true slopes; the outline shows the slopes exaggerated ten times.

[1] "A Bathymetrical Survey of the Fresh-water Lochs of Scotland." By Sir John Murray, K.C.B., D.Sc., F.R.S., and Fred. P. Pullar, Esq., F.R.G.S. Part i. The Lochs of the Trossachs and Callander District.

Loch Drunkie is a peculiar irregular little Highland lake, shut in on all sides by high hills, situated, at an elevation of 416 feet above sea-level, a quarter of a mile to the south of Loch Vennachar, into which it flows. It is remarkable in shape, a quadrangular body throwing out three arms in different directions; the maximum length is over a mile, the maximum width of the body over a quarter of a mile, and the area nearly a quarter of a square mile. The greatest depth, 97 feet, was found near the base of the north-eastern arm; the mean depth is 36 feet. Loch Drunkie was raised twenty-five feet in connection with the Glasgow water-supply, for the purpose of supplying compensation water to the River Teith.

Lochs Voil and Doine formed at no distant date a continuous loch, which has been divided into two portions by the material deposited by the rivers. The level of these lochs being fifty feet higher than that of Loch Katrine, it has been suggested that an additional supply of water to Glasgow can be obtained by means of a tunnel from Loch Doine to Loch Katrine through the intervening hills. Loch Voil is over 3½ miles in length, about one-third of a mile in maximum width, and covers an area of nearly nine-tenths of a square mile. The greatest depth, 98 feet, was found towards the western end; the mean depth is 41 feet. Loch Doine is nearly a mile in length, and over a quarter of a mile in maximum breadth, with an area of nearly a quarter of a square mile. The greatest depth, 65 feet, was found towards the eastern end; the mean depth is 33 feet.

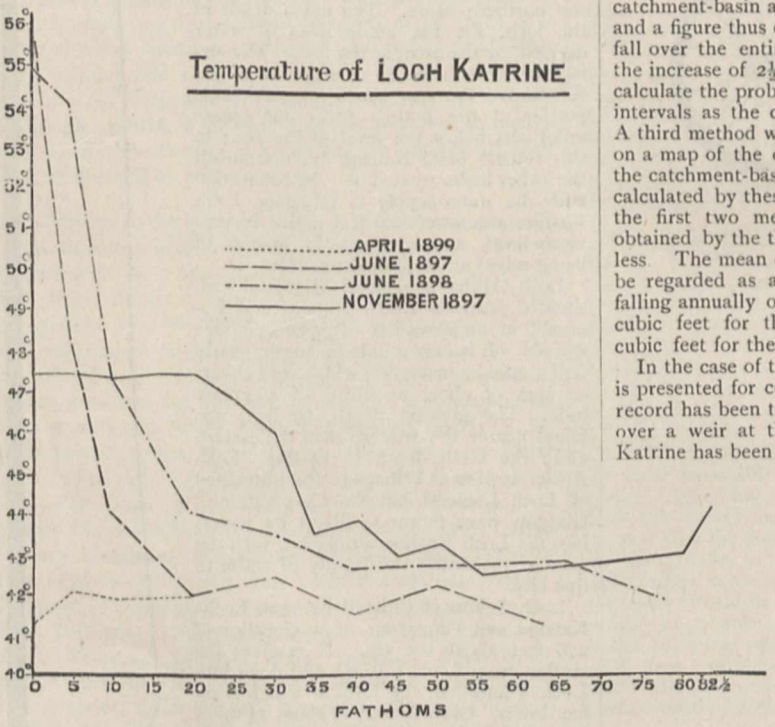


FIG. 4.—Temperature of the water in Loch Katrine.

Loch Lubnaig is one of the most interesting of the lochs under consideration, the configuration of the bottom being much more irregular than in any of the others. It receives the outflow from Lochs Doine and Voil, its level being nine feet lower (405 feet above sea-level). The greatest depth, 146 feet, was found approximately near the centre of the loch; the mean depth is 42¾ feet. The contour-lines of depth do not follow the contour of the loch, hollows and ridges alternate with each other, and in some places comparatively deep water is found close to the shore, while in other places shallow water extends a considerable distance from shore.

The deposits forming on the floor of these lochs are described in detail, and the numerous temperature observations taken at the surface and at various depths down to the bottom (some of which were taken as recently as March 1900) are fully discussed. The serial temperatures taken in Loch Katrine are shown graphically in Fig. 4. The relation between the variation of temperature and the size and depth of the lochs is pointed out, and shows how much more suitable a large deep lake is, as a source of water-supply, than a shallow basin, ensuring a relatively low temperature in summer and a relatively high temperature in winter. Interesting observations were made on the pelagic and other organisms in the various lochs, and on their variation with the season, certain species being obtained in abundance at certain seasons and absent or rare at other seasons.

The amount of rain falling annually on the drainage areas of these lochs was estimated by three methods, the lochs being grouped into two series, viz. Lochs Katrine, Achray, Drunkie and Vennachar, which have their outlet at the eastern end of Loch Vennachar, forming one series; and Lochs Doine, Voil and Lubnaig, which have their outlet at the southern end of Loch Lubnaig, forming the other series. The readings of the rain-gauges at all the observing stations within and near the catchment-basins of these lochs were grouped together into two series corresponding with the two series of lochs indicated, and the average annual rainfall at the average height of the gauges calculated for each series. By the first method, 2½ per cent. of annual rainfall was added for each 100 feet of mean height of the catchment-basin above the average height of the rain-gauges, and a figure thus obtained representing the average annual rainfall over the entire catchment-basin. By the second method, the increase of 2½ per cent. per 100 feet of height was used to calculate the probable annual rainfall at the same heights and intervals as the contour-lines on the Ordnance Survey maps. A third method was afforded by drawing lines of equal rainfall on a map of the district. The total amount of rain falling on the catchment-basins of the two series of lochs indicated was calculated by these three methods, and the results obtained by the first two methods agree very closely, while the results obtained by the third method were in each case considerably less. The mean obtained by the three methods may probably be regarded as a close approximation to the amount of rain falling annually on these catchment-basins, viz. 14,100 million cubic feet for the Vennachar catchment, and 14,700 million cubic feet for the Lubnaig catchment.

In the case of the Vennachar catchment a unique opportunity is presented for comparing the outflow with the rainfall, for a record has been taken twice a day of the depth of water flowing over a weir at the east end of Loch Vennachar since Loch Katrine has been made use of by the Glasgow Corporation as the source of the water-supply to that city. The readings of the depth of the outflowing water during the year 1869 have been calculated out, and the outflow for that year has been estimated at 9572 million cubic feet. The quantity of water supplied to Glasgow during the year 1869 is estimated at 1660 million cubic feet. There is thus an excess of rainfall, according to the mean of the three methods, over the overflow of 2860 million cubic feet. This difference must be accounted for by absorption, evaporation and loss of water by underground channels. The readings of the outflow for a series of twenty-five years or more would be a far more satisfactory basis for calculation than a single year's readings (and the year 1869 was not an average, but a very dry year), and it would be very interesting to have the average annual outflow calculated over the whole period during which the record has been kept, in the same way as the mean annual rainfall is calculated for a particular station. Records of the rainfall at high elevations in different parts of the catchment-basins would also be desirable in comparing the average annual rainfall with the average annual outflow.

Appended to the paper is an account of the geology of the district by Messrs. B. N. Peach, F.R.S., and J. Horne, F.R.S., based on materials collected during the Geological Survey of that region, and published by permission of Sir Archibald Geikie, the Director-General. A brief sketch is given of the geological structure of the area embracing the various lochs, which has an important bearing on the question of the evolution of the valley-system. It is shown that, along the Highland border, there is a great development of conglomerates, grits and greywackes, belonging partly to the crystalline schists and partly to the Old Red Sandstone. These strata, being vertical or nearly so, would be much less easily eroded than the gently inclined schistose rocks

lying to the north-west. Such an arrangement would naturally lead to the formation of narrow and comparatively flat-bottomed valleys behind rocky gorges, the latter being cut through the vertical beds of hard grit and conglomerate along the Highland border. Evidence is adduced to show how this remarkable structure likewise contributed to the erosion of rock basins during the glacial period. The glacial phenomena of the region are reviewed, which indicate at least two periods of glaciation; one, when the ice-shed lay to the north of the area under consideration, when the ice-movement was independent of the existing valley-system, and when even the highest mountains were overridden by the ice. This great development was followed by a period of local glaciation, when the glaciers were confined mainly to the existing valleys. Lastly, the soundings of the various lochs are viewed in relation to the geological history of the area, and with reference to the question of the origin of the various lakes. It is shown that some of the lochs are typical examples of rock basins, that in some instances the deepest soundings occur in front of the rocky barriers at or near their outlets. Reference is made to all the important faults traversing the region, which have led to the more rapid disintegration of the materials, but though they have in certain cases produced modifications of the floors of the lakes, they cannot account for the excavation of the rock basins. The soundings of Loch Lubnaig reveal the striking fact that one of the deep basins in that lake lies on the upthrow side of the most powerful fault traversing the crystalline schists of that region. Messrs. Peach and Horne believe that the soundings of the various lakes in the basin of the Teith above Callander furnish strong evidence in support of Ramsay's theory of their excavation by ice-action.

The paper is illustrated by seven coloured maps, the first three showing on a small scale the orography and drainage areas, the surface geology and the rainfall of the district, the other four showing on a larger scale the bathymetry of the various lochs and the relief of the surrounding country. There are also numerous woodcuts, some of which are reproduced in this review.

IRON AND STEEL INSTITUTE.

THE annual meeting of the Iron and Steel Institute was held on Wednesday and Thursday, May 9 and 10, in the hall of the Institution of Civil Engineers, under the presidency of Sir William Roberts-Austen, K.C.B., F.R.S. The attendance of members was larger than at any previous gathering. The report of the council, which was read by the secretary, Mr. Bennett H. Brough, showed that the Institute is in a flourishing condition. The receipts last year were greater than in any previous year, 110 new members were added to the roll, the supply of original papers was well maintained, and a Royal Charter of Incorporation had been granted. After the usual formal business, the president presented the Bessemer gold medal for 1900 to Mr. Henri de Wendel, the eminent French metallurgist, in recognition of his great services to metallurgy in developing the iron-ore resources of French and German Lorraine. Mr. de Wendel having expressed his appreciation of the honour conferred upon him, Mr. Stead announced that he had decided to postpone the reading of his paper until the autumn meeting in Paris.

Mr. J. Riley then described the various attempts that have been made to use fluid metal in the open-hearth furnace. The results he obtained at Wishaw, in 1898, were encouraging, and experience over a considerable period show that great advantages are derived from the adoption of this method. The best future open-hearth practice, he considers, will include the use of fluid metal direct from the blast furnaces.

The next paper read was one of most conspicuous novelty, by Mr. B. Talbot, on the open-hearth continuous steel process. This process was introduced at the Pencoyd steelworks in Pennsylvania. The furnace used is a basic-lined tilting furnace of seventy-five tons capacity. Many thousands of tons of steel have been made by this method with very satisfactory results, all grades of steel having been produced. The cost and delay in charging cold material is avoided. There is a saving in fuel in charging molten pig iron. The demand for a large supply of good scrap is dispensed with. A regular supply of steel in any desired quantity and at frequent intervals is insured. There is an increased output, an increased yield, and a saving in repairs and in labour charges. At the same time it is possible to use very large furnaces, with consequent reduction in cost of production, without the necessity for very large cranes and ladles. A long discussion followed the reading of the paper, the opinion being general that the process is an important advance in open-hearth steel practice.

Mr. A. Greiner gave an account of the results obtained at the Cockerill works, Belgium, with the first blowing-engine worked by blast-furnace gas ever employed in any ironworks. This 600 horse-power engine has been running since November 20 last with unpurified gas taken from the Seraing blast-furnaces.

Baron H. von Jüptner submitted a further instalment of his researches on the theory of solution of iron and steel. He discussed the application of the laws of chemical mechanics in the case of iron carbon alloys, and showed what an important bearing thermo-chemistry possesses for a knowledge of the constitution of the alloys of iron and their alterations of state.

The meeting then adjourned until May 10, when Mr. C. Dellwik dealt with the manufacture and application of water-gas, describing the production of the gas by means of a simple apparatus with a degree of economy surpassing that of other less valuable gas. Whilst in the old processes the gas leaving the generator during the blow contains principally carbon monoxide and nitrogen, in the author's process it consists chiefly of carbon dioxide and nitrogen.

The subject of utilising blast-furnace slag is a fruitful source of inquiry, and a recent important development was dealt with by Mr. C. von Schwarz. This is a successful method of manufacturing cement from blast-furnace slag, recently employed in Germany and Belgium. The cement thus made obtains a higher price in the market than ordinary Portland cement.

Mr. L. F. Gjers and Mr. J. H. Harrison described an apparatus for equalising the varying temperatures of hot blast. Hitherto the hot blast has been allowed to enter the furnace as it left the stove, and in order to obviate the interference with the steady working of the furnace, the authors have devised an apparatus consisting practically of another small stove with a central division wall. It is filled with chequer work; and the hot blast, entering at one side of varying temperature, is delivered out at the other side at an even mean temperature.

The form of ingot that would seem to be the most natural for the manufacture of a gun-tube or a propeller shaft is one with a circular section. Mr. F. J. R. Carulla, however, pointed out the drawbacks of this form, and showed that a polygonal ingot with concave sides answers the required conditions.

Mr. H. K. Scott contributed a paper on manganese ore deposits and mining in Brazil, giving a detailed account of the geological structure of the deposits, and of the economic development of the industry.

After the usual votes of thanks to the Institution of Civil Engineers, proposed by Sir John Alleyne, Bart., and to the president for his conduct in the chair, proposed by Mr. Carnegie, the proceedings terminated. Incidentally, Mr. Carnegie announced his intention of founding a scholarship in connection with the Iron and Steel Institute for the advancement of research in connection with iron and steel.

THE ROYAL SOCIETY CONVERSAZIONE.

THE general opinion of the scientific company at the Royal Society on Wednesday, May 9, on the occasion of the first of the two soirées held annually, was that novel and striking exhibits were not so numerous as in some exhibitions of previous years. The following were among the most noteworthy exhibits:—

Mr. Richard Kerr showed a clock controlled at a distance by wireless telegraphy of the Hertzian wave system. Mr. J. Wimshurst, F.R.S., exhibited an influence machine, constructed with twelve plates of vulcanite. Prof. Silvanus P. Thompson, F.R.S., showed some pretty electromagnetic experiments, one being the converse of De La Rive's experiment, using floating magnet instead of floating battery, and others showing new varieties of the De La Rive experiment (see p. 71). Prof. Minchin, F.R.S., showed that luminous flashes could be induced in a helium tube by Hertz waves.

An electric micrometer was shown by Mr. P. E. Shaw. The instrument was designed primarily to measure the small movements of a telephone diaphragm. A screw abuts on a system of three levers, set up on a strong wooden frame. By turning the

screw, the far end of the levers moves to and fro through distances which can be controlled and measured. This end of the levers carries a rod, and the diaphragm a small plate, both of iridio-platinum; if these two surfaces touch one another, a flow of a small amount of electricity occurs, producing a sound in a telephone held by the observer; at the same time he reads by a telescope a graduated circular scale fixed on the screw. Since the screw and levers can be moved at will by the observer, he can, by this contact method, find the position of the diaphragm, and follow its movements. Precautions against vibrations are taken by having indiarubber suspensions, and against temperature changes by covering the working parts with boxes wrapped in felt. Movements as small as $\frac{1}{20}$th of a wave-length of sodium light have been measured by this apparatus.

Mr. Killingworth Hedges exhibited jointing boxes and aigrettes used in the rearrangement of the lightning conductors of St. Paul's Cathedral. The original system for the protection of the Cathedral from lightning was installed under the advice of the Royal Society in about 1756. This was replaced in 1872 by what was then considered the most improved method, when the unsoldered joints were found to be very defective; in some cases they were quite loose; also the earths, originally made by laying the cable in a drain which had become disused, were in some cases insulated from the ground. New earths have been substituted. The method adopted to protect the structure unites the old system and the new cables to a horizontal conductor run on the top of the parapet, entirely round the building; to this copper aigrettes as shown are teed at intervals.

Other electrical exhibits were models illustrating leakage from electric tramways, shown by Mr. A. P. Trotter, and improved forms of standard resistance coils made by the Cambridge Scientific Instrument Co., Ltd.

Dr. Isaac Roberts, F.R.S., exhibited his magnificent volume of photographs of stars, star-clusters and nebulæ, recently reviewed in NATURE (vol. lxi. p. 533). The volume contains seventy-two photographs, which have been enlarged by mechanical processes from the original negatives, and they furnish evidence of the evolution of stellar systems from nebulous matter as seen in the convolutions of spiral nebulæ. They also furnish a foundation for the inference that the system of the *Milky Way* is not unlimited in extent, and that the numerous aggregations of stars, seen in lines and curves in the stellar regions, indicate their development from spiral nebulæ.

Mr. Thomas Thorp exhibited some of his grating films and their application to diffraction colour photography, on Prof. Wood's principle. Dr. Downing, F.R.S., exhibited maps illustrating the track of the total eclipse of the sun of May 28.

Mr. W. A. Shenstone, F.R.S., and Mr. H. G. Lacell showed a quantity of non-splintering silica, suitable for use in the oxy-gas flame. The method of converting this into tubes and other forms of apparatus, as recently described in NATURE (May 3), was demonstrated practically, together with experiments to illustrate the behaviour of vitreous silica under sudden and great changes of temperature. The following apparatus, constructed of silica, was also exhibited. A long tube for use with a platinum thermometer; a mercury thermometer; bulbs and stems for thermometers; a Giessler tube; a small distilling tube; and rods and tubes of various sizes for various purposes.

Some examples of leadless glazed ware were shown by Dr. T. E. Thorpe, F.R.S.

Mr. H. B. Hartley and Mr. H. L. Bowman gave a demonstration of the properties of crystals yielding doubly-refracting liquids on fusion. Certain crystalline organic compounds, viz. *p*-Azoxyanisol, *p*-Azoxyphenetol, and Cholesteryl benzoate, have been found by Prof. Lehmann, of Carlsruhe, to give on melting (at temperatures of 116°, 134° and 145° respectively) liquids possessing the properties of double-refraction and dichroism, even under conditions in which a state of strain is impossible. When these anisotropic liquids are further heated, they change at definite temperatures of transition (134°, 165° and 178° respectively) into ordinary isotropic liquids. The intermediate bodies have been called "liquid crystals," for, although the evidence of their elasticity, viscosity, and dielectric capacity shows them to be undoubtedly liquids, yet nevertheless they possess, like crystals, both double refraction and dichroism.

Specimens from the reefs of Funafuti were exhibited by Prof. J. W. Judd, C.B., F.R.S., on behalf of the Coral-Reef Committee of the Royal Society. The exhibits included:—(1) Specimens illustrating the rate of growth of corals and calcareous algæ from the reefs of Funafuti. Experiments made by Mr. A. E. Finckh, of Sydney, who in 1898 carried the boring made by Prof. T. E. David in the previous year from the depth of 698 ft. to 1114 ft., have thrown much new light upon this important question. Specimens illustrating these experiments are exhibited. (2) New and interesting forms of Foraminifera, which have been described by Mr. F. Chapman. These include:—(*a*) *Cycloclypens*, a genus previously regarded as being very rare, but now shown to exist abundantly at Funafuti. The two species formerly described are now shown to be dimorphic forms of the same organism. (*b*) A curious form of *Polytrema*, which occurs encrusting various objects in alternate layers with the marine alga *Lithothamnion*, thus forming loose nodules. (*c*) The newly-described *Haddonia*, first obtained from Torres Straits, &c.

Prof. H. G. Seeley, F.R.S., showed drawings of restorations of Dimorphodon. The drawings, of the natural size, are based upon fossil remains from the Lias, in the British Museum. They represent the skeleton as in the quadruped and biped positions; and show the contours of the body at rest, walking, and preparing for flight, to illustrate proportions of the skeleton. Dr. C. I. Forsyth-Major exhibited remains of extinct gigantic and lesser lemurs from Madagascar, and living forms for comparison. Some beautiful examples of chalk fossils were exhibited by Dr. Arthur W. Rowe.

Dr. Manson exhibited longitudinal sections of filariated mosquitoes (*Culex ciliaris*), showing that *Filaria nocturna*, like the malaria parasite, leaves its mosquito host *viâ* the proboscis.

A collection of living marine worms (Annelids) from the neighbourhood of Plymouth, designed to illustrate, as far as possible, the prominent features in the habits of life of the different types of this class of animals, and such modifications of form as are related thereto, formed the exhibit of the Marine Biological Association.

Prof. E. Ray Lankester, F.R.S., on behalf of the Archæological Survey of the Egypt Exploration Fund, showed reproductions of paintings and sculptures in tombs of Ancient Egypt, representing domestic and wild animals and birds. The tombs of Ancient Egypt contain abundant representations of animal life. In spite of the artists' ignorance of perspective and occasional faulty colouring, the outlines are rendered with remarkable fidelity to nature, often enabling the species to be identified. Among domestic animals, the dogs are perhaps the most interesting, as showing that extreme development of various breeds had already taken place. The monuments from which the drawings exhibited were copied are of two periods:—(1) Tombs at Beni Hasan, of the XIIth Dynasty (*circa* 2000 B.C.); (2) the Tomb of Ptah-hetep at Saqqareh, of the Vth Dynasty (*circa* 3000-2500 B.C.).

Prof. A. C. Haddon, F.R.S., showed specimens illustrating the decorative art of the Sea Dayaks of Sarawak. The carved and painted designs of the Dayak men are entirely different from the woven and embroidered patterns made by the women. The former are chiefly plant derivatives, while the latter are mainly greatly modified animal forms. The significance of the distinction and the real meaning of the patterns themselves are not yet elucidated. The method by which the women make the patterns in their woven fabrics was also illustrated. The warp is stretched on a frame, and numerous strands are tied tightly with strips of leaves; the whole is removed and then submerged in a dye. The lashing is then undone, and the tied-up portions are found to be undyed. The whole process is repeated if a three-colour pattern is required.

Ethnographical objects from Malay Peninsula (Malay and Sakai) were shown by Mr. W. W. Skeat. The phonographic records of songs of the Pangan tribe, a wild aboriginal tribe of Negrito stock, received much attention.

A collection of anthropometric instruments was shown by Dr. J. G. Garson.

The Royal Geographical Society exhibited a section cut from the tree on Lake Bangweulu, Central Africa, under which Livingstone's heart was buried, and containing the inscription carved by his native followers.

In the course of the evening, short discourses and demonstrations were given by Sir Andrew Noble, K.C.B., F.R.S., on modern explosives; Dr. Arthur W. Rowe, on the photomicrography of chalk fossils by reflected light; and Mr. F. Enock, on photographs from living insects, showing the metamorphoses of one of the Odonata.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The King of Sweden and Norway was on Monday admitted by the Chancellor to the honorary degree of LL.D. The ceremony was witnessed by a vast assembly, and the King gave much pleasure by his gracious bearing and evident interest in the proceedings.

The General Board are about to appoint a lecturer in experimental physics in succession to Mr. W. N. Shaw. Applications are to be sent to the Vice-Chancellor by May 19.

The Master of Downing and Dr. Barclay-Smith announce a course of instruction in practical histology, to be given during the long vacation, beginning on July 7.

The trustees of the late Miss R. F. Squire have offered the University a sum of about 13,500*l.* for the erection of a law library in connection with the new law school, and adjoining the Sedgwick Memorial Museum. This timely benefaction will probably facilitate the speedy erection of the the Botanical and Medical Schools, plans for which are now under the consideration of the Senate.

The proposal to establish a special examination in the sciences bearing on agriculture, as a qualification for the ordinary B.A. degree, was favourably received in the Senate on May 10, and a grace for its adoption has been sanctioned by the council.

An examination for minor scholarships in Natural Science will be held at Downing College in March 1901. Application for particulars should be made to the tutor.

A VERY satisfactory side of technical education is the work carried on in the lecture-rooms and laboratories of University Colleges, in connection with Technical Instruction Committees. Two short courses of evening lectures to teachers, just arranged by the Technical Instruction Committee of Liverpool with Prof. Oliver Lodge and Prof. Herdman, are instances in point. The lectures deal with some recent developments of physical and natural science, Prof. Lodge taking for his subject "Electric Vibrations," and Prof. Herdman "Oceanography." The lectures are free to teachers who can give evidence that they are able to profit by them.

VISITS to museums, and outdoor lessons, are counted as school attendances by the Board of Education, with the result that they are now given a definite place in the scheme of instruction of many schools. In a similar way, the National Zoological Park at Washington is used to place great object-lessons before the hundreds of thousands of visitors to the national capital from all parts of the United States. The pupils in the public schools of Washington benefit greatly by these opportunities. It has become a part of their routine to visit, under the care of a teacher, the Smithsonian Institution and National Museum buildings, as well as the park; while those outside the city benefit indirectly through the numerous excursions of teachers, and the stimulus and suggestion they may thus receive.

TWO new buildings in connection with the Yorkshire College, Leeds, to be devoted to the development of clothworkers' research and dyeing, &c., were formally opened, on Friday last, by the Master of the Clothworkers' Company, Mr. A. C. Cronin. Principal Bodington, of the Yorkshire College, the professors and students, and mayors of various boroughs, also attended on the occasion. It was explained that it was intended to raise the tone of dyeing, and that the outlay on the extensions is likely to yield a tenfold return. Mr. Cronin, in declaring the new buildings open, expressed a hope that increased knowledge in the industries would be the result of these extensions. At a luncheon which followed, in responding to the toast of "The Clothworkers' Company," he said it was the intention of the Company that the Yorkshire College should become the first and most complete example of a textile and dyeing school not only in Europe, but in the world. There is now hardly any manufacturing town of any size in Yorkshire which has not its technical school or institute, and with which the Clothworkers' Company has not been or is not still connected.

THE medical school of the future was the subject of an address delivered before the fifth triennial Congress of American Physicians and Surgeons, on May 2, by the president, Prof. H. P. Bowditch, of Harvard. According to Prof. Bowditch, we may expect that a medical school of the first rank will, in the immediate future, be organised and administered somewhat as follows:—(1) It will be connected with a university, but will be so far independent of university control that the faculty will practically decide all questions relating to methods of instruction and the personnel of the teaching body. (2) It will offer advanced instruction in every department of medicine, and will therefore necessarily adopt an elective system of some sort, since the amount of instruction provided will be far more than any one student can follow. (3) The laboratory method of instruction will be greatly extended, and students will be trained to get their knowledge, as far as possible, by the direct study of nature, but the didactic lecture, though reduced in importance, will not be displaced from its position as an educational agency. (4) The work of the students will probably be so arranged that their attention will be concentrated upon one principal subject at a time, and these subjects will follow each other in a natural order. (5) Examinations will be so conducted as to afford a test of both the faithfulness with which a student performs his daily work and of his permanent acquisition of medical knowledge fitting him to practise his profession.

THE first official ceremony of the University of London in the new home at South Kensington was the presentation of degrees by the Prince of Wales on Wednesday, May 9. The University has thus entered upon a new phase of its career. As the Chancellor of the University remarked in his address, nothing has been more striking within the last few years than the progress of new universities in different parts of the country. The University of Wales, of which the Prince of Wales is Chancellor, has been founded, and, although very young, it is already making notable progress and will ultimately be a great success. Besides this, there is the Victoria University, of which Lord Spencer is Chancellor, and which has made remarkable progress; and also the completely new University of Birmingham. What does all this mean? It means that the country is stirred up on the subject of education; and among all classes and places there is a greater sense of the importance of it than ever there has been before. As to the University of London, the Chancellor quoted figures to show the great progress which has taken place, and made special reference to the great stimulus to the improvement of the education of women throughout the country arising out of the action of the University in obtaining a supplementary charter to enable women to be admitted to the examinations. Up to the present time the University has been only an examining body. It has by its examinations done a good work for the education of the people, and it has set an example which has had a very important effect upon all the schools throughout the country. But it is now a teaching University, and with its large list of faculties its work will be very widespread. The Prince of Wales then made a few remarks, in the course of which he said: "No one wishes more sincerely than I do happiness and prosperity to this University; and from all that we have heard from the Chancellor I think the University is in a fair way of becoming one of the greatest importance, and one that will hold its own, no doubt, with many of the others which are of more ancient origin. I am glad to think that, as the result of somewhat difficult, and I may say somewhat delicate, negotiations, the London University has now found a home in this large building, better known as the Imperial Institute, in which, as you all know, I take a deep interest. We are very grateful to Her Majesty's Government for all they have done, and for having facilitated the arrangements which I hope are now complete. It only rests with me to express the fervent wish that the London University will not regret having come to a more distant part of London, and that they will find that they have ample room for all their requirements in this University."—Sir Michael Foster, M.P., then addressed those who had received awards at the hands of the Chancellor. He reminded them that the value of the degree was not in the degree itself, but in the labour which had led up to it. The degree might be the guinea stamp, but it was the work and the mental discipline which was the real gold.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, April.—Prof. F. N. Cole summarises the *Proceedings* of the February meeting of the Society, and abstracts a few of the papers communicated. The bye-laws were revised. By this amendment it is provided that the ex-presidents shall be life-members of the council, and that the presidential term of office shall be

extended to two years.—Prof. J. Pierpont gives an interesting account of the summer meeting of the Deutsche Mathematiker-Vereinigung held at Munich in September of last year.—Some theorems concerning linear differential equations of the second order is an abstract by Prof. M. Bôcher of certain results which he communicated at the February meeting (see *supra*).—A paper by Dr. M. B. Porter, read at the same meeting, is entitled "A note on the enumeration of the roots of the hypergeometric series between zero and one." It is a continuation of a note published in the May (1897) number of the *Bulletin*.—Dr. J. Sommer reviews Hilbert's "Grundlagen der Geometrie," and Prof. E. O. Lovett does the same for Kœnig's "Leçons de Cinématique."—The longer papers read before the Society will, we presume, be printed in the new *Transactions*.—The notes are very full, and there is a fair list of publications.

Bulletin de l'Académie des Sciences de St. Pétersbourg, vol. vii. No. 3.—On the rotation of Jupiter and his spots, by Th. Bredikhin. An analysis of the observations made by the author himself at Moscow, and of some later observations at Pulkova. A comparison of the times of rotation of spots situated in the same latitudes shows that some of them are formed in the lower, and some in the higher strata of Jupiter's atmosphere. Prof. Joukovsky's formulæ hold good as a rule; but a more careful discussion shows that the law of friction must be altered; the latter is proportional to the square or even to a higher degree of velocity. But it would be extremely difficult to make a theoretical discussion if the law be altered in this sense.—The scientific results of the Black Sea expedition, by A. Ostroumov: iii. Fishes of the Sea of Azov.—Materials for the hydrology of the White Sea and the Murman Sea (Arctic Ocean along the Norman coast), by N. Knipovitch: i. Lists of the Observations.

Vol. vii. No. 4.—The series of Jean Bernoulli, by N. Sonin.—New researches into the spectrum of β Lyræ and η Aquilæ, by A. Belopolsky. These new researches were made with the aid of the 30-in. refractor of Pulkova. The spectroscopic velocities of η Aquilæ showed a periodicity very near to the periodicity of the variations of magnitude, *i.e.* 7 days 4 hours, and it was possible to calculate its orbit. Similarly, as for δ Cephei, it was proved that the changes of brilliancy in η Aquilæ cannot be explained by eclipses of the star. As regards β Lyræ, the former suppositions of the author are now fully confirmed. This star represents a system of two bodies, having at any instant opposite spectroscopic velocities, and one of the two bodies eclipses the other during their revolutions.—Preliminary communication on applications of Rykatschew's method for studying the relations between rainfall and height of water in rivers, by Dr. Harry Gravelius.—The third international balloon ascents of May 1, 1897, by Ed. Stelling.—Observations of the satellites of Mars with the 30 in. refractor at Pulkova, by F. Renz; and on the photographs of Mars, by S. Kostinsky.

Vol. vii. No. 5.—On the changes of pressure under the piston of the air-pump, by Prince Galitzin. Theoretical discussion is compared with direct observation.—Some remarks on the sensibility of the eye, by the same author.—Abstract from the yearly report for 1896 of the Central Physical Observatory, by M. Rykatschew.—On the excretory organs of *Ascaris megalocephala*, by S. Metalnikoff.—On the routes of the cyclones over Russia in 1890–92, preliminary communication, by P. Rybkin.

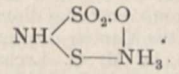
SOCIETIES AND ACADEMIES.

LONDON.

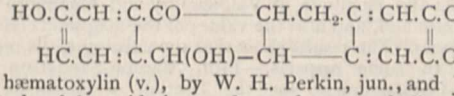
Physical Society, May 11.—Prof. O. J. Lodge, F.R.S., President, in the chair.—A discussion of Prof. Lodge's paper on the controversy concerning Volta's contact force was commenced by Prof. Armstrong. Prof. Armstrong expressed his indebtedness to the president for putting forth clearly what we are trying to understand, and said that it was hardly time for chemists to enter the discussion when physicists themselves differed. There has apparently been a change in front since the time when the effect was supposed to be due either to (1) chemical action between the metals, or (2) oxidation. Prof. Lodge's view is intermediate, but approximates to the second. Prof. Armstrong said that from a practical point the existence of the effect was unknown, because sufficient precautions had never been taken to prevent chemical action. He urged the continuance of experiments similar to those carried out by Mr. Spiers, and stated that modern ideas of chemistry were favourable to the view which Prof. Lodge had taken up with regard to the Volta effect.—Mr. Glazebrook made some remarks upon the meaning of the term E which occurs in the expression for the Peltier effect at the junction of two metals. If we confine our attention to an infinitesimal cycle at the junction of two metals at slightly different temperatures, we get the equation for the Peltier effect in which E is the potential difference at the point considered. If then, assuming reversibility, we sum up all the infinitesimal cycles round a circuit and get a finite cycle, the E.M.F. of the circuit is a function of the two temperatures between which it is working. Differentiating with respect to temperature the total E.M.F. of the circuit, we get an equation which applies to the circuit as a whole, and in which E is the total E.M.F. round the circuit. Mr. Price asked if any critical experiment could be suggested to settle the question.—Dr. Lehfeldt called attention to some experiments which had been performed to measure the potential difference between an electrolyte and a gas. The electrolytes considered were chiefly aqueous solutions, and the potential differences observed varied largely. The surface tensions of the liquids were measured, and it was shown that the variations in the potential difference were very similar to those in surface tension. This suggests, in the case of electrolytes, true physical surface effects, and not chemical action.—The chairman remarked that Dr. Lehfeldt evidently looked upon the metal-ether boundary as being the effective one. The experimental evidence is not sufficient to say exactly which is the effective contact, but it seems to show that the metal-ether effect is of the same order of magnitude as the oxygen layer effect. According to Helmholtz they ought to be related, and they apparently are.—The chairman then read a paper, by Mr. J. B. Tayler, on the heat of formation of alloys. Experiments have been made upon alloys of lead with tin, bismuth and zinc, and of zinc with tin and mercury. The method employed consisted in dissolving (1) the alloy, and (2) the corresponding mixture of metals in mercury, and measuring the heat of solution in each case. On the assumption that the solutions obtained are identical, the difference between the heat of solution of the mixture and that of the alloy is the heat of formation of the latter. The calorimeter was a thin glass tube silvered on the outside and supported by a stouter tube silvered on the inside. Suitable arrangements were adopted for the introduction of the metals or alloys, which were used in the form of filings. Solution was often complete in less than a minute, and rarely took more than two minutes and a half. The alloys first experimented upon contained their constituents in equivalent proportions, and the heats of formation were found to be small in comparison with those found for brass by Galt and Baker. It was thought that only a small percentage of the atoms present had entered into definite chemical combination, and that more reliable results would be obtained by dissolving a small quantity of one metal in an excess of the other, and calculating from the experimental results the heat of formation of the gramme-molecular weight of compound upon the supposition that the whole of the small quantity of metal had entered into chemical combination by the exercise of its normal valency. Using the numbers so obtained to find, by Kelvin's theory, the potential difference which should exist between the metals concerned when put in contact, results were arrived at which agreed neither with the Volta effect nor the Peltier effect, but which were considerably nearer the former than the latter. A paper on the want of uniformity in the action of copper-zinc alloys on nitric acid was read by Dr. J. H. Gladstone. Experiments have been made by dissolving copper-zinc alloys in nitric acid, following the method of Dr. Galt, and adopting the precautions mentioned by him. The reaction between nitric acid and these metals or alloys is very complicated, and there is a difference between the products in the case of an alloy and in the case of the equivalent mixed metals. The gases evolved being small in the experiments performed, attention was directed to the determination of the substances remaining in solution, *i.e.* the nitrous acid and ammonia. The alloys gave much more nitrous acid and less ammonia—in fact, two of the alloys employed produced no ammonia. Discrepancies in results may be due to the fact that the zinc and copper in contact form a zinc-copper couple which in the presence of acid sets up a vigorous action and produces a different evolution of heat. Difficulties arise in the investigation because the alloys used may not be definite chemical compounds, but mixtures of two or more alloys with uncombined zinc and copper. The alloy with 38·38 per cent. of copper appears to be fairly uniform. Different observers disagree as to the amount of heat produced by any

reaction, but the excess of calories in a zinc reaction over those in a copper reaction appears to be fairly constant. Starting with 640 calories, the value, according to Galt, when copper is dissolved in nitric acid of sp. gr. 1·360, we should have 1357 calories when zinc is dissolved, provided the chemical action is the same in each case. All the calorimetrical results from the different specimens of alloys would theoretically lie upon the straight line drawn between 604 and 1357. This is practically so from pure copper to the copper 70 per cent. alloy, but beyond that there is less heat produced than that indicated by the straight line law, the maximum deviation lying at about copper 37 per cent. The specimen containing 38·38 per cent. copper, which is not far from the alloy $CuZn_2$, shows a loss of 32 calories. The only way in which this deficit can be accounted for is by supposing that the action of this alloy on nitric acid produces a larger quantity of nitric oxide than in the case of pure copper. But, allowing full force to this argument, it cannot account for as much as 10 calories of the deficit. There is, therefore, a residual deficit as yet unaccounted for on chemical grounds. The author states that it is desirable that experiments should be conducted on the zinc-copper alloys with solvents which give a simpler chemical action than that produced by nitric acid. The chairman pointed out that the results obtained by Galt for an alloy which appeared to be a chemical compound, were in close agreement with what would be expected from the existence of the Volta contact force. Prof. Armstrong said that the action of nitric acid on brass or zinc and copper was a function of the quantity of acid present, its strength, the temperature and the pressure; and that, therefore, it was unsatisfactory to conduct experiments using nitric acid as a solvent. He suggested the use of a solution of bromine in which finely-powdered zinc, copper and brass are easily soluble with a simple chemical reaction. Mr. Tomlinson pointed out that it was impossible to use the ordinary formula for the calculation of the Volta effect from the heat of formation of alloys, unless we know exactly the chemical composition of the alloy which is produced. Mr. W. R. Cooper, referring to Mr. Tayler's paper, said it was difficult to see that anything could be proved by the application of the Kelvin theory to a metallic contact, unless there is ground for believing that some particular alloy of fixed composition is always formed. There is also a further difficulty in converting heat of formation into E.M.F. in cases where the metals have different valencies, for there is no reason why one valency should be selected rather than the other. Referring to Dr. Gladstone's paper, Mr. Cooper said that it was possible that the difference in the reducing powers of mixtures and alloys might be due to local action, which would be more pronounced in the case of alloys. More hydrogen would be evolved, and the reduction would be more complete.—Prof. S. P. Thompson then showed an electromagnetic experiment. A circular coil capable of carrying a strong current was placed with its axis horizontal in a tank of water. Into the tank were also placed some small magnets in sealed glass tubes so adjusted as to have a density approximately equal to that of water. The magnets just floated or just sank. On running a current through the coil it was possible to "fish" for the magnets, which, acted upon by the magnetic field, immediately made their way to the coil. When the current was carefully reversed upon the approach of a magnet, repulsion instead of attraction took place, and the magnet retreated. In general, however, reversal of the current produced reversed polarity in the magnet, and attraction still persisted.—The Society then adjourned until May 25.

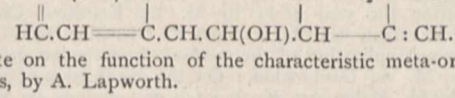
Chemical Society, May 3.—Prof. T. E. Thorpe, President, in the chair.—The following papers were read:—The substituted nitrogen chlorides and nitrogen bromides derived from ortho- and para-acet-toluide, by F. D. Chattaway and K. J. P. Orton. Hypochlorous and hypobromous acids convert ortho- and para-acet-toluide into substituted nitrogen chlorides and bromides, which readily undergo transformation into the isomeric substituted toluides.—The estimation of hypoiodites and iodates; and the reaction of iodine monochloride with alkalis, by K. J. P. Orton and W. L. Blackman. The authors' method of estimating hypoiodites is based on the oxidation of sodium arsenite by hypoiodites, but not by iodates. The initial reaction of iodine monochloride and alkalis is represented by the equation $ICl + 2MOH = MIO + MCl + H_2O$; conversion of the metallic hypoiodite into iodide and iodate becomes complete after twenty-four hours.—Products of the action of sulphur dioxide on ammonia, by E. Divers. Amongst the products of spontaneous decomposition of ammonium amidosulphite is found a substance of acid properties to which the author assigns the constitution



—On brazilin (iv.), by A. W. Gilbody, W. H. Perkin, jun., and J. Yates. From a study of the reactions of brazilin and trimethylbrazilin, the authors conclude that brazilin probably has the constitution



—On hæmatoxylin (v.), by W. H. Perkin, jun., and J. Yates. The study of the oxidation products of tetramethylhæmatoxylin leads to the view that hæmatoxylin has the constitution



—Note on the function of the characteristic meta-orientating groups, by A. Lapworth.

Anthropological Institute, April 24.—Mr. C. H. Read, President, in the chair.—Dr. W. H. R. Rivers described a genealogical method of collecting social and vital statistics which he had used with success when in Torres Straits with the Cambridge Anthropological Expedition. Genealogies of the inhabitants of Murray Island and Mabuiag were compiled which went back for three to five generations, and included nearly all the families at present on those islands. In working out these genealogies, the only terms of relationship used were father, mother, child, husband and wife, and care was taken to limit those terms to their English sense. The chief difficulties were the prevalence of adoption in Murray Island and the custom of exchanging names in Mabuiag. The trustworthiness of the genealogies was guaranteed by the fact that nearly every detail was derived independently from several informants. These genealogies afford material for the exact study of numerous sociological problems; thus the system of kinship can be worked out very thoroughly by ascertaining the native terms which any individual applies to other members of his family, *i.e.* the subject can be investigated entirely by means of concrete examples, and abstract terms of relationship derived from European sources avoided. The genealogies also afford material for the study of totemism, marriage customs, naming customs, &c. By this method also vital statistics may be collected, both of the present and the past. The genealogies compiled in Torres Straits supply data for the study of the size of families, the proportion of the sexes, the fertility of mixed marriages, &c. The method has the further advantage of bringing out incidentally many facts in the recent history of the community, to which it gives increased definiteness and concreteness. The paper was discussed at some length by the President, Mr. Gomme and Dr. Japp.—Dr. A. C. Haddon, F.R.S., exhibited a large number of lantern slides illustrating various native industries in British New Guinea; the photographs were taken during the recent Cambridge Anthropological Expedition. The most complete series was one showing all the stages in the manufacture of pottery by Port Moresby women; other slides illustrated the manufacture of canoes at Keapara with stone implements. Photographs were shown of the process of pile-driving and the erection of buildings, as well as of fire-making, and various women's industries, such as tattooing, making string, &c.—Mr. Gowland pointed out a number of parallels from Korea to the mode of pottery-making described by Dr. Haddon.—The secretary laid before the meeting a brief account of the proceedings of the Cretan Exploration Fund, and of the discovery by Mr. A. J. Evans, at Gnossus, of a collection of clay tablets inscribed with pictographic signs.

PARIS.

Academy of Sciences.—M. Maurice Lévy in the chair.—The President announced to the Academy the loss by death of M. E. Grimaux, member of the Section of Chemistry.—Preparation of the β-alkyloxy-α-cyanocrotonic esters, isomers of the aceto-alkylcyanacetic esters, by M. A. Haller. The true acetyl-alkylcyanacetic esters, $CH_3.CO.CR(CN).CO.OC_2H_5$, have been prepared by Held by acting with cyanogen chloride upon the sodium derivative $CH_3.CO.CR.Na.CO.OC_2H_5$; the isomeric ester of the enol form, $CH_3.C(OH)=C(CN).CO.OC_2H_5$, are obtained by first converting the sodium into the corresponding

silver derivative, and then treating this with the alkyl iodide. The reactions of the ester so obtained are clearly those of the enolic ester, the alkyl group not being directly united to carbon.—The arable earths of the Canton of Redon from the point of view of phosphoric acid, by M. G. Lechartier. The analyses given show how it is that certain lands in the Canton have been successfully cultivated from time immemorial, without the use of phosphatic manures.—Geographical positions and magnetic observations on the eastern coast of Madagascar, by M. P. Colin. The latitude and longitude of Vatomandry and Mahanoro have been redetermined, and also the values of the magnetic elements at those places. The results show that the existing maps require correction in some respects.—Prof. Burdon-Sanderson was elected a Correspondant for the Section of Medicine and Surgery in the place of the late Sir James Paget.—Positions of fundamental polar stars determined at the Observatory of Lyons, by M. F. Gonnessiat.—Shooting stars observed at Athens during the year 1899, by M. D. Eginitis.—On the method of Neumann and the problem of Dirichlet, by M. A. Korn.—On an application of the method of successive approximations, by M. A. Davidoglou.—On the distribution of prime numbers, by M. Helge von Koch.—On gas engines, by M. L. Marchis. A reply to the criticisms of M. Witz.—An electrically driven pendulum, by M. Ch. Féry. The mechanism described is arranged so as to leave the pendulum as far as possible unconstrained.—The heat of neutralisation of hydrogen peroxide by lime, by M. de Forcrand.—Solubility of a mixture of salts having a common ion, by M. Charles Touren. The curve showing the relation between the solubility of potassium bromide in solutions of potassium bromide of different concentrations is not coincident with the corresponding curve for potassium nitrate and chloride. Hence the law proposed by Nernst, that equivalent solutions of nitrate and bromide should lower the solubility of the chloride to the same extent, is not verified. The author notes as an interesting application of the phase rule that the study of the solubility of a mixture of salts may show that they are isomorphous, when direct proof may be difficult.—The action of phenyl isocyanate and of aniline upon some γ-ketonic acids, by M. T. Klobb.—Some new compounds of antipyrine with mercury halides, by MM. J. Ville and Ch. Astre.—On acetyl-phenylacetylene and benzoyl-phenylacetylene, by MM. Ch. Moureu and R. Delange. Acetyl-phenylacetylene is quantitatively decomposed by alcoholic potash into phenylacetylene and potassium acetate; benzoyl-phenylacetylene reacts differently, acetophenone being produced.—On the stability of saccharose solutions, by M. Œchsner de Coninck.—Study of the hydrolysis of fibrous tissue, by M. A. Etard. The fibrous tissue of beef, hydrolysed with sulphuric acid, gives a polysaccharide, but practically no leucine.—On some fresh-water *Palaemonidae* of Madagascar, by M. H. Coutière.—On a new edible tuber from the Soudan, the Ousounify, by M. Maxime Cornu. The Ousounify is a tuber resembling the potato in taste, which is cultivated and sold in the Soudan. It is a labiate, and is provisionally named *Plectranthus Coppini*. It has the advantage over the potato that it can be grown in a truly tropical climate.—On the mineralogical composition of the teschenites, by M. A. Lacroix. The hornblende teschenites of Madagascar are analogous, both in structure and mineralogical composition, to the teschenites from Portugal and the Pyrenees, but they contain the nepheline intact. The teschenites from both regions were probably originally identical from the mineralogical point of view.—On the excitement of the electrical nerve of the gymnotus by its own current, by M. Mendelssohn. The electric nerve of the torpedo fish may be excited by its own current.—On the southern aurora observed during the wintering of the Belgian Antarctic expedition.—Barometric deviations produced on the parallel on successive days of the synodic revolution, by M. A. Poincaré.

DIARY OF SOCIETIES.

THURSDAY, MAY 17.

ROYAL SOCIETY, at 4.30.—The Circulation of the Surface Waters of the North Atlantic Ocean: H. N. Dickson.—(1) On Cerebral Anæmia and the Effects which follow Ligation of the Cerebral Arteries; (2) The Influence of Increased Atmospheric Pressure on the Circulation of the Blood. Preliminary Note: Dr. Leonard Hill.—Contributions to the Comparative Anatomy of the Mammalian Eye, chiefly based on Ophthalmoscopic Examination: Dr. Lindsay Johnson.

ROYAL INSTITUTION, at 3.—A Century of Chemistry at the Royal Institution: Prof. J. Dewar, F.R.S.

ZOOLOGICAL SOCIETY, at 4.30.—The Freshwater Fishes of Africa: G. A. Boulenger, F.R.S.

SOCIETY OF ARTS (Indian Section), at 4.30.—The Industrial Development of India: J. A. Baines.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Alternating Current Induction Motors: A. C. Eborall.

CHEMICAL SOCIETY, at 8.—Chlorine Derivatives of Pyridine. VI. The Orientation of some Aminochloropyridines: W. J. Sell and F. W. Dootson.

FRIDAY, MAY 18.

ROYAL INSTITUTION, at 9.—The Structure of Metals: Prof. J. A. Ewing, F.R.S.

EPIDEMIOLOGICAL SOCIETY, at 8.30.

SATURDAY, MAY 19.

ROYAL INSTITUTION, at 3.—South Africa: Past and Future: Dr. Alfred Hillier.

MONDAY, MAY 21.

SOCIETY OF ARTS, at 8.—The Incandescent Gas Mantle and its Use: Prof. Vivian B. Lewes.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary Meeting.

VICTORIA INSTITUTE, at 4.30.—Ethics: Rev. Dr. Wace.

TUESDAY, MAY 22.

ROYAL INSTITUTION, at 3.—Brain Tissue and Thought: Dr. A. Hill.

ZOOLOGICAL SOCIETY, at 8.30.—On the Development of the Skeleton of the Tuatera, *Sphenodon* (*Hatteria*) *punctatus*: Prof. G. B. Howes, F.R.S., and H. H. Swinnerton.—On Crustaceans from the Falkland Islands collected by Mr. Rupert Vallentin: Rev. T. R. R. Stebbing, F.R.S.—The Significance of the Hair-slope in certain Mammals: Dr. Walter Kidd.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Hydroquinone and Colour Impressions: Alfred Watkins.

WEDNESDAY, MAY 23.

SOCIETY OF ARTS, at 8.—Salmon Legislation: J. Willis-Bund.

GEOLOGICAL SOCIETY, at 8.—The Igneous Rocks of the Coast of County Waterford: F. R. C. Reed.—On a New Type of Rock from Kentallen and elsewhere, and its Relations to other Igneous Rocks in Argyllshire: J. B. Hill and H. Kynaston.

THURSDAY, MAY 24.

LINNEAN SOCIETY at 3.—Anniversary Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Annual General Meeting.

FRIDAY, MAY 25.

ROYAL INSTITUTION, at 9.—The Great Alpine Tunnels: Francis Fox.

PHYSICAL SOCIETY, at 5.—Experiments illustrating the Aberration called Coma: Prof. S. P. Thompson, F.R.S.—Notes on the Measurement of some Standard Resistances: R. T. Glazebrook, F.R.S.—On the Strength of Ductile Materials under Combined Stresses: J. J. Guest.

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