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THE COLLECTED PAPERS OF PROFESSOR ADAMS.

The Scientific Papers of John Couch Adams, M.A., Sc.D., D.C.L., LL.D., F.R.S., late Lowndean Professor of Astronomy and Geometry in the University of Cambridge. Vol. i. Edited by W. G. Adams, Sc.D., F.R.S. With a memoir by J. W. L. Glaisher, Sc.D., F.R.S. Pp. liv+502. (Cambridge: University Press, 1896.)

TO collect with completeness, and to edit with care and reverence, the scientific work of those whom the world has followed with close and respectful attention, must be a grateful and, at times, a necessary task. The opportunities of publication are fortunately numerous, for many learned societies and scientific bodies are eager to make known the researches of those whom they are proud to reckon among their associates or supporters. Obviously, this general scattering is attended with many evils, which collection will effectually remove. Not only will readier access be given to the student to those papers in which he is interested, but the reputation of the author will probably be enhanced by the greater coherency which his work is likely to acquire. In the present instance, however, though the result will be welcomed by many, the necessity for collection is not so apparent as in some other famous cases. The number of published papers is not large—sixty-two in all, of which five are addresses from the presidential chair to the recipients of the medals of the Royal Astronomical Society, and a few others, the results of observations connected with the direction of the Cambridge Observatory. Of the more important papers, each is usually complete in itself, since it was seldom necessary for Adams to return to a subject which he had once discussed. Neither did Prof. Adams select many channels by which to make his thoughts and results known to the world. The Astronomical Society sufficed him for the greater part, and their publications are readily accessible, though it must be admitted that the Council of that Society have very recently found themselves compelled to republish one of his more interesting papers.

Dr. Glaisher contributes an appreciative account of Adams's life. Without containing many new facts, it shows a keen insight into his character, and makes the reader understand in some measure, the reason why Adams maintained so pre-eminent a position among his contemporaries. The thoroughness with which he did his work, the innate craving after perfection, the steady maintenance of a high standard of excellence, the dislike to hurried and incomplete publication, all contributed to give him that superiority which he never courted, and to make him an authority whom all respected. Naturally, the history of the discovery of Neptune figures largely in the biographical notice. It is a subject that apparently never wearies, and concerning which the last word will never be written. But all the material facts have long since been threshed out, and there is no new source from which any fresh information can be derived. Dr. Glaisher permits himself to criticise in some particulars the conduct of both Airy and Challis.

"Adams was not fortunate," he says, "in the two astronomers to whom he communicated his results; neither of them gave to a young and retiring man the kind of help or advice that he should have received. . . . As Professor in the University, he (Challis) should not have allowed a young Senior Wrangler, through modesty or diffidence, to do such injustice to himself. . . . It is impossible not to contrast the admiration with which he (Airy) received Le Verrier's published writings with the indifference shown towards Adams's still unpublished work. Adams was certainly as clearly convinced of the reality of the planet as Le Verrier, and whatever claims the latter has to the name of philosopher rather than mathematician, apply equally to the former."

This is no doubt true, but it does not seem to be as distinctly remembered as it should be that Adams in fame and reputation suffered no irreparable injury. Greater attention could not have been drawn to the excellence and originality of his work, or the philosophic character of the original conception, than was occasioned by the untoward circumstances that surround the discovery of Neptune. Though no one sought less for public applause than did Adams, the effect of the controversy was to advertise his merits far more widely than would have been the case, if Le Verrier's papers had not appeared. The immediate effect was to place Adams at one bound in the front rank of astronomers; and perhaps there is no other instance, in scientific life, of a reputation so assured being so swiftly won. He presents the singular—perhaps the unique—instance of a young man being unable to add to his rapidly acquired reputation. That the high level at which he commenced his career was amply sustained, will of course be universally admitted; but it was almost impossible that it could be raised, in the public mind, at least.

The investigation of the perturbations of Uranus, of course, occupies the first place in the collected series of papers; and to this discussion is added, as a matter of historical interest, some of the earliest observations of Neptune made by Prof. Challis, as well as an account of the zonal measurements made at the instance of the late Astronomer Royal, with a view to the detection of the planet prior to the actual discovery at Berlin. More interest, however, attaches to a reference to a reprint of Adams's original paper in Liouville's *Journal de Mathématiques* for 1875, because it is accompanied by a less known note, that Prof. Adams contributed in reply to some criticisms of Prof. Pierce. Very shortly after the discovery of the planet, Prof. Pierce had contended that the true period of Neptune differed so widely from that assigned by Adams to the hypothetical planet, that the discovered object was not the planet indicated by geometry, and that in fact its discovery must be regarded as a happy accident. The main contention of Prof. Pierce was that the commensurability of the mean motion of Uranus with that of Neptune would give rise to perturbations always in the same part of the orbit of the inferior planet, whereas the perturbations due to the hypothetical planet would not occur with the same regularity, but would vary 80° upon the orbit of Uranus, at each successive conjunction and opposition. Adams had little difficulty in disposing of this criticism, though this collection of papers would indicate that he took no notice of it for thirty years. He then points out that the objection would be valid if it were sought to explain the perturbations of Uranus throughout one or more whole synodic periods of the planet. Practically, and for the purposes of the particular solution, the action of the disturbing planet on the motion of Uranus is limited to some twenty years before and after 1822, when the two planets were last in conjunction. The preceding conjunction took place in 1650, some forty years before Flamsteed's earliest observation, and the sensibly elliptic orbit in which Uranus was moving from that time to the beginning of the century, was the elliptic orbit on which the perturbations of Neptune at the last conjunction had been impressed. The outstanding discrepancy exhibited by Flamsteed's observation, in 1690, from the place indicated by the theories of both Adams and Le Verrier, arose from the inadequacy of those theories to represent the place of the planet in the remote past, owing to the erroneous distance assigned to the hypothetical planet.

Passing over a few short papers generally referring to the orbits of comets and of double stars, we come to Adams's work on the Moon. The papers on this subject refer to lunar parallax, the secular acceleration of the moon's mean motion, and critical notices on the lunar theory, both theoretical and numerical. The work on lunar parallax includes an entire revision of the equations from which the parallax is deduced in the tables of Burckhardt and Damoiseau, as well as in the theories of Plana and Pontécoulant. Henderson had found a difference of 1″·3 in the value of the mean parallax deduced from observation, according as he employed the tables of Damoiseau or Burckhardt. Clausen had also called attention to discrepancies in the equations of parallax between the same two authorities, but had not pursued the subject, probably on account of the labour involved. But Adams not only instituted a rigorous comparison between the coefficients employed, and traced the errors of Burckhardt to their source, but added a table of corrections to the daily values of the parallax given in the Nautical Almanac from 1840–1855. This heavy piece of work, demanding as much nicety in its mathematical investigation as patience in its numerical application, Dr. Glaisher describes as characteristic of the author. No part of the work is given; the method of procedure is briefly sketched, and the final conclusions are stated in the fewest words, and simplest manner possible.

The discussion of the secular acceleration of the moon's mean motion is known almost as well as the history of the discovery of Neptune. Fierce controversy has centred round this question, and forced it on public notice. It is difficult to understand now, and impossible to explain briefly, the reason for the controversy called forth by Adams's paper in 1853. This somewhat acrimonious debate was carried on with undiminished force for some years, though Adams took little part in it beyond practically settling the fray in 1860. To Adams, and to mathematicians of the present day, the problem is purely one of dynamics. Given that the eccentricity of the earth's orbit changes at a slow uniform rate, to determine the corresponding rate of change in the mean motion of the moon. The solution of this problem is, as Adams pointed out, to be effected by means of a purely algebraical process, the validity of each step of which, admits of being placed beyond all possible doubt. Here there would seem to be no room for dispute. But the question did not present itself quite in this simple manner to Laplace and others of his time. They always had before them the necessity of explaining on purely gravitational grounds the observed motion of the moon. The complete vindication of the Newtonian theory was dear to the hearts of the schoolmen of the last century. Many triumphs had been successively won by investigations undertaken with this object, the greatest of which was due to Laplace, who was believed to have satisfactorily explained and laid to rest the last difficulty, revealed by the complicated motion of the moon. In his paper of 1853, Adams joined issue with Laplace, and in showing that the work of the earlier astronomer was incomplete, he not only destroyed the harmony that was so long supposed to exist between observation and theory, but practically impeached the judgment of those who upheld the authority of Laplace. M. de Pontécoulant seems to have urged, as a reason for the non-acceptance of Adams's value, the fact that it had "l'inconvénient d'altérer profondément l'expression analytique admise jusqu'à present, au coefficient de cette equation."

It is curious to reflect on what slender grounds the observed value of 10″ assigned to the secular acceleration was based, and, consequently, how little increased weight it could add to any theoretical value with which it chanced to accord. We may take Dunthorne's investigation as typical of the others made with the same purpose. He computed from the lunar tables in use in his time, probably those published in 1739, and in which the moon's centennial mean motion would have a considerable error, the circumstances of the eclipses recorded by Tycho Brahe, by Regiomontanus (1478–1490), by Ebn Jounis (977–8), the eclipse of Theon (364), and those of Ptolemy. Not one of these sources is unobjectionable, or possesses the necessary accuracy. Ptolemy's catalogue of eclipses was probably selected by him to satisfy a preconceived theory. Theon says that he computed the time of the beginning of the eclipse, and found the observation agreed with his calculation. This agreement is suspicious. The Arabian observations, eye determinations of the beginning and end of the phenomena, are the best suited to the purpose; though here the error in the moon's mean longitude must be considerable, and a secular acceleration of 7″ will satisfy the observations. Those of Regiomontanus and Tycho Brahe, still made without a telescope, must have approximately the same error, and are too near in point of time to gain the advantage of accumulation.

It is scarcely necessary now to point out the source of the error in Laplace's theory. In this error he was followed by Damoiseau and Plana, who, while extending the method to include the square and higher powers of the disturbing force, failed to detect the incompleteness of the reasoning which vitiated the earlier portion of the work. Laplace only took into account directly the radial component of the disturbing action of the sun.

This neglect of the tangential disturbing force, or the assumption that the area described in a given time by the moon about the earth undergoes no permanent alteration, introduced a considerable error in the coefficient of m^4 in the expression for the true longitude. Correcting the whole of the coefficients in the expansion as far as m^7, Adams assigned a value to the secular acceleration that has not been sensibly disturbed by any subsequent investigation. This value is 5"·7, a quantity only about one-half of that assigned by Laplace, or of that which seemed to be demanded by observation. The minuteness of the quantity sought affords a good illustration of the powers of analysis. The acceleration of the moon's motion implies, of course, an approach to the earth, but the amount is less than one inch per annum, and this minute quantity is determined by theory to within about one-thousandth part of its true amount.

Such an investigation as this last, exhibits the patient examination which Adams was prepared to give to a term, the value of which has been frequently under review by methods that have long been pursued. It shows a confident reliance upon the accuracy of his judgment, the completeness of his work, and a refusal to be led by authority. But some later papers on the general method of treating the lunar theory will be better appreciated, as showing, perhaps, greater originality, and illustrating the application of the results of more modern mathematical inquiry to obtain greater accuracy with less expenditure of labour. It is curious to notice that but for a lucky accident, this peculiar method of treating the lunar motion, and which is likely to be much developed in the future, would not have been published by Adams himself. In 1877, Mr. Hill published his inquiry into the motion of the moon's perigee, in which is sought an absolutely accurate value of that part of c (the ratio of the synodic to the anomalistic months) which depends upon m alone. This is the historic problem that Clairaut successfully solved by adding the term depending upon m^3, and thus supplying a confirmation of the Newtonian theory when it was most needed. Delaunay has since determined the numerical value of the series as far as m^9, and possibly human patience could get little further by this process. Mr. Hill had recourse to quite a different method, which, as applied, gives the same accuracy that would be attained by carrying the series to m^{27}. The sight of this paper by Mr. Hill, seems to have reminded Prof. Adams that some ten years previously he had been at work on similar lines in order to arrive at an accurate value of g, which is related to the motion of the node in the same way that c is to the perigee. The differential equation which determines z, the moon's coordinate perpendicular to the ecliptic, is

$$\frac{d^2z}{dt^2} + \left(\frac{\mu}{r^3} + \frac{\mu'}{r_1^3}\right)z = 0.$$

Prof. Adams puts

$$\frac{\mu}{r^3} + \frac{\mu'}{r_1^3} = (n - n')^2\{l^2 + 2q_1 \cos 2(n - n')t + 2q_2 \cos 4(n - n')t + 2q_3 \cos 6(n - n')t + \&c.\},$$

and on solving this equation was led to the form that Mr. Hill had employed in his work. For Mr. Hill had made the general equations of motion depend upon a single differential equation having the form

$$\frac{d^2w}{d\tau^2} + \Theta w = 0,$$

where τ denotes the mean angular distance between the sun and moon, and Θ can be developed in a periodic series of the form

$$\Theta_0 + \Theta_1 \cos 2\tau + \Theta_2 \cos 4\tau + \&c.,$$

leading to the same infinite determinant in both cases. This is developed in a series of powers and products of small quantities, the coefficient of each term being given in a finite form. The similarity of method pursued independently by the two mathematicians, and the greater accuracy obtainable with less labour, seem to point to a new departure in the method of treating the lunar theory. Prof. Adams has indicated what appears to him the most advantageous method of treating this problem.

We can but barely mention one other of Adams's investigations, the discussion of the orbit of the November meteors. It is well known that the late Prof. Newton left undecided the periodic time in which the meteors revolved about the sun, indicating, however, the method which might lead to the settlement of the question by the discussion of the observed amount of secular perturbation of the node. By a method given by Gauss in his "Determinatio Attractionis," it is shown how to determine the attraction of an elliptic ring, such as the meteors form, on a point in any given position. By dividing the orbit of the meteors into a number of small portions, and summing up the changes corresponding to these portions, Adams found the total secular changes of the elements produced in each of the five possible periods that Prof. Newton showed might be assigned as the meteoric path. With only one of these periods, that of about thirty-three years, was it possible for the node to advance in the manner required by the several historical accounts of the meteoric display. With a thirty-three years' period, and with no other, the longitude of the node is increased 20' by the action of Jupiter, 7' by that of Saturn, and 1' by Uranus, thus 28' in all, giving a mean annual motion of 52", agreeing with the observed motion, and thus satisfactorily settling the periodic time in which the November meteors revolve.

Several other papers possess great interest, and evidence among other things much painstaking arithmetic. Such is the calculation of thirty-one of Bernoulli's numbers, and the computation of the Eulerian constant to 263 places of decimals. These may have been the occupation of his leisure moments. The reputation of Adams will ever rest upon the determination of the inverse perturbations of Uranus, the work on the lunar theory, and his inquiry into the period of the November meteors.

A CYCLOPÆDIA OF BIOLOGICAL THEORY.

Les Théories sur l'Hérédité et les grands problèmes de la Biologie générale. Par Yves Delages, Professeur à la Sorbonne. Pp. xiv + 878. (Paris: Reinwald, 1895.)

PROFESSOR DELAGES has produced in this large volume of 880 pp. royal octavo, a valuable exposition and critical discussion of the modern theories bearing upon the great problems of biology. The work is remarkable for the ability with which so vast a variety of theories and observations are epitomised and considered. Whilst the author does not profess to give more than an outline of the chief doctrines concerned, it is the fact that there is no treatise in English or German which contains so useful a review of biological theory. Written as it is, with a patriotic motive—namely, that of inducing the rising generation of French zoologists to occupy themselves with the general theories (such as those of Darwin, Wallace, Weismann, Spencer, Naegeli, and others) which have, as he justly states, received far more attention in this country and in Germany than in France—the book should prove of very great value also to English students. This is sufficient excuse for now drawing attention to Prof. Delages' volume, although it was published more than a year and a half ago. So far as I am aware, it is not so widely known in this country as it should be on account of its comprehensive and thoroughly interesting character.

It is true that the preface to his work has caused some disagreement among the Professor's own colleagues. M. Delages in severe terms expresses his disapproval of the old school of zoological and botanical studies. He points out (and I think justly) that whilst French men of science have taken a leading part in the development of biological doctrine and methods of study during the century, yet that there has been during the past twenty years in France a tendency to "une fausse direction des recherches biologiques." For works or memoirs of importance bearing upon the great problems of general biology, there are, says M. Delages, for every one written in French, three in English and ten in German. He attributes this to the fact that French students have not had their attention sufficiently directed to these great problems. Accordingly, by a very remarkable effort, he has produced the present work which shall (and in my opinion does) serve as a cyclopædia of biological theory, by aid of which the French student may be introduced to this hitherto neglected field, and led to study for himself original authorities. In fact Professor Delages has, first of all by diligent study, corrected for himself what he regards as the defect in the current education of a French zoologist, and then has embodied his valuable abstracts and critical notes in the volume which he offers to the young men who come after him.

In spite of the fact that there are others in France who have recognised, as does M. Delages, the importance of modern theories in biology as stimulating and directly producing new observations, and thus building up the fabric of biological science, yet, on the whole, I am convinced that M. Delages is right, and that such a book as his was needed and will be very fruitful in France. It is so good a book that it will be of great service also in England.

It is true that M. Delages seems to have forgotten for a moment, in speaking of the growth of histological technique as foreign to France, that Ranvier, of the Collège de France, is one of the most original and fertile discoverers in this field at present living. It is also true that his colleague, Prof. Alfred Giard, who is surrounded by an enthusiastic band of disciples, has for many years taken actually the same attitude as that adopted by Prof. Delages, and has proclaimed the importance of the new theories, and insisted, not only by precept, but by example, on the necessity of carrying on observation and experiment in zoology in order to test hypothesis, and to determine the truth or error of current theory, rather than let them take the form of exact but meaningless record of facts, pointing to no general conclusion. None the less, it seems to me that Prof. Delages' contention is true, and that, in spite of brilliant exceptions, biological science has too often followed a false direction in France (and no doubt in England also), owing to an ignoring of the great search-lights of theory which happen to have originated outside France. The tendency to which Prof. Delages alludes was sufficiently obvious to those who were able to watch, as many still alive did, the reception of Darwin's theory of the origin of species by natural selection in France, on the one hand, and in Germany on the other. There can be no doubt that the publication of M. Delages' book is evidence of the fact that what may be called "modern biological theories" are now receiving due attention in France, and that the brilliant originality and independence of thought, as well as honesty and ingenuity of observation which characterise French men of science, will more and more be directed to the solution of those great problems which occupy the attention of the biological world at large.

A brief sketch of the contents of Prof. Delages' book is all that the space of this article permits me to give. It is divided into four parts: Part i. The Facts; Part ii. Special Theories; Part iii. General Theories; Part iv. The Theory of Actual Causes. Under Part i. are treated (1) *The Cell:* its constitution, its physiology, its reproduction; an admirable *résumé* in ninety pages of the recent work, both on karyokinesis and the physiology of protoplasm. (2) *The Individual:* regeneration, grafting, generation, ontogeny, alternation of generations, sex and secondary sexual characters, latent characters, teratogeny, correlation, death and continuity of life, the germ-plasma. (3) *The Race:* heredity, variation, the formation of species. Under Part ii. we find statements of the following theories. (1) Speculative theories as to the structure of protoplasm and the cause of its movements, viz. the theories of Berthelot, of Verworn, of Quincke, and of Butschli; (2) theories of cell-division; (3) theories of regeneration; (4) of polar globules; (5) of sexual generation; (6) of the ontogenetic process; (7) of the parallelism of ontogeny and phylogeny; (8) of the origin of sex; (9) of teratogeny; (10) of death and of germ-plasma; (11) of heredity; (12) of the transmission of acquired characters; (13) of latent characters; (14) of telegony; (15) of hybridity; (16) of variation; (17) of the formation of species.

Under Part iii. we have statements and brief, but trenchant, criticism of the theories of "animism," "evolutionism" (spermatists and ovists), and "micromerism." Under the last term are included and considered the views of Buffon, Béchamp, H. Spencer, Haacke, Dolbear, Erlsberg, Haeckel, His, Cope, Orr and Maulia, and many others, including that of "ancestral plasmas" (Weismann), pangenesis (Darwin), stirpes (Galton), whilst "organicism" is the term applied to the theory of Descartes and to the auto-determination of Roux.

In the fourth and last Part are given "Idées de l'auteur," a retrospect and review of much of what has been already treated at greater length, with the definite introduction of the author's own conclusions. By this method of division of his work, Prof. Delages has very successfully made clear to his reader the facts under consideration, the theories which have been advanced in relation to those facts, and finally his own judgment as to what is sound and permanent and what erroneous in current theories; whilst those theoretical views which are novel, and here put forward for the first time by himself, are kept distinct. A bibliographical index, of eighteen closely-printed pages, completes the work; and with regard to this long and useful list of books and memoirs, I may say that the impression given to a reader of M. Delages' book is that he has not merely cited the titles of this large mass of literature, but has actually performed the heavy task of reading and critically estimating each work thus catalogued.

It is, of course, inevitable that such a task as that undertaken by the author should not be accomplished without some omissions and some mistakes; but it is no little merit to have performed such a task conscientiously, as it has here been performed. The criticisms advanced by M. Delages may not always be those which commend themselves to another biologist; his own theoretical views, though always philosophical and worthy of full attention, may not be necessarily acceptable in every case. Yet the value of the work is not lessened by such considerations. He is no dogmatist, and candidly declares that the theories, which he for the present accepts, are open to correction and replacement with the progress of knowledge. The worthy and useful object of the book is, in short, not to impose a set of theories on the reader's mind, but to interest him in the theoretical aspects of biological phenomena, and to assist him, as far as may be, in arriving at theoretical conceptions which may guide his investigations, if he be a naturalist, or furnish him with a key to the more popular discussions of biological problems, should he be merely a philosopher, or even "un homme curieux des choses de la science." It is a book which should be read and closely studied by every young biologist. The full and comprehensive treatment of the subject has resulted in what must appear a formidable volume equivalent to some three or four modern manuals; yet the reading of it will be found to entail but little effort, on account of the lucidity of the author's method and the unflagging interest which he himself evinces in the successive sections of his work. It is, after all, a distinct pleasure to see English and German theories formulated in the clear logical phrases of the French language. E. RAY LANKESTER.

COMPARATIVE MYTHOLOGY.

Contributions to the Science of Mythology. By F. Max Müller. Vol. i. Pp. xxxvi + 426. Vol. ii. Pp. ix + 427-864. (London: Longmans, 1897.)

IT has for some time past been tolerably well known by many that Prof. Max Müller was working at a treatise on comparative mythology, and with others we have been anxiously awaiting the appearance of the "last word" on the subject by the eminent Oxford professor. General interest in the matter has, moreover, been excited to a more than usual extent by the comments made upon the last edition of "Chips from a German Workshop" by writers for the press and others, for all felt that the veteran expounder of dead and gone beliefs would rise in his might and rend certain of his critics who boldly stated that he stood alone, and was the only defender of a set of dying and dead theories. It seems that Prof. Max Müller hesitated for some time before he decided to publish the 864 octavo pages which form his present work, for he had almost made up his mind that he had arrived at a time of life when rest is more pleasant than work, and at a stage in his work where it was wise to stop and let the younger men carry it on in his place. Every reader of the volumes before us will be glad that the taunts of his enemies stung Prof. Max Müller into action, for, as he says, he had all along intended that his last work on comparative mythology should contain in a comprehensive form what he had hitherto written, and what he still wished to say, and he intended it to be the logical ending of a system of works which he had planned several years ago. On Language, Religion, and Thought he has already written learnedly and charmingly, and now that we have the volumes on the fourth subject, viz. Comparative Mythology, the system which Prof. Max Müller has elaborated is before us in its entirety. Those who seek for polemics or hostile observations upon critics and their rival theories will be disappointed in the perusal of this last section of the work, for he confines himself chiefly to re-stating his views and theories, and it is pretty clear that he has made up his mind to differ from his critics on fundamental principles and methods.

Prof. Max Müller quotes many great names in support of his views, and the general reader will find it very difficult to make up his mind which school he is to follow—the linguistic or the anthropological. The anthropological school holds that mythology is, on the whole, the narrative of the various grades through which the human race has advanced slowly towards what we call civilisation, and it proves many of its statements by drawing comparisions between the beliefs, manners and customs, and habits of savages which still exist on the earth, and those of the nations which have long since passed away.

Prof. Max Müller holds that mythology is the result of a period of moral decay, and a falling away from high moral and spiritual views; we must admit that our sympathies lie with the anthropological school, and we heartily wish that Prof. Max Müller had seriously set to work to classify and arrange the arguments which have been brought in line against him, and also that he had disproved many of the statements and facts alleged against his views. Some, too, will complain that little notice has been taken by him of the writings of men who, though they be his adversaries, are held in esteem by many thoughtful and intelligent people. With the details of the minor differences between the schools we have nothing to do, for, after all, they are only interesting to the experts themselves; we hear that Mr. Lang is about to write a refutation of the most recent expression of Prof. Max Müller's views, and we may be tolerably certain that the *minutiæ* of the subject will not be passed over.

It is but just to call attention to the great learning and skill with which Prof. Max Müller has arranged his information, and the careful student will find scores of facts stated quite simply, and without any attempt to impress the reader, which could be found in no other book in the English language. Whether Prof. Max Müller be all right or all wrong, it must never be forgotten that he is a great linguist as well as an expounder of mythology, and that if some of us hold views other than his, we ought not to belittle the labours of the hard-working scholar who has done so much to explain to two generations of men the lessons which language has to teach. To write easily, accurately, and pleasantly of a difficult subject is a gift which is worth a great deal.

OUR BOOK SHELF.

The Story of the Earth's Atmosphere. By Douglas Archibald, M.A., Fellow and some time Vice-President of the Royal Meteorological Society. Pp. 208. (London: George Newnes, Ltd., 1897.)

THIS is one of the best of the Story series that we have read, but will probably not prove itself one of the most popular. If this prognostication prove correct, it will be because a large part of the public prefers to be amused rather than instructed. The author has endeavoured to compress too much information within the small compass at his command, and this design has in some measure destroyed the ease with which such a book should be read. The mechanics of the earth's atmosphere is not an easy subject for popular treatment, and though we cannot regret that the attempt has been made to give wider publicity to the work of Ferrel, Helmholtz, and Von Bezold, we cannot help feeling that the result would have been more satisfactory if the author could have given more space to his work, or had ventured to fill a larger canvas. The tale, on the whole, is pleasantly told, and the author is frequently able, from his wide travels, to illustrate his remarks by his own personal experience in climates where meteorological manifestations can be witnessed on a grander scale than in our own country.

Starting with the nature and chemical composition of the atmosphere, the author treats of the circumstances that affect its varying temperature. In this section some of the diagrams might have been a little clearer and a little more finished. The reference letters are in some cases barely legible. We notice, too, a curious sentence on page 52, which will puzzle the student: "As a general rule we find the greatest ranges of temperature of the lowest atmospheric stratum between day and night occur in the driest parts of the earth . . . where it often amounts to 40° F., and the smallest ranges in small oceanic islands, where it is as small as 50° F." From the remarks on temperature the author proceeds to discuss the winds and general circulation of the atmosphere, but the description of the more local phenomena of cyclones is deferred till after the consideration of precipitation. Some little improvement would, we think, result from a different arrangement of the chapters, which would not only have brought the same class of phenomena more closely together, but might have prevented the partial repetition of some of the facts contained in the earlier chapters. For example, two chapters on the sounds and colours of the atmosphere separate the one on cyclones from that relating to whirlwinds, tornadoes, &c., while the few remarks on dust and disease, in the last chapter, could possibly have found adequate expression in some of the others. But we willingly admit that Mr. Archibald had a very difficult task, and has accomplished it with a great measure of success. He was not willing to give a bare statement of facts, but has everywhere attempted to add an explanation of them. The book is written right up to date; and though some of the explanations may require modification as the study and science of meteorology advance, this is no impeachment of their present value, nor does it imply any fault on the part of the author. W. E. P.

Wild Bird Protection and Nesting-Boxes, &c. By J. R. B. Masefield. 12mo, pp. 129. Illustrated. (Leeds: Taylor Brothers, 1897.)

ALL interested in the preservation of the feathered denizens of our woods, heaths, streams, and lakes (and who is not?), will give a hearty welcome to this useful, although unpretentious, little volume, which seems evidently the work of one well acquainted with his subject. After a short introduction, in which the author tells us that he has induced no less than six-and-thirty species to nest in his own garden, the book is divided into four chapters. The first deals with modern legislation on bird preservation, and the powers which a County Council can acquire for the purpose. In the second, we have a brief account of mediæval laws for the protection of those birds which were becoming scarce in early times. The third, and most generally interesting chapter, gives the author's experiences as to the best mode of attracting different kinds of birds to build; and the contrivances, which he describes so well and figures so admirably, will be found worthy of the best attention of those who may be inclined to devote their spare hours to this pursuit. In the fourth and final chapter, we find lists of the various species scheduled for special protection by different County Councils. From this we are glad to see that a very large percentage of these authorities have taken up the matter in good earnest. If a suggestion may be offered, it would seem preferable, in cases where a large number of species are scheduled, to include all the smaller birds, as otherwise none but a professed ornithologist can determine whether the order has been infringed. R. L.

Reports from the Laboratory of the Royal College of Physicians, Edinburgh. Edited by J. Batty Tuke, M.D., and D. Noël Paton, M.D. Vol. vi. Pp. 303. (Edinburgh: William F. Clay, 1897.)

A DESCRIPTION of the new laboratory of the Royal College of Physicians, Edinburgh, and a retrospect of the work done in the old laboratory, forms an introduction to this volume. The papers refer to investigations in anatomy, physiology, pathology, and pharmacology. Many of them are of too special a character to be usefully mentioned here, but among the subjects dealt with are: the relationship of the liver to fats, the action of large doses of dilute mineral acids on metabolism, acid and alkali albumin, influence of thyroid feeding on the proteid metabolism in man, the amount of iron in ordinary dietaries and in some articles of food, analyses of iron in the liver and spleen in various diseases affecting the blood, *Catha edulis*—a plant grown in parts of Arabia and Eastern Africa and widely used as a mild stimulant, carbonic acid gases in diseases of the alimentary tract (this paper brings out some interesting points as to the influence of carbonic acid gas upon digestion), and the Malayan arrow poisons.

First Principles of Natural Philosophy. By A. E. Dolbear. Pp. x + 318. (London: Ginn and Co., 1897.)

THIS elementary book is intended for those who wish to obtain some knowledge concerning the more generally recognised problems and principles pertaining to physics. With this object in view, the author has restricted himself to a simple exposition of the subject, and, with the further help of numerous illustrations and worked-out examples, the reader is made acquainted with the fundamental laws and principles relating to heat, optics, electricity, magnetism, &c. The mathematical treatment of the subject is, for the most part, laid on one side, only that of the most elementary character being attempted. The beginner, however, should get a fair insight into the subject if he uses this book as a first step to a more elaborate treatise, and in this respect it should find many readers.

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.*]

Adjustable X-Ray Tubes.

THE writer has discovered a method of adjustment for X-ray tubes, somewhat different to those he has previously described, which possesses distinct practical advantages.

The arrangement is as shown in the illustration, and its essential feature consists in mounting the kathode upon a sliding support, so that it can be moved axially to a very small extent in and out of a tubular neck, blown on one end of a glass bulb. When arranged in this manner, the exact position of the kathode is found to have an enormous influence upon the penetrative value of the X-rays produced. With a suitable and constant degree of exhaustion, if the kathode is placed as shown in full lines in Fig. 1, X-rays of very high penetrative value are produced, while the small movement of about ·3 inch required to place it in the position indicated by the dotted lines, will suffice to reduce the penetrative value of the rays almost to nothing. Between these two extremes every grade of penetrative value is readily obtained by simply altering the position of the kathode between its limits of travel. If the tube be used in a horizontal position, this can easily be done by merely tapping it at one end or the other, without removing it from its support, and the anti-kathode being a fixture, the point of origin of the X-rays remains always in the same position. In this manner, with a single tube, and without alteration to the vacuum, X-rays of any desired penetrative value can readily be obtained, while at the same time it is possible to compensate for the uncontrollable variations in vacuum that are found to occur in practice, and thus to maintain the penetrative value of the rays at any desired degree.

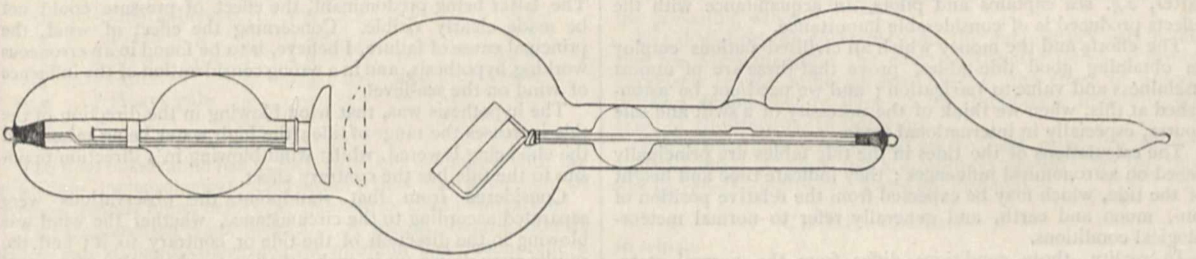


FIG. 1.

The effect is evidently due to changes in the electrical resistance of the tube, which, as measured by the alternative spark in air, is much highest when the kathode is in the position shown in full lines, *i.e.* that which gives rays of the greatest penetration, and appears to be closely connected with the proximity of the kathode to the glass, which is greatest in the position just mentioned.

This factor is evidently so important that it much more than neutralises the effect of the alteration to the distance between kathode and anti-kathode, which, as the writer has previously shown, has the result of increasing the penetrative value of the rays, and also the resistance of the tube, the nearer these two electrodes are together.

In order to obviate the overheating of the anti-kathode, which is a considerable source of trouble in all X-ray tubes when much electrical power is employed, the writer finds it convenient to mount the ordinary small disc of platinum upon a considerably larger and thicker disc of aluminium, say about 1 inch in diameter and ·25 inch in thickness, the platinum being tightly wedged and riveted in a shallow circular depression turned out of one face of the aluminium disc. Owing to the considerable radiating surface of the aluminium, and its considerable mass, this arrangement prevents the platinum from attaining an excessive temperature. In addition, the platinum having only one surface exposed, the tubes do not blacken so quickly.

May 17. A. A. C. SWINTON.

Boomerangs without Twist.

IN your issue of May 13 (p. 46), a writer mentions some Australasian boomerangs as thrown *not to return* (if I have rightly understood him). I had not heard of these before, but in British India at least one race, the Kolis of Northern Gujarat, have the like. These are invariably of "fish" section, varying in weight, curve, and material; but the commonest and most efficient sort is of "Babul" wood (*Acacia arabica*), with the natural curve of the heart of the wood, something like that of an old-fashioned genuine Turkish sabre, rather a "knee" than any regular geometric curve.

They are used with great effect on ground-game; much less, of course, on birds. In one case an old and feeble man, threatened by a swordsman, cut the assailant's shins across with his boomerang at about ten paces, and *brought him down*. Before the astonished thief could rise, the now unarmed old man had disarmed and literally taken him captive.

I tried the case myself, gave the swordsman two years, and the boomerang man much honour. Certain people called *Maravars*, in the south of the Madras Presidency, are said to have similar boomerangs; but I have not seen them.

Many Indian races throw straight sticks at game habitually, and even in a city riot the thrown sticks are often more dangerous than those in hand (bar iron-bound clubs). But their practice is not scientific, like boomerang-throwing.

W. F. SINCLAIR.

102 Cheyne Walk, Chelsea, S.W., May 14.

Scorpion carrying Flower.

ONE evening last February, while sitting in the verandah of my house at Aden, my attention was drawn to an object advancing across the floor, which seemed to be some peculiar leaf insect or phasma. On looking at it closer I saw it to be a scorpion (identified by Mr. Pocock from my description as *Parabuthus liosoma*), which was holding over its back by one claw a large blossom of *Poinciana regia*, known in Aden as the white-gold mohur tree. Its tail, curled over its back, further assisted in retaining the flower in position. The nearest tree from which it could have obtained it was at least 30 feet away, and to bring it the scorpion must have carried it over a low stone parapet and up two or three steps, so that intention seems to be proved. What that intention was it is hard to define. Hardly for concealment, for the size of the flower made it more conspicuous; besides, it was night. If it was the lamp-light it wanted to avoid, it is necessary to assume that, finding the light too strong, it went back to get the flower. It could hardly be as food, for scorpions are not known to live on vegetable substances; nor, as far as I know, do they construct nests. I regret that I did not allow the creature to reach its destination, and so ascertain its intention; but, unfortunately, I gave in to my first impulse and crushed it. My wife suggested that perhaps it was going to a wedding, but this explanation is more poetical than scientific.

Some of your readers may be able to throw a little light on this curious instance; but Mr. Pocock, of the British Museum, to whom I related the above, said he had never heard of a similar case.

A. NEWNHAM.

The Utility of Specific Characters.

MR. COCKERELL asks whether it is possible to explain right-handedness, the dextral or sinistral coil of snail-shells, and similar features as having any utility to the species, and he then speaks of the advantages of uniformity. In the case of right-handedness it is obvious that these advantages must be great, as various tools and machines are made in conformity with the fact that nearly all persons use their hands alike; screws, for instance, having to be driven in by the rotation outward of the right hand. A left-handed man would naturally turn his wrist outwards to the left, and therefore the driving of an ordinary screw by turning the hand inward would be difficult and awkward.

In any community where there existed some left-handed men, and a building had to be erected, they would be found to be inferior workmen, and remain behind in the struggle for existence.

I understand Mr. Cockerell to say that in the case of spiral shells there may be natural environments tending to favour uniformity of shape and prolonged existence, just as in man these environments are artificial, but at the same time beneficial and tending to the same end. SAMUEL WILKS.

Grosvenor-street, May 19.

Luminous Phenomena observed on Mountains.

CONCERNING the letter of Mr. C. G. Cash, on "luminous phenomena observed on mountains," in your number of May 13 (p. 31), I do not doubt you will be informed by many readers of NATURE that they are evidently, and undoubtedly, due to St. Elmo's fire. J. M. PERNTER.

Innsbruck, University Observatory, May 21.

The Effect of Wind and Atmospheric Pressure on the Tides.

THE problem of the effect of wind and atmospheric pressure on the tides has received repeated and considerable attention from scientific as well as from practical men. Especially for the latter, *e.g.* sea captains and pilots, an acquaintance with the effects produced is of considerable importance.

The efforts and the money which all civilised nations employ in obtaining good tide-tables, prove that these are of utmost usefulness and value to navigation; and we need not be astonished at this, when we think of the necessity of a swift and safe course, especially in international trade.

The calculations of the tides in the tide-tables are principally based on astronomical influences; they indicate time and height of the tide, which may be expected from the relative position of sun, moon and earth, and generally refer to normal meteorological conditions.

In reality, those conditions differ from the normal state. Wind and atmospheric pressure are continually changing, and cause the time and the height of tide to vary in different degrees from the normal value indicated in the tide-tables.

Navigation has an interest in exact tide-tables, and, in the same way, the pilots and sea captains wish to be able to calculate the extent to which the depth of the water will be affected by meteorological influences, because it may depend on these, if it will be possible to cross a bar or shoal in a tidal river, or enter into the mouth of a tidal harbour.

So far there does not exist a formula, which allows the calculation of the correction to add to the data of the tide-tables, if the force and direction of wind and the indication of the barometer are known.

While in Germany considerable attention to the effect of wind on the tides has been paid by Hugo Lentz, Prof. Möller, Prof. Bübendey, and others, French scientific men have principally given their attention to the effect of atmospheric pressure. In the "Annuaire des marées des Côtes de France" a table is to be found, according to which a rise of one millimetre in the barometer causes a depression of the tide of 13 millimetres. The same correction can be used for all the harbours, and the seamen are advised to apply this correction. It can, however, be neglected for barometrical indications lower than the mean position, viz. 760 millimetres.

A civil engineer, E. Engelenburg, tried to calculate separately the effects of wind and atmospheric pressure for Flushing, in his article published in *De Ingenieur* (a Dutch weekly paper), No. 39, 1891. Unfortunately the records he used were not sufficient to afford a definite solution of the problem. Nevertheless, his study remains a very interesting addition to the literature on this subject.

All these investigations, however, have not led to any suitable formula by which the corrections for wind and pressure might be calculated. No wonder, therefore, that in England, the navigation-country *par excellence*, particular consideration has been paid to the said subject.

Many elaborate investigations thereon have been made by Mr. W. H. Wheeler, of Boston, who communicated the results of his study at the meeting of the British Association at Ipswich, in 1895.

Mr. Wheeler's address gave rise to the appointment of a Committee, consisting of Prof. Vernon-Harcourt, Prof. Unwin, Mr. Deacon, and Mr. Wheeler (Secretary), in order to investigate this subject, especially for the practical purpose of ascertaining whether the records of the wind and atmospheric pressure, as obtained by an observer at any particular port, might afford a trustworthy guide to pilots and mariners as to the variations to be expected in the height of the tides, from those ascertained by calculations and given in the tide-tables.

Information was asked from authorities of all the principal ports in Great Britain, and also from the Hydrographic Departments of the principal maritime ports in other countries.

The tidal records of five English ports, viz. Liverpool, Sheerness, Portsmouth, Hull and Boston, were selected for a careful examination. The results of these investigations have been presented in a report of the said Committee, drawn up by the Secretary.

In general the results obtained, both those relating to the effect of atmospheric pressure and those relating to the effect of wind, are not very satisfactory.

Nevertheless, the summary of the report contains a useful table giving the increase or decrease of tide for different forces of wind (3° to 10° Beaufort scale) per foot rise of tide.

The reason why the results are so little satisfactory, seems to me due to the method of investigation employed.

In analysing the effects of atmospheric pressure, a mistake was made by not sufficiently eliminating the effect of the wind. The latter being predominant, the effect of pressure could not be made clearly visible. Concerning the effect of wind, the principal cause of failure, I believe, is to be found in an erroneous working hypothesis, and in a wrong consideration of the influence of wind on the sea-level.

The hypothesis was, that wind blowing in the direction of the tide increases the range of tide; the high water being raised and the ebb being lowered, whilst wind blowing in a direction opposite to the tide has the contrary effect.

Considered from that standpoint the observations were separated according to the circumstance, whether the wind was blowing in the direction of the tide or contrary to it; and the results were drawn up in such a way as to show the amount of the raising or depressing of the tide, caused by the same force of wind at different ports, proportional to the mean rise of tide at those ports.

These considerations are contrary to the facts mentioned in Hugo Lentz's work, and also to the observations of the Dutch engineers on the coasts of Holland.

Those facts and observations show everywhere, that high and low water both are raised or depressed by wind, so that the range of tide is not considerably affected. They also show that the raising or depressing are not dependent on the range of tide, but depend to a great extent on the form of the coast-line, and especially on the depth of water; the effect increasing when the water is shallow.

Another point of difference is, that the most important influence is not felt when the wind is blowing in, or opposite to, the direction of the tide—as was supposed by the Committee—but, on the contrary, when the wind is blowing at right angles to the coast-line, *e.g.* perpendicular to the direction of the tide.

Hence the arrangement of the observations in the way adopted by the Committee could not but have the result that the raising and depressing of the tides partially neutralised each other.

The reasons just mentioned cause the table, according to which the variations due to wind is given per foot rise of tide, to be erroneous in principle, because the variation caused by wind is not proportional to the range of tide.

Trustworthy results can only be obtained if exact tide-tables are at our disposal; if the calculated data are compared with the observations, and the variations are arranged according to the simultaneous direction and force of the wind, and the atmospheric pressure; and last, not least, if the results are carefully arranged in such a way that each effect comes forth unaffected by the other. This principle is applied to the height and to the time of the tide on the Holland coast.

In order to get a thorough check, the calculations are made independent of each other for five series of observations as to the height, and for three series as to the time of the tide. A comparison of the results will show what degree of exactness can be obtained, and how far the obtained results can be trusted.

The said series contain—

I. (1) The height of high water at Ymuiden in 1895
(2) ,, ,, ,, ,, 1896
(3) ,, low ,, ,, 1895
(4) ,, ,, ,, ,, 1896
(5) ,, high ,, Hoek van Holland 1896

and

II. (1) The time of high water at Ymuiden in 1895
(2) ,, ,, ,, 1896
(3) ,, ,, Hoek van Holland 1896

The importance of checking is further increased because of the different methods of wind-observation.

At Hoek van Holland the indications of a self-registering apparatus were used, which gave the force in kilogrammes (kg.) per square metre. (1 kg. per square metre) = 0·205 lb. per square foot.)

At Ymuiden the direction and force were noted at 8 a.m. and 4 p.m.; the force was estimated by a scale of 6 degrees, the signification of these being as follows:—

Ymuiden scale	Signification	Equal to: Degrees of Beaufort scale	Pressure in kg. per square metre	Velocity in metres per second (1 m. = 1·09 yard = 3·28 feet).
1	Gentle breeze	1·9	4	5·7
2	Fresh ,,	3·3	9	8·5
3	Strong ,,	4·9	18	12·0
4	Gale	7·3	45	19·0
5	Heavy gale	—	—	—

The tidal observation has in each case been combined with the preceding meteorological observation; thus the latter, on an average, fell six hours before the moment of tidal observation.

This combination is not illogical. A special investigation at Hoek van Holland, concerning the question how much time a certain wind preceded its observed effect on the tide, in order to find the limits of this precedence, showed that the average effect on the height of tide followed the cause after a minimum of five hours (out of 17 observations), and a maximum of 6 hours (60 observations); and on the time of high water after a minimum of 4 hours (13 observations) and a maximum of 7 hours (33 observations).

The calculations for finding the effect of wind and atmospheric pressure have been made as follows.

The variations between observation and prediction (those for the height of tide after a proper correction concerning the annual variation of the height of half-tide) were arranged in groups. Each group contained the observations at a definite direction of the wind and a definite force; *e.g.* all the observations during N. wind and a force = 1° Ymuiden scale, were combined to a group N 1.

Considering that each group corresponds to a definite influence of wind, it is evident that the reciprocal differences of the variations, united in that one group, are caused by differences in atmospheric pressure.

A second supposition was, that the effect of atmospheric pressure in every group was proportional to the difference of the barometer from its normal value of 76 centimetres mercury.

Let, therefore, the wind-effect for a certain wind-group and normal barometer be x . . .

The rise of 1 centimetre barometric pressure corresponding to a depression of the sea-level of y centimetres . . .

The value of a variation $= v$ . . .

The observed barometric pressure $= 76 + b$ centimetres, then we have

$$x + by = v.$$

We have, therefore, in one group containing n observations, n equations with two unknown quantities x and y, out of which the values of x and y can be solved. This method has been applied to the groups containing ten or more variations.

The values of y thus calculated, with consideration of the number of the observations, served to deduce the effect of the directions of the wind on the value of y; this known, the groups containing less than ten variations were submitted to a correction according to the calculated value of y, and so the real value of x was obtained.

These values of x now served to deduce the following quantities:—

(1) The effect of absolute calm.
(2) ,, ,, the force of wind.
(3) ,, ,, the direction of wind.

As is known, the level of the sea at absolute calm differs from the mean annual level, because the latter is influenced by the prevailing winds.

In calculating the effect of wind the supposition was made, that for every direction the effect of definite forces is always expressed by the same proportion—*e.g.* the effect of a force 3 being double that of force 2; this proportion remaining the same at all directions of the wind.

The calculations made according to these principles showed that the effect of wind and atmospheric pressure on the tides can be represented by the following formula:—

$$C = (KR - a) + R_b(B - 76{\cdot}0),$$

in which

C is the correction in centimetres to be applied to the predicted height of high, as well as low water.

K is a coefficient depending on the force of wind.

R is a coefficient depending on the direction of wind.

$-a$ is the correction which should be applied in the case of absolute calm (when $K = 0$).

R_b is a coefficient depending on the direction of wind, although relative to atmospheric pressure.

B is the atmospheric pressure in centimetres mercury.

In order to examine the results obtained by calculating the independent series of observations, I give those *in extenso*. They have reference to conditions which have, in general, similarity enough to allow the comparison, as the following results will prove.

I. Value of K.

Force of wind according to: Estimation in degrees of the Ymuiden scale	Pressure in kg. per m².	Calculated values of K at Ymuiden: High water 1895	High water 1896	Low water 1895	Low water 1896	Mean of the 4 values	Pressure of wind registered at Hoek van Holland, kg. per m².	Calculated value of K at Hoek van Holland, high water 1896
1	4	4	4	5	3	4	0	4
2	9	10	8	11	9	9·5	0 – 5	6
3	18	21	23	20	20	21	5 – 10	12
4	45	50	38	38	45	43	10 – 20	17
5	—	71	—	75	—	73	20 – 30	34
							30 – 50	38
							50 – 70	56

II. Value of R.

Direction of wind	N.	N.N.E	N.E.	E.N.E	E.	E.S.E	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W.	W.	W.N.W	N.W	N.N.W
High water, 1895 (Ymuiden) ...	0·6	−0·3	−1·2	−1·2	−1·1	−0·9	−0·4	0 2	0·6	0·7	0·8	1·1	1·4	1·5	1·3	0·9
,, 1896 (Ymuiden) ...	0·6	0·1	−0·7	−1·2	−1·6	−1·2	−0·4	−0·1	0·1	0·5	0·9	1·3	1·6	1·4	1·2	0·8
Low water, 1895 (Ymuiden) ...	0·8	0·1	−0·7	−1·0	−1·3	−1·0	−0·4	0·4	1·1	0·9	0·9	1·1	1·5	1·6	1·6	1·2
,, 1896 (Ymuiden) ...	0·7	0·5	0·0	−0·7	−1·4	−1·5	−1·0	−0·3	0·2	0·5	0.9	1·4	1·8	1·3	0 9	0·8
High water, 1896—Hoek van Holland	0·4	−0·3	−0·9	−1·0	−1·1	−1 4	−1·6	−0·6	0·0	0·4	0·8	1·3	1·7	1·7	1·3	0·9

III. Value of a.

High water, Ymuiden, 1895 ... $a = -3$ centimetres	Low water Ymuiden, 1896 ... $a = -2$ centimetres
,, ,, 1896 ... $a = -1$,,	High water Hoek van Holland... 1896 ... $a = -2$,,
Low water, Ymuiden, 1895 ... $a = -8$,,	

IV. Value of Rb

Direction of wind	N.	N.N.E.	N.E.	E.N.E.	E	E.S E.	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W.	W.	W.N.W	NW	N.N.W
High water, 1895 (Ymuiden) ...	−12	−10	−8	−8	−7	−7	−6	−6	−6	−7	−7	−8	−11	−14	−15	−14
,, 1896 (Ymuiden) ..	−13	−13	−10	−9	−8	−9	−10	−9	−8	−7	−7	−7	−6	−9	−15	−15
Low water, 1895 (Ymuiden) ...	−11	−6	−6	−6	−1	+1	−3	−7	−8	−5	−4	−5	−8	−12	−15	−14
,, 1896 (Ymuiden) ...	−12	−14	−11	−9	−8	−6	−5	−5	−4	−4	−4	−6	−7	−9	−12	−11
High water, 1896—Hoek van Holland	−13	−14	−15	−13	−10	−10	−12	−14	−12	−9	−9	−13	−16	−17	−12	−11

In calculating the effect of wind and atmospheric pressure on the time of high water at Ymuiden in 1895 and 1896, and at Hoek van Holland in 1896, exactly the same method has been followed.

The formula by which this effect can be expressed, is the following:—

$$C_r = KR + R_b(B - 76{\cdot}0).$$

C_r means the correction in minutes to be applied to the predicted time. For the rest the form of the formula is in every way equal to that for the height, except the disappearing of the term *a*. At absolute calm the mean time of high water, therefore, will not differ from the normal. The sign + signifies that the observed time of high water is later than the predicted, the propagation of the tide being retarded.

The following tables again give an idea of the results and the obtained degree of exactitude:—

I. Value of K.

Force of wind in degrees of the Ymuiden scale	Velocity of wind in m per second	Calculated values of K at Ymuiden: High water 1895	High water 1896	Mean value	Pressure of wind registered at Hoek van Holland, kg. per m²	Mean value	Corresponding velocity of wind in m. per second	Calculated value of K at Hoek van Holland, high water 1896
1	5·7	3	6	4^6	0	0	2	1
2	8·5	6	5	5^9	0 − 5	3	4·9	4·5
3	12·0	9	9	8^8	5 − 10	7	7·5	7
					10 − 20	14	10·6	10
					20 − 30.	24	13·9	13
					30 − 50	38	17·4	20

As an explanation, it may be mentioned that the velocity of wind being v metres per second, the pressure can be represented by $k = \frac{1}{8}v^2$ (k being expressed in kg. per m²); and the pressure k being known the velocity $v = \sqrt{8k}$.

II. Value of R.

Direction of wind	N.	N.N.E.	N.E.	E.N.E.	E.	E.S.E.	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W	W.	W.N.W	N.W	N.N.W
Ymuiden, 1895	$0{\cdot}4^5$	1·1	1·6	0·8	−0·4	−1·2	−1·1	−1·0	−1·3	−1·1	−0·9	−0·7	−0·2	0·1	0·3	$0{\cdot}4^5$
,, 1896	1·5	1·6	1·3	0·5	−0·2	−0·7	−1·1	−1·1	−0·9	−0·7	−0·6	−0·4	−0·1	0·5	1·1	1·3
Hoek van Holland, 1896	1·4	1·6	1·1	0·6	0·0	−0·5	−0·7	−1·5	−1·8	−1·4	−1·0	−0·7	−0·5	0·1	0·5	0·9

III. Value of R_b.

Direction of wind	N.	N.N.E.	N.E.	E.N.E.	E.	E S.E.	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W	W.	W.N.W	N.W	N.N.W
Ymuiden, 1895	1	−1	0	3	4	3	4	5	4	3	3^5	4^5	7	8	6	2
,, 1896	2	2	1	3	5	6	5	4	4	6	7	6	5	3	−1	0
Hoek van Holland, 1896	−2	−3	1	3	4	5	5	6	7	7	6	5	6	7	5	2

The given data may serve to show the value of the results.

We see that the correction for the height of high water, as well as of low water, at Ymuiden and Hoek van Holland, can be expressed by one formula with a sufficient degree of exactitude for practical use.

Herewith the proof is given that the wind and atmospheric pressure do not considerably change the range of tide, but affect the high and the low water in the same way, both being raised or depressed.

The value of *a* at low water seems rather larger than at high water; thus on an average the absolute calm-level at low water is 5 centimetres lower than the mean low water, and at high water 2 centimetres lower than the normal. In practice this difference of 3 centimetres may fairly be neglected; for the study of the phenomena, however, they are important, because they show that the raising of the level, caused on the Holland coast by the prevailing western winds, is rather more considerable at low water than at high water. The reason of this is the greater depth of water at high water-level.

The tables show very clearly that the influence of atmospheric pressure on the height of the tides is not the same for the different directions of the wind, but is the greatest during northern winds, the feeblest during southern winds; the proportion often being much more considerable than we might expect from the proportion of the densities of mercury and sea-water.

I think it probable that in this proportional factor, the character of wind is comprehended—that is to say, that at a certain atmospheric pressure the same observed wind may be more local than at another barometric pressure; in the latter case the wind, for instance, reigning over a more considerable part of the North Sea, and thus having a greater effect on the height of the sea-level.

Very remarkable is the evident and regular influence of atmospheric pressure on the time of high water, which at first consideration one would not expect. High barometer retards the time of high water.

The values of R show clearly that the sea winds raise the level of the sea, and off-shore winds cause a depression. North and south winds act as sea winds; the neutral line lies N.N.E. and S.S.E. The greatest rise is more considerable than the greatest depression, the former being caused by W.-W.N.W. wind, the latter by E.-E.S.E. wind.

The effect of wind on the time of high water is not in phase with that on height, but differs about 90° with it.

The tables indicate that southern winds, which have the same direction as the tidal wave, advance the moment of high water, whilst northern winds retard this moment. The most important retardation is observed during N.N.E.-N.E. wind; the most important advance during southern winds; the neutral line is between E.N.E. and E. and between W. and W.N.W.

The most remarkable result, brought out with surprising clearness, seems to have the character of a general law of nature (which, however, should be affirmed with perfect evidence by comparing the obtained results with those on other points observation), and is the following:—

That the raising or depressing is proportional to the pressure of wind, and that the advance or retardation in time is proportional to the velocity of wind.

It would be highly interesting if the same kind of investigation could be applied to the English North Sea coast, in order to see whether the influence of wind, as found for the Holland coast, is local, and therefore opposite to the results to be obtained at the English side; or if the results are the same, thereby indicating the influence to dominate the whole North Sea.

A special investigation as to whether a wind, continually blowing, increases or decreases the effect on the high water-level, did not give a definite rule. In general there seemed little difference in height between the first and the second high water for the same conditions of wind.

Strong off-shore winds seem to influence the second, and, principally the third and following high water-tide less than the first; so that the long duration seems to weaken the effect of off-shore winds.

Preceding formulæ now permit us to give a formula for practical use. This formula is:

(1) For the height of high water and low water at Ymuiden and Hoek van Holland,

$$C = KR - 3 - R_b(B - 76{\cdot}0),$$

expressed in centimetres.

(2) For the time of high water at Ymuiden and Hoek van Holland,

$$C_r = K_r R_r + R_{br}(B - 76{\cdot}0),$$

expressed in minutes.

These formulæ give, as for the sign, the correction to be applied to the height, and the time predicted in the tide-tables.

The value of the coefficients are given in the following tables:—

Direction of wind	N.	N.N.E.	N.E.	E.N.E.	E.	E.S.E.	S.E.	S.S.E.	S.	S.S.W.	S.W.	W.S.W	W.	W.N.W	N.W	N.N.W
Values of R ...	0·6	0	−0·7	−1·0	−1·3	−1·2	−0·8	−0·1	0·4	0·6	0·9	1·2	1·6	1·5	1·3	0·9
Values of R_b ...	12	11	10	9	7	6	7	8	8	6	6	8	10	12	14	13
Values of R_r ...	1·1	1·4	1·3	0·6	−0·2	−0·8	−1 0	−1·2	−1·3	−1·1	−0·8	−0·6	−0·3	0·2	0 6	0·9
Values of R_{br} ...	0	0	1	3	4	5	5	5	5	5	5	5	6	6	3	1

The way in which the values of K and K_r are to be chosen, depend on the way of observing the force of the wind. The mentioned relation between pressure, velocity of the wind, and the value of K and K_r permits the choice of the proper value of the latter, pressure or velocity of wind being given.

If the force is estimated in degrees of the Beaufort scale, as is usual among mariners, we may choose K and K_r according to the following table:—

Degrees of Beaufort scale	K=	K_r=
0	0·4	1·5
1	2	3
2	6	4·5
3	10	6·5
4	16	8
5	25	10
6	36	12
7	50	15
8	70	18
9	90	21
10	110	25

The mean age of the effect of wind and atmospheric pressure in the calculation being considered as six hours, which is not far from the truth, we may consider that the prediction of the next high water in general ought to be corrected with the observation of wind and barometer at about the preceding low water; a case which will often occur in practice, when vessels wait for the rising water to enter into the harbour.

Suppose a sea captain approaches a harbour entrance, and wishes to determine the correction for the next high water, in order to apply it to the predicted height of the tide-table. He therefore observes direction and force of the wind, and also the state of the barometer, and finds, for instance:—

Direction	N.
Force	7 Beaufort.
Barometer	77·5 centimetres.

The values to be found in the given tables are:—

$$K = 50 \quad R = 0{\cdot}6 \quad R_b = 12.$$

The correction $C = (50 \times 0{\cdot}6) - 3 - 12(77{\cdot}5 - 76{\cdot}0) = 30 - 3 - 18 = 9$ centimetres.

Thus the high water-level will be raised by 9 centimetres above the predicted height of the tide-table.

It will be easy for English mariners to change these formulæ into others, expressed in feet and inches instead of in centimetres.

At the end of these deductions it will, perhaps, not be out of place to state that the calculations give an approximation, and that no absolute reliance can be placed on the formula.

The effects to which the level of the sea is subject are so many and so varied, and there may be in operation agencies acting over a distant area which cannot be discovered by local observation, or which may have been in operation on previous days, that it will never be possible to give a correction of mathematical exactitude.

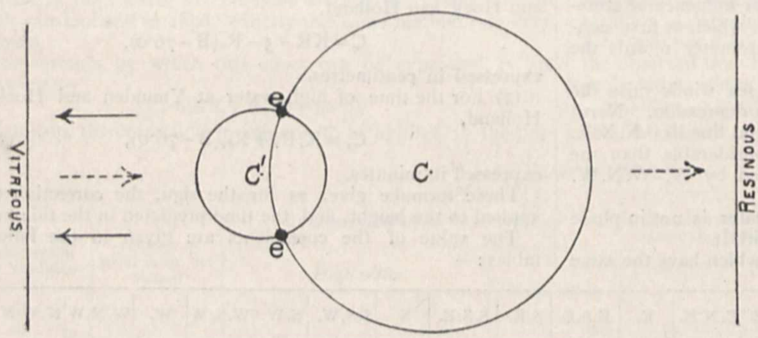
But every indication which approaches truth, and which increases our knowledge, is useful, and in this light the formulæ given should be considered. F. L. ORTT.

The Hague, Holland.

CONTACT ELECTRICITY AND ELECTROLYSIS ACCORDING TO FATHER BOSCOVICH.

YESTERDAY evening, in the Royal Institution, I spoke of an ideal one-fluid electricity subject to attractions of solid substance, to account for contact electricity of metals; and I said that before the end of our meeting I might speak of it further and might have to reverse the conventional language I was using as to positive and negative, and call resinous electricity positive, and vitreous negative. My allotted hour was woefully overpast, and half an hour more gone, before I could return to the subject; and I felt bound to stop. What I wished to say may be said in the columns of NATURE in fewer words than I could have found, to make it intelligible, last night.

CONFIGURATION BEFORE ACTION OF ELECTROLYTIC FORCE



ELECTROLYTIC FORCE SHOWN BY ARROWS.

Varley's fundamental discovery of the kathode torrent, splendidly confirmed and extended by Crookes, seems to me to necessitate the conclusion that resinous electricity, not vitreous, is *the electric fluid*, if we are to have a one-fluid theory of electricity. Mathematical reasons, to which I can only refer without explanation at present, prove that if resinous electricity is a continuous homogeneous liquid, it must, in order to produce the phenomena of contact-electricity which you have seen this evening, be endowed with a cohesional quality such as that shown by water on a red-hot metal, or mercury on any solid other than a metal amalgamated by it. It is just conceivable, though it does not at present seem to me very probable, that this idea may deserve careful consideration. I leave it, however, for the present, and prefer to consider an atomic theory of electricity foreseen as worthy of thought by Faraday and Clerk Maxwell, very definitely proposed by Helmholtz in his last lecture to the Royal Institution, and largely accepted by present-day theoretical workers and teachers. Indeed, Faraday's law of electro-chemical equivalence seems to necessitate something atomic in electricity, and to justify the very modern name *electron*. The older, and at present even more popular, name *ion* given sixty years ago by Faraday, suggests a convenient modification of it, *electrion*, to denote an atom of resinous electricity. And now, adopting the essentials of Aepinus' theory, and dealing with it according to the doctrine of Father Boscovich, each atom of ponderable matter is an electron of vitreous electricity; which, with a neutralising electrion of resinous electricity close to it, produces a resulting force on every distant electron and electrion which varies inversely as the cube of the distance, and is in the direction determined according to the well-known requisite application of the parallelogram of forces.

In a solid metal the ponderable atoms must exert such other mutual forces, compounded with the electric forces, that the assemblage in equilibrium shall have the crystalline configuration, and the elasticity-moduluses, of the metal. The electrions must be perfectly mobile among the ponderable atoms, subject only to the condition that the electric attraction ceases to increase according to the inverse square of the distance and becomes zero (or, perhaps, strong repulsion) when the distance is diminished below some definite limit. For simplicity we may arbitrarily assume the following conditions:

(1) Each electrion is a point-atom of resinous electricity and repels every other electrion with a force varying inversely as the square of the distance between them.

(2) Each electrion is attracted by each ponderable atom with a force which varies inversely as the square of its distance from the centre of the ponderable atom when the distance exceeds a certain limit r and is zero when the distance is less than r.

(3) The shortest distance between two centres of ponderable atoms need not be limited to be $>2r$: it may be whatever we find convenient for the structure and properties to be realised. It will be $>2r$ in an insulating solid and $<2r$ in a conductor.

Two pieces of metal, M, M′, each constituted as I have now explained, will behave in respect to contact-electricity just as two pieces of metal behave in a perfect vacuum. For example, if $r>r'$, M will behave to M′ as zinc behaves to copper.

To illustrate electrolysis, consider an ideal case of a detached compound zinc-copper atom, composed of two single atoms with their centres at C, C′; and two electrions e, e which must, for equilibrium, be in the positions shown in the diagram, if r, r' be of such magnitudes as the radii of the circles showing the shortest distances to which C and C′ attract electrions. Let now electrified bodies at great distances (such as the vitreously and resinously electrified plates indicated in the diagram) act in the manner indicated by the dotted arrows relatively to the ponderable atoms, and the full arrows relatively to the electrions. The ponderable atom C will be drawn away to the right by the electric force on itself: and the ponderable atom C′ will be dragged away to the left by the two electrions overcoming the rightward force which itself experiences in virtue of the electric field. Lastly, to take a real case, the electrolysis of copper-sulphate, let C′ be the centre of an atom of copper in combination with oxysulphion (SO_4), not shown in the diagram; with, in all, six electrions. The copper atom C′ will be drawn away to the right, with no electrion attached to it: and the oxysulphion will be pushed and dragged to the left by the excess of leftward electric forces on the six electrions above rightward electric forces on the five ponderable atoms. KELVIN.

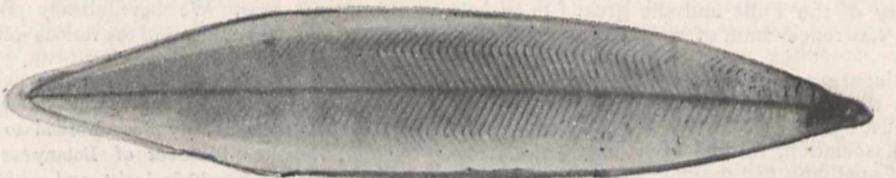
London, May 22.

NEW OBSERVATIONS ON THE LARVA OF THE COMMON EEL.[1]

IN our last note we announced that we had succeeded in following the transformation of *Leptocephalus brevirostris* into *Anguilla vulgaris*, and that the proof had been repeated by Prof. Ficalbi.

Our discovery was thus also confirmed by experiment. We were therefore ready to publish our work *in extenso*, and only regretted that we were unable to supply figures of the intermediate stages between the transparent (blind) Anguillina and the *Leptocephalus brevirostris* with its larval teeth still intact. The only example of this Leptocephalus obtained in a fit condition to survive and undergo its transformations in aquaria—that is to say, one uninjured and sufficiently advanced in its development (already deprived of a considerable proportion of its larval teeth), had already been made the subject of the above-named experiment.

Anterior extremity of the dorsal fin.



Anus.

FIG. 1.—*Leptocephalus brevirostris*, with its larval teeth still intact (enlarged).

An unexpected chance has, however, fortunately procured us a *Leptocephalus brevirostris* which had acquired such characteristics as to convince anyone of the reality of the metamorphoses discovered by us. We think it desirable to give a preliminary notice of this precious specimen, by publishing an illustration of it by the side of that of another *Leptocephalus brevirostris* still having its larval teeth intact.

The present specimen was captured, last January, by Dr. Silvestri in the Straits of Messina.

Its total length is 71 mm. The anus is at about 29 mm. from the apex of the snout, the anterior extremity of the dorsal fin being about 25 mm. from the apex of the snout.

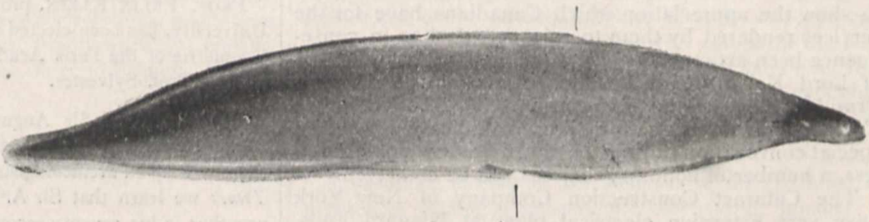
The head and the point of the tail have already noticeably acquired the known special characteristics of the eel.

The larval teeth have totally disappeared, while the distinctive ones seem still entirely absent.

It lacks all traces of pigment.

We will not proceed to further particulars, reserving them for our larger work.

Anterior extremity of the dorsal fin.



Anus.

FIG. 2.—*L. brevirostris* captured by Dr. Silvestri (enlarged on the same scale as the preceding).

[1] "Description of a *Leptocephalus brevirostris* in process of transformation into *Anguilla vulgaris*." Preliminary Note by G. B. Grassi and Dr. S. Calandruccio. Translated from the *Atti della Reale Accademia dei Lincei*, vol. vi. pp. 239-40, 1897.

TORONTO MEETING OF THE BRITISH ASSOCIATION.

II.—LOCAL ARRANGEMENTS.

THE material for the "Handbook of Canada," which is being prepared for the meeting, under the direction of the Publication Committee, is now complete, and there is every ground for believing that a large number of copies of the book will be ready about July 15, for distribution in England amongst the members of the Association who propose attending the Canadian meeting. The aim of the handbook is to give information on the Geography, Geology, Natural History, and Economic Resources of Canada. It will embrace chapters also on Public Administration and on the History of the Dominion. The Chairman of this Committee, Prof. Ramsay Wright, has succeeded in enlisting in the preparation of this work the aid of the most expert Canadian authorities, and there is no doubt that the publication, when it appears, will be regarded as a valuable guide to the Dominion.

In all probability the meeting will have a special distinction in the very large attendance of foreign men of science, an attendance larger than that of any previous meeting. The presence of the Presidents of a number of the leading American Universities, with a very large representation of the scientific members of their Faculties, will make the occasion one of very great interest to both nations. Out of this has again risen the suggestion to form an International Association for the Advancement of Science, and it has been pointed out that the nucleus of such an organisation can be formed at Toronto from the representative men from Europe and America in attendance here. The first meeting, according to this proposition, would be held in Paris in 1900.

His Excellency, the Governor-General of Canada, and Lady Aberdeen have accepted the invitation to be present at the meeting, and have arranged to hold a special Reception for the members of the Association, probably in the new Legislative Buildings, during the evening of August 19. His Excellency takes a deep interest in the coming meeting, and has expressed a wish to do what is possible to make it a success. The Lieutenant-Governor of Ontario, the Hon. G. A. Kirkpatrick, and Mrs. Kirkpatrick have also graciously offered to hold a reception for the members.

The Local Committee recognise how interesting the country about and near Toronto is from a scientific point of view and they have made arrangements whereby the more important points can be seen under competent guidance. Prof. Coleman has undertaken to conduct a party interested in geology to examine the Glacial Beds of the Don Valley immediately east of Toronto. Here are found drift deposits more than 200 feet thick, resting directly on Silurian strata, and containing an abundance of fossils of extinct animal and vegetable forms which point to a climate in Glacial times considerably warmer than that which now obtains in the temperate zone. The change in the lake level brought about since the Glacial Era, is shown by the old shore-line of the ancient lake ("Iroquois Water") demonstrated in these deposits, which is 170 feet above the surface of the present Lake Ontario. At Scarboro' Heights, a few miles further east, the beds reach a thickness of 350 feet. The excursion to be conducted along the course of the Niagara River to the Falls will be under the guidance of two geologists who have made a special study of the region. The vertical walls of rock, 200 feet high, provide an admirable section of the Silurian strata of the region; and the marvellous history of the Falls and the great lakes and rivers of the St. Lawrence chain of waters will be illustrated on the spot.

The excursion to the Niagara region will be made on Saturday, August 21, and that to the Don Valley and Scarboro' Heights on August 23.

The Muskoka Lakes Association, formed of a large number of public-spirited Canadians, are making special arrangements for the excursion to the Muskoka Lake region. Some of the loveliest bits of scenery are to be found in this locality, and a stay of a couple of days (August 21–23) will constitute a very pleasant feature in the programme of the meeting. Many of the members who will take this excursion will be received as guests amongst the members of the Muskoka Lakes Association who have summer residences and camping-grounds on the islands. The Muskoka Lake Navigation Company have arranged for special trips of their steamers on the occasion. The railway fare from Toronto to Muskoka and return will probably be a nominal one.

It is generally recognised that this will be the last occasion for many years on which Canada will be honoured by the visit of so many scientific men, many of whom are veterans in the scientific progress of the nineteenth century, and it is felt that the opportunity should not be allowed to pass without attempting in some way to show the appreciation which Canadians have for the services rendered by them to science. It has in consequence been arranged to give a public banquet in honour of Lord Kelvin, Lord Lister, and Sir John Evans, the President-elect of the Association. The University of Toronto will, to judge from present indications, hold a special convocation during the meeting, at which, doubtless, a number of honorary degrees will be conferred.

The Cataract Construction Company of New York have very extensive electrical plant at Niagara Falls, which generates a large part of the current which supplies Buffalo and the neighbourhood. The Company has generously invited the members of the Association to inspect the plant, and it will arrange specially for the reception of the members who will accept the invitation.

The Director of the Harvard Astronomical Observatory has issued a special invitation to the members of the Association who are interested in astronomy, and who may be in Boston, to visit the Observatory.

The loss sustained by the American Association in the death of its President, Prof. E. D. Cope, is a severe one, and occurs at a critical time. Prof. Cope, it is understood, is to be succeeded by Prof. Theodore Gill, senior Vice-President of the Association, and there will consequently be no interruption in the arrangements for the session. The Council of the Association, at its recent meeting, resolved to extend to all the members of the British Association who will attend the Detroit meeting the privilege of honorary membership. It has also been proposed that, in the interval between the Toronto and the Detroit meetings, the members of the American Association take an excursion trip, the terminal point of which would be Toronto, and its final day August 18.

A. B. Macallum.

NOTES.

Prof. E. A. Schäfer, F.R.S., is unavoidably prevented from attending the forthcoming meeting of the British Association at Toronto, and in his absence the duties of General Secretary will be undertaken by Prof. W. C. Roberts-Austen, C.B., F.R.S., who will also deliver one of the evening discourses, on "Canada's Metals." The other evening discourse will be given by Prof. John Milne, F.R.S., on "Earthquakes and Volcanoes." The Council of the Association have resolved to nominate Mr. W. Crookes, F.R.S., as President for the meeting to be held at Bristol next year. We have already printed (March 25, p. 494) the list of the presidents of the various sections of the Toronto meeting.

At the anniversary meeting of the Linnean Society, held on Monday, the gold medal of the Society was awarded to Dr. Jacob Georg Agardh, Emeritus Professor of Botany at the University of Lund, the distinguished algologist, and author of the "Species, Genera, et Ordines Algarum," which contains the first embodiment of the natural system applied to marine algæ as a whole. Greville, Harvey, and Kützing, no doubt, paved the way and made this task possible, but it nevertheless remains a monument of research and true systematic judgment. In 1872 he commenced a series of memoirs, "Till Algernes Systematik," which he completed in 1890; another great work, "Florideernes Morphologi," having appeared meanwhile in 1879. Ten years later he published his "Species Sargassorum Australiæ"; and in 1892, in his eightieth year, commenced a remarkable series of memoirs, the "Analecta Algologica," the completion of which he has happily achieved. In his unavoidable absence from England, the gold medal just awarded to him was received on his behalf by His Excellency the Minister for Sweden and Norway.

Prof. Felix Klein, professor of mathematics in Göttingen University, has been elected a Correspondant in the Section of Géométrie of the Paris Academy of Sciences, in succession to the late Prof. Sylvester.

The death of Sir Augustus Wollaston Franks, K.C.B., F.R.S., President of the Society of Antiquaries, will be deeply regretted by all archæologists. From an obituary notice in the *Times* we learn that Sir A. W. Franks was born in 1826, and was thus in his seventy-second year. He early developed the taste for mediæval archæology, upon which he afterwards became the leading authority. In 1849 his "Ornamental Glazing Quarries" was published, and among his other archæological works may be mentioned "Medallic Illustrations of British History," and an edition of Kemble's "Horæ Ferales," a volume which his additions converted into a standard work. He entered the British Museum as an assistant in 1851, and afterwards became Keeper of the Department of British and Mediæval Antiquities, and of Ethnography. Not only his own, but other sections of the Museum, bear witness to his catholic taste and great liberality. Upon his retirement from the Museum, he was placed on the Standing Committee, and took an active part in the work up to the time of his death. For some time he was Director of the Society of Antiquaries, and in 1891 he was elected President of the Society for a period of seven years. The Society as well as the Museum was familiar with his liberality, and quite recently he presented to the Society some hundred volumes from his antiquarian library. His principal discovery in archæology was to separate the work of the age which produced what he called "Late Celtic" antiquities from that of the age which preceded and followed it. His persistency as a collector, moreover, managed to secure for the nation the best collection that exists of the remains of this period—a period which lies on the borderland between the prehistoric and historic periods in Britain, and about which antiquarian relics are our only means of knowledge. He was elected a Fellow of the Royal Society in 1874.

THE fund established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to 26,000 dols. (5200*l.*). We are informed that, as accumulated income will be available in November next, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but the trustees give the preference to those investigations, which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund, in order to receive consideration, must be accompanied by full information, especially in regard to the amount required, nature of the investigation proposed, conditions under which the research is to be prosecuted, manner in which the appropriation asked for is to be expended. All applications should reach, before November 1, 1897, the Secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. Decided preference will be given to applications for small amounts, and grants exceeding 300 dols. will be made only under very exceptional circumstances. It appears from the list we have received, that of the seventy-one grants hitherto made, three have come to Great Britain, viz.: 150 dols. to Dr. Samuel Rideal, for investigations on the absorption of heat by odorous gases; 125 dols. to Mr. Edw. E. Prince, of St. Andrews, for researches on the development and morphology of the limbs of teleosts; and 250 dols. to Mr. Herbert Tomlinson, F.R.S., for researches on the effects of stress and strain on the physical properties of matter. Twenty-four of the remaining grants were given to men of science in America, twenty went to Germany, five to Switzerland, four to France, three to Belgium, three to Canada, and two to Italy.

DR. CHARLES W. DABNEY has been appointed "special agent in charge of scientific and statistical investigations" of the U.S. Department of Agriculture.

THE steamer *Bear* left Seattle on May 6 for the Arctic regions, having on board surveying parties of the United States Coast and Geodetic Survey, who have gone to survey the Pribyloff Islands.

THE *Times* correspondent at Copenhagen states that the "Carlsberg Fund" for scientific purposes has offered 150,000 kroner (about 8300*l.*) to the Danish scientific expedition to the east coast of Greenland, for the purpose of making a chart of the coast northwards to Angmagsalik.

AN "at home" was held by the President and Council of the Geological Society at the Society's Rooms in Burlington House, on Wednesday, May 19, when Mr. E. J. Garwood, who was a member of Sir Martin Conway's expedition to Spitzbergen, gave some account of the geology and glacial phenomena of that region.

THE annual report of the Brooklyn Institute shows steady growth in membership. Sir Archibald Geikie delivered before the Institute, on May 10, an illustrated lecture on the Hebrides. In the course of the lecture he remarked that he had never been able to understand the remarkable volcanic phenomena of these islands till his visit to the volcanic region of the western part of the United States eighteen years ago.

WE regret to have to include in this week's obituary the names of Mr. Martin L. Linell, assistant in the Department of Insects of the U.S. National Museum; Dr. C. A. L. Robertson, distinguished for his work in medico-psychology, and joint editor of the *Journal of Mental Science*; and Mr. John Ramsbottom, president of the Institution of Mechanical Engineers in 1870-71.

A SEVERE shock of earthquake, which lasted six or seven seconds, was experienced at Guadeloupe, West Indies, at 10.30 a.m. on April 30. It was most strongly felt at Pointe à Pitre, where the stone gable-end walls of over a hundred houses fell and crushed adjoining buildings. Several minor shocks were felt after the first disturbance. No premonitory sounds were heard.

THE report of the medical superintendents to the Metropolitan Asylums Board on the use of antitoxin in the treatment of diphtheria during the year 1896, has just been presented to the Board. The statistical results with regard to mortality are compared with those for 1894, the year immediately preceding the introduction of antitoxin, and the one in which the lowest mortality had been recorded up to that time; they show a marked improvement in all classes of cases, and especially in the severer ones. "We have had, in fact," the report states, "somewhat better results to record for 1896 than we had for 1895. . . . We have only to add that we still hold to the opinion that in the antitoxic serum we possess a remedy of distinctly—we would now say much—greater value in the treatment of diphtheria than any other with which we are acquainted."

THE conference of the members of the Institution of Civil Engineers was opened on Tuesday, under the Presidency of Mr. J. Wolfe Barry, C.B., F.R.S., President of the Institution. The President, in an address to the combined Sections, congratulated the members who had taken part in the designing and construction of the Blackwall Tunnel upon the successful completion of that work. He then gave an outline of the birth, parentage, and career of the Institution, which dates from 1818. At the conclusion of the address the work of the various Sections began. A conversazione was held on Tuesday evening, and was attended by some 1500 guests.

A GENERAL meeting of the members of the Federated Institution of Mining Engineers will be held in London, on Thursday (June 3) and Friday (June 4). The following are among the papers to be read:—"Presidential Address," by Mr. Lindsay Wood; "Machine Coal-mining in Iowa, U.S.A.," by Mr. H. Foster Bain; "Occurrence of Cinnabar in British Columbia, Canada," by Mr. W. Hamilton Merritt; "Notes on a Boring at Netherseal, Ashby-de-la-Zouch, Leicestershire," by Mr. G. J. Binns, with stratigraphical remarks by Mr. C. Fox-Strangways, and petrographical remarks by Mr. W. W. Watts; "The South Wales Anthracite Coal-field," by Mr. Morgan W. Davies; "The Lake Superior Iron Ore Region, with special reference to the Masabi Range," by Mr. Horace V. Winchell; "Gold in Nature," by Captain C. C. Longridge.

AN air-ship made a remarkable ascension from Nashville a few days ago, under the management of Mr. A. W. Barnard. The air-ship is a cylindrically-shaped silken bag, with rounding ends, and is 42 feet long and 16 feet wide, enclosed in a netting which is attached to a beam. Ten feet below from this beam a saddle is suspended, with pedals like a bicycle, by which the four-bladed propeller, 10 feet in the rear of the aeronaut, is turned. Hydrogen gas was used to inflate the ship. After the ship had risen to the height of about 500 feet, the aeronaut turned completely around, to show that the propeller was effective. He continued rising till he was out of sight, and propelled the machine in a direction diagonally to the wind at a rate of ten or twelve miles an hour. After travelling fifteen miles, he returned to within four miles of the city; but he had to rise and fall so many times that his supply of gas became exhausted, and also one of the blades of his propeller broke, and he descended.

It is stated in the *Times* that, in accordance with the recommendations of the Departmental Committee on Dogs, upon which the Board of Agriculture have already taken action in London, Lancashire, Yorkshire and the Midlands, a muzzling order will shortly be issued by the Irish Privy Council, and that, as the cases of rabies in Ireland are so widely scattered, the order will extend to the whole of that country. The Irish Privy Council intend also to issue an order relating to the importation of dogs, following closely upon the lines of the order already sanctioned for Great Britain, and referred to last week (p. 60). This combined action gives us reason for hope that rabies will some day be exterminated from our islands.

The President of the Board of Trade has appointed a Committee, consisting of Sir Charles Hall, Q.C., K.C.M.G., M.P. (Chairman), Mr. James Alward, Mr. T. Gibson Bowles, M.P., Captain A. J. G. Chalmers, Rear-Admiral W. J. L. Wharton, C.B., F.R.S., Mr. Charles H. Wilson, M.P., to consider and report whether any, and, if so, what, alterations or additions are required in the regulations for preventing collisions at sea, as regards (1) the lights to be carried and exhibited, and the signals to be carried and used, by sailing ships, steam ships, and boats when engaged in fishing; (2) the expediency of requiring all ships to keep out of the way of steam ships when such ships are engaged in fishing; (3) the lights to be carried and exhibited by steam ships carrying pilots when engaged on their stations on pilotage duty.

A remarkable glacial eruption occurred in the early months of the present year in the south of Iceland. A postman was crossing the sands of Skeidara, when suddenly he heard the glacier about two miles in front of him emit a long, groaning sound, and saw large masses of ice being hurled into the air from the glacier, immediately followed by a flood that descended upon the level sands, surging to and fro and carrying everything before it. He promptly turned his horse and rode away to the station of Nupsstad, on the western side of the glacier. Six days later he returned to the sands, and saw them as a belt of ice-waves extending from the glacier to the sea, a distance of at least twenty-five miles. The average breadth of this belt was about four miles. The height of the ice-floes or waves varied from 70 feet to 90 feet. It was impossible to cross this wall of ice except close by the foot of the glacier where the floes were far apart. On the other side of the ice-field were six newly-formed torrents rushing from the glacier. No damage to life or property was caused by this eruption, which is believed to have some connection with the severe earthquakes of last summer.

The Report on Admiralty Surveys for the year 1896, by the Hydrographer, Rear-Admiral Wharton, C.B., F.R.S., has just been published as a Blue-book. Notwithstanding the progress of hydrography, and the constant employment of our own and foreign surveying vessels in many parts of the world, the requirements of modern steam navigation increase more rapidly than the advance of surveys. Every year newly-discovered rocks are reported, the number of which shows no signs of diminishing. During the year 1896 no less than 209 rocks and shoals which were dangerous to navigation were reported, and required to be notified to the public by notices to mariners. Among the many observations recorded in the report, we notice that the Goodwin Sands has continued its general movement towards the coast, and the area of drying sand has very largely increased since the last ten years, when only small parts of the bank were above low water. An account is given of the part taken by H.M.S. *Penguin* in the coral-boring expedition sent by the Royal Society to Funafuti Island, Ellice Group. Reference is made to the determination of the contour of the outer slopes of the atoll; and it is also pointed out that the soundings obtained by H.M. surveying ships during the past few years in the south-western part of the Pacific, on the course of their voyages from and to Australia, have very largely added to our knowledge of the conformation of the bottom, and valuable information has been collected for submarine telegraph cables, if required. H.M.S. *Waterwitch* was engaged at Tasmania and the Fiji Islands in 1896. A line of soundings run towards Norfolk Island, and from thence to Smoky Cape on the Australian coast, passing between the Elizabeth and Middleton reefs, disclosed the interesting fact that these reefs are not on the comparatively shallow ridge that connects New Zealand with Queensland, but rise from deep water on its flanks.

We have received the Report of the Director of the Liverpool Observatory for the year 1896. In addition to the transit and other astronomical observations required by the Mersey Docks and Harbour Board, special attention has been given at this observatory to anemometrical observations, and various interesting papers have from time to time been published upon this subject, *e.g.* one on the velocity of the wind at Liverpool, by the late W. W. Rundell, based upon the data between 1852 and 1866. During the past year, Mr. W. E. Plummer has made a number of comparisons between the results obtained from a Dines' tube anemometer and the Robinson cup and Osler plate anemometer. The values of the first two have been recorded under eight principal points of the compass, and Mr. Plummer states that the result of the comparison is to some extent a surprise, as it was anticipated that the record of the Robinson instrument would be much too great, owing to the wind velocities being computed on the assumption, now generally regarded as erroneous, that the wind travelled at three times the velocity of the cups. The experiments, however, go to show that the appropriate factor to reduce the Robinson velocities to the Dines standard is not so low as was expected, and that the velocities published in past years have not been in error by so great an extent as 10 per cent. It is important to remember, however, that in such comparisons much depends not only upon a proper exposure, but upon the size of the cups and the length of the arms of the instrument employed.

Dr. C. Diener, of Vienna, contributes to the *Mittheilungen der K. K. geographischen Gesellschaft* in Vienna an exhaustive discussion of the bearing of geological research on the destruction of Sodom and Gomorrah. The Scriptural account of the catastrophe is examined in detail, and the descriptions of travellers are employed to work out a complete picture. From a comparison with similar more recent disturbances in various parts of the globe, Dr. Diener concludes that the cities of Pentapolis were overwhelmed by a violent earthquake affecting the whole basin of the Dead Sea, and following upon a series of minor undulatory movements. Masses of subterranean water were forced up to the surface, giving rise to extensive landslips, and consequent inundation of large districts by the waters of the Dead Sea. At the same time the shock reopened the crater of a volcano on the eastern margin of the sea, and a violent eruption followed. This account, in Dr. Diener's opinion, best satisfies the geological conditions observed, and it may be admitted that it confirms the descriptive accuracy of the Biblical narrative.

THE new number of the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin* contains two important memoirs—one by Dr. G. Schweinfurth on the stone quarries of the Mons Claudianus in the Eastern Egyptian Desert, and one by Dr. Hans Steffen on the relations of Patagonia to the frontiers of Argentina and Chili. Dr. Steffen's paper is illustrated by an excellent map of an almost unknown region.

DR. ARTHUR KEITH has reprinted his four papers on the Anthropoid Apes, published in *Natural Science* during last year, and has formed thereby a very useful index to the literature of these important animals. The books and papers on this subject are, as Dr. Keith observes, much more numerous than most people imagine, and are, moreover, scattered about in the publications of all parts of the world. New contributions to this engrossing subject cannot satisfactorily be made without a full knowledge of what has been previously written. This is, therefore, a most useful piece of work, for which naturalists should be duly grateful to the author.

THE work undertaken by Prof. Balfour Stewart, some years ago, in conjunction with Mr. W. W. Haldane Gee, and entitled, "Lessons in Elementary Practical Physics," was unfortunately interrupted by the death of Prof. Stewart, who only saw the completion of the second volume—that on Electricity and Magnetism. It has now been decided to complete the work by entrusting it to the hands of separate coadjutors; accordingly part 1 of volume iii. will appear immediately, containing a treatise on "Practical Acoustics," by Mr. C. L. Barnes. Part 2 of volume iii. will be a treatise on "Heat," by Mr. Haldane Gee; while the third part, completing the volume, will comprise "Optics."

AMONG noteworthy papers and other publications which have come under our notice during the past few days are the following:—*The Psychological Index*, No. 3, being a bibliography of the literature of psychology and cognate subjects for 1896, compiled by Mr. H. C. Warren and Mr. Livingston Farrand. This valuable index is a special issue of the *Psychological Review*.—Six fine portraits of the late Prof. E. D. Cope are given in the May number of the *American Naturalist*, together with several appreciative notices of his life and work.—A detailed obituary of the late Prof. Du Bois Reymond is contributed to the *Revue de l'Université de Bruxelles* by Prof. Paul Heger.—A catalogue of works on pure and applied mathematics, from the libraries of the late Prof. Cayley and Dr. Todhunter. These books and papers are offered for sale by Messrs. Macmillan and Bowes, and the list of them will interest many mathematicians and astronomers.—Dr. James Cappie contributes to the *Monist* (April) some suggestive considerations on the bearing of elementary physical principles on intercranial activities.

IN view of the growing use of acetylene for heating and illuminating purposes, it has become of importance to find out under what conditions the storage of the gas may become dangerous. Some time ago MM. Berthelot and Vieille found that an explosive decomposition could be set up in acetylene either by a fulminate cap or by a red-hot wire, provided that the pressure was above two atmospheres, this explosive decomposition taking place with extreme ease in the case of the liquefied gas. In the latter case, the effects of the decomposition were similar in character to those produced by high explosives. These results were only too rapidly confirmed by the fatal explosion in Paris of a cylinder of liquid acetylene. It has recently been found out that acetone is a good solvent for acetylene, and in the *Comptes rendus* (May 10) MM. Berthelot and Vieille give an account of their very complete experiments on this solution. After examining the relations between pressure and temperature for solutions of various strengths, they next studied the effects produced by exploding a small charge of mercury fulminate, and by a red-hot wire. It was found that solutions of acetylene in acetone, although still capable of explosion, were much safer than the gas alone, the pressure at which explosion began to be possible being raised from two to ten kilograms per square centimetre. For a given sized vessel the quantity of acetylene that can be safely stored is fifty times greater with acetone than without it.

THE additions to the Zoological Society's Gardens during the past week include two Common Marmosets (*Hapale jacchus*) from South-East Brazil, presented by Mr. W. A. Bromwich; a White-throated Capuchin (*Cebus hypoleucus*) from Central America, presented by Mr. T. H. Rudkin; two Bonnet Monkeys (*Macacus sinicus*) from India, presented by Mrs. Hardisty; a Cape Hunting Dog (*Lycaon pictus*) bred in Ireland, presented by the Royal Zoological Society of Ireland; a Vulpine Phalanger (*Trichosurus vulpecula*) from Australia, presented by Dr. J. Martin Kennedy; a Peregrine Falcon (*Falco peregrinus*), captured in the Red Sea, presented by Mr. J. Kilpatrick; an Alexandrine Parrakeet (*Palæornis alexandra*) from India, presented by Mrs. E. Hight; three Cocteau's Skinks (*Macroscinicus cocteaui*) from the Island of Raza, Cape de Verde, presented by Mr. Boyd Alexander; an Antillean Boa (*Boa diviniloque*) from St. Lucia, presented by Captain Digby H. Barker; a West African Python (*Python sebæ*) from West Africa, presented by H.E. Colonel F. Cardew, C.M.G.; a Smooth-headed Capuchin (*Cebus monachus*, albino) from South-east Brazil; two Green Monkeys (*Cercopithecus callitrichus*) from West Africa, two Blue Penguins (*Eudyptula minor*) from New Zealand, deposited; two Wallabys (*Macropus*, sp. inc.), an Australian Pelican (*Pelecanus conspicillatus*) from Australia, purchased; a White-tailed Gnu (*Connochetes gnu*) from South Africa, received in exchange; a Japanese Deer (*Cervus sika*), a Patagonian Cavy (*Dolichotis patachonica*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ORIGIN OF SOLAR AND STELLAR LIGHT.—We have received a small pamphlet of eight pages (including the preface and a supplement) entitled "The Explanation of the Origin of Solar and Stellar Light, and the minor phenomena connected therewith," written by Mr. M. R. Dissett, and published at the moderate (?) price of one shilling. The author of these pages expounds a theory of the universe in which the element of "temperature" plays no *rôle* whatever; in fact, he says "it requires only magnitude and distance sufficient for any non-luminous body to become a brilliant star." Indeed, he goes on to say, "the fact that all the heavenly bodies, without exception, the rarest gases as well as the most solid bodies, give light in proportion to their magnitude, density and distance, might long ago have suggested that their brilliancy must be due to some such principle and not to their being incandescent matter, a theory as puerile as it is unscientific." The "principle" alluded to in the extract, is none other than that by which the light "reflected by a comparatively dull body, such as a planet, becomes more intense as its apparent disc diminishes in increasing distance, till finally it becomes a brilliant star." Arguing from this, the author explains how our sun does not shine by his own light, but is non-luminous and reflects star light. In fact, he infers that every body in the heavens appears bright on this principle. One might be inclined to ask whence the original light, since every body seems to be capable only of reflection, comes. This difficulty is also explained on this "principle," for it "accounts for how light itself is generated, for the forces that generate light . . . are everywhere at work, though the result may not be immediately apparent to our senses." As this "principle" seems to be capable of enlightening astronomical science on so many points, we think we have mentioned enough of them for the reader to imagine the rest.

THE NEBULA OF ORION.—Two publications of the observations of the nebula of Orion have recently come to hand, one relating to eye observations, and the other restricted to photographic work. The former of these forms part of the publications of the "Leander McCormick Observatory of the University of Virginia" (vol. i. part 7), and consists of the eye observations made by the Director, Mr Ormond Stone. A minute comparison of the results obtained by this survey with those given in the second publication should no doubt prove of great interest. This latter work we owe to Dr. Scheiner; it forms the second part of the eleventh volume of the "Publicationen des Astrophysikalischen Observatoriums zu Potsdam." In this Dr. Scheiner has investigated the details of this nebula as registered by several photographs, and he had also, with the intention of tracing some relationship between the nebula and the stars in and around it, completed a rigorous measurement of the position of the stars on the photographic plates. The main result of the investigation shows that undoubtedly there is a relationship between the nebula and the neighbouring stars. This result is satisfactory in that it is just what we should expect on the meteoritic hypothesis, and further corroborates Mr. Isaac Roberts's recent work, which also indicated a close connection between stars and nebulæ.

THE PARALLAX OF 61[1] CYGNI.—Mr. Herman S. Davis contributes to the *Astronomical Journal*, No. 402, the results of his investigation of the parallax of 61[1] Cygni. In this work he has employed the nineteen negatives of this star taken, between the years 1871–74, by Mr. Rutherfurd. The methods of reduction by differences of distance of two stars, having approximately equal distances, and differing about 180° in position-angle, are here the same as were employed for the parallax of μ, θ and η Cassiopeiæ in previous investigations. In addition to measures of distance, those of angle have here been employed. Taking the means of the values given in the *Astronomical Journal*, that for measurement of distance is $+0''\cdot3999 \pm 0''\cdot0230$, and for measurement of position-angle $+0\cdot3326 \pm 0''\cdot0189$. The resulting value for the mean relative parallax of this star is therefore $+0''\cdot360 \pm 0''\cdot0146$. Mr. Davis adds that a complete discussion of the measure of 61[1] Cygni will soon be published as Contribution No. 13 from the Observatory of Columbia College.

THE ROYAL SOCIETY CONVERSAZIONE.

THE first of the two conversazioni held annually at the Royal Society took place on Wednesday, May 19. The following is a list of the exhibits:—

Illustrations of the Dansac-Chassagne process of producing photographs in colour: Sir H. Trueman Wood.

Apparatus for ascertaining duration of explosion, pressure developed, and rate of cooling of products of combustion: Sir A. Noble, K.C.B., F.R.S. The recording instrument consists of a rotating drum on which two pencils mark (1) seconds, (2) the pressure in tons per square inch indicated by a specially designed manometer; the pressure pencil traces out a curve, from which can be deduced the approximate time of explosion, the pressure reached, and the rate at which the gases cool; a second instrument is attached, on which the pressures and seconds are indicated by small electro-magnets.

Stress effects produced by convective electric discharges: Mr. J. W. Swan, F.R.S.

Apparatus for the comparison of thermometers: Mr. W. Watson.

A powerful electrical influence machine: Mr. J. Wimshurst. The machine has 24 discs, each 3 feet in diameter; they are so arranged as to furnish three poles, one of which may be negatively charged, the other two poles positively charged, or at pleasure the reverse order may be followed; by this arrangement two separate streams of discharge may be in use at the same moment.

(1) Model of a Hertz wave transmission; (2) two kinematic models: Prof. Silvanus P. Thompson, F.R.S.

Graphic representation of the Rothamsted observations on the continuous growth of wheat: Dr. H. E. Armstrong, F.R.S.

Certain bones of the ancient Naquada race, exhibiting characters of morphological or pathological interest: Mr. E. Warren.

Restored skeleton of *Æpyornis Hildebrandi* (Burckhardt) from Madagascar. The skeleton exhibited is the *first* and almost complete skeleton of *Æpyornis Hildebrandi* hitherto obtained from Madagascar. *Nesopithecus Roberti* (Forsyth-Major), a fossil monkey of an entirely new genus, and other objects: Dr. C. I. Forsyth-Major. (The collection was made by means of grants from the fund administered by the Royal Society.)

Glacial phenomena of Cambrian or Pre-Cambrian age, from the Varanger Fjord, Norwegian Lapland: Mr. Aubrey Strahan.

Photographs of the moon taken with the new Thompson 26 in. photographic telescope, at the Royal Observatory, Greenwich: the Astronomer Royal.

Photographic Atlas of the Moon, published by the Observatory of Paris; executed by MM. Lœwy and Puiseux: the Library of the Royal Society.

(1) Photographs illustrating enhanced lines in the spectra of the chemical elements, and the importance of such lines in the spectra of the hotter stars. (2) Solar photographs, taken at Dehra Dun, India, showing a kite and a locust projected on the sun's disc. Forwarded by Mr. J. Eccles. (3) Photographs illustrating the spectroscopic results obtained by the Eclipse Expedition to Novaya Zemlya, August 1896. (4) Photographs illustrating preparations and arrangements for the observation of the total eclipse of the sun August 1896, at Kiö Island, Varanger Fjord, Norway: Mr. J. Norman Lockyer, C.B., F.R.S.

Experiments with kathode and X-rays: Mr. A. A. C. Swinton.

A selection of dried plants from Tibet, collected by Captain Deasy and Mr. Arnold Pike, Captain Wellby and Lieutenant Malcolm: the Director, Royal Gardens, Kew.

Photographs illustrating the micro-structure of alloys: Mr. J. E. Stead.

Some photographs of optical projections in space: Mr. Eric Stuart Bruce.

Apparatus showing the phase change of light reflected at a glass-silver surface: Mr. E. Edser and Mr. H. Stansfield. The apparatus exhibited is a modification of Michelson's differential refractometer, the interfering rays being reflected at the back surfaces of the end mirrors On these surfaces are deposited silver films, one being wedge-shaped, with a horizontal streak rubbed off, and the other uniform. Where vertical bands cross from the glass-air to the glass-silver surface a lateral displacement is produced, which varies from zero at the thin end of the wedge to ⅔ of a band at the thick end. The direction of the displacement indicates a retardation.

Apparatus for micro-photography: Prof. Roberts-Austen, C.B., F.R.S. A microscope and camera is arranged for obtaining photographs of metals and alloys under high magnification. The illustrations show the mode of existence of carbon in steel, and include the diamond form of carbon. The magnifications vary from 500 to 1000 diameters.

Living specimens of *Proteus anguinus*, Laurenti: Mr. E. J. Bles.

A collection of British Medusæ: Mr. E. T. Browne.

(1) Experiments with highly-dilatable and nearly non-dilatable nickel steel; (2) diagrams of expansion; (3) compensated pendulum made of nickel steel: M. C. E. Guillaume, Bureau International des Poids et Mesures.

(1) Superficial colour changes of a silver-zinc alloy; (2) X-ray photographs of sodium-gold alloys: Mr. C. T. Heycock, F.R.S., and Mr. F. H. Neville.

(1) Improved hatchet planimeter; (2) the cyclesograph, an instrument for describing arcs of circles of large radius: Mr. E. K. Scott.

The diffraction kaleidoscope: Mr. C. P. Butler.

A mid-water tow-net: Dr. G. H. Fowler.

Rotating discs, showing subjective colour phenomena: Mr. Shelford Bidwell, F.R.S.

Demonstration of Zeeman's discovery of the broadening of spectrum lines by the action of a magnetic field on the source of light: Prof. Oliver Lodge, F.R.S.

Commensalism amongst marine animals: the Marine Biological Association.

Experiments on the transmutation of sound vibrations: Mr. J. Gould.

Examples of animal-forms peculiar to Lake Tanganyika: Mr. J. E. S. Moore.

The Tsetse fly and the parasite of Tsetse fly-disease, or Ngana: Dr. A. A. Kanthack, Mr. W. F. H. Blandford, and Mr. H. E. Durham.

(1) Egg of *Æpyornis maximus* (Grandidier), Madagascar; (2) egg of African ostrich for comparison of size; (3) photograph of a fossil frog (*Discoglossus Troscheli*, Meyer sp.) from the lignite (Miocene) of Rott, near Bonn, and sciagraph of a recent frog of the same genus (*Discoglossus pictus*, Otth), for comparison. By Messrs. James Green and James H. Gardiner: Dr. Woodward, F.R.S., on behalf of Mr. R. Damon.

Ceraterpeton Galvani, Huxley, coal measures, Kilkenny, Ireland: Dr. Woodward, F.R.S., for Mr. J. G. Robertson, of Dublin.

(1) Living specimens of the British Mymaridæ (egg parasites), terrestrial and aquatic; (2) mounted specimens of newly-discovered genera. Mounted specimens of newly-discovered male Prestwichia: Mr. F. Enock.

(1) Specimens of Lepidoptera altered by temperature experiments, and reared by the exhibitor; (2) some of the results of crossings carried out by the exhibitor: Dr. M. Standfuss, of Zürich.

Examples of alteration of insects by temperature applied in the pupal stage: Mr. F. Merrifield.

Some examples of geographical distribution among the micro-Lepidoptera, with specimens from different regions, and coloured maps: Lord Walsingham, F.R.S.

Blood corpuscles of some invertebrate animals. Digestive gland of *Ostrea*: Dr. C. A. MacMunn.

A rotating mirror, specially made to the order of exhibitor by the Cambridge Instrument Co.: Sir David Salomons, Bart.

A rowing indicator, giving continuous record: Mr. F. C. Atkinson.

A new pocket mercurial standard barometer: Prof. J. Norman Collie, F.R.S., and Captain H. H. P. Deasy.

An apparatus for investigating the influence of proximity of substances on voltaic action: Dr. Gore, F.R.S.

Micrometer for microscopic measurement of large objects. Manufactured by the Cambridge Scientific Instrument Co.: Prof. W. F. R. Weldon, F.R.S.

Earth thermometer. A simple apparatus for the determination of earth temperatures: Mr. E. H. Griffiths, F.R.S.

Experiments illustrating a new method of controlling the electric arc in its application to photo-micrography: Mr. T. A. B. Carver and Mr. J. E. Barnard.

Kamm's "Zerograph," or "Printing Telegraph System": Mr. L. Kamm.

New phototheodolite, designed by Mr. J. Bridges-Lee: Mr. Casella.

The following demonstrations, with experiments and lantern illustrations, took place in the meeting-room:—

Experimental demonstration of "some electric and mechanical analogues": Prof. W. E. Ayrton, F.R.S.

Lantern-slides from micro-photographs, illustrating nuclear division in animal and vegetable cells: Prof. J. B. Farmer. Slides were shown illustrating the process of fertilisation and segmentation of the egg in *Ascaris megalocephala*, and in *Fucus vesiculosus*.

INFLUENCE OF RÖNTGEN RAYS UPON ELECTRICAL CONDUCTIVITY.[1]

IN a note read on March 1 in the Royal Society of Edinburgh, Lord Kelvin, Drs. Beattie, and Smolan treat of the influence of the Röntgen rays on the conductivity of air, paraffin, and glass (NATURE, vol. lv. pp. 498-99). After careful experiments, made with different potentials, they conclude that no perceptible increase of the conductivity of paraffin and glass is produced on them by the action of the X rays. On the contrary, Messrs. J. J. Thomson and M'Clelland have thought, after their experiments, that paraffin and glass, submitted to the X-rays, increase conductivity. I had employed myself in the same question some time before, and I have explained the results of my researches in two notes presented to the Royal Academy of Naples on May 9 and July 4, 1896, and in a third note presented to the Royal Academy of the Lincei in Rome on June 6, 1896. This last note begins with the following words:—

"My first idea was to study whether the X-rays, crossing a dielectric, could render it conductor, so as to facilitate across it the discharge of an electrified body. In these researches of mine I employed, as a dielectric, some paraffin because, besides its being one of the best insulators, it is also very transparent to the X-rays."

The results set forth in those three notes may be thus shortly re-stated.

The discharge of a conductor in the air, provoked by the X-rays, seems to take place by convection or transport; so to say by an electric dance of the particles in the air, roused by radiation. Righi's experiments lead likewise to a similar interpretation.

The discharge of the conductor becomes slower when the surface exposed to air is diminished—that is to say, when a portion of it is covered with paraffin.

A conductor, loaded with electricity and narrowly surrounded by a wrapper of paraffin, loses, by a first action of the X-rays, a small part of its discharge, and in the following times, after having been freshly charged to its primitive force, it always loses less, so that at the third, fourth, or fifth experiment the discharge is imperceptible or next to nothing. Therefore paraffin, under the action of the X-rays, does not gain in conductivity.

India-rubber behaves almost in the same manner as paraffin.

If the conductor is surrounded first by air and further out by a tube of paraffin, the conductor excited by the X-rays discharges itself, at first rapidly enough; but, soon after, the discharge proceeds, to the last, very slowly. As usual, electricity, carried by air, soon loads the sides of the tube, and then disperses itself with difficulty.

Electricity, scattered from the body, submitted to the action of the rays, can join itself again on a tube of paraffin, or of insulated metals, surrounding the discharging body. This electricity, gathered up on a tube, can be directly observed with an electroscope provided with dry piles, and is found, as is to be expected, of the same nature as that of the body itself.

Insulating liquids (turpentine oil, vaseline, Venetian turpentine, and petroleum) were also examined by me, and they behaved almost in the same manner as paraffin. An electrified conductor submerged in one of these liquids (vaseline oil is the best of all), under the action of the X-rays, discharges itself at first rapidly, but soon after the discharge stops almost entirely.

Lastly, the conductive property of the gases, crossed by the X-rays, increases with their density, and may be ranged in the following order:—

Hydrogen, lighting gas, air, carbonic anhydride, and vapours of ether or carbonic sulphur.

The results, relative to the first four gases, agree with those already given by Righi.

[1] Experiments published May, June, July 1896, proving that solid and liquid insulators retain their insulating powers under the influence of the Röntgen rays. By Prof. Villari. Communicated by Lord Kelvin.

THE CHEMISTRY OF THE HOTTEST STARS.

AT a discussion meeting of the Royal Society, held some two months ago, a paper was read by Mr. J. Norman Lockyer, C.B., F.R.S., under the above title. This has recently been published, and we reproduce the general conclusions.

(1) In a mixture of vapours at a particular temperature, a vapour which is not present in sufficient quantity to show all the lines of its spectrum will be represented by the lines which are longest in its spectrum at the particular temperature in question.

Only some of the short lines in metallic spectra represent the effects of high temperature.

(2) Some of the substances which have been investigated, including iron, calcium, and magnesium, have probably a definite spectrum, consisting of a few lines, which can only be completely produced at a temperature higher than any which is at present available in laboratory experiments. The lines constituting the new spectra are those which either only appear in the spark spectrum, or are lengthened in passing from the arc to the spark. Such lines are termed enhanced lines.

(3) In the case of iron, calcium, and magnesium, there are four distinct temperature steps which are marked by spectral changes: (*a*) the flame spectrum, (*b*) the arc spectrum, (*c*) the spark spectrum, (*d*) a spectrum consisting solely of those lines which are enhanced in passing from the arc to the spark.

(4) The order of temperature of certain stars, as determined from a comparison of the extensions of the continuous spectrum into the violet or ultra-violet, is precisely the same as that which follows from a comparison of the metallic spectra at the four stages of temperature.

(5) The variations of the metallic lines furnish the most convenient means of determining relative stellar temperatures, for the reason that photographs with special exposures are unnecessary.

(6) Having ascertained the relative temperature of a star in this way, and assuming that all the absorbing vapours are at the same temperature, the presence or absence of any other metallic substance can be determined by looking for the lines which are longest in its spectrum at that temperature. In the case of the hottest stars, the fourth stage spectrum must be the term of comparison.

(7) Accepting the new results with regard to the lines enhanced in the spark, several lines in the spectra of the hottest stars, for which no origins could previously be assigned, can now be ascribed to metallic substances at the fourth stage of temperature.

(8) The lines of the cleveite gases appear only in the hotter stars, as indicated by the extension of the continuous radiation into the ultra-violet. They increase in intensity with increased temperature in certain stars.

(9) The order of stellar temperatures, determined from the *increasing* intensity of the lines of the cleveite gases, is identical with that determined from the *decreasing* intensity of the metallic lines in the case of those stars which show both series of lines.

(10) Different substances are spectroscopically visible through different ranges of stellar temperatures. The hydrogen lines are visible in stars ranging in temperature from that of α Orionis to that of Bellatrix, while those of the cleveite gases do not appear below the temperature of α Cygni. The enhanced lines of calcium appear at temperatures as low as α Orionis, and persist, with reduced intensity, to the temperature of Bellatrix; those of iron do not appear at temperatures lower than that of α Cygni, and disappear altogether at the temperature of Bellatrix; while the enhanced line of magnesium appears at the temperature of α Cygni, and remains feebly visible at the temperature of Bellatrix.

(11) It follows, then, that the enhanced metallic lines may be absent from a stellar spectrum, either because the temperature is too low or too high.

(12) In the case of those stars which previous investigations have shown to be cooling, the metallic line phenomena are inverted. The enhanced lines first become visible, then the arc lines; while the enhanced lines disappear at a certain stage in the process of cooling the arc lines continue to become stronger.

(13) The lines of the cleveite gases show a similar inversion on the downward side of the temperature curve. Strongly represented in the hottest stars, they thin out very rapidly in cooling stars, and disappear before the arc lines have begun to show themselves.

(14) Utilising the iron lines as a method of bringing together stars of approximately equal temperature, it is found that at each stage the stars are divisible into two groups, which, in accordance with my previous work, correspond to increasing and decreasing temperatures respectively.

(15) As determined in this way, stars of increasing temperature differ from those of decreasing temperature at the same stage of heat: (1) in the greater continuous absorption in the violet or ultra-violet, (2) in the generally greater intensity and breadth of the metallic lines, (3) in the smaller thickness of the hydrogen lines, (4) in the greater thickness of the helium lines at those stages in which they are visible.

(16) These differences are all explained on the meteoritic hypothesis.

(17) There are stars, near and at the top of the curve, which cannot be arranged in order of temperature by the criteria referred to in (15), for the reason that the iron lines have disappeared, and the lines of hydrogen and cleveite gases show little variation.

(18) The arrangement of stars about the top of the curve will depend upon the conditioning of certain lines, at present of unknown origin; the necessary criteria, therefore, require further investigation.

(19) The known facts with regard to changes in the line spectrum of an element can be easily explained on the hypothesis of successive dissociations analogous to those observed in the case of undoubted compounds.

(20) Similarly, the differences in the lines representative of a metal such as iron in the spectra of sun-spots, prominences, chromosphere, or different stars, are explained by supposing that there are different molecular groupings at each stage of temperature.

(21) The change from a continuous spectrum to one consisting of flutings, and afterwards to one of lines, is now acknowledged to be due to the existence of different molecular combinations.

(22) The recent investigations of Humphreys and Möhler on the shifts produced in metallic lines, when the vapours are observed at different pressures, confirm my view that the line spectrum of a metal integrates for us the vibrations of several sets of molecules.

(23) It is argued that the existence of "series" of lines in the spectra of some chemical elements is another indication of molecular complexity, each series probably representing the vibrations of similar molecules.

(24) The behaviour of the magnesium lines in stellar spectra is ascribed by Dr. Scheiner to differences of temperature, in accordance with my experimental results of 1879.

(25) The experiments on the spectrum of mercury which have been made by Eder and Valenta have revealed variations which according to them favour the dissociation hypothesis.

(26) On various grounds, the view that the differences in stellar spectra represent fundamental differences of chemical composition is untenable. The fact that many stars which are widely separated in space give identical spectra, indicates that they not only contain the same "elements," but that the "elements" exist in the same proportions in all.

(27) On the non-dissociation hypothesis, the action of heat on the sun's chromosphere could not produce such a spectrum as that which we know to be associated with hotter stars, since the relative proportions of different vapours could not be changed. The only change which can be imagined to take place on this hypothesis is a reduction of intensity of all the lines due to reduced pressure.

(28) On the dissociation hypothesis, increased temperature would bring about fundamental changes in the spectrum due to molecular simplifications, and in this way the effect of an increase of temperature on the sun's chromosphere, as indicated by hotter stars, can be predicted, and receives a simple and sufficient explanation.

(29) The disappearance of the enhanced iron lines in the hottest stars, and the simultaneous intensification of the lines of hydrogen, helium, and gas X, bring us face to face with the fact that iron is a compound, into the ultimate formation of which one or all of these gases enters.

(30) The ultimate molecules of the chemical elements discussed in the present paper may be provisionally arranged in the following order of resistance to the effects of temperature:—

Gas X ⎫ Doubtful which.
He ⎭
H
Ca
Mg
Fe

(31) Each step in advance which has been made since 1873, has demonstrated more and more that there is really such a "celestial dissociation" going on as that which I then suggested.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The sixth Robert Boyle Lecture of the Junior Scientific Club will be delivered in the Examination Schools, on Tuesday, June 1, at 8.30, by Captain Abney, C.B., F.R.S., who has chosen for his subject "The Scientific Requirements of Colour Photography."

Mr. W. Garstang, Fellow and Lecturer of Lincoln College, has been appointed Naturalist to the Marine Biological Association, Plymouth.

The Drapers' Company have asked Mr. Jackson, the University architect, to inquire whether, for the sum of 15,000*l.*, a new building can be erected to accommodate the Radcliffe (Scientific) Library.

Before the end of the present term an election will be made to the Oxford Biological Scholarship at Naples. Candidates must be graduates of the University, and are requested to send their names to the Linacre Professor of Comparative Anatomy at the University Museum before the end of May.

An examination for Scholarship and Exhibition is announced to take place at Wadham College on December 6. No papers in Natural Science will be set, but in the election to one of the Exhibitions preference will be given to any candidate who shall undertake to read for honours in Natural Science, and to proceed to a Degree in Medicine.

CAMBRIDGE.—The Grace for confirming the resolution of the Syndicate on titular degrees for women was rejected by 1707 votes to 661. The opposition of the majority of the residents has thus been unmistakably endorsed by the non-resident members of the Senate. It is probable that the question of admitting women to the membership of the University, whether by stages or directly, will not again be raised. The suggestion that powers should be obtained enabling the women's colleges to confer degrees on their own students will now have a better chance of calm consideration. The University might long continue to teach and examine the women students, while the titles which have been sought by them as necessary for their professional success might in this way be acquired without endangering the peace of Cambridge as a place of education for men.

Prof. Rücker, Sec.R.S., will give the Rede Lecture on "Terrestrial Magnetism," in the Senate House, on Wednesday, June 9, at noon.

The General Board of Studies propose to establish a University Lectureship in Experimental Psychology, including the physiology of the senses, at a stipend of 50*l.* a year. The appointment will probably be made next month.

Prof. Hughes, F.R.S., and Mr. P. Lake, of St. John's College, are appointed to represent the University at the International Geological Congress to be held at St. Petersburg in the summer.

FIELD-MARSHAL SIR JOHN LINTORN SIMMONS, G.C.B., will distribute the prizes to the students of the Charing Cross Hospital Medical School, on Wednesday, June 2, at 4 o'clock.

MRS. JOSIAH M. FISKE has given to Barnard College, of New York City, one hundred and forty thousand dollars for a new dormitory. Other gifts of considerable aggregate value have also been recently received by the college. Gifts are constantly pouring in on Columbia University; and the new buildings for these two institutions are rapidly rising on the new site on Morningside Heights.

THE following are among recent appointments:—Dr. E. Fischer to be full Professor of Botany in the University of Berne, and Director of the Botanical Gardens there; Dr. G. Jäger to be Assistant Professor of Theoretical Physics in the University of Vienna; Dr. F. Gräfe to be Assistant Professor of Mathematics in the Polytechnic Institute at Darmstadt; Dr. F. Deichmüller, Privat-docent in Astronomy and Observer in the Bonn Observatory, to be Assistant Professor.

THE Lords of the Committee of Council on Education are taking steps to ascertain the number of pupils now receiving secondary education in England in endowed, proprietary, and private schools. It is not proposed to include in the return any pupils who are only receiving instruction in occasional classes or evening schools; and technical institutes (except in so far as they have secondary day schools) and University colleges will fall outside the scope of the inquiry.

IN the House of Lords, on Friday, Lord Norton asked the Lord President whether he hoped to be able to introduce a Bill on secondary education this Session; or, if not, early next year. The Duke of Devonshire replied that he did not entertain any hope that Parliament would be asked to deal seriously with the subject in the course of the present Session. He hoped, however, that there would be laid before Parliament a Bill the main proposals of which were contained in the Bill of last year, so far as they related to secondary education, with some amendments and additions, in order that the general views of the Government might be once more placed before the country, and that the country might be in a position to consider them during the vacation.

SCIENTIFIC SERIALS.

THE most important paper in the numbers of the *Journal of Botany* for April-May is the completion of Mr. I. H. Burrill's very interesting notes on the fertilisation of spring-flowering plants on the Yorkshire coast. A series of careful observations are recorded on the species of the insect-visitors and the frequency of their visits.—Welwitsch's African collections are still affording to Messrs. W. and G. S. West a large number of new species of desmids.

IN the *Nuovo Giornale Botanico Italiano* for April are only two short papers on structural botany.—Sig. I. Baldrati describes the peculiar excrescences (*pellule*) found on the bulbs of certain species of *Allium*, which he decides to be of a foliar character.—Sig. E. Matteucci speaks of the structure of the corky spots in leaves, which are of the nature of lenticels.—The remaining papers are descriptive.

THE papers in the numbers of the *Bullettino de la Soc. Botanica Italiana* for February-April are also mostly descriptive.—Sig. G. Mattej discourses on the red spots found on the leaves and petals of a number of plants, and of the gum-resinous substance which they contain.—Sig. L. Macchiati returns to the vexed question of the peculiar structure of the seeds of *Vicia narbonensis*, which he declares to present marked differences from those of allied species.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 8.—"Kathode and Lenard Rays." By J. A. McClelland, M.A. Received March 15.

The experiments described in this paper have to do partly with kathode, and partly with Lenard rays.

An arrangement is described by which the charge of electricity carried by the kathode rays can be directly measured, and the same method is then applied to the Lenard rays, which are found to carry a similar negative charge.

In one set of experiments the Lenard rays are examined inside the tube, the kathode rays being allowed to fall upon a screen of thin aluminium, and the charge that is carried by the Lenard rays on the further side of the aluminium measured.

In a second set of experiments, a window of oiled silk is placed in the vacuum tube in the path of the kathode rays, and here, again, the charge carried by the Lenard rays outside the tube can be detected and measured.

It can also be shown that there is a negative discharge from the window by placing a plate of ebonite opposite the window, and dusting it over, after exposure, with minium and sulphur. The well-known negative figure is produced on the plate.

The Lenard rays appear to be simply a secondary propagation of kathode rays, produced by the rapid pulsations of negatively charged particles up to the aluminium screen. Measurements of the amount of electricity carried by these charged particles show that the electrostatic effects produced when they are stopped at the screen are sufficient to produce discharge on the further side of the screen, and a secondary stream of kathode rays. All the observed properties of Lenard rays admit of explanation on the theory that, like the kathode rays, they consist of a stream of charged particles.

In the paper an arrangement is described to measure the portion of the current actually carried by the kathode rays in a vacuum tube. With the tube used, even at a pressure at which there was little phosphorescence, a considerable fraction (more than 1/50) of the whole discharge was carried away from the kathode by the negative rays, while at lower pressures these rays carried a large portion of the discharge.

Chemical Society, April 29.—Prof. Dewar, President, in the chair.—The following papers were read:—On the explosion of chlorine peroxide with carbonic oxide, by H. B. Dixon and E. J. Russell. On exploding a mixture of carbonic oxide and chlorine peroxide, less of the carbonic oxide is burnt as the mixture is the more carefully dried; this result does not favour the view that "nascent" oxygen attacks carbonic oxide more readily than ordinary oxygen.—On the decomposition of iron pyrites, by W. A. Caldecott. The "slime" obtained on crushing auriferous pyritic Witwatersrand conglomerate contains no ferrous sulphide as it leaves the battery, but this substance can be detected in the slime soon after deposition in the dams; ferrous sulphide is also formed when iron pyrites is crushed to an impalpable powder in a mortar. It would thus appear that ferrous sulphide, and not sulphate, is the first decomposition product of pyrites.—Monochlordiparaconic acid and some condensations, by H. C. Myers. Monochlordiparaconic acid, $C_9H_9ClO_2$, is obtained on treating dichlormethylparaconic acid with barium hydroxide.—Corydaline, Part v., by J. J. Dobbie and F. Marsden. On heating corydaline with dilute nitric acid, dehydrocorydaline nitrate $C_{22}H_{25}NO_4HNO_3$ is formed, and if the action of the acid be pushed further, corydic acid, $C_{14}H_9N(OMe)_2(COOH)_2$, is obtained; on oxidising this with permanganate, at least four different acids are produced.

May 6.—Prof. Dewar, President, in the chair.—The following papers were read:—A Bunsen burner for acetylene, by A. E. Munby. A modified form of Bunsen burner for use with acetylene is described, which has a much greater heating effect than a Bunsen consuming an equal volume of coal-gas instead of acetylene.—The reactions between lead and the oxides of sulphur, by H. C. Jenkins and E. A. Smith. The authors find that Hannay's hypothetical compound, PbS_2O_2, the formation of which was premised in order to explain the reaction between sulphur dioxide and lead, and between air and galena at high temperatures does not exist. The investigation of other of the reactions of lead salts at high temperatures prove the accuracy of the equations which Dr. Percy gave as the basis of the metallurgy of lead.—X-ray photographs of solid alloys, by C. T. Heycock and F. H. Neville. The authors have applied the fact that some metals, such as sodium and aluminium, are comparatively transparent to X-rays, whilst others, like gold, are opaque, to the investigation of alloys; a thin section is cut from the alloy to be examined, and an X-ray photograph obtained of it. Examined thus, pure sodium shows no crystalline structure, but alloys containing 3–10 per cent. of gold show transparent sodium crystals interspersed with opaque gold crystals. Many other gold-sodium and some aluminium alloys have been examined by this new method.

Entomological Society, May 5.—Mr. Roland Trimen, F.R.S., President, in the chair.—Mr. C. H. Peers was elected a Fellow of the Society.—Mr. J. J. Walker exhibited an earwig, *Apterygida arachidis*, Yersin, new to Britain, and recently found in large numbers in chemical works at Queenborough. It had been probably imported among bones.—Mr. Burr showed a complete series of the British species of Forficulidæ.—Mr. Enock showed eggs of *Stenopsocus cruciatus*, L., containing parasitic larvæ of *Alaptus fusculus*, Hal., the male of which would probably prove to be *Alaptus minimus*, Hal.—Mr. Merrifield exhibited the results of temperature experiments on the pupæ of *Pieris daplidice*, *Melitæa didyma*, and other species. He thought that changes produced by abnormal temperatures might be classed as follows: (1) enhancement or diminution of intensity of colour without alteration in the form of the markings; (2) substitution of scales of a different colour, scattered or in groups; (3) imperfection in the development of scales or their pigment.—Mr. Tutt showed a series of insects collected at Cannes in March, and remarkable for their early emergence.—Dr. Dixey read a paper on mimetic attraction, in which he dealt with the steps by which a wing-pattern, as in South American Pierinæ, could be modified in various directions so as to secure a mimetic result, and with the theories of mimicry put forward by Bates and Fritz Müller.—Mr. Blandford exhibited and discussed series of homœochromatic and mimetic Neotropical species of butterflies, chiefly of Heliconiidæ and Heliconioid Danaidæ. The discussion was continued by Prof. Poulton, who showed similar groups of several genera, remarkable as having been collected and sent to England as examples of a single species, and by the President, and it was ultimately adjourned to June 2.

Geological Society, May 12.—Dr. Henry Hicks, F.R.S., President, in the chair.—The following communications were read:—On the gravels and associated deposits at Newbury (Berks), by E. Percy Richards. After a general sketch of the geology of the Valley of the Kennet, the superficial deposits at and in the neighbourhood of Newbury were described in detail, from observations made by the author during the progress of the main drainage-works in 1894. The author classified the strata which he examined into five groups: (1) The Preglacial Southern Drift; (2) the Glacial Drift (Donnington); (3) the Upper River-gravel; (4) the Lower River-gravel; (5) the Neolithic peat-beds (shell-marl, peat, and loam).—The Mollusca of the Chalk Rock, Part ii., by Henry Woods. The first part of this paper, dealing with the Cephalopoda, Gasteropoda, and Scaphopoda, appeared in the last volume of the *Quarterly Journal* (vol. lii. p. 68). In the new communication the author gave an account of the characters, synonymy, and distribution of the Lamellibranchia: 29 species were recognised, 6 being new. In the concluding part the author compared the fauna of the *Reussianum*-zone (Chalk Rock) in England with that of other European areas, particularly North-West Germany and Saxony. In the latter country the number of species in some groups—particularly Gasteropoda and Lamellibranchia—was much greater than in England; this difference was probably due to the sea having been of less depth than in the English area. It was noticed that the species of Cephalopoda had a much wider geographical distribution than the other groups of the Mollusca. Finally, by a study of the present distribution of the genera—particularly of those which formed the predominating element in the fauna—taken in conjunction with the other characters of the zone, the author arrived at the conclusion that in England the *Reussianum*-zone was probably formed between the depths of 100 and 500 fathoms.

Mathematical Society, May 13.—Prof. Elliott, F.R.S., President, in the chair.—The following communications were made:—On cubic curves as connected with certain triangles in perspective, by S. Roberts, F.R.S.—Determination of certain primes, by F. W. Lawrence.—An analogue of anharmonic ratio, by J. Brill.—An essay on the geometrical calculus (continuation), by E. Lasker.—On the partition of numbers, by G. B. Mathews.—Notes on synthetic geometry, by W. Esson, F.R.S.

Zoological Society, May 18.—Prof. G. B. Howes in the chair.—Mr. Sclater exhibited a plan of the new Zoological Garden attached to the Pará Museum, Brazil, and called attention to the description of it recently published in the "Der Zoologische Garten" by Herr Meerwarth.—Mr. Sclater exhibited the skin of a penguin which he had received in exchange from the Musée d'Histoire Naturelle of Paris as a specimen of *Microdiptes serresianus* (Oust.); and read a note from Mr. Ogilvie-Grant, according to which this specimen was only an immature example of the Rock-hopper penguin (*Eudyptes chrysocome*).—Mr. R. E. Holding exhibited a skull of a Theban goat (*Capra hircus*, var. *thebaica*), and made remarks on the shortening of the skull in this and other domesticated animals.—Mr. G. A. Boulenger, F.R.S., read a paper entitled "A Revision of the Lizards of the Genus *Sceloporus*." From a study of the large mass of material in the British Museum, the author had come to the conclusion that the difficult genus *Sceloporus*, so far as was at present known, consisted of thirty-two species. Nearly all the specimens examined, with the exception of very young ones, had been measured, and their dimensions and the number of scales and femoral pores possessed by each of them were recorded in the paper. One new species (*Sceloporus asper*) was described.—Dr. G. Herbert Fowler read the second of a series of papers on the Plankton of the Faeroe Channel, which dealt with the distribution of *Conchœcia maxima* (a midwater or mesoplankton form), with the European species of *Tomopteris*, and with the distribution of *Tracheloteuthis riisei*.—Mr. Martin Jacoby contributed the second part of a paper on the Phytophagous Coleoptera of Africa and Madagascar. Nine new genera and eighty new species of the families *Eumolpinæ*, *Halticinæ*, and *Galerucinæ* were described.—Mr. W. G. Ridewood read a paper on the structure and development of the hyobranchial skeleton of *Pelodytes punctatus*.—Messrs. Oldfield Thomas and R. Lydekker, F.R.S., contributed a paper on the number of grinding-teeth possessed by the Manatee. From an examination of several specimens of this animal it had been ascertained that the number of its grinding-teeth was not a fixed one, but that it developed a continuous and indefinite number to replace those which had become worn away by the sand which was necessarily present in somewhat large quantities in its food of water-weeds.

Royal Meteorological Society, May 19.—Mr. E. Mawley, President, in the chair.—Mr. F. Gaster, of the Meteorological Office, read a paper by Mr. R. H. Scott, F.R.S., and himself, on the mean monthly temperatures of the British Isles. The authors dealt with the means of the daily minimum, average, and maximum temperatures for the various months of the year in the twenty-five years 1871-95. They pointed out that there is a great difference between the amount of range of temperature at the coast stations and that recorded inland. The range between January and July amounts to about 16° at coast stations, but to more than 23° at the inland stations. The contrast between the temperature of the air at inland stations and at coast stations at different times of the year is due to the following causes: (1) The constant tendency of the sun to heat the surface of the earth; (2) the equally constant tendency of the earth to radiate its heat into space, both of these being modified greatly by the aqueous vapour and the clouds suspended in the atmosphere; (3) the fact that the solid portions of the earth absorb and reflect heat much more rapidly than the water; and (4) that while the ocean to the westward is of enormous size and great depth, the sea to the eastward is, comparatively speaking, limited in area and shallow, and separates the eastern shores of the British Islands from those of continental Europe by a small distance.—A paper, by Mr. C. V. Bellamy, on the rainfall of Dominica, West Indies, was also read. The author gave an interesting account of the climate of the island, and then discussed the monthly returns of rainfall from twenty-seven stations during the four years 1893-96. The rainy season extends from July to November, the other months representing the dry season. The month of November, 1896, was the wettest on record.

PARIS.

Academy of Sciences, May 17.—M. A. Chatin in the chair.—On the photographic atlas of the moon, published by the Observatory of Paris (second part), by MM. Lœwy and Puiseux.—Signification of appendices and their symmetry in the measurement of gradation in vegetable species, by M. Ad. Chatin. Plants are classified into two large groups, according as they have appendices or not. The symmetrical relations between the appendices serve to further subdivide the larger series.—Fourth note on the applications of radioscopy to the diagnosis of diseases of the thorax, by M. Ch. Bouchard. The preceding notes deal with the applications of radioscopy to the diagnosis of pleurisy, pulmonary tuberculosis, and hypertrophy of the heart. In the present note four cases are described: one of cancer of the œsophagus, and three of diseases of the aorta subsequent to acute rheumatism, in all of which the examination by the Röntgen rays proved to be of great service.—Demonstration by the Röntgen rays of the osseous regeneration in man after surgical operations, by M. Ollier. Studies of this nature have hitherto been very difficult, owing to the fact that accidental deaths at suitable stages in the osseous development are necessarily rare. The form and dimensions of the osseous masses in the new formation can now be readily demonstrated by means of the X-rays. The exact knowledge afforded in this way of the position of diseased bone (as in osteo-myelitis), renders unnecessary the immediate amputation of the limb, since the whole of the diseased portions can be removed with precision.—Disturbances in lakes and hurricanes, by M. F. A. Forel. It is shown that sudden barometric changes of the order of magnitude actually registered on one or two occasions are sufficient to account for the extraordinary changes of level occasionally observed on the Lakes Leman and Geneva. The effects are magnified by interference, and by the narrowing down of the lake.—M. Klein was elected a Correspondant of the Academy in the Section of Geometry, in the place of the late Prof. Sylvester.—Converse theory of binomial theorem, by M. Sitanath Chakrabarthy.—On the medicinal properties of *Œnothera biennis*, by M. Lewis Germain.—On the curves of which the tangents belong to a complex, by M. A. Demoulin.—On some applications of the theory of cyclic systems, by M. C. Guichard.—On a graphical method of integration for differential equations, by M. Michel Petrovitch. A mechanical apparatus is described capable of integrating all equations of the form $\Phi(y)\, dy/dt + \lambda \sqrt{y} - af'(t) = 0$, and of certain other equations derived from this by suitable substitutions.—On the kathode rays and some phenomena in vacuum tubes, by M. C. Maltézos. Experiments are described leading to the conclusion that anode light consists of matter carrying positive electricity.—On the transparency of ebonite, by M. Perrigot. Ebonite in thin films (0·5 mm.) is obviously transparent to red light, and light after passing through ebonite produces distinct effects upon orthochromatic plates rendered sensitive to the red and yellow rays. Ebonite plates 2 mm. in thickness, although opaque to the eye, still affect the photographic plate. These results confirm those of M. Becquerel as to the true cause of the effects observed by M. Le Bon.—New determinations of gravity, by M. J. Collet. The results of a series of pendulum observations along the forty-fifth parallel of latitude. The final results are compared with those calculated by Defforges' formula, the experimental results being always slightly lower than the theoretical.—On lithium borate, by M. H. Le Chatelier. The monoborate $LiBO_2$ is readily obtained in the dry way; it dissolves, readily forming the hydrate $LiBO_2 8H_2O$. The solubility curve shows some peculiarities, there being a temperature of maximum solubility. The heats of hydration, solution, and combination were determined. In the wet way, a diborate analogous to borax is formed, but the salt is so soluble that it could not be isolated.—On the alloys of the silver-copper group, by M. F. Osmond. In spite of the fact that the alloy containing the metals in the proportions indicated by Ag_3Cu_2 is the only one that does not liquate on solidifying, the alloy is not a homogeneous compound, but a mixture. The results of Heycock and Neville on the melting points of the copper zinc alloys indicate this, and the micrographical study affords results leading to the same view.—Researches on the coloration of glass by the direct penetration of metals or metallic salts, by M. Léon Lémal. Glass of a suitable composition can be coloured by a process similar to cementation at temperatures between 500° and 550° C. With silver salts a reddish orange stain is produced.—Remarks by M. Armand Gautier on the preceding note.—The action of water upon phosphoryl trichloride, by M. A. Besson. By the action of small quantities of water upon $POCl_3$ at 100°, several chlorides appear to be produced, from which pyrophosphoryl chloride, $P_2O_3Cl_4$, can be isolated and analysed in a fairly pure state. The residue is stated to consist of metaphosphoryl chloride, but no analyses are given, nor any indications that the residue was a homogeneous substance. The action of water is thus shown to be analogous to that of hydrogen sulphide.—On some new symmetrical aromatic ureas, by MM. P. Cazeneuve and Moreau. The authors conclude from their experiments that the best method of preparation of symmetrical substituted ureas is by acting with primary bases upon the carbonic ethers of the phenols, especially upon the carbonate of guiacol.—On the amido-amidines, by M. Charles Lauth.—*Rôle* of tannins in plants, and especially in fruits, by M. C. Gerber. One of the chief functions of tannin appears to be to prevent pectic transformations, and hence to prevent the fermentation of their sugars. In fruits containing tannins, these disappear completely by oxidation without giving rise to any carbohydrates.—On the *Pseudocommis vitis* (Debray), and on new proofs of the existence of these Myxomycetes, by M. E. Roze.—The clear rings ("lunure") in sections of oak wood, by M. Emile Mer.—Physiological disturbances due to the X-rays, by M. Destot. The differences between the effects of exposure to the sun and X-rays are clearly marked, the latter not being felt at the moment of application, and only becoming evident after a considerable time.—Researches on the causes of disturbances due to growth with the aid of the X-rays, by MM. Maurice Springer and D. Serbanesco.—Rule for solving two numerical equations of any degree with two unknowns, by M. Teguor.

ST. LOUIS.

Academy of Science, May 3.—Mr. H. von Schrenk spoke of the respiration of plants, with special reference to the modification of those growing with their roots submerged in water. The lecture was illustrated by a demonstration of the liberation of carbon dioxide in respiration from the roots of an ordinary flowering plant and freshly gathered fungi, and the more usual ærenchyma structures were made clear by the use of lantern slides.—Prof. F. E. Nipher described a simple means of measuring the resistance of a tube to the flow of air, when compared with an accepted standard, by the use of a tubular device, similar in principle to the Wheatstone bridge used in electrical instruments; the apparatus, in the present instance, consisting of parallel tubes filled with air, connected by a tubular bridge, in the middle of which a drop of water was placed, so as to change position with the variations in the flow of air on the one hand or on the other.

AMSTERDAM.

Royal Academy of Sciences, April 21.—Prof. van de Sande Bakhuyzen in the chair.—Prof. Haga communicated a method of determining the wave-length of X-rays. This method, the result of experiments made by Mr. P. G. Tiddens, of Gröningen, is founded upon the fact that a perfectly identical deflection image is produced by rays of very different wave-length, by varying the distance between the source, the diffracting slit, and the screen in a definite manner. Starting from a diffraction image of light rays, provisional experiments were made to determine whether the wave-length of X-rays was equal to, or one-quarter or one-fifteenth of, that of light rays. In the last-mentioned case, the image resembled that obtained from light rays more than the others did; it was not, however, quite identical with it —Prof. Haga read a paper, by Dr. C. H. Wind, on the influence of the dimensions of the light beams on Fresnel's diffraction phenomena, and on the diffraction of X-rays. From experiments, made by Mr. Tiddens, it appeared that the X-shadow figures obtained by Fomm and others, are not ordinary Fresnel diffraction images. The author showed that the shadow figures obtained are to be conceived as secondary diffraction images (arising from ordinary ones on the slit serving as a source of light being widened), and he developed the main points of the theory of these secondary diffraction images, and pointed out the way it opens to determining the wave-length. The existence of secondary diffraction phenomena, analogous to those observed when employing X-rays, can easily be ascertained when ordinary light is used. This, in the author's opinion, as good as proves the undulatory character of X-rays.—Mr. Hamburger communicated a new quantitative method of determining the anti-bacterial action of blood and tissue fluid. This method avoids the usual counting of microbes with the help of plate cultures, because this occasions errors of 40 to 50 per cent. Instead of counting the microbes, their total volume is determined by centrifugal action. This method occasioned errors of only 6·5 per cent.—Prof. van der Waals presented, for publication in the *Proceedings*, a paper on the equilibrium of a compound solid in the presence of a gas and a liquid. The author proves that by adding to the ψ surface for a mixture (*Arch. Néerl.*, t. xxiv.) a ψ line for the solid, the laws of these phenomena can be deduced in a simple way by geometrical construction.

DIARY OF SOCIETIES.

THURSDAY, MAY 27.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

FRIDAY, MAY 28.

ROYAL INSTITUTION, at 9.—The Isolation of Fluorine: Prof. H. Moissan.

PHYSICAL SOCIETY, at 5.—The Perception of Difference of Phase by the Two Ears: Dr. A. A. Gray.—The Isothermals of Isopentane: Mr. Rose-Innes.

SATURDAY, MAY 29.

LONDON GEOLOGICAL FIELD CLASS.—Excursion to Sheerness. Drive to East Church, Hensbrook. London Clay. Leave Holborn Viaduct, 1.25.

MONDAY, MAY 31.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Nupe and Ilorin (Nigeria): Lieut. Seymour Vandeleur.

TUESDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—The Heart and its Work: Dr. E. H. Starling.

ZOOLOGICAL SOCIETY, at 8.30.—On the Structure of the Skull in the Paraguayan Lepidosiren: Prof. T. W. Bridge.—On the Classification of the *Thyrididæ*, a Family of the Lepidoptera Phalænæ: Sir George F. Hampson, Bart.—On a Collection of Lepidoptera obtained at Shoa in 1894 by Mr. F. Gillett: Dr. A. G. Butler.

WEDNESDAY, JUNE 2.

ENTOMOLOGICAL SOCIETY, at 8.

VICTORIA INSTITUTE, at 4.30.—Annual Meeting.—Address by Lord Kelvin.

THURSDAY, JUNE 3.

ROYAL SOCIETY, at 4.—Election of Fellows.——At 4.30.—*Probable* Papers: The Sensitiveness of the Retina to Light and Colour: Captain Abney, F.R.S.—On the Mechanism by which the First Sound of the Heart is produced: Sir R. Quain, F.R.S.—Mathematical Contributions to the Theory of Evolution. On the Relative Variation and Correlation in Civilised and Uncivilised Races: Miss Alice Lee and Prof. K. Pearson, F.R.S.—An Investigation on the Variability of the Human Skeleton, with especial reference to the Naquada Race, discovered by Prof. Flinders Petrie in his Explorations in Egypt: E. Warren.—On the Brains of Two Sub-Fossil Malagasy Lemuroids: C. I. Forsyth Major.—(1) On the Dielectric Constants of certain Frozen Electrolytes, at and above the Temperature of Liquid Air; (2) On the Dielectric Constants of Pure Ice, Glycerine, Nitrobenzol, and Ethylene Dibromide, at and above the Temperature of Liquid Air: Prof. Fleming, F.R.S., and Prof. Dewar, F.R.S.—Preliminary Communication on the Nature of the Contagium of Rinderpest: A. Edington.

LINNEAN SOCIETY, at 8.—Observations on Termites: Dr. G. D. Haviland.—On the Genus Ramulina: Prof. T. Rupert Jones, F.R.S., and F. Chapman.

CHEMICAL SOCIETY, at 8.—On the Thermo-chemistry of Carbohydrate Hydrolysis; On the Thermal Phenomena attending the Change in Rotatory Power of Freshly-prepared Solution of certain Carbohydrates, with some Remarks on the Cause of Multirotation: Horace J. Brown, F.R.S., and Spencer Pickering, F.R.S.—Optical Inversion of Camphor; Derivatives of Camphoric Acid. Part II. Optically Inactive Derivatives; Racemism and Pseudo-racemism: Dr. F. S. Kipping and W. T. Pope.—On some New Gold Salts of the Solanaceous Alkaloids: Dr. H. A. D. Jowett.

FRIDAY, JUNE 4.

ROYAL INSTITUTION, at 9.—Signalling through Space without Wires: W. H. Preece, C.B., F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Origin of the High-Level Gravel with Triassic Débris adjoining the Valley of the Upper Thames: H. J. Osborne White.

SATURDAY, JUNE 5.

GEOLOGISTS' ASSOCIATION—Excursion to Cheltenham and Stroud. Leave Paddington at 10.32 a.m.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—A Ride through Western Asia: Clive Bigham (Macmillan).—A Text-Book of Geology: W. J. Harrison, new edition (Blackie).—A Handbook to the Order Lepidoptera: W. F. Kirby. Vol. v. Moths, Part 3 (Allen).—Uber Verwachsungsversuche: Prof. G. Born (Leipzig, Engelmann).—Year-Book of the Scientific and Learned Societies, 14th annual issue (Griffin).—Catalogue of the Tertiary Mollusca in the Department of Geology, British Museum (Natural History): G. F. Harris, Part 1 (London).—Catalogue of the Fossil Cephalopoda in the British Museum (Natural History): Dr. A. H. Foord and G. C. Crick, Part 3 (London).—The Concise Knowledge Natural History (Hutchinson).—Harrow Butterflies and Moths: J. L. Bonhote and Hon. N. C. Rothschild, Vol. 2 (Harrow, Wilbee).—L'Évolution Régressive en Biologie et en Sociologie: J. Demoor, J. Massart, and E. Vandervelde (Paris, Alcan).

PAMPHLETS.—Annual Report of the Geological Survey of the United Kingdom: Sir A. Geikie (Eyre).—Vergleichende Studien über das Seelenleben der Ameisen und der Höhern Thiere: E. Wasmann (Freiburg in Bresgau, Herder).

SERIALS.—Zeitschrift für Physikalische Chemie, xxii. Band. 4 Heft (Leipzig, Engelmann).—Geological and Natural History Survey of Minnesota, 22nd and 23rd Annual Reports (Minneapolis).—Proceedings of the Academy of Natural Sciences of Philadelphia, 1896, Part 3 (Philadelphia.)—Maori Art, Part 1 (Wellington, N.Z.).—Good Words, June (Isbister).—Sunday Magazine, June (Isbister).—L'Anthropologie, Tome viii. No. 2 (Paris, Masson.—Essex Institute Historical Collections, Vol. xxxii. (Salem, Mass.).—Longman's Magazine, June (Longmans).

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