THURSDAY, MARCH 3, 1898.

ARCHIMEDES.

The Works of Archimedes. Edited in Modern Notation, with introductory Chapters by T. L. Heath, Sc.D., sometime Fellow of Trinity College, Cambridge. Pp. clxxxvi + 326. (Cambridge: at the University Press, 1897.)

THIS is a companion volume to Dr. T. L. Heath's valuable edition of the "Treatise on Conic Sections" by Apollonius of Perga, and the same patience, learning and skill which have turned the latter book into a delightful guide to early Greek geometry have been here applied to present in a most readable form the extant works of perhaps the greatest mathematical genius that the world has ever seen. The same general plan of editing has been followed in this book as in that of Apollonius, such condensation and modernisation having been introduced as is possible without alteration of the methods employed. We consequently now possess for the first time in English dress a reproduction of Archimedes' work, without addition or essential omission, from which have been removed the thorns and briars that have hitherto beset the path of the English student who would make himself acquainted with the methods invented and employed by the extraordinary genius of Archimedes in order to make those measurements which now-a-days are rendered easy only by the use of the integral calculus. Not the least deterrent of these obstacles have been the Doric dialect of parts of the original and the abbreviations and corruptions in which the text of the accessible editions abounds, so that hitherto the French translation by Peyrard, or that in German by Nizze, has been preferable for the purposes of study.

The volume itself is a handsome example of mathematical printing such as we are wont to expect from the Cambridge University Press, and it is most fitting that it should have been issued by that Press, since Torelli's standard edition (in Greek with a Latin version) was published by and at the expense of the sister University under the editorship of Prof. Abram Robertson, D.D., of Christ Church.

The book will do much to restore Archimedes to his proper place in the estimation of mathematicians; for, in spite of the admirable histories of mathematics that lie to our hand, Archimedes is scarcely known at all except as the discoverer of an important principle in hydrostatics, or the constructor of a spiral, or the inventor of a screw, or the destroyer of ships by the use of a mirror. Indeed it is but little known that in his books on Equilibrium he laid the foundation of theoretical mechanics, and that in his treatises on Floating Bodies he created the science of hydrostatics; that he it was who discovered $3\frac{1}{7}$ as a superior limit of the ratio of the circumference of a circle to its diameter, and $3\frac{10}{71}$ as a still closer lower limit; that to him we owe the quadrature of the conic sections and of the surfaces generated by their revolution, as well as the cubature of the volumes so formed; or that he was the author of a system of representing numbers up to that which would now be expressed by 1 with eighty thousand million millions of cyphers following it. What else he may have done we do not know for certain, as our information rests on vague accounts by later authors; but eight at least of his published works are lost, and these cannot but have shown the same originality and been marked by the same presentation of new truths as those which have survived, while none of them, or of those that we have, relate to his numerous mechanical inventions, of which in comparison with his mathematical speculations he seems to have thought meanly since, in Plutarch's words, he would not deign to leave behind him any written work on such subjects.

Not the least important part of this book is the introduction of 186 pages which precedes the 326 pages of text. This contains a very valuable discussion of the problems that attracted the attention of the early Greek geometers, and also a most interesting account of the various suggestions that have been put forward as to the mode in which Archimedes obtained certain results which he states without entering into details respecting them.

After a preliminary recital of the stories told of Archimedes by ancient writers, and a short account of the ingenious mechanical inventions they have attributed to him, Dr. Heath discusses the MSS. sources of the text that survive, and enumerates with slight details the principal editions of their text that have been published. From this we learn all that is really needful, though the Latin version with commentary made by Abbot Maurolycus in 1534–49, and published at Palermo in 1685 by Cyllenius Hesperius, also deserves notice. One might further remark that if the titles of the different editions are given at all in anything like fullness, they should be given with absolute exactness, and this is not done in any of the Latin versions save those of Torelli and Heiberg.

Then follows an excellent chapter upon the relation of Archimedes to his predecessors, and this is full of interest not only historically, but also as contrasting Archimedes' methods with those of others, and illustrating his extraordinary facility in the manipulation of proportions, a special instance of which is, in modern notation, the elimination of b, c, d from the conditions $a/b = b/c = c/d > 1$, $3d(a - c) = 5x(a - d)$, $(a - c)(2a + 4b + 6c + 3d) = 5y(a + 2b + 2c + d)$. Next comes a clear account of the Greek system of numerals and the Greek modes of performing arithmetical operations, more especially with reference to the approximations to the square roots of numerics which are not squares; but in this last matter there is plenty of room for conjecture, as not much direct information is available, and Dr. Heath gives a fairly exhaustive account of what has been written on the subject. The fifth chapter treats of the problems known as νεύσεις, which deal with the straight lines that have to verge towards a given point, and fulfil some other condition too; these have not much to do with Archimedes, but they are exceedingly interesting, and without their discussion a study of Greek geometry would be incomplete. The Greek methods of geometrically solving problems that practically involve cubic equations are next unfolded at length, and a discussion of the classification of problems and loci as plane, solid and (curvi-) linear completes a most interesting chapter. Finally Archimedes' anticipations of the integral calculus by an admirable extension of the method of exhaustion are considered, and copiously illustrated; and the introduction concludes with a most useful account of the mathematical terms and phraseology employed by Archimedes.

Dr. Heath's general treatment of the text is excellent, but there is one point on which we do not think that he has exercised a sound judgment. This is the renumbering of the propositions in three of the books, which renders reference to them a matter of entire uncertainty. Thus the celebrated Prop. 37 of Book I. on the Sphere and Cylinder, which gives $\frac{2}{3}$ as the ratio of the surfaces and of the volumes of a sphere and the cylinder that just contains it, appears in Dr. Heath's book as a corollary of Prop. 36, which is numbered 34; he further puts Props. 33, 43, 45, 46 as corollaries, and includes Prop. 1 in the introductory letter, thus reducing to 44 the 50 propositions of the MSS. In Book II. he treats Prop. 1 similarly, even though Archimedes himself, in the introductory letter to his work on Spirals (p. 152), mentions this proposition as the first of those which were proved in this book. In the book on Conoids and Spheroids he further puts as a Lemma what appears as Prop. 1 in all the Greek and Latin texts, so that the famed Prop. 12 on certain plane sections of these figures, the characters of which are said by Archimedes to be φανερά, appears as Prop. 11, and Prop. 18 is put as the third part of Prop. 17 (numbered 16)—without any reason, since it is not an extension of, though deducible from, the other parts.

Complete as the book is, there is one addition that would be welcomed by all students, viz. a table of all the writers named, and of the approximate dates at which they flourished; this, if of easy reference, would be of great help when the relation of different geometers to any problem was under consideration. A larger number of references is also desirable in the interests of the student who is stirred to go to the fountain-head by his thirst for first-hand information. Thus the proofs on pp. liv-lviii of the above-cited Prop. 12 on Conoids and Spheroids are so introduced, especially in being contrasted with Zeuthen's, as to appear to be quite modern, while really being contained in Torelli's edition, and practically also in the earlier editions of Maurolycus and Rivaltus.

We feel much inclined to challenge Dr. Heath's rendering of Euclid's definition of a straight line in his note on p. 3, and to maintain the correctness of the ordinary version of it. The special point seems to us to lie in the word ἐπί, "on," the use of which seems to be due to the thought in the writer's mind of points marked by letters over the line; thus Aristotle ("Ethics," v. 4, 12) writes ἴσαι αἱ [*i.e.* γραμμαὶ] ἐφ' ὧν ΑΑ, ΒΒ, ΓΓ ἀλλήλαις where the sentence can only mean "the lines AA, BB, CC are equal to one another"; the words must therefore mean "the lines are equal over the two ends of which A and A, B and B, C and C are written," so that Euclid's τὰ ἐφ' ἑαυτῆς σημεῖα must mean "its own extreme points."

Such slight blemishes, however, or what we deem to be such, do not detract from the very great value of this work, and Dr. Heath deserves our grateful thanks for the labour he has expended upon it. It is a fitting addition to his former task; for as, to quote Charles, in Apollonius work we find the origin of the geometry of Forms and Situations as it is now developed, so in the present book we are introduced to the basis of the geometry of Measurement which has demanded a new calculus for its perfection. R. E. B.

A NEW TEXT-BOOK OF EXPERIMENTAL PHYSIOLOGY.

The Essentials of Experimental Physiology. For the use of Students. By T. G. Brodie, M.D., Lecturer on Physiology, St. Thomas's Hospital Medical School. Pp. xiv + 231. (London: Longmans, Green, and Co., 1898.)

THIS volume appears in the same series as two books already well known to the medical student of this country, viz. Schäfer's "Essentials of Histology" and Halliburton's "Essentials of Chemical Physiology." It is bound uniformly with these two volumes, but on opening the books all resemblance disappears. Instead of being divided into a number of "lessons," each of suitable length for one day's work of a practical class, the new volume is divided into "chapters" the length of which bears no proportion to the practical work of a class-meeting. In the other two volumes of the series, each lesson is commenced by a concise and definite description for the student of how to perform a number of experiments; and this description is followed by a few pages of theoretical teaching bearing on those experiments. In the present volume this arrangement is departed from, and the experiments are interpolated in a discursive fashion through the text.

An attempt is made to mark off by heavy type a portion of the book as an elementary course, but it is questionable whether this would not have been much better done by dividing the volume into an elementary and advanced course, as has been done by Prof. Halliburton in the "Essentials of Chemical Physiology." Again, some of the experiments described in this elementary portion are quite beyond the reach of the junior student—for example, the maximum work performed during a muscular twitch; while other simple and important experiments, such as the effect of temperature on muscular contraction, are excluded from this part.

The book commences with a description of various forms of galvanic cells and the chemical changes involved in their action. Such a description is scarcely necessary, for the student is supposed to be already familiar with the commoner forms of galvanic cell before commencing practical work in physiology; but, if inserted, it would have been much better to have described the action of the cells correctly. For example, the student who has just attended a junior course of instruction in a physical laboratory will be somewhat disturbed in his notions of electrolysis by being told that when the Daniell's element is in action—

"the chemical changes in the battery are, solution of zinc and formation of $ZnSO_4$ at the zinc plate, and decomposition of the $CuSO_4$, *by the hydrogen appearing at the copper plate* to form H_2SO_4 and metallic Cu, which latter is deposited on the copper surface."

Similarly, in the case of the Bunsen cell the student is informed that, "the H_2 appearing simultaneously at the carbon pole (?) is oxidised into H_2O by the nitric acid." It is surely a new discovery that hydrogen appears at the negative plate in these elements, and one well calculated to upset all present electrolytic hypotheses.

The induction coil and its action are next considered, and here again some mistakes occur.

"The E.M.F. of the induced current depends upon several factors: (1) It is directly proportional to the intensity of the current change in the first wire. (2) It is directly proportional to the rate of change of the inducing current."

It is difficult to see any difference between (1) and (2); there is probably a misprint somewhere, but this is precisely the kind of blunder most calculated to waste the time and temper of a student who is not strong in physics. In describing the theory of the extra currents of make and break it is stated that—

"as the duration of this induced current (the extra current at make) is very short its effect is soon exhausted, but not before it has produced the result that more time is required for the current to reach its full strength than would have been the case if the wire had been perfectly straight."

Now the extra current at make lasts just as long as there is any variation of the primary current, and therefore as long as there is any induced current in the secondary coil, and its effect is no sooner over than any of the other effects involved.

A further error in connection with the same subject is worth noting, since it is not peculiar to this volume, but occurs in other text-books of physiology.

"On breaking the circuit the circuit of the primary is broken, so that no induction currents can be set up in the primary."

"The fall in potential is therefore instantaneous."

Now the fall in potential at break is *not* instantaneous, otherwise the E.M.F. of the induced current in the secondary circuit would be infinitely great. The primary circuit cannot by any means be instantly broken, and there *is* an induced extra current in the primary at break. Only in the circuit during break there is a high resistance in the spark gap, and both the extra current and the primary current are rapidly diminished by this rapidly increasing resistance.

The more purely physiological part of the book is fairly well written, and contains descriptions and figures of new and sometimes ingenious adaptations of simple apparatus for experimental work. Some of these artifices for making simple apparatus are certain to become extensively used, and it is here that the book will probably render most assistance to teachers of physiology. The book is also copiously illustrated, and contains a large number of reproductions of experimental tracings. Many of these it is impossible for the student to imitate for himself, but they will doubtless form valuable aids in assisting him to recollect the results of class demonstrations.

OUR BOOK SHELF.

L. Rütimeyer. Gesammelte Kleine Schriften allgemeinen Inhalts aus dem Gebiete der Naturwissenschaft. Nebst einer autobiographischen Skizze. Edited by H. G. Stehlin. 2 vols. 8vo. Pp. iv + 400 and 455. With a portrait and woodcuts. (Basel: Georg et Cie, 1898.)

IN these two well-printed and handy volumes we have the more important of the contributions made to science by the late Prof. Rütimeyer, which could be reproduced without costly illustrations. By the kindly care of Leopold Rütimeyer and H. G. Stehlin, we have these as an "In Memoriam" tribute, the crowning stone of which is the very interesting series of notes by Prof. Rütimeyer himself of the chief incidents of his life. In a work of this nature, there is left but little room for criticism, and we will serve the reader's purpose best by a brief notice of the contents of the volumes. In the stray memories of his scientific life we learn that, born in February 1825, his early days were spent in the country; his life was in the open air, wandering over field and meadow, in woods, and up the hill-tops. Educated at home, he records his happiness at having escaped the mischiefs and sorrows of a public school. When sixteen years old, falling under the influence of Bernhardt Studer, his studies took the direction of the natural sciences, and his future career was marked out. In these "Memories" many are the interesting facts recorded in a busy life. As an author he began with a "Memoir on the Nummulitic Region of the Bernese Alps," which was published in 1848, and we have on record a long list, published from year to year, with but few exceptions, until 1895, when in June he put his initials to the "Memories," passing out of the world, though not beyond memory, on the 25th of the following November. Ever fond of nature, his latter years were rendered happier by winter sojourns in the sunny south of Europe.

The memoirs in the first volume are chiefly of a zoological character. We find an essay on the form and history of the vertebrate skeleton; on the historic method in palæontology; on the origin of our animal kingdom; on the limits of the animal kingdom—a critical notice on Darwin's writings; on the alterations in the animal life in Switzerland, since the appearance of man; on the evolution of organic beings. Most of these memoirs were at one time of interest, but while they were, as we think, worth gathering into a volume, it must be confessed that the greater part of their novelty has gone.

The second volume contains a long essay, "Vom Meer bis nach den Alpen," being a sketch of the structure, form and colour of the country met with in a section between England and Sicily; also a paper on the people of the Alps; a glance at the history of glacier studies in Switzerland; a very brightly written sketch of Brittany and its people. Obituary notices of Louis Agassiz, Charles Darwin, Peter Merian, and Bernhardt Studer, bring this volume to an end. There is in an appendix a list of all Rütimeyer's writings, arranged in chronological order.

Recherches expérimentales sur quelques Actinomètres Électro-chimiques. By H. Rigollot, Docteur ès Sciences, Chef des travaux de Physique a l'Université de Lyon. Pp. vi + 138. (Paris: Masson et Cie, 1897.)

IN this work M. Rigollot has collected together, in a convenient form, his researches on photo-electric cells. Two metallic plates being immersed in an electrolyte, and the one exposed to light whilst the other is protected from it, a difference of potential is established between them. The author gives the large amount of valuable information, which he has accumulated in his study of this phenomenon, in the form of experimental results;

we cannot but regret the absence of any attempt to formulate a theory of them. The work is divided into three parts; in the first the effects of white light are studied, in the second the different parts of the spectrum are taken separately, and the third contains experiments on the increase of sensibility due to colouring matters. Plates of copper coated thinly with oxide, sulphide, fluoride, bromide and iodide, of tin coated with oxide and sulphide, and of silver coated with sulphide, are examined in solutions of some thirteen different salts.

The electromotive force developed depends on many circumstances, such as the thickness and nature of the coating, the concentration and nature of the electrolyte and the temperature, so that it is difficult to prepare two identical cells. The electromotive force of a given cell is, however, proportional to the intensity of the light when this is not too large. All the elements had a maximum sensibility in some part of the spectrum, the position of the maximum depending on the nature of the coating on the plates, but, for a given instrument, being independent of the nature of the electrolyte. With dyed plates the position of the maximum was independent of the compound of copper employed, but was determined by the nature of the dye, and was always found at a wave-length greater than that for which the colouring matter had a maximum absorption. The sensibility is largely increased by the employment of colouring matters. The actinometers may be employed for photometric purposes, since it is possible to prepare one with a maximum sensibility for almost any wave-length. Since the development of the electromotive force is accurately synchronous with the action of the light, they may also be used as radiophones.

Neudrucke von Schriften und Karten über Meteorologie und Erdmagnetismus. Edited by Prof. Dr. G. Hellmann. No. 10, Rara Magnetica, 1269-1599; No. 11, Ueber Luftelektricität, 1746-1753. (Berlin: A. Asher and Co, 1898.)

DR. HELLMANN is so well known by his laborious researches in matters relating to the history of early scientific documents and instruments, and by the very valuable bibliographical knowledge which he brings to bear upon the various publications of this nature, that it is unnecessary to say more than that the present volumes exhibit the same painstaking labour as those which have preceded them. The first contains fac-simile copies of some of the earliest papers on terrestrial magnetism and the mariner's compass; each document is very scarce, and only accessible with difficulty, and must be considered as a literary rarity. Among them is a letter from Pierre de Maricourt, dated August 12, 1269, which is the earliest known treatise on magnetism in Europe. The principal point in the paper is the distinction of the two poles of the magnet, and of their opposite attraction. A paper by F. Falero (Sevilla, 1535) contains the first published instructions for determining the magnetic declination, although its existence was discovered by Columbus in 1492. A letter by G. Hartmann, dated March 4, 1544, gives an account of his discovery of the magnetic dip and the first determination of the declination on the mainland. This document was buried in the archives at Königsberg until 1831, so that the discovery of the magnetic dip is generally attributed to R. Norman, who determined it for London in 1576. In a letter from G. Mercator to the Bishop of Arras, which was discovered during the present century in the library at Göttingen, the first mention is made of the earth possessing a magnetic pole. There are various other papers which we cannot refer to here, all of which are of great interest and value in throwing light upon the earliest development of the subject. The second volume contains a reproduction of the first fundamental papers relating to atmospheric electricity. The electrical nature of thunderstorms was suspected early in the eighteenth century by Hauksbee and other Englishmen, but Prof. J. H. Winkler, of Leipzig, first clearly demonstrated the analogy between them and the electric spark in 1746; the experimental proof was proposed by B. Franklin in 1749, and first carried out, near Paris, by Dalibard on May 10, 1752.

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.*]

Does a Phosphorescent South American Liana exist?

IN collecting the literature regarding phosphorescent plants, I chanced on an article, by Mr. C. F. Holder, on "Living Lamps," in No. 392, vol. lxvi. (January 1883) of *Harper's Magazine*. In this article, at page 191, it is said: "In South America, a vine known as the Cipo, when injured, seems to bleed streams of living fire. Large animals have been noticed standing among its crushed and broken tendrils, dripping with the gleaming fluid, and surrounded by a seeming network of fire."

Could any reader of NATURE confirm the existence of this Cipo with a phosphorescent sap? Cipo, I believe, is a name for liana, not for vines. If true, the existence of a phosphorescent sap in a superior plant would be of great physiological interest. But no mention of this or a similar case is to be found in the standard works on vegetable physiology. I fear the statement may have as much foundation as the assertion, made in the same article, that among the peasantry of Italy girls complete their gala toilet with diadems of fireflies. ITALO GIGLIOLI.

Portici, near Naples, February 18.

Insusceptibility of Insects to Poisons.

YOUR reviewer's observation that one insect's food is another insect's poison, is applicable to a single insect at different stages of development. The scarlet fungus, *Agaricus muscarius*, derived its name from use in an old-fashioned decoction for fly-papers; nevertheless, it is eaten freely by maggots. Other poisonous fungi, such as *A. æruginosus*, *A. phalloides*, *Russula emetica*, &c., are evidently innoxious to maggots and slugs. With regard to the effect upon more highly organised animals, it may be noted that *Boletus luridus* is eaten by mice and rabbits, and that squirrels are very partial to several species of *Tricholoma* and *Boletus*. I have some doubt as to whether squirrels are not occasionally poisoned by eating fungi, but I have not noticed any suspicious mortality in the case of the rabbits or mice.

February 19. H. B. POTTER.

The Mandrake.

IN a foot-note to my letter under this heading (NATURE, vol. liv. p. 343, August 13, 1896), I quoted from a Chinese work the names of the nine plants reputed to assume frequently the human or animal figures; and I remarked thereon that most of the alleged figures in these plants were recognised in their subterraneous members. Lately, however, I have found this remark not quite correct, inasmuch as it concerns some of them, viz. mustard and turnip: the alleged figures in these two appear to have suggested themselves to the Chinese imagination by the deformities in their floral parts caused by some parasitic infestations. This is evident from the following passage that occurs in "Mung-ki-pih-tan," written by Chin Kwoh (1031-94 A.D.): "When such vegetables as the turnips and mustard are injured by draught, their inflorescences mostly form the blossoms resembling the lotus-flower, or like the dragon and serpent. These are of common occurrence, and anything but wonderful. Once in the period of Hi-ning (1068-77 A.D.), when Mr. Li Kih-chi was the governor of Jun-chau, all blossoms of the vegetables in his garden happened to have the form of the lotus-flower, each having one Buddha sitting in it. They were innumerable, and looked as if engraved, and well preserved the figures after desiccation. Some one used to ascribe this ominous event to the great zeal with which all members of Mr. Li's family devoted themselves to the worship of Buddha."

February 21. KUMAGUSU MINAKATA.

ANTARCTIC RESEARCH.

THE desirability of a well-equipped expedition for the study of the Antarctic regions has been so frequently set forth by men of science, and recorded in the columns of NATURE, that little can now be said on the subject without repetition. But if little that is new can be said, much remains to be done; and unless the unanimous and often repeated declarations of British scientific men culminate in action, the reputation of science in this country will suffer seriously. The large and enthusiastic meeting of the Royal Society on Thursday last, February 24, showed more emphatically than had before been possible how great is the importance attached to the renewal of Antarctic exploration by the leaders of all departments of natural science. The meeting is fully reported below; but the steps which have led to it, and the reasons why the goal has not sooner been attained, may be referred to here.

Sir Wyville Thomson, on the return of the *Challenger*, and of the Arctic expedition which followed it, came to the pessimistic conclusion that "we can only anticipate disasters multiplied a hundred-fold should the South Pole ever become a goal of rivalry among the nations" (NATURE, xv. p. 123); but much has been learnt as to methods of polar travel since 1876, and the fear of possible disaster was, we believe, never strong enough to check any British scientific expedition. Dr. Neumayer had several years previously very strongly urged the importance of Antarctic work on many grounds (NATURE, vii. p. 21), and to him, more than to any other, is the recent revival of interest due. As early as 1875 the question was seriously raised in Australia, though not pressed.

At the British Association meeting in 1885 Sir Erasmus Ommanney urged the advisability of renewing Antarctic exploration, and a Committee was appointed to consider the matter. As a result the Royal Society of Edinburgh and the Scottish Geographical Society appointed Committees to draw up reports in 1886, which were published as an appendix to a paper on Antarctic exploration, by Dr. John Murray, in the *Scottish Geographical Magazine*, vol. ii. p. 527. At the Birmingham meeting of the British Association in 1886, a Report was presented stating the importance of a Government expedition, and Captain Creak, R.N., read a paper giving forcible expression to the necessity of research in the Far South from the point of view of terrestrial magnetism. The Australasian Colonies became keenly interested, and the Legislature of Victoria actually voted 5000*l*. to assist in an expedition if the Imperial Government would also take part in it. The Manchester meeting of the British Association in 1887 again considered the question, and at Bath in 1888 Sir Erasmus Ommanney's Committee gave in a final report expressing regret that Her Majesty's Government had declined to support the Australian proposals; which they did on the ground that if successful a more expensive expedition would be called for. During the year 1891 an effort was made in Australia to initiate a joint Australian and Swedish expedition, but without result, and financial difficulties afterwards prevented the renewal of Australian offers. At the Fifth International Geographical Congress at Bern, and at the British Association at Cardiff, papers were read by Sir Erasmus Ommanney and Mr. Delmar Morgan on the advisability of getting up an expedition. In 1892 a new phase of the question was entered upon. Whaling expeditions to the seas south of the Falkland Islands were despatched from Dundee and from Norway. Thanks to the efforts of Mr. Leigh Smith and the support of the Royal Geographical Society, the *Balæna* and *Active*, of Dundee, were supplied with instruments, and their surgeons, Messrs. Bruce and Donald, were selected with a view to making scientific observations. Captain Larsen, of the Norwegian whaler *Jason*, also made good observations. They returned in 1893, and the results, although not very striking, were sufficient to show the necessity for finding out more, and the comparative ease with which steam vessels could navigate Antarctic waters. The British Association again appointed a Committee, which reported in 1894.

Meanwhile the Royal Geographical Society invited Dr. John Murray to bring the subject forward, which he did by an address at an evening meeting in November 1893. Interest in the question has been kept up ever since. Sir Clements Markham and other geographers have never ceased to urge by lectures, and articles in the press, the necessity of renewing exploration. In 1894 the representations of the Royal Geographical Society's Antarctic Committee induced the Royal Society to appoint a Committee which, after pronouncing in favour of a Government expedition, sought an interview with the authorities at the Admiralty. A recent article in the *Times* describes the result—"A deputation from the Royal Society waited upon the first Lord of the Admiralty to lay the matter before him; but another member of the Government intervened and informed the deputation that Sir James Ross, fifty years ago, had done all that was necessary for the exploration of the Antarctic."

In 1895 the Norwegian whaler *Antarctic* reached Cape Adare, where Kristensen and Borchgrevink landed. A conference of the greatest interest was held at the Sixth International Geographical Congress in London, and a resolution of enthusiastic approval carried. The British Association's Council reported, at their meeting in Ipswich, that after considering the question "the Council resolved to express their sympathy with and approval of the effort which is being made by the Royal Geographical Society." This was but cold encouragement, as the Association proposed to do nothing; but the promoters of Antarctic research were not at any time baffled by the ice-barriers of officialism, and efforts to compel attention to the scheme were renewed. The Royal Society appointed December 12, 1895, for a discussion on the scientific aspects of the case, to be introduced by Dr. John Murray, and arrangements were made in the same month for a deputation, representing the scientific societies of the United Kingdom, to wait on the First Lord of the Admiralty. He intimated that it would be inconvenient to receive it, on the ground of the small strength in officers of the British Navy making it impossible to spare the few required for an expedition. Circumstances led to the discussion being also postponed.

Throughout 1896 energetic efforts were made by various private individuals to get up commercial expeditions to the Antarctic regions, but without success. During the Jubilee rejoicings in 1897, the Royal Geographical Society seized the opportunity to hold a conference of Colonial Premiers and others, in the hope of reviving Australian offers of co-operation; and, encouraged by the result, the Society appealed once more to Government, not this time to the First Lord of the Admiralty, but to Lord Salisbury. It is understood that this representation is now under sympathetic consideration; and the great meeting at Burlington House has come at a singularly appropriate time. We may be sure that the unanimous voice of that meeting cannot be disregarded; and if an expedition is not now arranged, there must be a serious reason for it.

The demand for Antarctic research is no sudden impulse on the part of men of science; it originated independently in several quarters, and was not taken up by any of the great societies until it had been made quite clear that it was earnest and widely based. In Germany the agitation for an expedition has resulted in a nearly completed plan, and from Belgium the *Belgica* sailed last summer, and is, we hope, now at work in the southern ice. In July next Sir George Newnes will send out a private expedition under Mr. Borchgrevink, the work of which is sure to be full of interest. The Royal Geographical Society

SOUTH POLAR CHART

J. G. Bartholomew.

also could easily have arranged for a small expedition under competent leadership, had it not felt that preliminary work is not now so much wanted as substantial and sustained research, the expense of which would be too great for an individual or a society, though trifling to a nation. A large expedition is necessary, and a vast amount of anxiety and uncertainty as to the manner of working would be spared if it could sail under naval discipline, like the *Challenger*. There must be no mixture of commercial with scientific interests: when the conditions of the region are investigated, and its resources tested, private enterprise will not be slow to take practical advantage of useful discoveries. The incidental scraps of scientific value which commercial cruises have produced are undoubtedly useful to a certain degree; but scientific men on board vessels of that class have too frequently failed to work smoothly with the executive authorities. The exact relations to be observed between naval officers and civilian scientific staff can be determined in the light of past experience.

The object of Thursday's meeting was to elicit expert opinion as to the scientific advantages likely to be derived from adequate exploration of the South Polar region. In the absence through illness of Lord Lister, Sir John Evans presided, and the meeting-room of the Royal Society was crowded by a remarkable audience. In addition to the leading authorities in London on every branch of science, there were present the three men who have been nearest the two poles, Dr. Nansen and Lieut. Johansen from 86° N., and Sir Joseph Hooker from 78° S., the only survivor of Ross's expedition, and the last man alive who has seen Mount Erebus and the southern Ice Barrier. Dr. Neumayer, of the Deutsche Seewarte, came from Hamburg specially for this meeting, an example of international generosity to be the more esteemed because the German Antarctic expedition, which he has done so much to promote, is at last on the verge of taking definite shape. The Italian Ambassador also represented by his presence the friendly interest of a country which in 1880 made a courageous attempt, under Lieut. Bove, to take an active part in south polar work. Invitations to many of the younger scientific men engaged in departments of research bearing on the subject of the meeting had been sent out by the Society, and these were taken advantage of to the full. The interest of some who could not be present was conveyed by letter; a communication from the Duke of Argyll was read by the Secretary, dwelling on the value of the proposed expedition. Lord Kelvin had the evening before, while presiding at a lecture by Dr. Nansen in Glasgow, expressed his own views very strongly. Stating that the lecturer was leaving immediately after the lecture to attend the Royal Society meeting, he said, as reported in the *Glasgow Herald*: "The object of that meeting was to consider a proposal for an expedition to investigate the Antarctic polar regions, and Dr. Nansen was going to help the Society in its deliberations. If such an expedition were undertaken, and he hoped it would, it ought to receive the help of the Government. The British Government should make one of its primary objects the work of exploration, so that there should be nothing unknown of the whole ocean coast-line."

Dr. John Murray introduced the discussion by touching on all the scientific desiderata of the Antarctic regions; and after him nine speakers enforced and extended his arguments. Sir John Evans wisely decided that the discussion should be confined to the purely scientific aspect of the case, and the speakers closely followed his advice. The audience received the various addresses with applause such as is seldom heard in Burlington House. A good deal was made of the extent of our present knowledge, and an outsider might suppose that there was less diversity of opinion than really exists. The different estimates of the value of an Antarctic expedition to zoology, expressed by Dr. Sclater and Prof. D'Arcy Thompson, and the emphatic statement of the discrepancy between Ferrel's (or rather Dr. James Thomson's) theory of atmospheric circulation, and the indications of meteorological observations in the Far South, by Dr. Buchan, were stimulating and suggestive. How little we know of the Antarctic may be gauged from the map accompanying this article.

The meeting, the Chairman observed in closing it, was of unprecedented length, and a number of gentlemen who were prepared to take part had no opportunity to speak; while some of the speeches, especially that of Sir W. J. L. Wharton, in which he spoke of the popularity of such an expedition in the Navy, had to be cut very short. It would be worth while to consider whether some further opportunity might be given to bring before the scientific public the unheard arguments of last week.

The historical argument was not brought forward; but it is of importance in relation to the motive for exploration. At first the Antarctic question was the purely academic one of the possible existence of Antipodes, and was discussed by the ancient Greek geographers from analogy alone. On the revival of exploration in the fifteenth century, the existence of an Antarctic continent shutting in the Indian Ocean to the south, as supposed by Ptolemy, was a matter of much practical concern, for it affected the possibility of a sea-route to India. After the discovery that Africa could be rounded on the south, the appearance of the continent of America was looked on as a sign of the existence of a mass of Antarctic land. When Magellan penetrated his straits, and even after the rounding of Cape Horn, a vast Antarctic continent reaching to the tropics was a matter of common belief. Cook's first voyage of exploration detached New Zealand from this hypothetical continent; his second proved that any continent which might exist lay within the Antarctic circle. With this discovery the political motive for Antarctic exploration vanished. The only possible reason for adequate exploration was thenceforward scientific, and sixty-four years after Cook returned the ships of Sir James Clarke Ross set out on their great cruise. That was fifty-nine years ago. The intervals of sixty-four and fifty-nine years were both marked by the incidental work of other expeditions, such as the circumnavigations of Bellingshausen and Dumont d'Urville, and that of the *Challenger*. Commercial enterprise also sent out a number of daring sailors, the fleets of the Enderbys before Ross, and those of the Scottish and Norwegian whalers since. The commercial motive has proved insufficient in the south, potent as it was for many centuries in the north. The fact stands to-day that if the scientific motive fails to produce the result, the Antarctic regions will never be explored.

Putting the matter in its simplest form, civilised man must understand his dwelling-place; the key to many puzzles, the end of many controversies affecting the theory of the phenomena of the whole world, lies behind the vast Antarctic veil. It is the duty of the human race to lift that veil, whether there be much or little behind it, and the British people, as represented by the Government, ought to take the lead. We ought to take the lead because our territory in Australasia, Africa, and the Falkland Islands comes nearest to the unknown region; because our national welfare is more concerned than any other in the intelligent and safe navigation of the Southern Ocean; and because our Government, our Navy, and our scientific societies are richer and stronger now than they were in the days of Cook and of Ross, both absolutely and with reference to other nations. That other nations are preparing, or have prepared, to take part in wiping off this huge reproach on the enterprise and the self-respect of nineteenth century man should surely be an inducement to action rather than a deterrent. The value of simultaneous expeditions working in friendly rivalry is in such a case far greater than that of consecutive or isolated work.

Hugh Robert Mill.

ERNST CHRISTIAN JULIUS SCHERING.

On November 2, 1897, as already announced in Nature, Göttingen lost, at the age of sixty-four, its senior mathematical professor, Ernst Christian Julius Schering, best known as the editor of Gauss's works.

Prof. Schering's life presents one curious feature, rare in the German academic world. Göttingen was the only University with which as student, teacher, or professor he had any connection. The forty-five years of his life there go back to the days when Gauss, Wilhelm Weber and Dirichlet still lived and taught. Although the first of these was to exercise paramount mastery over Schering's future, we can trace the influence of each in his life and writings. Schering's published work deals entirely with subjects in which his celebrated teachers were pioneers—theory of numbers, non-Euclidian geometry, hydrodynamics, electricity and magnetism. As far as one can judge, Schering's personal predilections were for a strictly analytical treatment of pure mathematics; the force of circumstances, however, directed part of his energies to applied mathematics and practical physics. He is said to have shown great mathematical promise at school at Lueneborg and at the Polytechnikum at Hanover; so much so that he abandoned his intention of becoming an architect, and went up to the University in 1852. His studies were crowned with success, and he received prizes both for his Doctor's dissertation, "On the mathematical theory of electric currents," and for his Habilitationsschrift, "On the conformal representation of the ellipsoid on the plane."

In 1860 he became Professor, and was at first engaged in astronomical calculations under Prof. Klinkerfues. In 1863 he embarked on his life-work, the editing of Gauss's papers. Gauss left, besides a large quantity of published work, a mass of notes and of half-finished productions. The work of collecting the published papers, and of looking through, arranging and collecting the unpublished, fell to Schering. From 1863 to 1874 he edited six volumes of collected works, published by the Gesellschaft der Wissenschaft, of Göttingen. He subsequently edited the *Theoria Motus* for the owner of the copyright; this volume, though apparently uniform with the others, does not properly belong to the set, and, the copyright having now expired, the Gesellschaft propose to publish the *Theoria Motus*, together with some still unpublished writings, in a seventh volume of their edition.

It is difficult for any one who has not seen the documents to estimate the labour required to bring them into a form fit for publication. There still remains an enormous mass of unpublished matter, notes on scraps of paper and backs of envelopes, calculations without explanations, statements without proofs, and so on. Until a lingering illness rendered him unfit for much exertion, Schering went on working to bring order into this chaos; but he was unwilling to publish except in a perfected form. Since 1874 no volume had appeared, and, except Prof. Schur, no one had access to any of the original manuscripts.

There was consequently great curiosity about the MSS. when, on Prof. Schering's death, they were brought out and examined. A number of mathematicians have been enlisted by Prof. Klein, and it is hoped that at least the notes on planetary disturbances and the correspondence on non-Euclidian geometry will soon be published. Work that is too imperfect for publication will in future be always accessible at the University library.

Apart from those already mentioned, Schering published numerous papers, mostly to be found between 1870 and 1887, in the Göttingen *Nachrichten* and *Anzeiger* and the *Comptes rendus*. His lectures, which for some years he had done little more than announce, were usually on higher pure mathematics.

In 1868 he became director of the Gauss Magnetic Observatory. His work consisted partly in directing the studies of students in magnetism and kindred subjects, partly in conducting observations, &c. Generally he continued and extended the work as Gauss had planned it. Accounts of his observations, and of various improvements made by him in the instruments, will be found in papers by himself and his brother, Prof. Karl Schering, of Darmstadt.

W. H. and G. Chisholm Young.

NOTES.

On Saturday last, at the Trocadero Restaurant, a dinner was given to Prof. T. McKenny Hughes by his old students, on the occasion of the twenty-fifth anniversary of his election to the Woodwardian Professorship of Geology at Cambridge. Sir Archibald Geikie presided, and covers were laid for old students and friends to the number of sixty-five. An illuminated address was presented to Prof. Hughes by Dr. R. D. Roberts and Mr. A. Strahan as the oldest and earliest of his Cambridge students in the company; and the healths of Prof. and Mrs. Hughes were proposed by Sir A. Geikie. In the course of his speech, Sir A. Geikie alluded to the great and continued growth and success of the Cambridge Geological School, which he characterised as second to none in the world. Prof. Hughes replied, and subsequently the President of the Geological Society (Mr. Whitaker), Sir Henry Howorth, M.P., Prof. James Stuart, M.P., and Dr. Hicks spoke and testified to the value of Prof. Hughes's professional work, and to the wide extent of his personal influence. In addition to those above mentioned, there were present Prof. Wiltshire, Mr. W. Hudleston, Prof. Etheridge, Dr. Henry Woodward, Prof. Lapworth, Prof. Watts, Prof. Ainsworth Davis, Messrs. Teall, Herries, Bauerman, Marr, Harker, Seward, Woods, Reed, Rudler, Kynaston, Mond, and several ladies, many of whom had studied under Prof. Hughes at Cambridge. Letters and telegrams of congratulation from leading Continental geologists were read by Sir A. Geikie. A magnificent silver loving-cup was presented to Prof. McKenny Hughes on Monday, February 28, by his past and present students at Cambridge as a permanent memento of his twenty-five years' work as Woodwardian Professor of Geology, and as a mark of their esteem and gratitude. The cup bore a suitable inscription in Latin, and the arms of the University and of Trinity and Clare Colleges; and an illuminated list of the subscribers was presented with it. Mr. Cowper Reed, Miss Blanche Smith, Dr. Roberts, Prof. Ainsworth Davis, and Rev. W. L. Carter made appropriate speeches, and Prof. Hughes replied.

The Physico-Mathematical Society of Kazan has made its first award of the Lobachévski Prize to Prof. Sophus Lie, of the University of Leipzig, in consideration of the third volume of his work, "Theorie der Transformationsgruppen." The prize, which is of the value of 500 roubles, is to be adjudged every three years for work in geometry, preferably non-Euclidean geometry, and all works published in Russian, English, French, German, Italian, or Latin in the six years preceding the award are eligible. In Prof. Lie's treatise the theory of non-Euclidean geometry has been exhaustively re-stated and re-established in a profound investigation on the space-problem, based on the work of the late von Helmholtz.

IT is announced in the *Times* that the Local Government Board has given orders that the new form of vaccine mixed with glycerine, described in last week's NATURE (p. 391), is to be served out to all vaccination officers, following upon the recommendation of the Special Commission on Vaccination, which recently examined all the great vaccination departments of foreign Governments. This is to be undertaken at once, without regard to the vaccination legislation promised in the Queen's Speech, and will be completely independent of such a measure. Some delay has arisen in sending out the new lymph, owing to the want of a special laboratory for the cultivation of the matter; but this will not now be long delayed, as soon as the Local Government Medical Board is granted funds to purchase or secure a laboratory.

M. DE FONVIELLE informs us that the President of the International Commission for the exploration of the high atmosphere has issued a circular notifying that a conference will be held at Strassburg on March 28, to discuss the results obtained up to this time by the ascent of free balloons to high altitudes, and determining the measures which are to be taken to collect registered observations. The German kite-balloons and American meteorological kites will also be subject for discussion. Invitations have been sent to a number of men of science who are working in similar fields of inquiry. The remarks and discussions will be carried on in three languages—English, French, and German.

ON Saturday last, February 26, the Council of the Society of Arts attended at Marlborough House, when the Prince of Wales, President of the Society, presented the Albert Medal to Mr. G. J. Symons, F.R.S., "for the services he has rendered to the United Kingdom by affording to engineers engaged in the water supply and the sewage of towns a trustworthy basis for their work, by establishing and carrying on during nearly forty years systematic observations (now at over 3000 stations) of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself."

THE lists of prize competitions for 1898 and 1899 have just reached us from the Belgian Academy. The international competitions consist in the answering of six questions, for each of which a prize of 600 francs is offered. These questions are the ollowing: (1) Describe the researches already made on critical phenomena in physical science, and complete them by new researches. (2) Expound and criticise the various theories of the constitution of solutions, and supplement them by new researches, especially with regard to the existence of hydrates in aqueous solution. (3) Make some important contribution to the theory of correspondences (*Verwandtschaften*) between two spaces. (4) Original research on digestion in carnivorous plants. (5) Original research on the structure and development of a Platode, with the object of determining whether there are any phylogenic relations between Platyhelms and Enterocœlians. (6) Do the Schizophytes possess a nucleus? If so, what is its structure and its mode of division? In addition, a prize of 800 francs is offered for a solution of the problem of determining the influence exercised by the nitryl radicle NO_2 in aliphatic compounds on the characteristics or functions appertaining to alcohol, haloid ether, oxy-ether, &c. All papers must be written in French or Flemish, and must be sent to M. le Secrétaire perpetuel, au Palais des Académies, Bruxelles, before August 1, 1898. They must bear a motto (not a pseudonym), and must be accompanied by a sealed envelope bearing the same motto outside, and the competitor's name and address inside. Special correctness is required in the matter of quotations. The conditions for 1899 are similar. The questions relate to the thermal conductivity of liquids and solutions, to straight-line geometry, to the variation of latitude, to albuminoid substances in nutrition, to the Apterygota, and to the Upper Eocene period.

THE Rome correspondent of the *Daily Mail* announces that King Humbert has given his permission to his young nephew, the Duke of the Abruzzi, to undertake an expedition in the Arctic regions. The Prince intends to visit Greenland and Lapland, and to study the sea currents and the geology of the locality. He will be accompanied by an aide-de-camp, by Drs. Gonella and Defilippi, who were his companions in the expedition to Alaska, and by a few young naval officers. According to a Reuter telegram from Christiania, the Duke will leave next summer for Spitsbergen in order to explore the country, but the expedition will not start until 1899, and its first objective will be Franz Josef Land. Should the conditions of the ice be favourable, depôts will be established, and an attempt will be made to reach the Pole by means of sledges and dogs. In the event of this proving impracticable, the expedition will confine itself to an exploration of Franz Josef Land. On the advice of Captain Sverdrup, the Duke will ask the Danish Government for a supply of dogs from Greenland, as these are considered to be the best.

THE brilliant lantern slides exhibited by Dr. Isaac Roberts at the Royal Societies' Club on Wednesday, February 23, in illustration of his lecture on "Recent Intelligence from Regions in the Stellar Universe," constituted a striking testimony to his achievements in astronomical photography. The nebulæ and clusters of stars which Dr. Roberts has now photographed number about five hundred, and a list of them, as they are taken each year, is published in his annual Observatory Report in the *Monthly Notices* of the Royal Astronomical Society. It is not too much to say that these photographs contain a mine of new astronomical information which has not yet been worked, and the value of which will increase with years. The pictures represent celestial species awaiting the mind of a Darwin to coordinate them; for they show stellar systems in the various stages of growth from the embryonic nebula to the finished star. Dr. Roberts has himself endeavoured to discover the scheme of stellar evolution as revealed by his photographs, and he placed the results before his audience last week. His method of doing this was soundly scientific. To begin with, he showed a number of photographs of star regions in which the stars could be seen grouped into semicircles, segments, portions of ellipses, and lines of various degrees of curvature. Some of these groups were composed of bright stars of nearly equal magnitude; some of faint stars, also of nearly equal magnitude; while the distances between the stars in the various groups were remarkably regular. Passing from these characteristics of stellar arrangement to photographs of spiral nebulæ, Dr. Roberts pointed out that the nebulous matter in the spirals was broken up into star-like loci, which in the regularity of their distribution resembled the curves and combinations of stars exhibited by photographs upon which no trace of nebulosity was visible. It thus seemed that the curvilinear grouping of stars of nearly equal magnitude gave evidence that the stars had been evolved out of some attenuated material in space by the action of vortical motions and by gravitation. Exactly how the vortical motions were caused, or what has brought about the distributions of nebulosity in the spiral nebulæ, cannot be answered; but the marvellous pictures exhibited by Dr. Roberts establish the reality of the grouping, and furnish students of celestial mechanics with rich food for contemplation.

THE Bishop of London, one of its Vice-Presidents, has consented to preside at the annual general meeting of Governors of the Dental Hospital of London, to be held at the Hospital, Leicester Square, on Thursday, March 17, at 5.30 p.m.

A CORRESPONDENT writes to inform us, with respect to the Lincolnshire Naturalists' Union, that the papers written by members of that association are published in the *Naturalist*, which is issued under the auspices of the Yorkshire Naturalists' Union. While desirous in every way to further the interests of local societies, the demands upon our space render it impossible for us to enter into local controversies, and we must decline to notice any further communications relating to this division among the naturalists of Lincolnshire.

THE following are the arrangements for lectures during March at the Imperial Institute. These lectures will be open free to the public, without tickets, seats being reserved for Fellows of the Imperial Institute and persons introduced by them. Monday, March 7, at 8.30, "The Mineral and other Resources of Newfoundland," by Mr. J. H. Collins; Wednesday, March 9, at 3, "A Demonstration with the Cinematograph of 'Harvesting in Manitoba in 1897,'" by Mr. J. S. Freer; Thursday, March 10, at 8.30, "Colonisation in Canada," by the Marquis Bouthillier-Chavigny; Monday, March 14, at 8.30, "The Alps of New Zealand," by Mr. E. A. Fitzgerald; Monday, March 21, at 8.30, "Siam—Present and Future," by Mr. Frederick W. Verney; Monday, March 28, at 8.30, "On a proposed Railway Connection between India and Ceylon," by Mr. John Ferguson.

FROM a preliminary note in the *Atti dei Lincei*, we learn that Dr. B. Longo, by studying the embryology of the *Calycanthaceæ*, has discovered in their ovules certain characteristics forming a new link between this order of plants and the *Rosaceæ*.

WE are glad to see that an attempt is being made to increase the usefulness of the collections of abstracts which, under the editorship of Mr. J. Swinburne, have for several years constituted the second half of the *Proceedings* of the Physical Society of London. With the title "Science Abstracts, Physics and Electrical Engineering," these records of current research have now, for the first time, appeared in separate form, and the Institution of Electrical Engineers has now co-operated with the Physical Society in their publication. Mr. Swinburne still holds the post of editor, and Mr. W. R. Cooper has been appointed sub-editor. The change is calculated both to extend the circulation and enlarge the scope of these abstracts by introducing matter of a practical nature without detracting from the value of the notices of the more theoretical papers. The numbers may be obtained by non-members from the publishers, Messrs. Taylor and Francis.

IN a communication to the *Philosophical Magazine* for February, on the failure of german-silver and platinoid wires used for resistance coils in tropical climates, Mr. Rollo Appleyard remarks:—"Can metallurgists tell us the difference in constitution and structure between a german-silver wire that decays in four weeks and another that, under similar circumstances, never fails? Or, what is even more important, can they make us platinoid that shall never fail? If they cannot, it becomes necessary to surrender these cheaper and better electrical materials, and fall back upon the more expensive alloys, beginning at platinum-silver. If sufficient time and means were at the disposal of metallurgists, they might discover the secret of permanence in alloys. Germany, with the advantages of a National Laboratory, has already attacked the question, and "manganin" is the result. Its adoption there as a satisfactory alloy is directly due to work done at the Reichsanstalt. But it has yet to be proved that manganin will endure the conditions imposed by the tropics. Moreover, the doubt arises as to whether it is desirable to obtain from abroad material that ought to be produced in our own country. British cable manufacturers are already importing thousands of tons of sheathing wire from Germany; and it seems probable that, for the want of a National Laboratory, instrument-makers will now get their resistance-wire from that same adventurous foreign source."

THE Report of the Meteorological Council for the year ending March 31, 1897, has recently been presented to Parliament. The Office continues to collect data relating to the meteorology of the ocean, and supplies complete outfits of meteorological instruments to officers of merchant ships who are willing to make observations. Her Majesty's ships are also supplied with instruments, and valuable observations are received from officers of the Royal Navy. We have previously noticed the monthly current charts which have been published for several oceans. A work on the meteorology of the Southern Ocean, between the Cape of Good Hope and New Zealand, is in course of preparation; and as no charts for this area have been previously published by the Office, the work will probably be of much value. The results of the weather forecasts continue to show a considerable amount of success; for those published in the morning newspapers a complete or partial succsss of 81 per cent. is claimed for the year in question, while for the special forecasts issued during the hay-harvest, the figures show that 88 per cent. were useful. A still greater success is claimed for the warnings of storms, no less than 91·5 per cent. being justified. For the study of the climatology of the British Isles, the Office continues to subsidise, and to maintain an intimate relationship with, a small number of observatories of the highest class, and to supplement this information by observations from a large number of voluntary stations. The principal miscellaneous investigations during the year refer to anemometer experiments, earth temperatures, and the recently published rainfall statistics for the British Islands.

UNDER the name of "alinit" a new manure suitable for all kinds of grain has been recently introduced to the scientific and agricultural worlds by that enterprising firm of colour manufacturers, Friedrich Bayer and Co., whose name is already so indissolubly associated with nitragin, and the production of diphtheria anti-toxins. The discoverer of this mysterious material is a certain Herr Caron, of Ellenbach; and alinit in its present form is the outcome of four years' laborious experimental investigations on the bacterial flora of different soils, resulting in the isolation of a particular bacillus, upon the presence of which would appear to depend to an important extent the fertility of certain soils. Caron has already obtained striking results on an experimental scale with crops from soil treated with pure cultures of this bacillus—*Ellenbachensis alpha*, as he has called it. Alinit is to be had commercially from the above firm, and is sent out as a creamy-yellow powder, of which the nitrogenous constituents have been ascertained to be 2·5 per cent. Its closer investigation has been made the subject of memoirs by Stoklasa, of Prague, and also Messrs. Stutzer and Hartleb. The bacillus is contained in this powder in the form of spores, and on cultivation is found to belong to the well-known aërobic group of bacteria known as the hay bacilli, resembling very closely the bacillus mycoides so frequently found in soil, and the bacillus *Megatherium*. It appears to grow easily upon all the usual culture media. Before its precise place amongst bacterial fertilisers can be determined, many more elaborate and carefully-conducted experiments must be carried out.

PROF. ARNALDO FAUSTINI contributes to the *Bollettino* of the Italian Geographical Society, which, by the way, appears in a new ornamental cover, a note on the "Appearances of Land" recorded by various voyagers in the Antarctic regions. The paper gives point to some of the strongest arguments for Antarctic research, and summarises the topographical uncertainties which future expeditions must set themselves to clear up.

AT the meeting of the Vienna Academy of Sciences, on December 16 last, letters were read from Dr. Steindachner, the Director of the *Pola* Expedition in the Red Sea. Writing at the end of November, Dr. Steindachner reports that deep-sea work was at an end, but that observations along the coast and amongst the islands were being continued as the very unfavourable weather permitted. Valuable collections were made on the Dahalak and Nakra Khor islands, specially in connection with the coral formations and the shallow-water fishes; and the extinct volcanoes and the lava-sheets of Peacock Hill Bay were examined. The *Pola* reached Assab on November 30, and Mocha on December 14, 1897.

M. LE COMTE P. DE BARTHELEMY publishes a letter in the *Comptes rendus* of the Paris Geographical Society, on the possible lines of communication between Luang-Prabang and the coast, and on the navigability of the Mekong. It would seem that little or nothing can be made of the Tran-Nunh plains as long as they remain in the hands of the present degenerate population; although something might be possible if the Meo population of the mountainous districts took their place. The only part of the Mekong really adapted to navigation is the stretch of 650 kilometres between Vien-Tiane and Savannakhek. The future of Luang-Prabang evidently depends on the speedy realisation of one or more of the numerous railway schemes proposed.

MR. PORTER has just published the tenth part of Messrs. Sclater and Thomas's illustrated "Book of Antelopes." Two more parts, already in a forward state, will finish the account of the Gazelles and allied forms, and bring the third volume to a close. The fourth and concluding volume will be devoted to the Oryxes and Strepsiceres. Altogether the work will contain one hundred coloured plates, about seventy of which were originally prepared under the superintendence of the late Sir Victor Brooke, many years ago, for a somewhat similar work which he had planned, but did not live to accomplish.

IN referring to the election of three new members of the Athenæum Club, in the first note last week, the designation of the Club was inadvertently omitted.

DR. G. LINDSAY JOHNSON writes calling attention to an obvious misprint in the fortieth stereotyped edition of Vega's Logarithmic Tables. The logarithmic sine of 0° 6′, printed as 9·2418771, should be 7·2418771.

PROF. CHARLES FABRE, of the University of Toulouse, has just completed the second supplement to his well-known treatise on Photography. The new volume deals with the progress made in all branches of the subject during the years 1893 to 1896.

THE additions to the Zoological Society's Gardens during the past week include three Black-backed Jackals (*Canis mesomelas*) from South Africa, presented by Mr. J. E. Matcham; a Black-backed Jackal (*Canis mesomelas*) from South Africa, presented by Captain Travers; two Black Spider-Monkeys (*Ateles ater*) from Eastern Peru, a Downy Owl (*Pulsatrix torquata*) from Pará, twelve White's Tree Frogs (*Hyla cærulea*) from Australia, deposited; a Temminck's Tragopan (*Ceriornis temmincki*) from China, a Bearded Lizard (*Amphibolurus barbatus*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

ECLIPSE NEGATIVES.—In order to minimise the risk in returning the eclipse negatives to England from the Eclipse Station at Viziadrug, they were divided into three batches, a complete set being made up in each batch by positives from the other negatives. Two of these sets have already arrived safely in England, and they testify to the clearness of the atmosphere during totality. The smallness of the prominences is very noticeable, both in hydrogen and K (calcium) radiations, a fact which was observed at South Kensington in H_α light on the day of the eclipse. Another conspicuous feature is the intense brightness of some of the coronal streamers at their base. The negatives of the corona also verify the reports from the visual observations, which stated that the general form was like those of 1886 and 1896. The resemblance to the latter is very striking, especially when we remember that it was the north point of the axis which was presented to us at that eclipse; whilst in the last eclipse in January, the south point of the axis is inclined towards us.

CINEMATOGRAPH IN ASTRONOMY.—We have already learnt that the cinematograph was employed with success during the recent solar eclipse, but M. Camille Flammarion has turned it to the further use of exhibiting to a large audience the various celestial movements. He has photographed the heavens at different times from sunset to sunrise with a wide-angled lens in the cinematograph, and as the whole movements during a single night are projected on the screen, and passed through in a few minutes, no very rapid rate of exposing the photographs is required. For showing sunset at one horizon, followed by the movement of the stars and sunrise at the other horizon, and also the movement of the moon amongst the stars, this method has been employed with great success. He proposes in addition to this to photograph the sun-spots, and thus exhibit by their movement the rotation of the sun. For the earth he has constructed a large model, and photographed it with a cinematograph when rotating and illuminated by light arranged so as to represent the sun; this was exhibited at the last meeting of the French Astronomical Society, and was greatly admired.

A PROBABLE NEW STAR.—In *Astr. Nach.*, No. 3476, it is pointed out that the probable new star announced by Espin, and not in the B.D., is, however, in the small edition as an addendum, +32°·1526*a*; 8·0 mag., 7h. 12m. 15·6s., +32° 18′·4 L. This is the same star as recorded by the Rev. T. E. Espin, so in all probability it is another observation of a variable star. An examination of its spectrum, made at South Kensington, at once showed that the star had not a spectrum peculiar to temporary stars, and hence was probably only an omission from the star charts.

ELECTROLYTIC REFLECTORS.—In a paper read before the Institution of Electrical Engineers, and reproduced in *Industries and Iron* for February 18, Mr. Sherard Cowper-Coles describes a method by which a metallic reflector can be made by an electrolytic process. The method is intended, in the first place, for the manufacture of metallic mirrors for use as projectors in search lights, and also to overcome the difficulty that has been experienced in producing a true metallic reflector that will not readily tarnish when exposed to the heat of an arc light; but the same method is also applicable for the production of mirrors for astronomical purposes. The process is, of course, a copying one, and consists in taking a concave surface from a convex mould, so figured as to give the correct curvature to the copy taken from it. In the words of the author, "a glass mould is prepared, the convex side of which is accurately shaped and polished to form a true reflecting surface. On the prepared surface is deposited a coating of metallic silver, which is thrown down chemically on the glass, and then polished so as to ensure the copper backing being adherent to the silver. The mould thus prepared is placed in a suitable ring and frame, and immersed in an electrolyte of copper sulphate, the mould being rotated in a horizontal position. The copper adheres firmly to the silver, and together they form the reflector, which is subsequently separated from the glass mould by placing the whole in cold or lukewarm water, and then gradually raising the temperature of the water to 120° F., when the metal reflector will leave the glass mould, due to the unequal expansion of the two." The concave surface of the reflector thus obtained has a brilliant polish, and requires no further treatment to answer all the purposes of a reflector; but for uses where tarnishing would soon take place, it is further immersed in a bath of palladium ammonium chloride, and a coating of palladium deposited on the concave side; this metal does not tarnish readily, and resists heat to a wonderful degree.

This new method of making mirrors electrolytically would seem to have a promising future before it, for great pains could be taken in making the mould, from which any number of copies could be taken without the usual laborious process of grinding and figuring each individual mirror, and yet each one would have a correct reflecting surface.

SCIENTIFIC ADVANTAGES OF AN ANTARCTIC EXPEDITION.[1]

Dr. Murray's Address.

From a scientific point of view the advantages to be derived from a well-equipped and well-directed expedition to the Antarctic would, at the present time, be manifold. Every department of natural knowledge would be enriched by systematic observations as to the order in which phenomena coexist and follow each other, in regions of the earth's surface about which we know very little or are wholly ignorant. It is one of the great objects of science to collect observations of the kind here indicated, and it may be safely said that without them we can never arrive at a right understanding of the phenomena by which we are surrounded, even in the habitable parts of the globe.

Before considering the various orders of phenomena, concerning which fuller information is urgently desired, it may be well to point out a fundamental topographical difference between the Arctic and Antarctic. In the northern hemisphere there is a polar sea almost completely surrounded by continental land, and continental conditions for the most part prevail. In the southern hemisphere, on the other hand, there is almost certainly a continent at the South Pole, which is completely surrounded by the ocean, and, in those latitudes, the most simple and extended oceanic conditions on the surface of the globe are encountered.

The Atmosphere.

One of the most remarkable features in the meteorology of the globe is the low atmospheric pressure at all seasons in the southern hemisphere south of latitude 45° S., with the accompanying strong westerly and north-westerly winds, large rain and snow fall, all round the South Polar regions. The mean pressure seems to be less than 29 inches, which is much lower than in similar latitudes in the northern hemisphere. Some meteorologists hold that this vast cyclonic system and low-pressure area continues south as far as the pole, the more southerly parts being traversed by secondary cyclones. There are, however, many indications that the extreme South Polar area is occupied by a vast anticyclone, out of which winds blow towards the girdle of low pressure outside the ice-bound region. In support of this view it is pointed out that Ross's barometric observations indicate a gradual rise in the pressure south of the latitude of 75° S., and all Antarctic voyagers agree that when near the ice the majority of the winds are from the south and south-east, and bring clear weather with fall of temperature, while northerly winds bring thick fogs with rise of temperature.

All our knowledge of the meteorological conditions of the Antarctic is limited to a few observations during the midsummer months, and these indicate that the temperature of the snow-covered Antarctic continent is even at that time much lower than that of the surrounding sea. The anticyclonic area at the South Pole appears therefore to be permanent, and when in winter the sea-ice is for the most part continuous and extends far to the north, the anticyclonic area has most probably a much wider extension than in summer. This is indicated by the south-easterly winds, which at times blow towards the southern point of the American continent in June and July.

All observations in high southern latitudes indicate an extremely low summer temperature. In winter we have no direct observations. The mean of Ross's air temperatures south of latitude 63° S. was 28·74° F., which is about the freezing-point of sea-water, and his maximum temperature was 43·5° F. Both Wilkes and D'Urville observed pools of fresh water on several icebergs, and, when sailing along the ice barrier, Ross saw "gigantic icicles depending from every projecting point of its perpendicular cliffs" (Ross, "Antarctic Voyage," vol. i. p. 237), so it is probable that extensive melting sometimes takes place.

In the latitude of the Antarctic circle the air is frequently at or near the point of saturation, and precipitation takes place in the form of rain, sleet, snow, or hail. Most of the observations near the ice-covered land show, however, a much drier atmosphere, and in all probability precipitation over the Antarctic continent takes place in the form of fine snow crystals, such as is recorded in the interior of Greenland.

There would appear, then, to be good reasons for believing that the region of the South Pole is covered by what may be regarded practically as a great permanent anticyclone, with a much wider extension in winter than in summer. It is most likely that the prevailing winds blow out from the pole all the year round towards the surrounding sea, as in the case of Greenland; but, unlike Greenland, this area is probably seldom traversed by cyclonic disturbances.

But what has been stated only shows how little real knowledge we possess concerning the atmospheric conditions of high southern latitudes. It is certain, however, that even two years' systematic observations within these regions would be of the utmost value for the future of meteorological science.

Antarctic Ice.

From many points of view it would be important to learn something about the condition and distribution of Antarctic sea-ice during the winter months, and especially about the position and movements of the huge table-shaped icebergs at this and other seasons of the year. These flat-topped icebergs, with a thickness of 1200 or 1500 feet, with their stratification and their perpendicular cliffs, which rise 150 or 200 feet above and sink 1100 or 1400 feet below the level of the sea, form the most striking peculiarity of the Antarctic Ocean. Their form and structure seem clearly to indicate that they were formed on an extended land surface, and have been pushed out over low-lying coasts into the sea.

Ross sailed for 300 miles along the face of a great ice-barrier from 150 to 200 feet in height, off which he obtained depths of 1800 and 2400 feet. This was evidently the sea-front of a great creeping glacier or ice-cap just then in the condition to give birth to the table-shaped icebergs, miles in length, which have been described by every Antarctic voyager.

All Antarctic land is not, however, surrounded by such inaccessible cliffs of ice, for along the seaward faces of the great mountain ranges of Victoria Land the ice and snow which descend to the sea apparently form cliffs not higher than 10 to 20 feet, and in 1895 Kristensen and Borchgrevink landed on a pebbly beach, occupied by a penguin rookery, at Cape Adare without encountering any land-ice descending to the sea. Where a penguin rookery is situated, we may be quite sure that there is occasionally open water for a considerable portion of the year, and that consequently landing might be effected without much difficulty or delay, and further that a party, once landed, might with safety winter at such a spot, where the penguins would furnish an abundant supply of food and fuel. A properly equipped party of observers situated at a point like this on the Antarctic continent for one or two winters might carry out a most valuable series of scientific observations, make sucessful excursions towards the interior, and bring back valuable information as to the probable thickness of the ice-cap, its temperature at different levels, its rate of accumulation, and its motions, concerning all which points there is much difference of opinion among scientific men.

Antarctic Land.

Is there an Antarctic continent? It has already been stated that the form and structure of the Antarctic icebergs indicate that they were built up on, and had flowed over, an extended land surface. As these bergs are floated to the north and broken up in warmer latitudes they distribute over the floor of the ocean a large quantity of glaciated rock fragments and land detritus. These materials were dredged up by the *Challenger* in considerable quantity, and they show that the rocks over which the Antarctic land-ice moved were gneisses, granites, mica-schists, quartziferous diorites, grained quartzites, sandstones, limestones, and shales. These lithological types are distinctively indicative of continental land, and there can be no doubt about their having been transported from land situated towards the South Pole. D'Urville describes rocky islets off Adélie Land composed of granite and gneiss. Wilkes found on an iceberg, near the same place, boulders of red sandstone and basalt. Borchgrevink and Bull have brought back fragments of mica-schists and other continental rocks from Cape Adare. Dr. Donald brought back from Joinville Island a piece of red jasper or chert containing Radiolaria and Sponge spicules. Captain Larsen brought from Seymour Island pieces of fossil coniferous wood, and also fossil shells of *Cucullæa*, *Cytherea*, *Cyprina*, *Teredo*, and *Natica*, having a close resemblance to species known to occur in lower Tertiary beds in Britain and Patagonia. These fossil remains indicate in these areas a much warmer climate in past times. We are thus in possession of abundant indications that there is a wide extent of continental land within the ice-bound regions of the southern hemisphere.

[1] Address by Dr. John Murray, F.R.S., and subsequent speeches, elivered at a special meeting of the Royal Society on February 24.

It is not likely that any living land-fauna will be discovered on the Antarctic continent away from the penguin rookeries. Still, an Antarctic expedition will certainly throw much light on many geological problems. Fossil finds in high latitudes are always of special importance. The pieces of fossil wood from Seymour Island can hardly be the only relics of plant life that are likely to be met with in Tertiary and even older systems within the Antarctic. Tertiary, Mesozoic, and Palæozoic forms are tolerably well developed in the Arctic regions, and the occurrence of like forms in the Antarctic regions might be expected to suggest much as to former geographical changes, such as the extension of the Antarctic continent towards the north, and its connection with, or isolation from, the northern continents, and also as to former climatic changes, such as the presence in pre-Tertiary times of a nearly uniform temperature in the waters of the ocean all over the surface of the globe.

Magnetic and Pendulum Observations, Geodetic Measurements, Tides and Currents.

In any Antarctic expedition magnetic observations would, of course, form an essential part of the work to be undertaken, and the importance of such observations has been frequently dwelt upon by eminent physicists and navigators. Should a party of competent observers be stationed at Cape Adare for two years, pendulum observations could be carried out there and at other points within the Antarctic, or even on icebergs and on the interior ice-cap. It might be possible to measure a degree on the Antarctic continent or ice-cap, which would be a most useful thing to do. By watching the motions of the icebergs and ice from land at Cape Adare, much would be learnt about oceanic currents, and our knowledge of the tides would be increased by a systematic series of tidal observations on the shores of Antarctica, where we have at present no observations. The series of scientific observations here mentioned, and others that might be indicated, would fill up many gaps in our knowledge of the physical conditions of these high southern latitudes.

Depth of the Antarctic Ocean.

In regard to the depth of the ocean immediately surrounding the Antarctic continent we have at present very meagre information, and one of the objects of an Antarctic expedition would be to supplement our knowledge by an extensive series of soundings in all directions throughout the Antarctic and Southern Oceans. It would in this way be possible, after a careful consideration of the depths and marine deposits, to trace out approximately the outlines of the Antarctic continent. At the present time we know that Ross obtained depths of 100 to 500 fathoms all over the great bank extending to the east of Victoria Land, and somewhat similar depths have been obtained extending for some distance to the east of Joinville Island. Wilkes sounded in depths of 500 and 800 fathoms about twenty or thirty miles off Adélie Land. The depths found by the *Challenger* in the neighbourhood of the Antarctic circle were from 1300 to 1800 fathoms, and further north the *Challenger* soundings ranged from 1260 to 2600 fathoms. To the south-west of South Georgia, Ross paid out 4000 fathoms of line without reaching bottom. In the charts of depth which I have constructed, I have always placed a deep sea in this position; for it appears to me that Ross, who knew very well how to take soundings, was not likely to have been mistaken in work of this kind.

The few indications which we thus possess of the depth of the ocean in this part of the world seem to show that there is a gradual shoaling of the ocean from very deep water towards the Antarctic continent, and, so far as we yet know, either from soundings or temperature observations, there are no basins cut off from general oceanic circulation by barriers or ridges, similar to those found towards the Arctic.

Deposits of the Antarctic Ocean

The deposits which have been obtained close to the Antarctic continent consist of blue mud, containing glauconite, made up for the most part of detrital matters brought down from the land, but containing a considerable admixture of the remains of pelagic and other organisms. Further to the north there is a very pure diatom ooze, containing a considerable quantity of detrital matter from icebergs, and a few pelagic foraminifera. This deposit appears to form a zone right round the earth in these latitudes. Still further to the north the deposits pass in deep water, either into a Globigerina ooze, or into a red clay with manganese nodules, sharks' teeth, ear-bones of whales, and the other materials characteristic of that deep-sea deposit. Since these views, however, as to the distribution of deep-sea deposits throughout these high southern latitudes, are founded upon relatively few samples, it cannot be doubted that further samples from different depths in the unexplored regions would yield most interesting information.

Temperature of the Antarctic Ocean.

The mean daily temperature of the surface waters of the Antarctic, as recorded by Ross, to the south of latitude 63° S. in the summer months, varies from 27·3° to 33·6°, and the mean of all his observations is 29·85°. As already stated, his mean for the air during the same period is somewhat lower, being 28·74°. In fact, all observations seem to show that the surface water is warmer than the air during the summer months.

The *Challenger* observations of temperature beneath the surface indicate the presence of a stratum of colder water wedged between warmer water at the surface. and warm water at the bottom. This wedge-shaped stratum of cold water extends through about 12° of latitude, the thin end terminating about latitude 53° S., its temperature varying from 28° at the southern thick end to 32·5° at the northern thin end, while the temperature of the overlying water ranges from 29° in the south to 38° in the north, and that of the underlying water from 32° to 35°. This must be regarded as the distribution of temperature only during the summer, for it is improbable that during the winter months there is a warmer surface layer.

In the greater depths of the Antarctic, as far south as the Antarctic circle, the temperature of the water varies between 32° and 35° F., and is not, therefore, very different from the temperature of the deepest bottom water of the tropical regions of the ocean. The presence of this relatively warm water in the deeper parts of the Antarctic Ocean may be explained by a consideration of general oceanic circulation. The warm tropical waters which are driven southwards along the eastern coasts of South America, Africa, and Australia into the great all-encircling Southern Ocean, there become cooled as they are driven to the east by the strong westerly winds. These waters, on account of their high salinity, can suffer much dilution with Antarctic water, and still be denser than water from these higher latitudes at the same temperature. Here the density observations and the sea-water gases indicate that a large part of the cold water found at the greater depths of the ocean probably leaves the surface and sinks towards the bottom in the Southern Ocean, between the latitudes of 45° and 56° S. These deeper, but not necessarily bottom, layers are then drawn slowly northwards towards the tropics, to supply the deficiencies there produced by evaporation and southward-flowing surface currents, and these deeper layers of relatively warm water appear likewise to be slowly drawn southwards to the Antarctic area to supply the place of the ice-cold currents of surface water drifted to the north. This warm underlying water is evidently a potent factor in the melting and destruction of the huge table-topped icebergs of the southern hemisphere. While these views as to circulation of oceanic water appear to be well established, still a fuller examination is most desirable at different seasons of the year, with improved thermometers and sounding machines. Indeed, all deep-sea apparatus has been so much improved as a result of the *Challenger* explorations, that the labour of taking salinity and all other oceanographical observations has been very much lessened.

Pelagic Life of the Antarctic Ocean.

In the surface waters of the Antarctic there is a great abundance of diatoms and other marine algæ. These floating banks or meadows form primarily not only the food of pelagic animals, but also the food of the abundant deep-sea life which covers the floor of the ocean in these south polar regions. Pelagic animals, such as copepods, amphipods, molluscs, and other marine creatures, are also very abundant, although species are fewer than in tropical waters. Some of these animals seem to be nearly, if not quite, identical with those found in high northern latitudes, and they have not been met with in the intervening tropical zones. The numerous species of shelled Pteropods, Foraminifera, Coccoliths, and Rhabdoliths, which exist in the tropical surface waters, gradually disappear as we approach the Antarctic circle, where the shelled Pteropods are represented by a small *Limacina*, and the Foraminifera by only two species of *Globigerina*, which are apparently identical with those in the Arctic Ocean. A peculiarity of the tow-net gatherings made by the *Challenger* Expedition in high southern latitudes, is the great rarity or absence of the pelagic larvæ of benthonic organisms, and in this respect they agree with similar collections from the cold waters of the Arctic seas. The absence of these larvæ from polar waters may be accounted for by the mode of development of benthonic animals to be referred to presently. It must be remembered that many of these pelagic organisms pass most of their lives in water of a temperature below 32° F., and it would be most interesting to learn more about their reproduction and general life-history.

Benthos Life of the Antarctic Ocean.

At present we have no information as to the shallow-water fauna of the Antarctic continent; but, judging from what we do know of the off-lying Antarctic islands, there are relatively few species in the shallow waters in depths less than 25 fathoms. On the other hand, life in the deeper waters appears to be exceptionally abundant. The total number of species of Metazoa collected by the *Challenger* at Kerguelen in depths less than 50 fathoms was about 130, and the number of additional species known from other sources from the shallow waters of the same island is 112, making altogether 242 species, or 30 species less than the number obtained in eight deep hauls with the trawl and dredge in the Kerguelen region of the Southern Ocean, in depths exceeding 1260 fathoms, in which eight hauls 272 species were obtained. Observations in other regions of the Great Southern Ocean, where there is a low mean annual temperature, also show that the marine fauna around the land in high southern latitudes appears to be very poor in species down to a depth of 25 fathoms, when compared with the number of species present at the mud-line about 100 fathoms, or even at depths of about 2 miles.

In 1841 Sir James Ross stated that the animals he dredged off the Antarctic continent were the same as those he had dredged from similar depths in the Arctic Seas, and he suggested that they might have passed from the one pole to the other by way of the cold waters of the deep sea.[1] Subsequent researches have shown that, as with pelagic organisms, many of the bottom-living species are identical with, or closely allied to, those of the Arctic regions, and are not represented in the intermediate tropical areas. For instance, the most striking character of the shore-fish fauna of the Southern Ocean is the reappearance of types inhabiting the corresponding latitudes of the northern hemisphere, and not found in the intervening tropical zone. This interruption of continuity in the distribution of shore-fishes is exemplified by species as well as genera, and Dr. Günther enumerates eleven species and twenty-nine genera as illustrating this method of distribution. The following are among the species:—Chimæra (*Chimæra monstrosa*), two species of Dog-fish (*Acanthias vulgaris* and *A. Blainvilli*), the Monk-fish (*Rhina squatina*), John Dory (*Zeus faber*), Angler (*Lophius piscatorius*), Bellows-fish (*Centriscus scolopax*), Sprat (*Clupea sprattus*). The genus by which the family Berycidæ is represented in the southern temperate zone (*Trachichthys*) is much more nearly allied to the northern than to the tropical genera. "As in the northern temperate zone, so in the southern . . . the variety of forms is much less than between the tropics. This is especially apparent on comparing the number of species constituting a genus. In this zone, genera composed of more than ten species are the exception, the majority having only from one to five." . . . "*Polyprion* is one of those extraordinary instances in which a very specialised form occurs at almost opposite points of the globe, without having left a trace of its previous existence in, or of its passage through, the intermediate space."

Speaking of the shore-fishes of the Antarctic Ocean, Günther says: "The general character of the fauna of Magelhæn's Straits and Kerguelen's Land is extremely similar to that of Iceland and Greenland. As in the Arctic fauna, Chondropterygians are scarce, and represented by *Acanthias vulgaris* and species of *Raja*. . . . As to Acanthopterygians, Cataphracti, and Scorpænidæ are represented as in the Arctic fauna, two of the genera (*Sebastes* and *Agonus*) being identical. The Cottidæ are replaced by six genera of Trachinidæ, remarkably similar in form to Arctic types. . . . Gadoid fishes reappear, but are less developed; as usual they are accompanied by *Myxine*. The reappearance of so specialised a genus as *Lycodes* is most remarkable."[2]

These statements with reference to shore-fishes might, with some modifications, be repeated concerning the distribution and character of all classes of marine invertebrates in high northern and high southern latitudes. The *Challenger* researches show that nearly 250 species taken in high southern latitudes occur also in the northern hemisphere, but are not recorded from the tropical zone. Fifty-four species of sea-weeds have also been recorded as showing a similar distribution.[1] Bipolarity in the distribution of marine organisms is a fact, however much naturalists may differ as to its extent and the way in which it has originated.

All those animals which secrete large quantities of carbonate of lime greatly predominate in the tropics, such as Corals, Decapod Crustacea, Lamellibranchs, and Gasteropods. On the other hand, those animals in which there is a feeble development of carbonate of lime structures predominate in cold polar waters, such as Hydroida, Holothuroidea, Annelida, Amphipoda, Isopoda, and Tunicata. This difference is in direct relation with the temperature of the water in which these organisms live, carbonate of lime being thrown down much more rapidly and abundantly in warm than in cold water by ammonium carbonate, one of the waste products of organic activity.

In the Southern and Sub-antarctic Ocean a large proportion of the Echinoderms develop their young after a fashion which precludes the possibility of a pelagic larval stage. The young are reared within or upon the body of the parent, and have a kind of commensal connection with her till they are large enough to take care of themselves. A similar method of direct development has been observed in eight or nine species of Echinoderms from the cold waters of the northern hemisphere. On the other hand, in temperate and tropical regions, the development of a free-swimming larva is so entirely the rule that it is usually described as the normal habit of the Echinodermata. This similarity in the mode of development between Arctic and Antarctic Echinoderms (and the contrast to what takes place in the tropics) holds good also in other classes of Invertebrates, and probably accounts for the absence of free-swimming larvæ of benthonic animals in the surface gatherings in Arctic and Antarctic waters.

What is urgently required with reference to the biological problems here indicated is a fuller knowledge of the facts, and it cannot be doubted that an Antarctic expedition would bring back collections and observations of the greatest interest to all naturalists and physiologists, and without such information it is impossible to discuss with success the present distribution of organisms over the surface of the globe, or to form a true conception of the antecedent conditions by which that distribution has been brought about.

Concluding Remarks.

There are many directions in which an Antarctic Expedition would carry out important observations besides those already touched on in the foregoing statement. From the purely exploratory point of view much might be urged in favour of an Antarctic Expedition at an early date; for the further progress of scientific geography it is essential to have a more exact knowledge of the topography of the Antarctic regions. This would enable a more just conception of the volume relations of land and sea to be formed, and in connection with pendulum observations some hints as to the density of the sub-oceanic crust and the depth of the Antarctic ice-cap might be obtained. In case the above sketch may possibly have created the impression that we really know a great deal about the Antarctic regions, it is necessary to re-state that all the general conclusions that have been indicated are largely hypothetical, and to again urge the necessity for a wider and more solid base for generalisations. The results of a successful Antarctic Expedition would mark a great advance in the philosophy—apart from the mere facts—of terrestrial science.

No thinking person doubts that the Antarctic will be explored. The only questions are: when? and by whom? I should like to see the work undertaken at once, and by the British Navy. I should like to see a sum of 150,000*l.* inserted in the estimates for the purpose. The Government may have sufficient grounds for declining to send forth such an expedition at the present time, but that is no reason why the scientific men of the country should not urge that the exploration of the Antarctic would lead to important additions to knowledge, and that, in the interests of science among English-speaking peoples, the United Kingdom should take not only a large but a leading part in any such exploration.

[1] "Antarctic Voyage," p. 207.

[2] Günther, "Study of Fishes, pp. 282–290. (Edinburgh, 1880.)

[1] Murray and Barton, "Phycological Memoirs of the British Museum," Part 3. (London, 1895.)

THE ANTARCTIC ICE-SHEET: DUKE OF ARGYLL.

Scientific men generally feel, I think, that they do not need to give detailed reasons in connection with particular subjects of inquiry, to justify their unanimous desire for an Antarctic Expedition. It is enough, surely, for them to point out the fact that a very large area of the surface of our small planet is still almost unknown to us. That it should be so seems almost a reproach to our civilisation. As to detailed reasons, it may almost be said with truth that there is hardly one of the physical sciences on which important light may not be cast by Antarctic exploration. Oceanic circulation; meteorology; magnetism; distribution of animal and vegetable life, not only in the present but in the past; geology; mineralogy; volcanic action under special conditions—all of these are subjects on which the phenomena of the Antarctic regions are sure to bear directly.

If, however, I am asked to specify more particularly the question on which I look for invaluable evidence which can be got nowhere else, I must name, above all others, the most difficult questions involved in quaternary geology. Geologists are nearly all agreed that there has been, very recently, a glacial age—an age in which glacial conditions prevailed over the whole northern hemisphere to a much lower latitude than they prevail now. But geologists differ widely and fundamentally from each other as to the form which glacial agencies took during that period. In particular, many geologists believe in what they call an "ice sheet"—that is to say, in the northern world having been covered by an enormous mass of ice several thousand feet thick, which, as they assert, "flowed" over mountain areas as well as over plains, and filled up the bed of seas of a considerable depth. Other geologists disbelieve in this agency altogether. They deny that even such a body of ice ever existed; it could not possibly have moved in the way which the theory assumes. They affirm, also, that the facts connected with glaciated surfaces do not indicate the planing down by one universal sheet of enormous weight and pressure; but, on the contrary, the action of small and lighter bodies of ice, which have acted partially and unequally on different surfaces differently exposed.

We might have hoped that this controversy could be settled by the facts connected with the only enormous ice-sheet which exists in the northern hemisphere, viz. that which covers the great continent of Greenland. But that ice-sheet, enormous though it be, does certainly not do what the ice-sheet of the Glacial Age is supposed to have done. That is to say, it does not flow out from Greenland, fill the adjacent seas, or override the opposite coasts, even in so narrow a sheet as Smith's Sound. But this evidence is negative only. In the Antarctic continent we have reason to believe that there is a larger ice-sheet, and it certainly does protrude into the adjacent seas, not merely by sending out broken, floating fragments, but in unbroken ice cliffs of great height. Now we want to know exactly under what conditions this protrusion takes place. Dr. Murray speaks of it as "creeping" seawards—a more cautious word than "flowing." But is it certain that it does even creep? May it not simply grow by accretion or aggregation till it reaches a depth of water so great as to break it off by flotation? Does it, or does it not, carry detritus when no detritus has been dropped on its surface? Or does it pick up detritus from its own bed? Or does it push foreign matter before it? Does the perfectly tabular form of the Antarctic icebergs indicate any differential movement in the parent mass at all; or does it not indicate a condition of immobility until their buoyancy lifts great fragments off? What is the condition of the rocks on which they rest? Is there any thrust upon the mass from the mountain ranges on which the gathering ground lies? Or is the whole country one vast gathering ground from the continual excess of precipitation over melting? These questions, and a hundred others, have to be solved by Antarctic discovery; and until they are solved we cannot argue with security on the geological history of our own now temperate regions. The Antarctic continent is unquestionably the region of the earth in which glacial conditions are at their maximum, and therefore it is the region in which we must look for all the information attainable towards, perhaps, the most difficult problem with which geological science has to deal.

SIR JOSEPH HOOKER'S VIEWS.

Dr. Murray's admirable summary of the scientific information obtainable by an organised exploration of the Antarctic regions, leaves nothing further to be said under that head. I can only record the satisfaction with which I heard it, and my earnest hope that it will lead to action being taken by the Government in the direction indicated.

Next to a consideration of the number and complexity of the objects to be obtained by an Antarctic Expedition, what dwells most in my imagination, is the vast area of the unknown region which is to be the field for investigation—a region which, in its full extension, reaches from the latitude of 60° S. to the Southern Pole, and embraces every degree of longitude. This is a very considerable portion of the surface of the globe, and it is one that has been considered to be for the most part inaccessible to man; I will, therefore, ask you to accompany the scientific explorer no further than to the threshold of the scenes of his labours, that you may see how soon and how urgently he is called upon to study some of those hitherto unsolved Antarctic problems that he will there encounter.

In latitude 60° S. an open ocean girdles the globe without break of continuity. Proceeding southwards in it, probably before reaching the Antarctic Circle, he encounters the floating ice fields which form a circumpolar girdle known as "The Pack" approximately concentric with the oceanic, interrupted in one meridian only, that south of Cape Horn, by the northern prolongation of Graham's Land. Pursuing his southward course in search of seas or lands beyond, after the novelty of his position in the Pack has worn off, he asks where and how the component parts of these great fields of ice had their origin, how they arrived at, and maintain their present position, what are their rate of progress and courses, and what their influence on the surrounding atmosphere and ocean. I believe I am right in thinking that to none of these questions can a fuller answer be given, than that they originated over extensive areas of open water in a higher latitude than they now occupy, that they are formed of frozen ocean water and snow, and that winds and currents have brought them to where we now find them. But of the position of the southern, open waters, with the exception of the comparatively diminutive sea east of Victoria Land,[1] we know nothing, nor do we know anything of the relative amount of snow and ice of which they are composed, or of their age, or of the winds and currents that have carried them to a lower latitude.

The other great glacial feature of the Antarctic area is "The Barrier," which Ross traced for 300 miles in the 78th and 79th degree of south latitude, maintaining throughout its character of an inaccessible precipitous ice-cliff (the sea-front of a gigantic glacier) of 150 to 200 feet in height. This stupendous glacier is no doubt one parent of the huge table-topped ice-islands that infest the higher latitudes of the Southern Ocean; but as in the case of the Pack, we do not know where the Barrier has its origin, or anything further about it than that it in great part rests upon a comparativeiy shallow ocean bottom. It probably abuts upon land, possibly on an Antarctic continent; but to prove this was impossible, on the occasion of Ross's visit, for the height of the ship's crow's-nest above the sea-surface was not sufficient to enable him to overlook even the upper surface of the ice. Nor do I foresee any other method of settling this important point, except by the use of a captive balloon, an implement with which I hope that future expeditions may be supplied. There were several occasions in which such an implement might advantageously have been used by Ross when near the Barrier, and more when it would have greatly facilitated his navigation of the Pack

I have chosen the Antarctic Ice as the subject upon which to address this most important meeting, not only because it is one of the very first of the phenomena that demand the study of the explorer, but because it is the dominant feature in Antarctic navigation, where the Pack is ever present or close by, demanding, whether for being penetrated or evaded, all the commander's fortitude and skill, and all his crew's endurance.

It may be expected that I should allude to those sections of Dr. Murray's summary that refer to the Antarctic fauna and flora; they are most important, for the South Polar Ocean swarms with animal and vegetable life. Large collections of these, taken both by the tow-net and by deep sea soundings, were made by Sir J. Ross, who was an ardent naturalist and threw away no opportunity of observing and preserving; but unfortunately, with the exception of the Diatomaceæ (which were investigated by

[1] I refer to the "pancake" ice, which, in that sea, on several occasions formed with great rapidity around Ross's ships, in lat. 76° to 78° S. in February 1842, and which arrested their progress. Such ice, augmented by further freezing of the water and by snowfalls, may be regarded as a genesis of fields that, when broken up by gales, are carried to the north and contribute to the circumpolar Pack.

Ehrenberg), very few of the results of his labour in this direction have been published. A better fate, I trust, awaits the treasures that the hoped-for expedition will bring back; for so prolific is that ocean, that the naturalist need never be idle, no, not even for one of the twenty-four hours of daylight throughout an Antarctic summer, and I look to the results of a comparison of the oceanic life of the Arctic and Antarctic regions as the heralding of an epoch in the history of biology.

THE PRACTICABILITY OF ANTARCTIC EXPLORATION.

Dr. Nansen said a great Antarctic Expedition should be undertaken by the British nation. He confined his observations to the great importance of a land expedition in the Antarctic continent. It would certainly be of the highest importance to have it in connection with a naval expedition, which would afford an excellent basis for such a land expedition. Dr. Murray had already mentioned the possibilities, and perhaps probabilities, that there was a large Antarctic continent covered by an ice-cap. They did not quite know yet. It might be that there were large islands, and there might be sounds in between covered with floating ice. Whether that was so or not, it was certain there must be one or several huge ice-caps inside this unknown territory in the South, and he felt certain that the exploration of these would give scientific information of the greatest importance. There were many problems to solve, and the only place they could try to solve them in was the polar regions. Greenland had already given them much information about the ice-sheet, but Greenland was too small, when compared with the big ice-sheets in the glacial packs. They should look to the much more extensive ice-sheets which they might find in the unknown territory. He did not think it would be very difficult to reach the Antarctic continent. They must remember they knew a great deal more about ice investigation than in the days of Ross. They had much better ships, and had steam, and were not afraid to push the ships into an ice-pack. They knew that if they were exposed to pressure and some hard times, they had the means to get out of it again; and his opinion was that in the Southern sea they were surrounded by much open water all round, and a ship would not run the risk of being shut up in ice as long as in the Arctic regions, where the seas were shut up by land round about. So far as he understood it, they would not run so much risk in that way in the South as in the Arctic. The ice generally opened in calm weather, and that was exactly when sailing-vessels would not be able to make use of the opportunity to get in. So he thought with their modern steamships it would not be difficult to get into the Antarctic. It had been said that the ice-sheet in the Antarctic continent was difficult to get at. It was difficult to ascend. Of course, when they went along the Barrier, as Ross did, it was difficult to get through, and probably the only way would be by captive balloons. He believed captive balloons would be of the greatest use for exploration in Polar regions. With regard to the probable thickness of the ice-sheet in the Antarctic, some put it at 2000 feet, some at 10,000 feet, but he would rather put it at 20,000 feet. The height might present considerable difficulty to any land expedition. This enormous ice-sheet must have an important influence upon the climatology of the whole world, and valuable information might be obtained as to meteorological conditions through an Antarctic expedition. If such a great naval expedition as had been suggested were sent from this country, Norway would gladly join in the work and send out another expedition to take part in the land work, and it would be of the greatest importance if there could be international co-operation in these expeditions, because simultaneous observations could then be made in these Antarctic regions, and they could lay their plans in a more scientific way.

DR. NEUMAYER ON GRAVITY AND TERRESTRIAL MAGNETISM.

A gravity survey is, in connection with a thorough geographical survey of the Antarctic, one of the most urgent requirements of the science of our earth. There are no measurements of the gravity constant within the Antarctic region; indeed, they are very scarce in the southern hemisphere south of 30° lat. S., and they are so closely connected with the theory of the figure of our earth that it is hardly possible to arrive at any conclusive results in this all-important matter without observations within the Antarctic region. It is impossible to foretell what effect an exact gravity survey in that region might exert upon our views with regard to all physical elements which depend upon the radius of our earth. Apart from that consideration, we may hope for another important enlargement of the knowledge bearing upon the connection between terrestrial magnetism and gravity. Gravity observations have been so much simplified of late, by von Herack's ingenious apparatus, that it does not offer a serious difficulty to multiply gravity determinations within the Antarctic region, so that we may well be able to speak of a "gravity survey." The all-important question of the distribution of land within the South Polar region is closely connected with it. The International Geodetic Permanent Commission expressed it as their conviction that a gravity survey within that region would be of the greatest benefit for higher geodetic theories.

The probable connection between gravity and terrestrial magnetism has already been referred to. But apart from this, a magnetic survey of the Antarctic region is of the greatest importance from other points of view. As, since the time of Ross, no other observations of the values of the magnetic elements have been made, we are perfectly ignorant of the values of the secular variations south of 50° lat., though this information is urgently needed for the construction of trustworthy magnetic charts required in navigation. Of the situation of the southern magnetic pole, and of its motion during the last fifty years, we are equally ignorant, though the facts are so highly important according to Gauss's theoretical deductions.

Much as the mathematical theory of terrestrial magnetism has been developed, of the physical theory of that mysterious force in nature we are yet in perfect ignorance. This defect is certainly to some considerable degree caused by the want of our knowledge in higher latitudes. It seems as if the magnetic character of the South Polar region is such as would afford all facility for a sound investigation when compared with the magnetic conditions of the North Polar region. A glance at a magnetic map shows how entirely different is the distribution of the magnetic action in both polar regions.

There is the interesting fact to be noticed in the south that the two foci of total intensity are situated on the side towards the south of the Australian continent, and nearly on the same meridian. The magnetic action which makes itself manifest by magnetic storms or disturbances reaches its highest degree likewise south of the Australian continent, whereas to the south of South America the storms become very scarce and of a similar magnitude to those in middle latitudes. This was most strikingly proved by the observations in Orange Bay and South Georgia during the period of international observations in 1882–83. Of course the magnetic south pole and the situation of the foci above mentioned, are in close connection with these facts, but the reason of their distribution remains unexplained. A discussion of all observations on southern polar lights also shows a connection between their frequency and the maximum region of magnetic disturbance.

Though the examination of these few facts ought to prompt the institution of a vigorous examination of the south polar regions, the series is far from being exhausted: there is the question of the geoid-deformation, the phenomena of the tides, and the structure of the ice and its drifting.

The resolution of the Sixth International Geographical Congress that the present century should not be allowed to expire without unveiling the mysteries of the south polar regions, ought to be carried into effect. All scientific institutions and societies trust that such will take place without any further delay.

SIR CLEMENTS MARKHAM ON ANTARCTIC GEOGRAPHY.

I need scarcely say how fully I concur in every word that has fallen from Dr. Murray on the subject of the scientific results, and more especially of the geographical results of an Antarctic Expedition.

It is sufficient to point out the vast extent of the unknown area, and that no area of like extent, on the surface of the earth, ever failed to yield results of practical, as well as of purely scientific interest by its exploration.

But there is much more to be said in the present instance: because the little that we do know of the Antarctic regions points unerringly to the very great importance and interest of the results that are certain to attend further research.

The ice barrier, discovered by Sir James Ross, is known to be the source of the immense ice islands of the southern polar sea. But it has only been seen for a distance of 300 miles. It requires far more complete examination before any approach to an adequate knowledge can be obtained, respecting the extent and nature of the supposed ice-cap in its rear.

We know that the southern continent is a region of actual volcanic activity; but the extent, nature, and effect of that activity remain to be ascertained.

On the Antarctic Circle land has been reported at numerous points, south of Australia and the Indian ocean, but it is unknown whether what has been seen indicates islets and rocks, or a continuous coast-line.

Dr. Murray has pointed out that the whole southern continent is certainly not bounded by such an ice-wall as was seen by Sir James Ross, and is not covered by an ice-cap. But the extent alike of the ice-cap and of the uncovered land is unknown.

We are ignorant of the distribution of land and sea, and of ice and water in summer, and of the causes which influence such distribution.

These are some of the geographical problems to be solved. The investigation of each one of them will lead to further discoveries as yet undreamt of, which must needs be of the deepest interest to geographers.

There are eminent men present who will no doubt refer to the results of Antarctic exploration as regards other branches of science. Combined together they make the discovery of the unknown parts of the Antarctic region the greatest and most important work that remains for this generation of explorers to achieve.

METEOROLOGY AND ANTARCTIC EXPLORATION.

Dr. Alexander Buchan stated that the remarks he was about to make would have exclusive reference to the first two paragraphs of Dr. Murray's address, under the heading of "The Atmosphere"; or, rather, more immediately to the relation between mean atmospheric pressure and prevailing winds. He supposed he had been asked to speak on this occasion, from the extensive and minute knowledge of the subject he had necessarily acquired in the preparation of the reports on atmospheric and oceanic circulation which were published as two of the reports of the scientific results of the voyage of H.M S. *Challenger*.

The former of these reports, on atmospheric circulation, is accompanied by twenty-six maps, showing by isobars for each month and the year the mean pressure of the atmosphere, and by arrows the prevailing winds of the globe, on hypsobathymetric maps, or maps showing by shadings the height of the land and the depth of the sea; first on Gall's projection, and second on north circumpolar maps on equal surface projection. The isobars are drawn from mean pressures calculated for 1366 places, and the winds from even a larger number of places, distributed as well as possible over the whole globe. It is also of importance to note that averages of pressure and prevailing winds are published with the report—an accompaniment to the maps of mean atmospheric pressure and prevailing winds of the globe not yet given in any other series of maps of mean pressure and prevailing winds.

This then is the work undertaken and published in these reports, which occupied seven years in preparing, as time could be spared from official duties. The result of the charting of the pressure and prevailing winds is this: stand with your back to the wind, then the centre of lowest pressure that causes the wind will be to the left in the northern hemisphere, and to the right hand in the southern hemisphere, a relation well known as Buys Ballot's law. In charting the 1366 pressures and the relative prevailing winds, no exception was found in any of the two hemispheres. This is one of the broadest generalisations science can point to.

Some years ago a theory of atmospheric circulation was published by the late Prof. Ferrel which, as it is not accordant with the broad results arrived at in the report of atmospheric circulation in the *Challenger* Reports, calls for serious consideration on account of its bearing on any attempt proposed to be undertaken for the exploration of the Antarctic regions.

One of the more recent expositors of this theory is Prof. Davis, of Harvard College, who, in his "Elementary Meteorology," gives an admirable exposition of the results now arrived at by the various workers in meteorology, and of the opinions and theories promulgated by different meteorologists in different departments of the science. The book is largely used in secondary schools and colleges of the United States, and these views are all but universally held there, and are now spreading over other countries.

The following extracts from Davis's book fairly represent these views as generally entertained.

"The surface winds of the temperate latitudes, and the high-level currents above them, sliding swiftly along on their steep poleward gradients, must all be considered together. They combine to form a vast aerial vortex or eddy around the pole. In the northern hemisphere this great eddy is much interrupted by continental high pressure in winter, or low pressure in summer, and by obstruction from mountain ranges, as well as by irregular disturbances of the general circulation in the form of storms" (p. 110).

Now the facts of observation do not support the theory of the existence, at any season of the year, of a low barometric pressure, or an eddy of winds, round or in the neighbouring regions of the north pole. Observations do not show us any prevailing winds blowing homewards to the north pole at any time of the year. Further, no low barometric pressure occupies the immediate polar region in any month; but instead, the opposite holds good for the four months from April to July. In April and May the mean atmospheric pressure is higher in the region of the pole than it is anywhere in the northern hemisphere north of 43° lat. N.; and in June and July, also higher than it is anywhere north of 55° lat. N. Now the higher pressure in these four months necessitates the existence of upper currents in order to maintain this high pressure about the north pole. These upper currents toward the pole are exactly opposed to the requirements of the theory, which intimates that the upper currents in the region of the pole must necessarily blow not towards but from the pole.

The actual centre in this hemisphere, north of the tropics, towards which the winds on or near the surface of the earth blow, is not the north pole; but, in the winter months, the low barometric depressions in the north of the Atlantic and Pacific respectively, and in the summer months, the low barometric depressions in the Eurasian and North American continents; and the sources out of which the prevailing winds blow, in the winter months, the high pressure regions in Siberia and North America; and in the summer months, the high pressure regions lying northward of these continents, which, as already explained, are virtually the polar region itself. These are the facts in all regions where the winds, according to the theory, become winds blowing over the earth's surface.

As regards the southern hemisphere, Prof. Davis states that—

"In the southern hemisphere the circumpolar eddy is much more symmetrically developed." Again, "the high pressure that should result from the low polar temperatures is therefore reversed into low pressure by the excessive equatorward centrifugal force of the great circumpolar whirl; and the air thus held away from the polar regions is seen in the tropical belts of high pressure" (pp. 110, 111).

The interpretation of this is that the remarkable low pressure region of the southern hemisphere is continued southward to the south pole itself, the pressure diminishing all the way; and that in the region of the south pole, the air currents poured thitherwards along the surface of the earth, ascend, and thence proceed northwards as upper currents of such enormous intensity and volume, that they pile up in the tropical region of the southern hemisphere a mean sea-level atmospheric pressure about an inch and a half more than the sea-level pressure near the south pole whence it starts. Now, to bring the matter to the business which this meeting of the Royal Society has taken in hand—if this theory be true and supported by the facts of observation, it is plain that no meteorologist could signify his approval of any scheme that could be proposed for exploring the Antarctic regions, it being obvious that these strong west-north-westerly winds, if they blow vortically round and in upon the pole, heavily laden, as they necessarily would be with the aqueous vapour they have licked up from the Southern Ocean, would overspread Antartica with a climate of all but continuous rain, sleet, and snow, which no explorer, however intrepid and enthusiastic, could possibly face.

But is this the state of things? Let it be at once conceded that, as far south as about 55° lat. S., the prevailing winds and the steadily diminishing mean pressures on advancing southward fairly well support the theory. South of this, however, southerly and south-easterly winds begin to increase in frequency, until from 60° lat. S. into higher latitudes, they become the prevailing winds. This is abundantly shown from the winds charted on the maps of the *Challenger* Report, as well as from the unanimous experience of all those who have navigated this region from Ross to the present time. Thus the poleward blowing winds from west-north-west in these summer months stop short, at least, thirty degrees of latitude from the south pole.

These prevailing S.S.E. winds necessarily imply, as has been shown in the case of the north pole, the existence of a more or less pronounced anticyclone overspreading Antarctica; which in its turn necessarily implies the existence of upper currents from the northward, blowing towards and in upon the polar region to make good the drain caused by the surface out-blowing south-easterly winds. It may therefore be concluded that both the surface winds and the upper aerial currents are diametrically opposed to the requirements of this theory.

What is now urgently called for is a well-equipped Antarctic Expedition to make observations which will enable meteorologists to settle definitely the distribution of atmospheric pressure and the prevailing winds of this great region. Were this done, the position in the Southern Ocean of the great ring of lowest pressure that encircles the globe could be mapped out; and since it is towards this low-pressure ring that the wind-driven surface currents of the ocean flow, a contribution would thereby be made to oceanography, of an importance that cannot be over-estimated, particularly as regards the great question of oceanic circulation.

SIR ARCHIBALD GEIKIE ON ANTARCTIC GEOLOGY.

Hardly anything is yet known of the geology of the Antarctic regions. By far the most important contributions to our knowledge of the subject were made by the expedition under Sir James Ross. But as he was unable to winter with his ships in the higher latitudes, and could only here and there with difficulty effect a landing on the coast, most of the geological information brought home by him was gathered at a greater or less distance from the land, with the aid of the telescope. Within the last few years several sealing vessels have brought home some additional scraps of intelligence, which only increase the desire for fuller knowledge.

As regards the land, merely its edges have here and there been seen. Whether it is one great continent or a succession of islands and archipelagos may possibly never be ascertained. We know that in Victoria Land it terminates in a magnificent mountain-range with peaks from 10,000 to 15,000 feet high; but that elsewhere it is probably comparatively low, shedding its ice-cap in one vast sheet into the sea.

The rocks that constitute the land are still practically unknown. The dredgings of the *Challenger* Expedition brought up pieces of granite, gneiss, and other continental rocks, and detritus of these materials was observed to increase on the sea-floor southwards in the direction of the Antarctic land. More recently several sealing vessels have brought home from the islets of Graham Land to the south of the South Shetlands pieces of different varieties of granite, together with some volcanic rocks and fossiliferous limestones. So far as these rocks have been studied, they do not appear to differ from similar rocks all over the globe. The granites have been found by Mr. Teall to be just such masses as might have come from any old mountain group in Europe or America.

Among the specimens sent to me by Captain Robertson, of the *Active*, from Joinville and Dundee Islands, which form the north-eastern termination of Graham Land, there was one piece of reddish jasper which at once attracted my attention from its resemblance to the "radiolarian cherts" now found to be so widely distributed among the older Palæozoic rocks, both in the Old World and in the New. On closer examination, this first impression was confirmed; and a subsequent microscopic study of thin slices of the stone, by Dr. Hinde, proved the undoubted presence of abundant radiolaria. The specimen was a loose pebble picked up on the beach of Joinville Island. We have no means of telling where it came from, or what is its geological age. But its close resemblance to the radiolarian cherts so persistent in the Lower Silurian formations of the United Kingdom, raises the question whether there are not present in the Antarctic regions rocks of older Palæozoic age.

It would be of the utmost interest to discover such rocks *in situ*, and to ascertain how far their fossils agree with those found in deposits of similar antiquity in lower latitudes; or whether, as far back as early Palæozoic time, any difference in climate had begun to show itself between the polar and other regions of the earth's surface.

Among the specimens brought home by Dr. Donald and Captain Larsen from Seymour Island, in the same region, are a few containing some half-dozen species of fossil shells which have been named and described by Messrs. Sharman and Newton, who suggest that they point to the existence of Lower Tertiary rocks, one of the organisms resembling a form found in the old Tertiary formations of Patagonia. Large well-developed shells of *Cucullæa* and *Cytherea* undoubtedly indicate the former existence of a far milder climate in these Antarctic seas than now prevails.

If a chance landing for a few hours on a bare islet could give us these interesting glimpses into the geological past of the south polar regions, what would not be gained by a more leisurely and well-planned expedition?

But perhaps the geological domain that would be most sure to gain largely from such exploration would be that which embraces the wide and fascinating field of volcanic action. In the splendid harvest of results brought home by Sir James Ross, one of the most thrilling features was the discovery of a snowy volcanic cone rising amid the universal snows of Victoria Land to a height of more than 12,000 feet, and actively discharging "flame and smoke," while other lofty cones near it indicated that they too had once been in vigorous eruption. Ross landed on one or two islands near that coast, and brought away some pieces of volcanic rocks.

If we glance at a terrestrial globe we can readily see that the volcanic ring or "circle of fire," which nearly surrounds the vast basin of the Pacific Ocean, is prolonged southwards into New Zealand. The few observations that have been made in the scattered islands further south show that the Auckland, Campbell, and Macquarrie groups consist of, or at least include, materials of volcanic origin. Still further south, along the same general line, Mr. Borchgrevink has recently (1894-95) made known the extension of Ross's volcanic platorm northwards to Cape Adare, the northern promontory of Victoria Land. He noticed there the apparent intercalation of lava and ice, while bare snowless peaks seemed still further to point to the continued activity of the volcanic fires. Some specimens brought by his expedition from Possession Island, were found by Mr. Teall to be highly vesicular hornblende-basalt, while one from Cape Adare was a nepheline-tephrite. This region is probably one of the most interesting volcanic tracts on the face of the globe. Yet we can hardly be said to know more of it than its mere existence. The deeply interesting problems which it suggests cannot be worked out by transitory voyagers. They must be attacked by observers stationed on the spot Ross thought that a winter station might be established near the foot of Mount Erebus, and that the interior could easily be traversed from there to the magnetic pole.

But it is not merely in Victoria Land that Antarctic volcanoes may be studied. Looking again at the globe, we observe that the American volcanic band is prolonged in a north and south line down the western side of the southern continent. That it has been continued into the chain of the South Shetlands and Graham Land is proved by the occurrence there of old sheets of basalt, rising in terraces over each other, sometimes to a height of more than 7000 feet above the sea. These denuded lavas may be as old as those of our Western Isles, Faroe, Iceland, and Greenland. But that volcanic activity is not extinct there has recently been found by Captain Larsen, who came upon a group of small volcanoes forming islets along the eastern coast-line of Graham Land. It is tantalising to know no more about them.

Another geological field where much fresh and important information might be obtained by Antarctic exploration is that of ice and ice-action. Our northern hemisphere was once enveloped in snow and ice, and though for more than half a century geologists have been studying the traces of the operations of this ice-covering, they are still far from having cleared up all the difficulties of the study. The Antarctic ice-cap is the largest in the world. Its behaviour could probably be watched along many parts of its margin, and this research would doubtless afford great help in the interpretation of the glaciation of the northern hemisphere.

To sum up:—Geologists would hail the organisation and despatch of an Antarctic Expedition in the confident assurance that it could not fail greatly to advance the interests of their science. Among the questions which it would help to elucidate, mention may be made of the following:—

The nature of the rocks forming the land of the Antarctic region, and how far these rocks contain evidence bearing on the history of terrestrial climates.

The extent to which the known fossiliferous formations of our globe can be traced towards the poles; the gaps which may occur between these formations and the light which their study may be able to throw on the evolution of terrestrial topography.

The history of volcanic action in the past, and the conditions under which it is continued now in the polar regions; whether in high latitudes vulcanism, either in its internal magmas or superficial eruptions, manifests peculiarities not observable nearer to the equator; what is the nature of the volcanic products now ejected at the surface; whether a definite sequence can be established from the eruptions of still active volcanoes back into those of earlier geological periods in Antarctic lands; and whether among the older sheets leaf-beds or other intercalations may be traceable, indicating the prolongation of a well-developed terrestrial flora towards the south pole.

The influence of the Antarctic climate upon the rocks exposed to its action; the effects of contact with ice and snow upon streams of lava; the result of the seaward creep of the ice-cap in regard to any lava-sheets intercalated in the ice. It is conceivable that portions of lava-streams might be broken off by the onward motion of the ice which they overspread, and might thus be carried out to sea, intercalated in or capping ice-bergs.

The physics of Antarctic ice in regard to the history of the Ice Age in northern Europe and America.

ANTARCTIC FAUNA.

Although an ardent advocate of Antarctic exploration, Mr. Sclater acknowledged that, as regards the higher vertebrates, with which he was most conversant, there was little chance of the discovery of new forms of animal life in the South Polar continent. The Antarctic mammals and birds (of the latter of which about twenty species were known) were exclusively of marine forms. Not a single land-mammal or land-bird had been yet obtained in Antarctica. As regards the class of fishes and the marine invertebrates, the case was quite different, and great discoveries might be anticipated in these groups, where very little had yet been done. The most promising zoological subject of Antarctic exploration seemed to him, however, to be the further investigation of the extinct fauna. The few fossil remains already obtained indicated the former existence in the South Polar area of a very different climate from that which now prevailed there, and further researches on this point might lead to most important results.

Prof. D'Arcy W. Thompson said that all we knew of the deep-sea life of the Antarctic came from eight hauls of the dredge, which hauls were, by common consent of the naturalists of the *Challenger*, the most productive of the whole cruise. The fauna of every ocean urgently demanded further exploration, for we knew now no more about the fauna of the deep-sea than was known a hundred years ago of the fauna of the shore. But the circumpolar fauna of the South, at the meeting of all the great oceans, presented problems of peculiar importance. He considered Dr. Murray's theory of a "bipolar fauna," closely akin both in the Arctic and Antarctic, as not proven; but he believed that there were many remarkable cases of continuous distribution, especially along the cold waters of the Western American coast from the Antarctic into the North Pacific, and even to Japan. If the "bipolar hypothesis" were broken down, Antarctic exploration would lead to new generalisations, not less interesting, to take its place.

Admiral Sir William Wharton said that an Antarctic Expedition must be under naval discipline. He hoped that such an expedition would not be far off, and he felt sure there would be a rush of officers and men to join it.

Sir John Evans, in briefly summing up the discussion, said it had maintained a high level, and that the meeting had been prolonged to an unprecedented hour in the Royal Society. All were agreed as to the immense advantages of an expedition, and he was sure it would find a warm advocate in the Hydrographer to the Admiralty.

ON THE ABSORPTION OF LIGHT BY FLUORESCING BODIES.[1]

MR. JOHN BURKE has recently given to the Royal Society of London (see NATURE, vol. lvi. p. 261) the result of some experiments which afford an important indication of the mode of action of bodies during fluorescence, and which may lead to a clearer conception of Kirchhoff's law on the equality of the emissive and absorptive powers of bodies

The following is one form of Mr. Burke's experiment:—A photographic plate, P (Fig. 1), is adjusted before two equal cubes of uranium glass, A and B, placed so that the light emanating from B is obliged to pass through A before reaching the photographic plate P.

The source of light, S, rich in the ultra-violet, illuminates the cubes by rays parallel to the plate, which is screened from the direct action of the source. An image is first formed by letting the exciting rays act on the two cubes simultaneously. The plate is then displaced, and a second image is produced by illuminating each of the cubes separately, each for the same length of time as in the first experiment.

The result is that on development the resultant impression of the two separate effects is always much more intense than that of the first due to the two conjointly.

The simplest explanation of this curious phenomenon is to suppose that the cube A absorbs the light emitted by the cube B more strongly when it is in a state of fluorescence than when it is screened from the exciting source. At first sight this property of fluorescent bodies appears to be a direct consequence of Kirchhoff's law, all luminous bodies absorbing the radiations which they are capable of emitting. But on looking at the matter more closely we find that this law, which includes so many facts, does not directly apply to the phenomenon discovered by Mr. Burke. This law states, in general, that all bodies, *at a given temperature*, have an emissive power and an absorptive power which are equal for each kind of radiation they emit. But we see here a class of bodies which, without having their temperature visibly altered, have their absorptive power changed, in consequence of the fact that, by a cause apparently different from an elevation of temperature, they emit, momentarily, and under the action of an external source, radiations which are extinguished at the same time as the excitation itself. By this excitation the molecule is not permanently altered, and it does not become susceptible of vibrating in unison with the light to which it had attained; but if, by an external cause, it is given this vibratory movement, then, and only then, it becomes a resonator for the radiations identically the same as that which it emits.

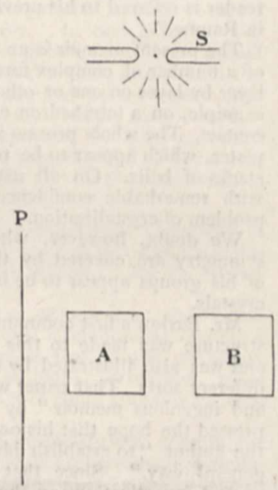

FIG. 1.

A familiar illustration will give us a more vivid conception of the mechanism of the phenomenon. Let us suppose a sound wave to approach a fixed tuning-fork of another pitch; the wave will pass on unabsorbed. But if we force the tuning-fork in such a way as to make it emit a note identical with that of the wave which approaches it, then it will behave as a resonator and will evidently become absorbent to the passing wave. The tuning-fork is thus capable of absorbing the vibratory energy which reaches it, not merely when the latter corresponds to its natural period of vibration, but also when it possesses a period identical with that of the forced vibration that is momentarily imparted to it.

It is probable, similarly, that the fluorescent molecules are excited momentarily to a forced vibration, and become, *for an instant*, susceptible of absorbing the vibrations of the same period.

It will be found, perhaps, that the familiar statement of Kirchhoff's law will apply, on comparing the small number of fluorescent molecules in the uranium glass, to any molecules whatsoever which have been raised to a fictitious temperature corresponding to their vibratory state. This extension of the notion of temperature has already been suggested with regard to various luminous phenomena other than that of incandescence, but it had merely led, up to the present, to the heaping up of difficulties without arriving at anything conclusive.

It seems to me far simpler to suppress the notion of *temperature* altogether in Kirchhoff's law, which is far too general to be limited by a conception that ought to have a precise and definite signification.

[1] Translation of a paper, by Prof. C. E. Guillaume, in the *Revue Générale des Sciences*, December 15, 1897.

THE STRUCTURE OF CRYSTALS.[1]

IT is impossible here to do more than call attention to these two memoirs; the subject with which they deal is too intricate to be intelligible without the aid of diagrams.

The author of the first appears to hold quite peculiar views on the nature of valency and chemical combination Each atom is surrounded by a "sphere of action," and this represents the volume of the element; whereas the volume of a compound molecule is less than the sum of the volumes of its components, for their spheres of action are supposed to interpenetrate to a certain extent when combination takes place. Their partial interpenetration gives rise to a complex surface of action for the molecule, which may be of a polar character, and approximates in form to a sphere when the molecule consists of a large number of atoms. Crystallisation is due to the attractive juxtaposition of such polar molecules. For the author's general views the reader is referred to his previous work, "Die Kraft und Materie in Raume."

The present memoir is an elaborate study of the development of a number of complex forms by the superposition of spheres layer by layer on one or other of a few simple "embryos"; for example, on a tetrahedron composed of four equal spheres in contact. The whole process is illustrated by twenty-six excellent plates, which appear to be photographs of skilfully constructed stacks of balls. On all matters the author expresses himself with remarkable confidence, and claims to have solved the problem of crystallisation.

We doubt, however, whether all the types of crystalline symmetry are covered by the author's hypotheses, and some of his groups appear to be incompatible with what is known of crystals.

Mr. Barlow's first communication on the subject of crystalline structure was made to this journal (vol. xxix. p. 186) in 1883, and was also illustrated by the regular grouping of spheres of different sorts. That paper was characterised as "an interesting and ingenious memoir" by the late Prof. Sohncke, who expressed the hope that his own criticisms (p. 383) would induce the author "to establish his theory in a more solid and more general way." Since that date Mr. Barlow has published several investigations on the subject, and the present memoir, which appears in the scientific *Proceedings* of the Royal Dublin Society, is an extended study of the close-packing of spheres of different sizes. In the arrangement and re-arrangement of such stacks he ingeniously traces a number of interesting analogies which lead him far beyond the features of mere crystalline growth and structure into chemical combination and decomposition, solution, diffusion, and the phenomena classed under stereo-chemistry.

Mr. Barlow himself regards the close packing of spheres as representing the position of equilibrium of mutually repellent particles, and this he believes to be the key to all the problems considered; but the reader must be referred to the original memoir for the details.

The study of crystalline structure as represented by the close packing of spheres or other figures is now being prosecuted by several investigators in very different ways, and with very different interpretations. The geometry of the subject is, of course, independent of all the speculations which gather round it, and deserves the very serious attention of chemists and physicists.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. Oldham, the University Lecturer in Geography, announces a public lecture on the North-west Frontier of India. Sir George Robertson, K.C.S.I., of Chitral fame, will take the chair.

The late Mr. Frank Chance has bequeathed 400 volumes to the University Library.

The Museums Syndicate report that owing to the increase of the number of buildings under their charge, and the greater requirements for research and other students, the sum placed at their disposal for the annual maintenance of the scientific departments must be augmented by 300*l.*

[1] "Das Problem der Krystallisation." By A. Turner. Pp. 98; 26 plates. (Leipzig: 1897.)
"A Mechanical Cause of Homogeneity of Structure and Symmetry geometrically investigated; with special application to Crystals and to Chemical Combination." By W. Barlow. Pp. 164. (Dublin: 1897.)

A proposal is made by the Local Lectures Syndicate for the granting of a diploma in Arts to University Extension students who have passed through a prescribed course of study and examinations.

DR. GOTTLIEB, assistant professor of pharmacology in the University of Heidelberg, has been provisionally appointed successor to the late Prof. Dr. W. von Schroeder.

MR. A. E. BRISCOE has been appointed Principal of the new technical institute in course of erection at Stratford. Mr. Briscoe is at present head of the Physics and Electrical Department of the Battersea Polytechnic.

REFERRING to the London University Commission Bill, 1898, which was introduced into the House of Lords by the Lord President of the Council on February 21, and read a first time, the *British Medical Journal* points out that it differs from the Bill of 1897 in the omission of the names of the Commissioners. From the schedule appended to the Bill it appears that the constitution of the Senate is modified by giving to the Council of the City and Guilds of London Institute one member, and by reducing the number of Crown nominees from five to four. The number of members of the Senate is thus retained at the same figure, fifty-five, or with the Chancellor, fifty-six. In the paragraph dealing with Faculties, the sub-section recognising examiners appointed by the University as members of the Faculties has been omitted. The instructions to the Commissioners as to examinations are practically the same, and the Senate will be required to hold separate examinations for internal and external students unless it otherwise determine, "either generally by regulation, or as to a particular subject by order." But there is this rather important addition, that the Senate will be required to communicate any such regulation to Convocation. Part II. of the Schedule is now headed, "Matters for which provision must be made." These include the adequate protection of all classes of students whether external or internal, collegiate or non-collegiate, the recognition of teachers of the University, and the regulations for the admission of internal students. The sub-clause dealing with this last point has been modified, and as it nows reads persons to be recognised as internal students will be "students who have matriculated at the University, and are pursuing a course of study approved by the University under one or more of the recognised teachers of the University."

THE official report of the *Proceedings* of the recent annual general meeting of the Association of Technical Institutions, containing the address delivered by the President, the Right Hon. Sir Bernhard Samuelson, Bart., F.R.S., has been issued. In the course of his remarks the President pointed out that much good will arise from the concordance between the various educational agencies which has been arrived at in ten or twelve county boroughs, one of the most conspicuous examples of which is Manchester, where the School Board, the City authorities with their splendid technical schools, and the Owens College of the Victoria University are all acting in harmony, and constructing the ladder so much talked of, but still so rarely provided, on which a child can by intelligence and perseverance mount from the humblest to the highest intellectual position. As to the expenditure of the funds available for technical instruction. Sir Bernhard Samuelson presented the following questions to his audience:—Have we fully considered the relative value of the various degrees of technical education; would it have been better for the nation if the 800,000*l.* per annum of Customs and Excise Fund had been in the main devoted to the higher rather than to the primary and secondary grades of technical education? Would not the lower grades even have been better served if we had in the first instance made a determined effort to extend and improve general elementary and secondary education? Many educationists would answer these questions in the affirmative.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 3.—"Researches in Vortex Motion. Part III On Spiral or Gyrostatic Vortex Aggregates." By W. M. Hicks, F.R.S.

The chief part of the paper refers to a kind of gyrostatic aggregate. The investigation has brought to light an entirely new system of spiral vortices.

The general conditions for the existence of such systems are determined, and are worked out in more detail for a particular case of spherical aggregate. It is found that the motion in meridian planes is determined from a certain function ψ in the usual manner. The velocity along a parallel of latitude is given by $v = f(\psi)/\rho$ where ρ is the distance of the point from the straight or polar axis. The function ψ satisfies an equation of the form (when expressed in polar coordinates)

$$\frac{d^2\psi}{dr^2} + \frac{1}{r^2}\frac{d^2\psi}{d\theta^2} - \frac{\cot\theta}{r^2}\frac{d\psi}{d\theta} = \rho^2 F - f\frac{df}{d\psi},$$

where F and f are both functions of ψ. The case F uniform, and $f \propto \psi$ is treated more fully. If $f = \lambda\psi/a$ where a is the radius of the aggregate,

$$\psi = A\left\{J_2\left(\frac{\lambda r}{a}\right) - \frac{r^2}{a^2}J(\lambda)\right\}\sin^2\theta.$$

The most striking and remarkable fact brought out is that as λ increases we get a periodic system of families of aggregates. The members of each family differ from one another in the number of layers and equatorial axes they possess. According to the number of independent axes they are called singlets, doublets, triplets, &c., in contradistinction to more or less fortuitous or arbitrary compounds of the former which are considered later and called monads, dyads, triads, &c. Of these families two are investigated more in detail than the others, both because they are specially interesting in their properties and because they serve as limiting cases between the different series. In one family (the λ_2 family) all the members remain at rest in the surrounding fluid. In the other (the λ_1 family) a distinguishing feature, common to all the members, is that the stream lines and the vortex lines are coincident.

The parameter λ gives the total angular pitch of the stream lines on the outer current sheet. The first aggregates—with $\lambda < 5{\cdot}7637$ (the first λ_2 value)—behave abnormally. Beyond these we get successive series, in one set of which the velocity of translation is in the same direction as the polar motion of the central nucleus, in the alternate set the velocity is opposite, and the aggregate regredes in the fluid as compared with its central aggregate.

At the end of the paper a theory of compound aggregates is developed. It is not worked out in detail in the present communication, but the conditions are determined for dyad compounds, whilst a similar theory holds for triad and higher ones. Each element of a poly-ad may consist of singlets, doublets, &c. The equations of condition allow three quantities arbitrary—as for instance ratio of volumes, ratio of primary cyclic constants, and ratio of secondary cyclic constants.

At the end of the abstract, illustrations of the relations of the theory to the vortex cell theory of the ether, and to the periodic law of the chemical elements are touched upon.

February 10.—"The Development and Morphology of the Vascular System in Mammals. The Posterior End of the Aorta and the Iliac Arteries." By Alfred H. Young, M.B., F.R.C.S., and Arthur Robinson, M.D.

Though numerous observations have been made on the development of the systemic aorta and on the aortic arches, including their modifications and transformations at the head end of the embryo, but little attention has hitherto been given to the development and modifications of the primitive vessels and the aortic arches at the caudal end.

The view that the primitive aortæ are prolonged backwards from the dorsal region into the tail, and that, fusing there, they form a caudal aorta—the middle sacral artery—seems to be generally accepted by embryologists. The iliac arteries are accordingly regarded as segmental vessels.

Observations on the development of the posterior end of the aorta and its terminal branches in mammals point, however, to very different conclusions.

The primitive aortæ are not directly continued into the middle sacral artery, but into primary caudal arches, one on each side, the ventral continuations of which either fuse together to form a common vitello-allantoic stem, as in rodents, or they remain separate and form the ventral parts of the allantoic arteries, as in carnivores, ruminants and man.

The middle parts of the primary caudal arches disappear and are replaced by "secondary" caudal arches which lie to the outer sides of the Wolffian ducts. In rodents and man the secondary arches are transformed into the common and internal iliac arteries and the dorsal parts of the hypogastric arteries, whilst in carnivores they are probably transformed into the posterior part of the adult aorta and into the internal iliacs and dorsal parts of the hypogastric arteries.

The vessels, which are to be looked upon as the posterior continuations of the primitive aorta in the adult in man, rodents, &c., are the common iliac, internal iliac, and hypogastric arteries, and in carnivores, &c., the internal iliac and hypogastric arteries.

The common and internal iliac arteries are not segmental vessels, their branches may be.

The middle sacral artery is a secondary branch, probably representing fused segmental vessels.

The permanent adult aorta, in so far as it is formed by the primitive dorsal aortæ, ends posteriorly either at the bifurcation into the two common iliac arteries or at a point corresponding to this bifurcation, when by more extensive fusion involving the dorsal parts of the secondary arches there are no common iliacs, and the external and internal iliac arteries appear to arise directly and separately from the aortæ. In each case the continuity of the primitive aorta is interrupted; the primary caudal arches are replaced by secondary caudal arches, after which the continuations of the aorta are represented by the vessels into which the secondary caudal arches are ultimately transformed.

These conclusions are further supported by more extended observations on the anatomy of the posterior end of the aorta, and its terminal branches in mammals, and on the abnormalities they present in man.

"Further Observations upon the Comparative Chemistry of the Suprarenal Capsules, with Remarks upon the Non-existence of Suprarenal Medulla in Teleostean Fishes." By B. Moore, M.A., and Swale Vincent, M.B.

In a previous communication these authors have shown that the paired segmental suprarenals of Elasmobranchs contain a chromogen giving the same reactions as that of the medullary portion of the suprarenal capsule of higher vertebrates, while the inter-renal body in the same order of fishes contains no such chromogen.

Now the suprarenal bodies of Teleosts do not contain the physiologically active principle which is characteristic of suprarenal medulla, and the natural conclusion would seem to be that the representative of the medulla is absent. But further evidence is desirable.

A decoction from the suprarenal bodies of *Gadus morrhua* and *Anguilla anguilla* was carefully tested for the chromogen, with entirely negative results. The lymphoid "head-kidney" was also tested, as well as other portions of the kidney, but no trace of the chromogen was found.

From these observations, combined with those previously made, the authors are forced to the conclusion that *the medullary portion of the suprarenal capsules is non-existent in Teleostean fishes.*

"The Effects of Extirpation of the Suprarenal Bodies of the Eel (*Anguilla anguilla*)." By Swale Vincent, M.B.

Teleostean fishes, having only suprarenal cortex, seemed to offer an admirable opportunity of testing how far these "cortical glands" were essential to the life of the animal. Accordingly, a series of extirpation experiments were performed upon the eel.

In three cases in which the animals survived the operation, they appeared quite lively soon after being put back in the tank. One survived twenty-eight days, another sixty-four days, and a third was killed on the 119th day. These experiments show that an eel will survive the operation of extirpation for a very much longer time than mammals or frogs; and the difference is so striking that one must attribute it to the absence of medulla in Teleosts, and must assume that *the cortical gland is not absolutely essential to the life of the animal.* The longest time that a frog will survive removal of its capsules is twelve or thirteen days. Mammals usually die in a day or two.

The validity of these experiments depends upon the actual removal of all suprarenal. This was verified in two ways. (1) Previous study showed that the bodies in the eel are never more than two. (2) All three eels were dissected *post-mortem*, and no trace of suprarenal was found left behind.

Chemical Society, February 17.—Prof. Dewar, President, in the chair.—It was announced that the following changes in the Officers and Council were proposed by the Council. As

Vice-Presidents, Profs. Liveing and J. M. Thomson, *vice* Mr. L. Mond and Prof. Roberts-Austen; as Hon. Secretary, Dr. W. P. Wynne, *vice* Prof. J. M. Thomson; as ordinary Members of Council, Messrs. E. J. Bevan, H. J. Fenton, W. Gowland and D. Howard, *vice* Messrs. B. H. Brough, J. W. Rodger, T. K. Rose, and Prof. S. Young. The following papers were read:—Observations on the influence of the silent discharge of electricity on common air, by W. A. Shenstone and W. T. Evans. Air, when exposed to the action of the silent discharge, first contracts considerably and then expands to nearly its original volume; this is thus explained. Up to a certain stage in the ozonisation of atmospheric oxygen, no nitric peroxide is formed, but after this point is reached, nitric peroxide is produced, and ozone is rapidly decomposed by the silent discharge in presence of nitric peroxide, which is itself at the same time destroyed.—Some lecture experiments, by J. T. Cundall. The author describes lecture experiments illustrating the laws of conservation of mass and of gaseous diffusion.—Note on the preparation and properties of *o*-chlorobromobenzene, by J. J. Dobbie and F. Marsden. Orthochlorobromobenzene is a straw-coloured liquid boiling at 204° under 765 mm. pressure.—The ultra-violet absorption spectra of some closed chain carbon compounds, by W. N. Hartley and J. J. Dobbie. The absorption of ultra-violet rays by diketohexamethylene, pyrrol, thiophene, furfurane, furfurol, pyromucic acid and furfuramide has been examined; the absorption is in some cases very intense, but no absorption bands indicating selective absorption are observed.—Note on the absorption bands in the spectrum of benzene, by W. N. Hartley and J. J. Dobbie.—A chemical examination of the constituents of Indian and American podophyllum, by W. R. Dunstan and T. A. Henry. The constituents of Indian podophyllum (*Podophyllum emodi*) and of American podophyllum (*P. peltatum*) are indentical; the chief constituent is podophyllotoxin, $C_{15}H_{14}O_6$; the latter on hydration yields podophyllic acid $C_{15}H_{16}O_7$, which forms a lactone, picropodophyllin, which is probably the hydroxycarboxylic acid of dimethoxymethylphenyl-hydro-γ-pyrone. An uncrystallisable resin, podophylloresin, was also isolated.—The volatile constituents of the wood of *Goupia tomentosa*, by W. R. Dunstan and T. A. Henry.—On oxycannabin from Indian hemp, by W. R. Dunstan and T. A. Henry.—On the condensation of formaldehyde with ethylic malonate and on cis- and trans- tetramethylenedicarboxylic acids (1 : 3), by E. W. Haworth and W. H. Perkin, jun. The condensation of formaldehyde with ethylic malonate in presence of acetic anhydride yields, in addition to ethylic propanetetracarboxylate, ethylic methylenemalonate and ethylic tetramethylenetetracarboxylate; one of the fractions on hydrolysis and elimination of carbon dioxide yields hexahydrotrimesic acid.—Formation of ethylic dihydroxydinicotinate from ethylic cyanacetate, by S. Ruhemann and K. C. Browning.

Linnean Society, February 3.—Dr. A. Günther, F.R.S., President, in the chair.—Prof. Stewart, F.R.S., exhibited (1) specimens illustrative of the articulation between the upper and lower jaw of a Skate, *Raia batis*, Linn., upon which remarks were made by Prof. Howes and Mr. Holt; and (2) sections of *Puccinia graminis* showing the form of the teleutospores and æcidiospores, upon which some observations were made by Dr. D. H. Scott, F.R.S., confirmatory of the exhibitor's views.—Mr. Thomas Christy exhibited a portion of an iron chain through the links of which a Virginian Creeper had grown, and had become naturally intertwined.—Mr. G. C. Crick read a paper on the muscular attachment of the animal to its shell in some fossil Cephalopoda (*Ammonoidea*). Having first briefly noticed previous descriptions and figures of what were believed to be impressions of the muscular attachment of the Ammonoid animal to its shell, the author pointed out the form and position of the "shell-muscles" and of the "annulus" in the recent *Nautilus*, and indicated the form of the impression of these structures as seen upon an artificial internal cast of its body-chamber for comparison with the fossil forms, in nearly all of which any indication of the muscular attachment there may be is similarly preserved upon the internal cast of that chamber. Dr. H. Woodward, F.R.S., and Mr. B. B. Woodward offered some critical remarks.—Mr. W. C. Worsdell read a paper on the comparative anatomy of certain genera of the *Cycadaceæ*. In conclusion the author endeavoured to show that certain characters in the vegetative structure of these plants showed them to be nearly allied to, or descended from, certain fossil fern-like plants, notably the Medulloseæ, and these characters were: the extrafascicular zones in the stem of *Cycas*, which really represent the outer portion of the flattened concentric strands in the stem of the Medulloseæ, the inner portion of which has died out; and various concentric structures mentioned in the paper. For the type of structure prevailing in the ancestors of the Cycads would have been the concentric, whereas in their descendants it is the collateral. The significant outcome of this study is to form, in the vegetative characters of these plants, a connecting-link, over and above that already afforded by the discovery of spermatozoids in *Cycas* and *Ginkgo*, between "flowering" and "flowerless" plants. Dr. D. H. Scott, F.R.S., in criticising the paper, referred to the importance of certain facts which had been elucidated by the author and which he himself was able to confirm.

Anthropological Institute, February 22.—Mr. F. W. Rudler, President, in the chair.—The Rev. H. N. Hutchinson was elected a member.—Mr. Edge Partington exhibited representations of two tattooed Maori heads, carved in Kawrie resin.—Mr. Cantrill, of the Geological Survey, exhibited a collection of objects, including a delicately-worked flint dagger or knife, obtained during his recent exploration of a cairn in Breconshire.—The Rev. Archibald E. Hunt, of the London Missionary Society, read a paper on the natives of the Murray Islands in Torres Strait, with whom he had lived for three years. His studies had been directed along the lines indicated by the volume of ethnological notes and queries issued by the Anthropological Institute.—Prof. A. C. Haddon exhibited and explained a large series of lantern slides illustrative of the natives described by Mr. Hunt.

CAMBRIDGE.

Philosophical Society, February 7.—Mr. F. Darwin, President, in the chair.—Some zoological results of an expedition to Melanesia during the years 1894-97 (illustrated with photographic slides), by Dr. A. Willey, the Balfour Student. The paper dealt chiefly with observations relating to *Nautilus*, *Ctenoplana*, *Heteroplana*, *Amphioxus*, *Balanoglossus* and *Peripatus*. An account was given of the habits, distribution, and oviposition of *Nautilus*. The function of the tentacular appendages of *Nautilus*, the ciliation of the osphradia or branchial sense-organs and of the accessory olfactory (pre-ocular and post-ocular) tentacles, and the distribution of the pallial, siphuncular, and genital arteries were described. In the metameric system of *Nautilus*, where there are indications of two segments, at least twelve paired structures are repeated. The sheathed tentacular appendages of *Nautilus* and the arms of Dibranchiata are probably to be regarded as pedal in nature and origin, not only on account of their function, innervation and development (Dibranchiata), but also from a general consideration of the phenomena of cephalisation. The "cephalopodium" of *Nautilus* and the Dibranchiata was contrasted with the cephalothorax of Arthropods. *Ctenoplana* is probably to be estimated as a morphological type hardly second in importance to such forms as *Amphioxus*, *Balanoglossus*, *Peripatus*, &c. It presents a transition from biradial to bilateral symmetry. Its pinnate tentacles, like those of the Ctenophora, lie in what corresponds to the sagittal plane of the bilaterally symmetrical Plathelminthes, and are therefore not homologous with the sensory nuchal tentacles of Polyclades as was suggested by Lang. The latter structures are represented in *Ctenoplana* by the aboral ciliated sensory tentacles which are paired about the axis along which the pinnate tentacles lie; and in the Ctenophora by the arcuate sensory ridges and papillæ (Beroidæ) known as the polar plates, which are similarly placed with regard to the aboral sense-organ. *Heteroplana* was described as an anomalous Plathelminth in which the structures of the left side of the body are aborted. This condition appears to be normal for the animal, and not a phase in regeneration. *Amphioxus* was referred to in connection with the discovery of the West Indian subgenus *Asymmetron* Andrews in New Guinea waters, and also at Lifu (Loyalty Islands). The author's view that *Ptychodera* was a relatively primitive type of *Balanoglossus* was confirmed by the structure of his new genus *Spengelia*, which is a *Glandiceps*-like form possessing synapticula or cross-bars in the walls of the branchial sac, medial gonads, and vestigial roots arising from the collar nerve-cord. A new *Peripatus* found in New Britain was described. This form differs essentially from the groups which comprise respectively the Neotropical, Australasian and Cape species of *Peripatus*, and in some respects it is intermediate between the Australasian and Neotropical types.

MANCHESTER.

Literary and Philosophical Society, February 22.—Mr. J. Cosmo Melvill, President, in the chair.—The President announced that Prof. Michael Foster, F.R.S., would deliver the Wilde Lecture before the Society on March 29.—Mr. Melvill exhibited an interesting series of distortions and hyperstrophical deformities of *Planorbis spirorbis*, L., found by Mr. Arthur Stubbs at Black Rock, Tenby. These distortions included (1) evolute whorls, (2) various forms of carination, (3) sinistral turbinate spirals, and (4) dextral turbinate spirals. The causes for such malformations are at present practically unknown, but may be traced to the obstructions to the active but tender-shelled mollusc caused by duckweed and conferva.

DUBLIN.

Royal Dublin Society, January 19.—The Right Rev. Monsignor Molloy in the chair.—Prof. Thomas Preston gave an account of some further observations which he had made in studying the influence of a strong magnetic field on the spectrum of a source of light placed in it. He exhibited photographs by lantern projection, which illustrated the different types of effect, showing that doublets, quartets and sextets are produced, as well as triplets when the source of light is viewed *across* the lines of force. The consideration of these modifications of the normal triplet type was entered into, and it was shown how such modifications could be produced by various forms of reversal accompanying absorption in the vapour of the spark which was the source of light. The connection of these modifications with the complexity of structure of some of the spectral lines, as observed by Michelson, was also passed in review, as well as further matters concerning the influence of the field itself on the molecules.—A paper, consisting of notes on certain Actiniaria (including *Phellia Sollasi*, Haddon) by Dr. Katherine Maguire, was communicated by Prof. A. C. Haddon, who also exhibited a phonograph, cinematograph, and other apparatus to be used in his projected expedition to New Guinea and Borneo.

EDINBURGH.

Mathematical Society, February 11.—Mr. J. B. Clark, President, in the chair.—Mr. Duthie read a paper on a geometrical problem, by S. Guimarães.—A proposal that, in the teaching of elementary geometry, Euclid's definition of proportion be abandoned, was introduced by Prof. Gibson and Mr. W. J. Macdonald, and discussed by several of the members present.

PARIS.

Academy of Sciences, February 21.—M. Wolf in the chair.—Chemical actions exerted by the silent discharge, by M. Berthelot. A preliminary account of the methods employed and general results obtained in the exposure of various mixtures to the action of the silent discharge. In all, more than a hundred and twenty systems were studied, the products being examined at various stages of each reaction.—Chemical actions caused by the silent discharge upon organic compounds. Gaseous systems. Hydrocarbons and nitrogen, by M. Berthelot. The action of the discharge upon the pure hydrocarbons was first studied. Marsh gas gave at first a little acetylene, which afterwards disappeared. After twenty-four hours the remaining gas was practically hydrogen, only five per cent. of the methane being unchanged. With nitrogen, absorption takes place with the formation of basic substances. Detailed results are also given for ethane, ethylene, acetylene, prophylene, trimethylene, and allylene, both alone and mixed with nitrogen.—On derivatives of cinchonine, by M. E. Grimaux. Several derivatives are described of the brominated substance obtained by adding bromine to the crude oxidation product of cinchonine according to the method of Kœnigs and Comstock.—On the place of the sponges in classification, and on the signification attributed to the embryonic leaflets, by M. Edmond Perrier. A criticism of a note on the same subject by M. Delage.—On iteration, by M. C. Bourlet.—Remarks on a note by M. Moreau on cycles of magnetic torsion and the residual torsion of soft iron, by M. H. Bouasse. The two laws announced by M. Moreau on residual torsion can be easily deduced from known facts.—On an analogy between the action of luminous rays and of lines of magnetic force, by M. Birkeland. A Crookes' tube is placed above an electromagnet, and is so arranged that the distance of the kathode from the magnet can be exactly regulated. Beyond a certain distance, the discharge in the tube is uninfluenced by the magnet, but as the tube gradually approaches there is a certain critical position at which all the properties of the discharge are suddenly changed, the difference of potential between the kathode and anode being reduced to a tenth of the original value, and the kathode rays are replaced by others which produce no phosphorescence in the tube. The critical distance increases with the strength of the magnetising current.—On the preponderance of the mechanical action of convection currents in the production of effluvia figures upon fogged plates submitted to the action of thermic poles in developing baths, by M. A. Guébhard.—On a combination of phosphoric anhydride with benzene, by M. H. Giran. The compound described is obtained by heating the two substances in a sealed tube at 120°. It is decomposed by water, and appears to be $C_6H_6 + 4P_2O_5$.—Influence of the X-rays upon the phenomenon of osmosis, by M. H. Bordier. The experiments show that in spite of the interposition of an aluminium plate in communication with the ground, osmosis is much slower when the apparatus is exposed to the X-rays.—Production of a mucinoid substance by bacteria, by MM. A. Charrin and A. Desgrez. A substance of an albuminoid nature is produced by the growth of the pyocyanic bacillus in beef broth. This possesses poisonous properties, a dose 0·15 grams per kilogram proving rapidly fatal to a rabbit. Other bacilli behave similarly.—On bitterness in wines, by MM. J. Bordas, Joulin, and Rackowski. A ferment has been isolated, to which the production of the bitterness in wine appears to be due.—On the aptitude of the spores of the truffle to germinate, and on the function of the aroma, by M. A. de Gramont de Lesparre. The aroma assists in the preservation of the species by its antiseptic action upon the spores.—On ktypeite, a new form of calcium carbonate, differing from both calcite and arragonite, by M. A. Lacroix.—The new form is found in the crystalline deposits of the thermal springs of Carlsbad and Hammam-Meskoutine. Heat transforms the mineral into calcite, with detonation.—Semolina and foods resembling vermicelli or macaroni, by M. Ballard. Analyses of semolina and macaroni from various sources. The quality appears to be in proportion to the amount of nitrogenous material.

NEW SOUTH WALES.

Royal Society, December 1, 1897.—The President, Henry Deane, in the chair.—On the steady flow of water in uniform pipes and channels, by G. H. Knibbs. The paper dealt generally with the nature of the two régimes under which flow takes place, and of the instability of the rectilinear flow in pipes. A general formula was proposed, to express the mean velocity of a flow of water in a circular pipe under either régime, at any temperature, and with any radius, "slope," or material of pipe.—Experimental investigation of the flow of water in uniform channels, by S. H. Barraclough and T. P. Strickland. The main object of this investigation was to fill in an hiatus in the existing series of experimental results, by determining the effect of change of slope upon the velocity of flow, when the slope is varied over a wide range.—Current Papers, No. 3, by H. C. Russell, C.M.G., F.R.S. This paper will be printed in vol. xxxii. of the Society's *Proceedings* for 1898.—Notes on Myrticolorin, by Henry G. Smith. In the abstract of proceedings for August 4, a paper by Mr. Smith is noticed wherein is announced a new dye-stuff obtained from the leaves of the "Red Stringy Bark," *Eucalyptus macrorhyncha*. This material, which in some respects is allied to aromadendrin, was stated to belong to the quercetin group of natural dyes. It was named by the author Myrticolorin, as it was supposed to be the only true dye substance obtained from the Myrtaceæ. This note amplifies previous statements by recording the results arrived at since the announcement above referred to. Myrticolorin is a glucoside of quercetin, and it breaks up on boiling with dilute sulphuric acid into quercetin and a sugar.—A second supplement to a Census of the Fauna of the Older Tertiary of Australia, by Prof. Ralph Tate, with an appendix on Corals, by John Dennant. Prof. Tate begins his paper by giving references to the principal contributions to Australian Tertiary Palæontology which have appeared since the publication of his first supplement in the *Journal* of this Society for 1888. He notes a number of genera hitherto unrecorded as being represented in Australia. In the Polyzoa, a synopsis is given of McGillivray's work, this author being almost entirely responsible for the very large additions to the genera and species of our Eocene fauna. Mr. Dennant's appendix is prefaced by a brief *résumé* of recent work on Australian Tertiary Corals, He then proceeds to record two hitherto unrecorded genera for the Australian Tertiary Corals.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (mathematico-physical section), part 3 (1897), contains the following scientific papers communicated to the Society:—

May 29.—E. Wiechert: The distribution of matter in the interior of the globe.

October 30.—W. Wirtinger: Green's function for a region bounded by non-intersecting spherical *continua* of *n* dimensions. K. Hensel: Determination of the discriminants of an algebraical *corpus*. K. Hensel: The fundamental equation and the non-essential discriminant-divisors of an algebraical *corpus*.

November 13.—W. Voigt: Further contributions to the kinetic theory of the process of evaporation.

November 27.—A. Hurwitz: The coefficients of development of the lemniscate-functions. G. Landsberg: On modular systems of the second grade and rings of numbers. O. Wallach: Researches from the Göttingen University Chemical Laboratory—(1) Cisisomerism and transisomerism in the menthol series; (2) ketones ($C_{10}H_{16}O$) from terpinene-nitrite; (3) reduction-products of carvone and eucarvone; (4) a new isomeric camphor from pinene; (5) on pulegenic acid; (6) new compounds from methylhexanone; (7) on fenchone-derivatives.

The official section, part 2 (1897), gives the text of an anniversary address by Dr. F. Merkel, on "the forces which mould the forms of animal bodies," and a report on a journey through Colombia and Venezuela by Prof. O. Bürger.

DIARY OF SOCIETIES.

THURSDAY, MARCH 3.

ROYAL SOCIETY, at 4.30.—The Relationship of Variations of the Ground Water Level to the Incidence of Malarial Fevers in Chotta Nagpur, Bengal: Dr. L. Rogers.—On the Depletion of the Endosperm of *Hordeum vulgare* during Germination: H. T. Brown, F.R.S., and F. Escombe.—On Apogamy and the Development of Sporangia upon Fern Prothalli: W. H. Lang and G. A. Clark.—Experimental Observations on the Early Degenerative Changes in the Sensory End Organs of Muscles: Dr. F. E. Batten.

ROYAL INSTITUTION, at 3.—Recent Researches in Magnetism and Diamagnetism: Prof. J. A. Fleming, F.R.S.

LINNEAN SOCIETY, at 8.—On the Sense Organs of the Lateral Line in certain Fishes: F. J. Cole.—On the Occurrence of *Carex helvola* in Britain: G. C. Druce.—On Arctic Spiders from Franz Josef Land: Rev. O. Pickard-Cambridge.

CHEMICAL SOCIETY, at 8.—Note on the Preparation of Dry Hydrogen Cyanide and Carbon Monoxide: John Wade and Lawrence C. Ponting.—Production of some Nitro- and Amido-Oxylutidines: Dr. J. N. Collie, F.R.S., and T. Tickle.—Production of some Nitro- and Amido-Oxylutidines: Dr. J. N. Collie, F.R.S., and Miss L. Hall.—The Interaction of Magnesium and Solution of Copper Sulphate: Dr. E. Divers, F.R.S.

FRIDAY, MARCH 4.

ROYAL INSTITUTION, at 9.—Some Recent Results of Physico-Chemical Inquiry: Prof. T. E. Thorpe, F.R.S.

MONDAY, MARCH 7.

SOCIETY OF ARTS, at 8.—The Principles of Design in Form: Hugh Stannus.

IMPERIAL INSTITUTE, at 8.30.—The Mineral and other Resources of Newfoundland: J. H. Collins.

VICTORIA INSTITUTE, at 4.30.—The Design of the Human Foot: Gerald Smith.

TUESDAY, MARCH 8.

ROYAL INSTITUTION, at 3.—The Simplest Living Things: Prof. E. Ray Lankester, F.R.S.

SOCIETY OF ARTS, at 8.—The Making of a Stained Glass Window: Lewis Foreman Day.

ANTHROPOLOGICAL INSTITUTE, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Papers to be further discussed: The Theory, Design, and Practical Working of Alternate-Current Motors: Llewelyn B. Atkinson.—Dublin Electric Tramway: H. F. Parshall.—Paper to be read with a view to Discussion: Calcium Carbide and Acetylene: Henry Fowler.

ROYAL HORTICULTURAL SOCIETY.—Floral and Botanical Demonstration.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—The Passage of a few of the Salts used in Photography through Gelatine Septa: A. Haddon.

ROYAL VICTORIA HALL, at 8.30.—A Work of Faraday: Prof. Reinold.

WEDNESDAY, MARCH 9.

SOCIETY OF ARTS, at 8.—Linde's Method of producing Extreme Cold and Liquefying Air: Prof. J. Ewing, F.R.S.

GEOLOGICAL SOCIETY, at 8.—Note on Clipperton Atoll: Rear-Admiral Sir W. J. Wharton, K.C.B., F.R.S.—A Phosphatised Trachyte from Clipperton Atoll: J. J. H. Teall, F.R.S.—The Pliocene Deposits of the East of England. Part I. The Lenham Beds and the Coralline Crag: F. W. Harmer.

THURSDAY, MARCH 10.

ROYAL SOCIETY, at 4.30.

ROYAL INSTITUTION, at 3.—Recent Researches on Magnetism and Diamagnetism: Prof. J. A. Fleming, F.R.S.

SOCIETY OF ARTS (Indian Section), at 4.30.—India and Sir Henry Maine: Charles Lewis Tupper, C.S.I.

MATHEMATICAL SOCIETY, at 8.—The Geodesic Geometry of Surfaces in non-Euclidean Space: A. N. Whitehead.—The Transformation of Linear Partial Differential Operators by Extended Linear Continuous Groups: Prof. Elliott, F.R.S.—Stereographic Illustrations of Catenaries: Prof. Greenhill, F.R.S., and T. I. Dewar.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On the Manufacture of Lamps and other Apparatus for 200 volt Circuits: G. Binswanger-Byng.

FRIDAY, MARCH 11.

ROYAL INSTITUTION, at 9.—Marked Unexplored: W. F. Lord.

ROYAL ASTRONOMICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Drainage of Cottage Property: H. C. Adams.

MALACOLOGICAL SOCIETY, at 8.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

BOOKS.—General Report on Public Instruction in the North-West Provinces and Oudh, 1896–97 (Allahabad).—Who's Who, 1898 (Black).—First Year of Scientific Knowledge: P. Bert, revised edition (Relfe).—The Wealth and Progress of New South Wales, 1895–96: T. A. Coghlan, Vol. 2 (Sydney, Gullick).—Das Weltgebäude: Dr. M. W. Meyer (Leipzig, Bibliographisches Institut).—Universal Electrical Directory, 1898 (Alabaster).—The Miner's Arithmetic and Mensuration: H. Davies (Chapman).—A Sketch of the Natural History (Vertebrates) of the British Islands: F. G. Aflalo (Blackwood).—Semitic Influence in Hellenic Mythology: R. Brown, jun. (Williams).—A Description of Minerals of Commercial Value: D. M. Barringer (Chapman).—Report on the Economic Resources of the West Indies: Dr. D. Morris (Eyre).—The *Electrician* Electrical Trades' Directory and Handbook for 1898 (*Electrician* Office).—Der Tägliche Wärmeumsatz im Boden und Die Wärmestrahlung Zwischen Himmel und Erde: Dr. T. Homén (Leipzig, Engelmann).—The Chemistry of the Garden: H. H. Cousins (Macmillan).—Note-Book of Agricultural Facts and Figures for Farmers and Farm-Students: P. McConnell, 6th edition (Lockwood).—Notes from a Diary, 1873–1881: Sir M. E. Grant Duff, 2 Vols. (Murray).—Report of Observations of Injurious Insects and Common Farm Pests: E. A. Ormerod, 21st Report (Simpkin).—Grundzüge der Geographisch-Morphologischen Methode der Pflanzensystematik: Dr. R. v. Wettstein (Jena, Fischer). The Naturalist's Directory, 1898 (Gill).

PAMPHLET.—La Teoria dei Raggi Roentgen: Prof. Filippo Re (Palermo, Reber).

SERIALS.—American Naturalist, January (Boston, Ginn).—Himmel und Erde, February (Berlin, Paetel).—Bulletin of the American Mathematical Society, February (New York, Macmillan).—Natural History Transactions of Northumberland, Durham, and Newcastle-on-Tyne, Vol. xiii. Part 2 (Williams).—Longman's Magazine, March (Longmans).—Good Words, March (Isbister).—Sunday Magazine, March (Isbister).—Humanitarian, March (Hutchinson).—Chambers's Journal, March (Chambers).—Botanische Jahrbücher, Vierundzwanzigster Band, iv Heft (Leipzig).—Natural Science, March (Dent).—Contemporary Review, March (Isbister).—Century Magazine, March (Macmillan).

CONTENTS.

PAGE