THURSDAY, NOVEMBER 7, 1912.

MATHEMATICAL TEXT-BOOKS.

(1) *A Treatise on Plane Trigonometry.* By Prof. E. W. Hobson, F.R.S. Third edition. Pp. xv+383. (Cambridge University Press, 1911.) Price 12*s.* net.

(2) *A Shorter Geometry.* By C. Godfrey, M.V.O., and A. W. Siddons. Pp. xxii+301. (Cambridge University Press, 1912.) Price 2*s.* 6*d.*

(3) *A New Geometry.* Books i–iii. By W. M. Baker and A. A. Bourne. Pp. xxii+122+iii. (London: G. Bell and Sons, Ltd., 1912.) Price 1*s.* 6*d.*

(4) *Lessons in Geometry.* Part i. By Dr. Charles McLeod. Pp. xii+212. (Aberdeen University Press, 1912.) Price 2*s.* 6*d.* net.

(5) *Examples in Arithmetic.* Part i., with answers. Taken from "A School Arithmetic." By H. S. Hall and F. H. Stevens. Pp. ix+115+xxii. (London: Macmillan and Co., Ltd., 1911.) Price 1*s.* 6*d.*

(6) *Solutions of the Examples in Godfrey and Siddons's "Solid Geometry."* By C. L. Beaven. Pp. 164. (Cambridge University Press, 1912.) Price 5*s.* net.

(7) *A B C of Hydrodynamics.* By Lieut.-Col. R. de Villamil. Pp. xi+135. (London: E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1912.) Price 6*s.* net.

(8) *A New Algebra.* By S. Barnard and J. M. Child. Volume ii. Containing Parts iv.–vi. Pp. x+301–731. (London: Macmillan and Co., Ltd., 1912.) Price 4*s.*

(9) *A Treatise on the Analytical Geometry of Three Dimensions.* By Dr. George Salmon, F.R.S. Revised by Reginald A. P. Rogers. Fifth edition. In two volumes. Vol. i. Pp. xxii+470. (London: Longmans, Green and Co.; Dublin: Hodges, Figgis and Co., 1912.) Price 9*s.*

(10) *Fergusson's Percentage Unit of Angular Measurement, with Logarithms; also a Description of his Percentage Theodolite and Percentage Compass.* For the use of Surveyors, Navigating Officers, Civil and Military Engineers, Universities and Colleges. By John Coleman Fergusson. Pp. lxvii+467. (London: Longmans, Green and Co., 1912.) Price 3*l.* 3*s.* net.

(11) *An Elementary Treatise on Statics.* By Prof. S. L. Loney. Pp. viii+393. (Cambridge University Press, 1912.) Price 12*s.*

(1) PROF. HOBSON'S treatise on plane trigonometry has for many years been regarded as the best work on the subject available for English students. There is probably no lecturer at Oxford or Cambridge who does not recommend his pupils to read it. In fact, before its publication it was necessary for those who wished for a rigorous treatment of those infinite series and products which occur in higher trigonometry to have recourse to French or German text-books. But recently much has been done in England to remedy this deficiency. Mr. Hardy's volume on "Pure Mathematics," Prof. Bromwich's work on "Infinite Series," and Prof. Hobson's "Theory of Functions of a Real Variable" are noteworthy examples. These, however, deal with a wider field, and students will still continue to gain their first insight into the problems of higher analysis from this volume.

The need of a third edition has given the author an opportunity for a complete revision; new matter has also been inserted. The theory of the measurement of circular arcs is discussed at some length in the opening chapter. Those who are interested in mathematical history will appreciate the section on the quadrature of the circle, in which is given a modified form of Gordon's proof that π is a transcendental number, thus establishing the impossibility of constructing by Euclidean methods a straight line bearing to a given straight line the ratio π. But the most important changes in the work are those which relate to the theory of series and products. Many additions have been made, further examples are given to illustrate the different cases that arise, and a number of references are supplied for those who wish to make a more thorough study of the subject. We have no doubt that this volume will retain its place as the standard text-book for many years to come.

(2) This volume is a carefully reasoned interpretation of the Board of Education circular on the teaching of geometry. The first stage aims at illustrating the fundamental concepts, the second leads to the discovery of the principal theorems, and the third builds up on this basis a deductive development of the subsequent propositions. The authors feel that too much time has in the past been devoted to purposeless drawing, and have therefore omitted much of the experimental work contained in their previous treatise; the number of theoretical exercises, on the other hand, has been increased. We shall be much surprised if this text-book is not widely used.

(3) This is an abbreviated form of the text-book on elementary geometry by the same authors published nine years ago. The only important change is the redistribution of the propositions in Book i., those on congruent triangles being now

grouped together. The supply of riders, particularly in connection with angle properties of the circle, seems rather inadequate. We are glad to see that limit methods of proof are employed for the fundamental tangent properties.

(4) There are several novel features in this text-book. It is divided into thirty-five sections, each of which professes to contain the material for one lesson; but we are inclined to think some of these sections will occupy four or five hours if an adequate amount of time is assigned to rider work. The theorems are not numbered, and no references to previous propositions are given in the proofs; a conversational method is employed which for beginners possesses obvious advantages, and the order of the theorems differs from that usually followed. The scope of the work includes the first three books of Euclid, the properties of similar figures, and the fundamental propositions of solid geometry. We are of opinion that the character of the book will render it more useful to the teacher than to the student.

(5) In order to meet the wishes of those teachers who prefer to take all book-work orally, the authors have now issued in a separate form the exercises contained in their "School Arithmetic." The work is published in two parts, the first of which deals with fractions, decimals, factors, compound quantities, and unitary method. Both in quality and variety the collection of examples is admirable.

(6) Many teachers will be glad to hear that the solutions of the exercises in Godfrey and Siddons's "Solid Geometry" have now been published. Where we have tested them we have found that they are set out very clearly. Mr. Beaven has avoided the temptation to which in such cases writers often succumb of allowing a desire for brevity to obscure lucidity of expression. The figures which illustrate the solutions of the problems on plan and elevation are drawn with great care, and the methods employed are fully explained.

(7) This is in no sense a text-book on hydrodynamics. A few formulæ are quoted from various mathematical treatises, but no proofs are given. The purpose of the author is to introduce the student to the ideas of the subject, and to point out the rather arbitrary conditions under which, in the present state of knowledge, the mathematician is compelled to work. We do not think that the novice will find the contents of this volume at all easy to understand and coordinate with his other scientific reading. The number of quotations from many different authorities and the variety of topics alluded to may well tend to confuse those who have little previous knowledge of the subject. In the hands of a skilled lecturer we think the material of this book and the lines of thought indicated would interest and stimulate a class of students of ordinary ability. The character of the work leads us to believe that the author's purpose would be achieved with a real measure of success by oral methods.

(8) The authors of this treatise have succeeded in producing a work wholly unlike any other text-book on the subject with which we are acquainted. They take as their motto a pregnant sentence from Tannery's "Leçons d'algèbre et d'analyse":—"J'ai horreur d'un enseignement qui n'est pas toujours sincère; le respect de la vérité est la première leçon morale, sinon la seule, qu'on puisse tirer de l'étude des sciences." Their contention is that the average schoolboy is fully capable of realising the fundamental ideas upon which the science of algebra and, in fact, all analysis is based, and that a powerful educative instrument is discarded if no attempt is made to discuss the base-principles of the subject. They regard rigour in fundamentals as important as variety in application, and the power to understand the meaning of a process as more valuable than the ability to apply it.

With these ideas in the abstract few people will disagree, but the majority of teachers hold that work of this character must be reserved for specialists. They consider that the mental calibre of the ordinary schoolboy, and the limited time at his disposal, are scarcely adequate to permit of the high standard required by the authors of this work. Great things can, of course, be done by an enthusiastic and able teacher; and we have no doubt at all that Mr. Barnard obtains excellent results at Rugby by following the lines here indicated. But we question whether the ordinary teacher could be expected to meet with success. We have not the space to comment in any detail on the contents of this volume, but we would urge teachers to procure a copy and study it for themselves. They will find in it much that is highly suggestive, and will gather from it a number of new ideas. It is in every respect a remarkable work.

(9) By the direction of the Board of Trinity College, Dublin, a new edition of Dr. Salmon's treatise on analytic geometry of three dimensions has been prepared. The editor has retained the substance of what appeared in the fourth edition, but has brought it into line with more recent work by inserting a number of new sections; the list of references has also been supplemented. Among the additions that have been made we note some excellent plates showing models of the various species of quadrics, a paragraph on Fiedler's pro-

jective coordinates, an account of the parametric representation of twisted cubics and quartics, Staude's elegant thread construction for confocal ellipsoids, and considerable reference to the later results obtained in differential geometry. There are a large number of minor changes, but the numbering of articles and chapters remains unaltered. Mr. Rogers is to be congratulated on the way in which he has executed a far from easy task.

(10) The author claims that the method explained in this volume abbreviates and simplifies very materially the work of surveyors and navigators. It is, of course, impossible for us to judge from a perusal of the book how far the theodolite which Mr. Fergusson has invented is successful in practical work. But Prof. Heath states that it has been tested in the engineering department of Birmingham University, and has proved extremely convenient. He also remarks that

"the reduction of the results of observations can be carried on simultaneously with the field work without reference to books of tables, thus giving the surveyor full information about any part of the field observed, while he is on the spot. For all traverse surveying, especially for rapid preliminary traverse, subject to modification, the instrument possesses distinct advantages over the ordinary theodolite."

The fundamental idea in the construction of the instrument lies in the method of graduation. To explain the system adopted, we will suppose that OA_0, OA_{100} are two radii of the circle, containing an angle of 45°. Then points A_1, A_2, . . . A_r . . . are marked on the rim such that the tangent of the angle A_rOA_0 is equal to $r/100$, where r takes all values from 1 to 100. By this means it is clear that the observer, instead of reading off the angle, obtains its tangent, which is more useful for his purpose. As a matter of fact, the new form of theodolite is also graduated in degrees so that the angle can also be obtained, if desired. The angle A_1OA_0 is taken as unit, and is called the one per cent. angle.

The first fifty pages explain very fully the theory, and numerous examples are given to show its application. The remaining 450 pages are occupied with tables, to the compilation of which the author has given nineteen years. The leading column gives the angle in the percentage form at intervals of 0·001 per cent. below 1 per cent., and of 0·01 per cent. above it. The other columns give logarithmic sines, cosines, tangents, secants with difference tables to seven places of decimals, and the angle in degrees to 0·001 of a second. A shorter table at the end contains tangents of half angles and versines. It seems almost incredible that any one man should have been able to carry through, almost single-handed, such a laborious work as Mr. Fergusson has accomplished. It undoubtedly merits the serious consideration of those engaged in survey work. The bulky size of the volume gives it rather an alarming appearance, but the processes are in reality very simple, and a single hour's work with the instrument would probably be enough to enable any practical man to gauge its utility.

(11) There is a distinct need for a treatise on statics suitable for candidates for entrance scholarships at the universities. A number of excellent introductory text-books exist, but with two possible exceptions we do not know of any work which exactly meets this demand. Many teachers will therefore welcome the publication of Prof. Loney's book, which may be regarded as a companion volume to his "Dynamics of a Particle and of Rigid Bodies," recently issued. It is assumed that the student possesses some knowledge of the methods of the calculus and the elements of analytical solid geometry. In addition to the ordinary elementary course, it contains chapters on shearing stresses, three-dimensional forces, wrenches, chains, attractions and potential, and slightly elastic beams. There is an excellent collection of examples, including some of very considerable difficulty. The author has the rare gift of writing simply, and he has chosen his material with the same skill that characterises his previous work.

PHILOSOPHY AND PSYCHOLOGY.

(1) *Scientific Method: its Philosophy and its Practice.* By F. W. Westaway. Pp. xxi+439. (London: Blackie and Son, Ltd., 1912.) Price 6*s*.

(2) *Proceedings of the Aristotelian Society.* New Series. Vol. xii. Containing the Papers read before the Society during the Thirty-third Session, 1911–1912. Pp. ii+345. (London: Williams and Norgate, 1912.) Price 10*s*. 6*d*. net.

(3) *Anales de Psicologia.* Trabajos del año 1910. Volumen ii. Pp. 360. (Buenos Aires: *La Semana Médica.* Imp. de Obras de E. Spinelli, 1911.)

(1) AN excellent book for science teachers and for the general reader who wishes to acquaint himself with scientific method. Beginning with the consideration of words and the importance of exactness in their use, Mr. Westaway enters on a sketchy history of philosophy, dealing with Plato, Aristotle, Bacon, Descartes, Locke, and Hume. Thence he proceeds to logic,

explaining its function in scientific method, and naturally giving prominence to J. S. Mill, though also quoting Whewell, Bain, Jevons, Alfred Sidgwick, and Welton. Book iii. consists of useful examples of scientific procedure, drawn from the investigations of White of Selborne, A. R. Wallace, Darwin, Harvey, Lord Avebury, and others; while book iv. deals with some elementary principles of science-teaching, and has some very sensible remarks on heuristic methods. The section on Bacon is particularly good, and the famous idols are lucidly explained. Indeed, the whole book is a model of clearness. If it has a fault, it is in the direction of excessive quotation; but this is difficult to avoid when an author is exceptionally well read, and it has the compensating advantage of giving the young student a wide range of actual "samples," some of which may lure him to the study of the authors themselves.

(2) This volume contains papers by Bertrand Russell, Percy Nunn, Boyce Gibson, Dawes Hicks, W. R. Sorley, James Ward, Bernard Bosanquet, and others, on the relations of universals and particulars, animism and the doctrine of energy, the experience of power, the time difficulty in realist theories of perception, and purpose and mechanism. Perhaps the most interesting to the man of science—particularly in view of Prof. Schäfer's British Association address and the various comments thereon—is the symposium on purpose and mechanism. Prof. Sorley, instancing a workman laying the bricks in house-building, points out that the purposive process involves (1) no creation or annihilation of matter, but only rearrangement of masses; (2) no creation or annihilation of energy; (3) no violation of the law of causation; but that it is by no means established that the laws of mechanics are valid also for purposive action; *e.g.*, the laws of motion do not explain the bricklayer. It is "ideal guidance"—guidance by the idea of the house or its parts, existing in the bricklayer's mind—that determines the place of each brick. Purposive action implies certain things which are inconsistent with fundamental principles of mechanics. "Energy is liberated, that is, passes from the potential to the kinetic form, as the result of a purpose, or mental idea, and the same purpose may control the direction of the movement. . . . If purposive action is a reality, then mechanism is an abstract or limited system, and cannot give an adequate account of the real process of things."

Mr. A. D. Lindsay, criticising, remarks that we cannot introduce a non-mechanical into a mechanical system, however much we may insist that it is only a little one; but, at the same time, we can maintain that the mechanical explanation will apply to every part of the human organism, while still holding that this is not a full account of the matter. The discussion was continued by Dr. Bosanquet and Prof. James Ward.

(3) A paper by the late Dr. Ameghino describes fossil remains of two human beings found on the Atlantic coast, 60 kilometres north of Necochea. The skeletons were small, almost pigmy, say about 1·40 metres, and of small build as to strength; skulls small, and decidedly dolichocephalic: frontal part small, face prognathous. Other articles discuss intellectualism and pragmatism, the psychology of criminals, and multiple personality. J. A. H.

GENERAL AND ECONOMIC GEOLOGY.

(1) *Earth Features and their Meaning.* An Introduction to Geology for the Student and the General Reader. By Prof. W. H. Hobbs. Pp. xxxix + 506. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1912.) Price 12*s.* 6*d.* net.

(2) *A Geological Excursion Handbook for the Bristol District.* By Prof. S. H. Reynolds. With an Introduction by Prof. C. Lloyd Morgan, F.R.S. Pp. 224. (Bristol: J. W. Arrowsmith, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1912.) Price 3*s.* 6*d.* net.

(3) *An Introduction to British Clays, Shales, and Sands.* By A. B. Searle. Pp. xi + 451. (London: C. Griffin and Co., Ltd., 1912.) Price 7*s.* 6*d.* net.

(4) *Graphical Solution of Fault Problems.* By C. F. Tolman, jun. Pp. 43. (San Francisco: Mining and Scientific Press; London: Mining Magazine, 1911.) Price 4*s.* 6*d.* net.

(5) *Observations on the West of England Mining Region.* Being an Account of the Mineral Deposits and Economic Geology of the Region, and forming Vol. xiv. of the Transactions of the Royal Geological Society of Cornwall. By J. H. Collins. Pp. xxiv + 683 + 18 plates. (Plymouth: Wm. Brendon and Son, Ltd., 1912.)

(6) *Types of Ore Deposits.* Edited by H. Foster Bain. Pp. 378. (San Francisco: Mining and Scientific Press; London: Mining Magazine, 1911.) Price 8*s.* 6*d.* net.

(1) PROF. HOBBS describes his new volume as "a series of readings," the substance of a course of lectures in expanded form. The title concisely expresses the character and scope of the work. The author discusses the figure of the earth, and lays stress upon the tetrahedral hypothesis. He touches lightly on rocks and their mode of formation; deals with earth movements, volcanic action, weathering, and the activities of

water and ice, desert conditions, and the characteristics of lakes and mountains. A separate chapter is devoted to the Niagara Falls as a clock of geological time. He hints that a large amount of original and unpublished material is interwoven in the older web. This may be, but much of it has either been skilfully concealed, or it has a familiar look. The book is quite pleasant reading, and the pleasure is enhanced by the abundant and excellent illustrations. There are five appendices; two on the determination of common minerals and rocks are unsatisfactory and not necessary in a book of this kind. The third describes the author's method of explaining the meaning of contoured maps by means of apparatus; it seems an elaborate way of passing the student's time. The fourth is a short explanation of apparatus for teaching the interpretation of geological maps; it consists of different shaped blocks, representing outcrops of various kinds, to be disposed on a table ruled into squares. This might be useful in setting examination exercises. The fifth outlines several fairly lengthy geological trips in the United States, and concludes with a sketch of a geological rush across Europe.

(2) A different series of geological excursions is provided for by Prof. Reynolds in his admirable little guide book. Forty excursions, all within easy distance of Bristol, are described on a uniform plan under the headings "special features," "access," "general structure," followed by, in each case, an itinerary with geological notes and a short list of references. There are numerous sketch maps and sections and an introduction to the geology of the district is written by Prof. Lloyd Morgan.

(3) The literature on British clays and sands is so meagre that any serious attempt to deal with the subject is welcome. The frontispiece to Mr. Searle's book, a "map of the chief clay works in Great Britain," is fairly characteristic of much that is to follow; it presents a medley of dots conveying no information of any value whatever, but representing, no doubt, a great deal of labour. It would be incorrect to suggest that no information can be gained from the text; Mr. Searle has produced a book containing much useful and interesting matter; one who can stand the fatigue and irritation caused by the lack of arrangement and the interminable repetitions will be able to extract a great deal. Only about half the volume is devoted to the geological position, the qualities and uses of British clays, and the small amount of space allotted to sands is not sufficient to warrant any mention in the title. The remainder of the book is concerned with ordinary geology and with the properties of clays in general. Much of the geology might have been condensed or omitted; it is very bookish, and it would be easy to point out many statements that are misleading or only half true. There are chapters on the mineral and other constituents of clays; the physical and chemical properties of clays (the table of analyses is quite inadequate); materials similar to clay (including halloysite, sillimanite, kyanite, zeolites, &c.); prospecting, mining, and quarrying; the purification and preparation of clays and the legal position of clays. There is a large but not quite trustworthy index. Throughout the work there are scarcely any references to original authorities, though many are mentioned.

(4) Prof. Tolman's small book of less than fifty pages deals with a subject of the greatest importance to all practical geologists and mining engineers. In most English text-books the movement on fault planes is usually treated as if it were quite simple, though everyone is aware that it has often been very complicated. The author explains very briefly, and on the whole clearly, how to represent the effects of faulting. He uses for this purpose two methods: the isometric projection, and the application of contouring. He introduces several terms in the nomenclature of fault movements which will be familiar to readers of American geological literature; his use, however, of the expression "pole" for axis is not fortunate. The book would have been more satisfactory in some respects if the author had permitted himself a little more elaboration in the treatment of the subject; it is none the less a useful pamphlet.

(5) On the mining region of Cornwall and Devon Mr. Collins has produced a valuable work of reference. Perhaps the most acceptable portion will be that giving short histories of individual mines. There is also a separate list of mines arranged alphabetically. A large part of the volume is occupied with theoretical matters of the usual kind, mingled with which is more interesting local information as to the character of the ore bodies. Occasionally the author launches out into elaborate estimates of the amount of certain minerals and ores contained in the rocks; they are neither of much use nor very accurate.

(6) It was an excellent idea to gather into a single volume the opinions of different mining engineers upon the type of ore formation with which each was most familiar. Separate chapters of this book are given to the Clinton iron ores, Lake Superior iron ores, the flats and pitches of the Wisconsin lead and zinc district, lead and zinc deposits of the Ozark region, native copper deposits, the Cobalt district of Ontario, the Treadwell mines, Alaska, saddle reefs, contact deposits,

the Witwatersrand conglomerates, replacement ore bodies, outcrops of ores, causes of ore shoots. A great deal of the information has appeared before, and there is naturally a certain amount of divergence of opinion among the writers.

OUR BOOKSHELF.

Leitfaden zum Bestimmen der Vögel Mittel-Europas, ihrer Jugendkleider und ihrer Nester nach leicht und sicher erkennbaren Merkmalen. By Prof. F. Dahl. Pp. viii + 162. (Berlin: Gebrüder Borntraeger, 1912.) Price 5.20 marks.

THE existing handbooks of bird-classification and description are deficient in three important particulars. They are inexact and incomplete on the distinction between immature, mating and ordinary adult plumages. Descriptive adjectives, such as "short" and "long," which have none but a relative application, are used instead of absolute descriptions. Lastly, the study of nidification is very unsatisfactory. Such defects are the cause of much error and waste of labour to the student.

Prof. Friedrich Dahl, in his guide to the birds of Central Europe, seeks to remedy these defects. It is a model of compression; its 154 pages, each fully paragraphed and subdivided, contain a very complete and well-ordered fund of data. The determination of species is the main object; the subject of life-habit is untouched. The study of nests has a section to itself. This department, naturally, is the less complete. Reference is made in every case throughout the guide to the descriptions and illustrations of Naumann.

An introductory section tabulates those crucial details of beak and pinion and claw which form the elements of classification and render the morphology of the bird unique in biology. These are well illustrated, though on too small a scale in many cases. The book is indispensable as a supplement to Naumann, and English students should make acquaintance with its method.

A. E. CRAWLEY.

Celluloid: Its Manufacture, Applications, and Substitutes. By Masselon, Roberts, and Cillard. Translated from the French by Dr. Herbert H. Hodgson. Pp. xx + 356. (London: Charles Griffin and Co., Ltd., 1912.) Price 25*s.* net.

THIS work, which must be judged in its English rendering, conforms with the forecast of the preface. It is a fairly complete account of celluloid manufacture, with a somewhat hesitating *exposé* of its technological basis. The authors acknowledge the collaboration of M. L. Clément in contributing (1) a theoretical study of nitration baths, and (2) a discussion of the "inflammability" of celluloid. The attendant risks of manufacture, storage, and use are treated, with full reference to the researches of Will, Vieille, Voigt, and others. Their own conclusions from the established data, in the form of "Precautions to be exercised in Celluloid Works," are practical and comprehensive.

The work is logically subdivided into:—Part i. "Manufacture," which comprises the processes involved in the production of the celluloid mass; Part ii., "Applications," deals with the production of celluloid articles, combs, handles, hollow articles, beads and buttons, and also films, including lacquers and the application of celluloid solutions in the production of filmed, or coated, and impregnated fibres; Part iii., "'Uninflammable' Celluloid and Substitutes," treats of modified celluloids, and the competing varieties of plastic colloids, such as the cellulose acetates, and xanthates (viscoid), as well as casein (galalith) and aldehyde-phenol derivatives (bakelite). In this section the authors modestly confess the insufficiency of their knowledge and information, and we shall not be thought hypercritical in remarking that this section is not to be taken "seriously."

There are unusual additions to our terminology; "pulpation" and "centrifugaliser" are instances of new words, which, however, are intelligible. But in the section dealing with the fibrous nitrocelluloses, we have "pile" (Fr. *pile*) for beater, "paste" (Fr. *pâte*) for pulp, and for the essential working parts of the beater we have "cylinder," or "drum" for roll, "slab" for bed-plate, "teeth" for bars. The general effect produced on the reader is that of *translated French*, which is not English.

The work appears at a moment which is opportune, in view of the appointment of a Royal Commission to inquire into the dangers of celluloid. The authors have dealt fully with this subject.

Atlas Photographique des Nuages. By Julien Loisel. (G. Thomas: Librairie Astronomique, Paris, 1912.) Price 18 francs.

THIS atlas contains twenty plates of beautiful reproductions from evidently very fine negatives, the size of each being $6\frac{1}{2} \times 4\frac{1}{2}$ inches. The letterpress accompanying them is extremely brief. It consists of twenty-three lines describing the methods adopted in securing the negatives, and three or four lines of description of each photograph, forming an index to the plates, in which is stated the type of cloud, general description of the formation and date of exposure.

The photographs were for the most part taken by Dr. Loisel, but they include some reproductions from negatives secured by M. L. Teisserenc de Bord, of Trappes, and by M. J. Vincent, of Uccle.

The cloud nomenclature used in this atlas is not that adopted by the International Meteorological Committee in their International Cloud Atlas, but it would have been an additional value to the present atlas if the international classification terms had been added in each case.

The photographs are so good and represent such typical clouds that the atlas should, and no doubt will, find a place not only in all meteorological institutions, but in the libraries of all interested in this fascinating application of photography.

LETTER 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.]*

The Jaw from the Stalagmite in Kent's Cavern.

IT is remarkable that so little notice has been taken of the important discovery by Mr. Pengelly of a part of a human upper jaw in the granular stalagmitic layer of Kent's Cavern, and even more so that some well-known anatomists appear to have been unaware of its existence.

If the deliberate evidence of Pengelly, who for so long so carefully and scientifically explored the floor of the cave, is not to be accepted on this point, his whole investigation will be rudely shaken. It is much to be regretted that Pengelly's pamphlet entitled "The Ancient Cave Men of Devonshire," containing a most clear *résumé* of his exploration, is not better known and more easily procurable. It would be most advantageous if it could be republished. On p. 9 of this pamphlet Pengelly writes as follows:—"The objects in the *modern stalagmite* were not numerous. They consisted of charred wood, marine and land shells, remains of various mammals, including the extinct cave bear, cave hyena, tichorine rhinoceros and mammoth; well-rounded pebbles of various kinds; flint flakes, implements, and cores; and a portion of a human upper jaw containing four teeth, with a loose tooth lying near it. Some of the remains of each of the extinct animals were not only in quite the uppermost portion of the stalagmite, but were not completely covered with it. The human jaw was near its base, where it was twenty inches in thickness."

From this it is clear that extinct animals were living in Devonshire up to the very end of the period during which the upper stalagmite was being deposited; and that this must have been some considerable time after the jawbone became embedded in the lowermost layers of it. E. A. PARKYN.

October 29.

TUBERCULOSIS AND THE MILK SUPPLY.

ATTENTION has been directed to the relationship of tuberculosis and milk, and to the problem of a pure milk supply and the methods whereby this may be ensured, by a series of articles and letters which have appeared in *The Times* during September and October. We may consider the questions thus raised under three headings: (1) how far is tuberculous-infected milk a danger to the community as a whole; (2) will pasteurisation, certified milk depôts, or other means remedy the evil if it exist; (3) can a safe milk supply be ensured without revolution in present methods.

1. The menace, if it exist, of tuberculous milk chiefly falls upon children from one to six or seven years of age, *i.e.*, when cows' milk forms a staple article of diet. There can be no risk to the breast-fed infant, but, unfortunately, the natural method of infant feeding is at present out of fashion! While it is true that tubercle bacilli have been found in some 10–20 per cent. of all samples of milk examined, and while the experiments of the Royal Commissions on Tuberculosis and of others have shown that tuberculosis may be communicated by feeding with tuberculous milk, the amount of human tuberculous infection derived from milk is still uncertain. The pulmonary ("consumption," phthisis) is the most frequent form of human tuberculosis, the death-rate per 100,000 living for 1901–1909 being 117, as against 50 for *all* other forms of tuberculosis.[1]

Now Bulloch,[2] from a very careful survey of the literature of the subject, comes to the conclusion that pulmonary tuberculosis is produced almost always, if not exclusively, by tubercle bacilli of the *human* type. More than two-thirds of human tuberculosis is, therefore, certainly not due to the *bovine* bacillus or to milk infection. Bulloch further remarks that the bovine tubercle bacillus plays a relatively unimportant rôle in the production of tuberculosis in man! But it may be objected that, inasmuch as 10–20 per cent. of milk samples contain tubercle bacilli, there must be grave risk of infection therefrom. It will be found, however, that the percentage of infected samples is much lower than this for milk obtained under reasonably good conditions, such as those under which the large dairy companies get their supplies. Again, the method of detection of the tubercle bacillus employed in the examination of milk samples is by the *inoculation* of guinea-pigs (not ingestion or feeding), after *concentration* of the bacilli by centrifuging.

Many experiments prove that inoculation is a method of infecting infinitely more certain than feeding. Probably not more than twenty tubercle bacilli are required to produce a general infection in a guinea-pig by inoculation, whereas Findel found that doses of 19,000–312,000 bovine bacilli did not infect by feeding, and Reichenbach estimated that a dose of no fewer than 140 million bovine bacilli was required to infect guinea-pigs by feeding.[3] It is well known that tubercle bacilli are scarcely ever detected by microscopical examination in mixed milk, which gives a positive result with the inoculation test; yet, if they were present in anything like the numbers necessary to infect by feeding, they should be easily detected thus, for of every 100 organisms present, 1–2 should be tubercle bacilli! The fact is, we have no data indicating the infectivity by feeding of ordinary mixed milk.

The work of the Royal Commission gives no information on this most important point, for in all their experiments on the transmission of tuberculosis by feeding, huge doses of bacilli were administered. Although, of course, every effort should be made altogether to exclude tubercle bacilli from milk, it may well be doubted if the risk of infection from ordinary mixed milk is anything like as great as has sometimes been suggested, and the expensive and harassing machinery sometimes formulated to accomplish that end would probably benefit the stockman far more than the general public.

1 Rep. Med. Officer Local Gov. Board for 1910–11.
2 Horace Dobell Lecture, 1911.
3 See McFadyean, Journ. Roy. Inst. Pub. Health, December, 1910, pp. 715 and 718.

2. Assuming that a danger of tuberculous infection from milk exists, how can it be prevented? Pasteurisation has had a great deal said in its favour, and efficient pasteurisation does destroy the tubercle bacillus. But pasteurisation, as commonly carried out, is uncertain in its action, and there are various other objections to this process. These, however, will be dealt with in another article.

"Certified" milk is another solution that has been suggested. This means that the milk is produced under stringent conditions as to cleanliness of the animals, milkers, cowhouses, milking, &c., the herds are tuberculin-tested, and the milk is cooled, bottled, and packed in ice for transit. A good deal has been said about the growth of the certified-milk-depôt movement in America, but it is not perhaps realised that this has been forced upon her populace by the deplorable condition of the general milk supply there. Moreover, certified milk, unless subsidised by public funds or private benevolence, can do nothing to help those to whom a pure milk supply is of the greatest importance, viz., the poor; for it is admitted that the cost of certified milk must be from 8*d*. to 10*d*. per quart—only a few of even the well-to-do will pay such a price! When, a year ago, the price of milk was, in stress of circumstances, raised from 4*d*. to 5*d*. per quart, what an outcry there was; and every practical dairyman knows that the consumption of milk fell off, and, what is more, has not risen again on the recent decline in price to the former level. Further, if a certified milk trade became general, enormous numbers of cases of bottles would have to be handled by the railway companies, and greatly increased truck capacity would be necessary to deal with them. These and other practical points are not always realised by the armchair reformer.

3. The great question at issue is not so much whether a very carefully dairied milk, with a low bacterial content, distributed in bottles under ideal conditions, would, or would not, be an advantage to the community as a whole, but rather whether the existing milk supply in general is the cause of such damage to the public health as is frequently so confidently asserted. Save, perhaps, as regards tuberculous infection, which, from what has been stated above, cannot be regarded as a serious menace, the general milk supply is better now than it has ever been, and it is steadily improving. Two factors, which are in the region of practical politics, would undoubtedly improve matters without revolution and unnecessary expense. These are (*a*) cooperation between the farmers in a district and the treatment of their milk (cooling, &c.) at a central depôt from which it would be distributed either to the towns around, or to the railway for forwarding to a distance by regular, fast, and properly equipped milk trains, all farms being under proper official inspection; (*b*) the elimination of the street dealer or hawker by the abolition of all station trade, and the absorption of the smaller dealers into a few large companies, so that there is but one middleman between the farmer and the consumer.

It will not be possible to speak definitely of the value of "synthesised milk," a preparation of soya beans, recently placed on the market, until its nutritional value has been ascertained.

R. T. HEWLETT.

JUBILEE OF THE PHILOSOPHICAL INSTITUTE OF CANTERBURY, NEW ZEALAND.

THE Philosophical Institute of Canterbury, New Zealand, celebrated its jubilee on August 30 by holding a conversazione in the Art Gallery, in Christchurch. The institute was established on August 30, 1862, twelve years after the foundation of the Canterbury Settlement. Sir Julius Von Haast, who had only recently arrived in the colony, was the principal leader of the movement to form the institute, and he devoted to it the remarkable energy and enthusiasm with which he founded Canterbury Museum and made it the best institution of the kind in New Zealand. He was elected the first president of the institute, and was one of its most prominent officers until his death, many years afterwards.

The institute made an excellent start on its career. It was ambitious, and it is characteristic of the spirit which animated the colonists of those days that it made up its mind at once to do something quite practical. It announced that it wished to take part in the development of the resources of the province, and to help the settlers by disseminating amongst them useful knowledge. It held its first business meeting, which was numerously attended, in November, 1862, and it listened to the reading of papers on the growth of thistles, the manufacture of the native flax (*Phormium tenax*), and other practical subjects.

Besides contributing largely to the Transactions of the New Zealand Institute, the institute has undertaken publications on its own account. Amongst these are the "Index Faunæ Novæ Zealandiæ" (1897), edited by Captain Hutton, and "The Subantarctic Islands of New Zealand" (1909), a large work in two volumes, containing reports on a scientific expedition to the Campbell and Auckland Islands, south of New Zealand. This work is the result of an enterprise which the institute took in hand in 1906, when it urged upon the Government the desirableness of extending the magnetic survey of New Zealand to the different groups of islands that lie south of the mainland. The Otago Institute gave its support, and the proposal was approved by the New Zealand Institute; and later on the scope of the scheme was extended to include investigations into the geology, zoology, and botany of the islands.

The jubilee celebration in August last was attended by a brilliant gathering. Dr. L. Cockayne, F.R.S., the president, whose researches in botany, especially in regard to ecology, are well known in the United Kingdom and other countries, and who has taken a prominent part in the institute enterprises in recent years, presided. In an

address, he showed how the institute had originated, and he sketched its career; he then dealt with the position of the man of science in regard to humanity and the world's progress. He said that it is true that man does not live and move and have his being at the dictates of science, but it is to science that civilisation owes its present position, and in the thickly populated centres man's very existence depends upon the progress of science. The works of science are so wrapped up in the ordinary man's daily life that he not only does not feel grateful to the scientific man, but frequently ignores his very existence. The man in the street, in fact, although he may be well informed in other directions, forgets, or never knows, that applied science must be based upon discoveries in pure science, which at first may appear to have no importance whatever for the human race. The progress of the world depends upon the number, the quality, and the zeal of the men of science. They are the ultimate makers of the people's wealth and the rulers of the people's destinies; and they must always be highly trained and enthusiastic in their work.

The Mayor of Christchurch, in a short address, congratulated the institute, and also congratulated Dr. Cockayne on being elected a Fellow of the Royal Society. Mr. G. M. Thomson, as the representative of the Parliament of New Zealand, read congratulatory messages from the Prime Minister of the Dominion and from the Hon. R. H. Rhodes to the institute and to Dr. Cockayne as the winner of the Hector medal for his researches in botany. Mr. Thomson added that he had been asked to present to Dr. Cockayne this first Hector medal, struck in honour of the late Sir James Hector. The medal had not arrived in the Dominion, and could not be handed to the recipient just then, but it carried with it a grant to help in the recipient's future work. Dr. Cockayne's researches had cost him large sums of money, and he had great pleasure in asking that gentleman to accept a sum which would help him in the great work he still had in hand.

Dr. Cockayne returned thanks, and after other addresses had been given, the gathering was brought to an end.

PLAICE FISHERIES OF THE NORTH SEA.

THE tenth meeting of the International Council for the Study of the Sea was held at Copenhagen in April last, and the *Procès-Verbaux* have recently been published. The most important subject considered was the general report on the plaice fisheries of the North Sea, which is being prepared by Prof. Heincke, of Heligoland. Only the first section of this report was, however, ready at the time of the meeting, and it was decided that another meeting should take place at the end of September for the further consideration of the matter. The section of the report laid before the meeting by Prof. Heincke in April was based chiefly on the special market statistics of plaice landed, the greater part of the material being derived from English ports. The results of the work of the special steamers remain to be considered.

From an economic point of view the study of the plaice question is undoubtedly the most important work which the council has undertaken, and it is to be regretted that such great delay has occurred in the preparation of the report. Prof. Heincke cannot be blamed for this delay, which seems to have been due to faulty organisation on the part of the council, and to a want of appreciation of the magnitude of the task. The work might well have occupied the entire time and energy of one man with a staff of trained assistants under him, and it was clearly impossible that it could be carried out within a reasonable time, in addition to his other duties, by the director of the Heligoland Biological Station. If some of the money which has been spent on the organisation and formal administration of the Council and on the less important parts of the programme had been employed to enable Prof. Heincke to devote his whole time and energy to the task and to obtain adequate assistance in doing the detailed work, the position at the present time would have been much more satisfactory.

THE PLASTIC ART OF PALÆOLITHIC MAN.

WE learn from *The Times* of October 31 that Count Begouen, the well-known investigator of prehistoric archæology, has made a remarkable discovery in the cave known as Tus Ditboubert, in the district of Montesquieu-Aventès (Ariège), where three months ago he found mural paintings of animals, presumably of Aurignacian age. On October 10 the Count and his son broke through a mass of stalactites, and in the new gallery thus exposed found two clay figures, respectively 26 in. and 30 in. long, representing a bull and cow bison. They appear to have been attached originally to a rock, as one side is rough while the other is completely modelled. They are nearly perfect; the only damage that they had received was that one of the horns of the female bison and its tail had been broken off; the tail was, however, found on the floor of the cave. A third small clay figure was also found, but it was so roughly modelled as to make it impossible to say what it represents.

In passing through the galleries the explorers found many footprints of bears and human beings. In one of the galleries, where there was a number of otherwise indistinguishable marks on the floor, some fifty imprints of human heels were discovered, and Count Begouen, in his communication to the Academy of Inscriptions of Paris on October 30, suggested that these may represent traces of ritual observances or dances similar to those which have been oberved among the savage tribes of the present day in Australia and Africa.

This is the first time clay figures of Palæolithic date have been discovered, and it affords one more example of the wonderful finds that have been yielded by the French caves. A very large number

of engravings and carvings of animals on bone and ivory have been found, as well as engravings and paintings on the walls of caves, in France and Spain; mural carvings in low relief are also known, outlines of bison traced on the clay floor occur in a cave at Niaux, and now clay figurines have come to light.

There can be little doubt that many of these works of art had what we now term a magico-religious significance. Artists are not likely to have carved, engraved, painted, or modelled in the black recesses of caves merely for the joy of expression, since few of their fellow-tribesmen would see their works of art, and then but imperfectly. The only adequate solution of the problem seems to be that these delineations and representations had a significance which was at the same time practical and religious, and it is possible that some at least of them were made for the purpose of enabling their originals to be captured, or may be, as in the case of certain Australian ceremonies, to increase their numbers; in either case, their significance would be more utilitarian than æsthetic.

NOTES.

We regret to have to announce the death of Mr. Henry Groves, at his residence at Clapham, on Saturday evening, November 2, at fifty-seven years of age, after an illness extending over many months. In conjunction with his brother James, Mr. Groves was widely known as possessed of exceptional acquaintance with the small but difficult group of the Characeæ, and the opinion of the brothers "H. and J. Groves" was constantly sought by botanists of all nations. It is understood that a volume on the British species, for issue by the Ray Society, is practically ready for the press. The most conspicuous task in which both brothers engaged was the editing of the ninth edition of Babington's "Manual of British Botany," which was in many respects remodelled, and came out in 1904. Mr. Henry Groves had served on the council of the Linnean Society some years since; at the time of his death he was again a councillor, and in certain questions he took a leading part. His death removes a loyal and devoted worker, whose place will not be easily filled.

Dr. Benjamin Boss, son of the late Prof. Lewis Boss, director of the Dudley Observatory, Albany, N.Y., has been appointed acting-director of that institution.

M. Émile Boutroux was on October 31 elected a member of the French Academy. The eminent French philosopher is honorary professor of modern philosophy at the Sorbonne, and director of the "Fondation Thiers," a residential college for post-graduate study. He is known as the author of numerous important philosophical works.

The eighty-seventh Christmas course of juvenile lectures, founded at the Royal Institution in 1826 by Michael Faraday, will be delivered this year by Sir James Dewar, F.R.S., Fullerian professor of chemistry, his title being "Christmas Lecture Epilogues." The lectures will be experimentally illustrated, and the dates and subjects are as follows:—Saturday, December 28, "Alchemy"; December 31, "Atoms"; January 2, 1913, "Light"; January 4, "Clouds"; January 7, "Meteorites"; January 9, "Frozen Worlds."

Owing to bad weather, the illuminated night flying and firework display that was to be held at the London Aerodrome, Hendon, on Tuesday, November 5, has been postponed until Saturday next, November 9. Special exhibition flights, speed and altitude tests will take place from 2.30 p.m. until dusk, and the illuminated night flying and firework display will be in progress from 7.30 p.m. until 10 p.m.

The series of lectures which the Selborne Society annually arranges will begin on November 11, when Lord Montagu of Beaulieu will preside, and Mr. Fred Enock will deal with "Fairy Flies and their Hosts." Among the subjects of other lectures are:—"Minor Planets," by Dr. A. C. D. Crommelin (January 20, 1913); "Fibres and Fibre Lore," by Mr. C. Ainsworth Mitchell (February 17); and "Byways in Biology," by Mr. James Saunders (March 3). The special children's lecture will be given by Mr. Spencer Fletcher on "Dew, Hoar-frost, and Clouds" (January 9).

The death is announced, at the age of seventy-two, of Dr. William Willard Daniells, the founder of the study of chemistry at the University of Wisconsin. In 1868 he was appointed to a chair in that institution, and established its first chemical laboratory, giving daily instruction to one student, and using an old carpenter's bench in the basement. Dr. Daniells continued in active work as the head of the chemistry department until 1907, when he became professor emeritus. He also conducted the weather bureau at the University, until this work was taken over by the U.S. Government. From 1872 to 1876 he was chemist to the Wisconsin State Geological Survey.

The Weber-Parkes prize (of 150 guineas and a silver medal), founded in 1895 by Sir Hermann Weber in memory of the late Dr. E. A. Parkes, and awarded every third year to the author of the best essay "upon some subject connected with the etiology, prevention, pathology, or treatment of tuberculosis, especially in reference to pulmonary consumption in man," has been awarded by the Royal College of Physicians to Mr. J. A. D. Radcliffe, pathologist to the King Edward VII. Sanatorium, Midhurst. The subject of the next essay, to be adjudicated upon in 1915, is an original research on the treatment of pulmonary tuberculosis with substances which are especially antagonistic to the specific organism and its products. This work must have been chiefly carried on since the year 1911. The following lectures will be given at the Royal College of Physicians during November:— Dr. Raymond Crawfurd will deliver the FitzPatrick lectures on "The History of Medicine" on November 7, 12, 14, and 19, the subject being "Echoes of Pestilence in Literature and Art"; the Horace Dobell lecture by Dr. C. J. Martin, on "Insect Porters of Bacterial Infection," will be delivered on November 21.

THE extension of the Manchester Museum was formally opened on Wednesday, October 30, by Mr. Jesse Haworth, the donor of the larger part of the cost of the new buildings, when Prof. Flinders Petrie delivered an address on the *raison d'être* for the study of Egyptology. The extension consists of a central building, 65 ft. long and 35 ft. wide, comprising basement, ground and first floors, the latter with a gallery 12 ft. wide all round. This central building is connected with the old museum by a bridge 12 ft. wide, at the level of the first floor, and, balancing the bridge in front elevation, is a low building 30 ft. long and 35 ft. wide, consisting of basement, ground and first floors, communicating with the corresponding floors of the central building. The larger room on the ground floor will be devoted to a museum of economic and applied geology, which will be practically an extension of the existing geological museum on the ground floor of the old building. The smaller room on the ground floor will contain the collections illustrative of anthropology, ethnology, and numismatics. The whole of the first floor and gallery will be given over to the exhibition of the valuable and extensive collection of Egyptian antiquities, and for those illustrating the allied civilisations of the Orient. These collections, which deal with the historic period of human development, will be directly connected, by means of the bridge, with those illustrative of Palæolithic and Neolithic man, which are exhibited on the first floor of the old museum. It has been possible, therefore, to add these important departments to the museum without any reorganisation of the existing collections, while at the same time they fall into their correct place in the general scheme of classification adopted in the museum.

FOR the third month in succession October was generally cold over the United Kingdom, although it was less so in the northern and western districts than elsewhere. At Greenwich the mean temperature for the month was 48°, which is 2° less than the average, but in both August and September the mean was more than 4° below the average. The mean maximum temperature for October at Greenwich was 57°, which is 1° below the average, and the mean minimum 39°, which is 4° less than the normal. The highest day temperature was 66°, which is the lowest October maximum since 1905. There were in all only nine days at Greenwich with the temperature above the average, and on three days at the commencement of the month the deficiency of temperature exceeded 10°. The aggregate rainfall at Greenwich for October was 1·86 in., which is 0·99 in. less than the average, and rain fell on fourteen days. The duration of bright sunshine for the month was 123 hours, which has only been exceeded twice in October in the last thirty years, and never by more than ten hours.

THE factors concerned in the ripening of cheddar cheese are discussed by Messrs. Hastings and Hart and Miss Evans in Research Bulletin 25 of the University of Wisconsin Agricultural Experiment Station. The ripening seems to be brought about first by the action of bacteria belonging to the *B. lactis acidi* group, and subsequently by that of another group of acid-forming bacteria, the *B. bulgaricus* group.

IMPORTANT studies on dietetics are being carried out by the U.S. Department of Agriculture. One of the latest bulletins (Yearbook for 1911) deals with the nutritional value of green vegetables. While they do not add greatly to the total nutrient and fuel values, they increase the wholesomeness of the diet in three ways, viz., by supplying necessary mineral matters less abundant in other food-stuffs, by supplying bulk desirable for the normal digestion of the more concentrated food materials, and by rendering the diet more varied and attractive.

A VALUABLE report on isolation hospitals, compiled by Dr. H. Franklin Parsons, has been issued by the Local Government Board. Many isolation hospitals all over the country have been inspected, and full details are given as to construction, cost, and maintenance, with plans. The utility of these hospitals is discussed, and the question of combination between adjacent authorities is considered. The architect of the Board (Mr. Kitchin) points out that the cost of a rod of stock brickwork in mortar has risen from 12*l.* 10*s.* in 1859 to 16*l.* 10*s.* in 1905 and 16*l.* 5*s.* in 1911. Suggestions are made for cheapening construction, *e.g.* by the use of steel or timber framework covered with patent slabs, which might result in a saving of 30 to 40 per cent., but this kind of construction is at present hampered by the building by-laws now in force.

THE effect of smoking on the physique of college undergraduates is discussed in a paper by Dr. Frederick J. Pack in *The Popular Science Monthly* for October, under the title "Smoking and Football Men." The author's reason for singling out football men for special study is that it is impossible to draw definite inferences from comparing students some of whom are athletes and some of whom are scholars, and, on the other hand, he considers that the football squad forms a very nearly homogeneous group on which observations can well be based. Further collections of statistics are given referring to the effects of smoking on scholarship as tested by examinations, and to the lung capacities of smokers and non-smokers. In every case the evidence is against smoking. In the football trials only half as many smokers as non-smokers were successful. In the case of able-bodied men smoking was associated with diminished lung capacity amounting to 10 per cent. Finally, in examinations it was found that about 70 per cent. of the candidates obtaining highest marks were non-smokers, while 70 per cent. of those obtaining lowest marks were smokers.

IN *The Nature Photographer* for October Mr. F. J. Koch gives an interesting photograph of a herd of chamois in the Alps, taken with a telephoto lens.

DR. C. C. HOSSÉUS, of Berchtesgaden, has favoured us with a copy of a paper from the *Nachrichtsblatten der Deutschen Malakozoologischen Gesellschaft* on land and marine shells collected during an expedition to the Malay Peninsula and Siam. The most important result appears to be the evidence of the molluscan fauna that the islands of Koh-Si-Chang and Koh-

Kam-Yei formerly constituted a portion of the Siamese mainland.

IN a paper on the origin of asymmetry in Cetacea published in vol. xli. (pp. 45–54) of the *Anatomischer Anzeiger*, Prof. G. Steinmann argues that the horizontal tail-fin of that group has been produced by torsion from the perpendicular type characteristic of the Mesozoic saurians. As the author believes cetaceans to be a convergent group derived from three of the Mesozoic marine reptilian orders (Ichthyosauria, Plesiosauria, and Thalattosauria), it is, to say the least, not a little curious that a similar torsion of the tail-fin should have occurred in each group. The same author has also sent us a copy of a pamphlet, by himself, published by Engelmann, of Leipzic, and entitled "Die Abstammungslehre, was sie bieten kann und was sie bieten."

THE interesting and rare fresh-water alga *Phaeothamnion confervicolum* has recently been found near Edinburgh by F. L. M'Keever, who describes (Trans. Bot. Soc. Edinburgh, vol. xxiv) the first recorded appearance of this plant in Great Britain. The genus Phæothamnion has by the majority of recent systematists been placed at the base of the brown algæ, and may be regarded as one of the intermediate forms in the ascending scale of brown organisms arising from the Flagellata with brown chromatophores (Chrysomonads), and giving rise to the true brown algæ (Phæophyceæ), hence it is a type of special interest from the phylogenetic point of view. Hitherto this genus has been found only in Sweden, Germany, Austria, and Italy. As the alga disappeared from Mr. M'Keever's cultures before its zoospores could be carefully studied, it is to be hoped that the plant will be found again, and further investigations made in order to determine its systematic position and affinities with greater certainty.

PROF. W. E. FORD has edited the thirteenth edition of "Dana's Manual of Mineralogy" (New York: Wiley and Sons, 1912, price 8*s*. 6*d*. net), which continues to be one of our best elementary text-books. The photographic illustrations of actual specimens, printed as separate plates, are distinctly helpful. As is usual in the smaller works on mineralogy, crystallographic considerations remain somewhat loosely stated. The problem of isomorphism outside the cubic system is not touched on in the three pages devoted to the subject, and the statement on p. 11 that "in general the ratio of the intercepts of a crystal face upon the crystallographic axes can be expressed by whole numbers or definite fractions" is surely, in this abbreviated form, misleading. Useful tables for the determination of minerals occupy nearly seventy pages.

THE Deutsche Seewarte has added another lustrum (1906–10) to the valuable results of the meteorological observations made at the stations of the second order under its control. The lustra previously dealt with cover the thirty years 1876–1905, and some of the former have already been combined into longer periods, *e.g.* in 1904 the results included the twenty-five years 1876–1900. The observations are made at 8h. a.m., 2h. and 8h. p.m., local time, and excepting at two stations, where the English-pattern (Stevenson) screen is used, the thermometers are installed outside suitable windows. The results are calculated for months, seasons, and the year.

A LENGTHY article (in Japanese) on observations of air currents appears in the Journal of the Meteorological Society of Japan (xxxi., No. 7, 1912). The author, Mr. Sato Junichi, describes some experiments which he carried out in January and February last on the summit of Mount Tsukuba (2925 ft.), both with small hydrogen balloons, known as "pilots," and with pyrotechnic balloons. The latter, devised by himself, are balloon-like firework pendants, which are released at various heights, determinable from the nature and quantity of explosives used. It is claimed that whereas "pilots," being released at ground-level, are at the mercy of surface winds from the start, the firework balloons are carried through the lower strata and begin their journey several hundred metres high. For the observation of these balloons the author uses a special form of theodolite, also designed by himself, provided with a sighting attachment and a plummet, and costing only a few pence. In the experiments referred to, when comparative observations were made with both types of balloon, air currents in the opposite direction to those at ground-level were found at heights of from two to five hundred metres. Details are given of numerous observations, the information obtained embracing speed and direction of air currents, the location of upward and downward eddies in the atmosphere, height of surface currents, &c. The meteorological conditions, nature of clouds, force and direction of the wind prevailing on each occasion are also given.

IN recording observations of periodic phenomena, it is very usual to make a certain number of groups of regular observations and to take the arithmetical mean of each group. In a note on the application of the method of harmonic analysis (Journal of the Meteorological Society of Japan, xxxi., 5), Mr. Y. Tsuiji shows that when the results are used for the purposes of harmonic analysis the coefficients thus obtained are too small, and formulæ and tables are given for the necessary corrections.

UNDER the title "Surfaces of Revolution of Minimum Resistance," Dr. E. J. Miles, writing in the Bulletin of the American Mathematical Society, discusses the form of an airship or other figure of revolution which experiences the least resistance in its motion through a resisting medium. The assumption made is that the pressure on any surface element is a function of the inclination of that element to the direction of motion, and is unaffected by the currents set up by the remaining portions of the surface, and in this respect the problem differs essentially from that presented by an airship or body moving through a material fluid medium. The problem is, however, a classical application of the calculus of variations dating back to the time of Newton.

A SERIES of articles on the origin of the earth's magnetic field have appeared in *Terrestrial Magnetism* during the last two years from the pen

of the editor of that journal, Dr. L. A. Bauer. The subject has been recently dealt with by Prof. Schuster in his address to the Physical Society of London, and by Dr. W. F. Swann in the July number of *The Philosophical Magazine*. The conclusion to which each examination leads is that none of the present theories offers a satisfactory explanation of the earth's magnetic state. In the September number of *Terrestrial Magnetism* Dr. Bauer shows that if the mean values of the magnetic elements be calculated for successive parallels of latitude between 60° N. and 60° S., these values are represented to within 1 per cent. by an expression for the magnetic potential which involves only the first and third zonal harmonics; that is, it involves the first and third powers only of the cosine of the colatitude. This fact serves as a very severe test of any theory advanced, and none of them appears capable of surviving its application.

AN interesting paper on the occurrence, analysis, and genesis of iridosmine obtained from the New Rietfontein Mines is communicated by Mr. C. Baring Horwood to vol. xv. of the Transactions of the Geological Society of South Africa. Iridosmine is an intimate mixture of iridium and osmium, found in small quantities, as small grey particles, associated with gold. Specimens microscopically examined by the author showed a decidedly crystalline character, but the metal has never been recognised *in situ* or in hand specimens; "panning" experiments show that in the New Rietfontein it chiefly occurs in a very narrow banket reef, known as the carbon leader, wherein the gold is always associated with carbon. Spectroscopic analyses, made for Mr. Horwood at the Solar Physics Observatory, South Kensington, indicate that the iridosmine is mainly composed of osmium, ruthenium, and iridium. A concentrate examined quantitatively at the Imperial Institute had a specific gravity of 19, and contained 95 per cent. iridosmine, of which 45 per cent. was iridium. The metal does not occur in paying quantities, and it took six months to collect 910 grains at the Rietfontein Mine, during which period 102,800 tons of ore were treated, and more than 52,500 oz. of fine gold were recovered. Mr. Horwood concludes that these metals of the platinum group are certainly of secondary origin, formed as primary segregations by magmatic concentration in the basic eruptives of the mines, and extracted from the dykes by active superheated gases during the pneumatolytic phase of eruptive activity. Probably, at a later stage, hydrothermal action was an important factor in concentrating them in the banket reefs.

ATTENTION may be directed to an article on isomerism by Werner Mecklenburg in *Naturwissenschaftliche Wochenschrift* for October 20. The article, which extends over ten pages, and occupies the larger part of the issue, deals with the phenomena of position isomerism, optical isomerism, stereo-isomerism, and dynamic isomerism, together with the Walden inversion and the isomeric derivatives of cobalt and other metals as investigated by Werner.

We have received from Messrs. A. Hermann et Fils a reprint of a series of lectures "Sur quelques Thèmes choisis de la Chimie Physique pure et appliquée," delivered by Prof. Arrhenius at the University of Paris from March 6 to 13, 1911. Some of the subjects are identical with those of the Silliman lectures delivered at Yale in 1911 and published recently under the title "Theories of Solution"; this statement applies to the lectures on molecular theory, on suspension and the phenomena of adsorption, and on free energy. But different ground is covered by the lectures on the atmospheres of planets and the physical conditions of the planet Mars. The five lectures cover 112 pages, and are issued at the modest price of three francs.

THE yearly memorandum issued by Mr. C. E. Stromeyer, chief engineer of the Manchester Steam Users' Association, deals with the relative costs of burning fuel or oil under boilers, and exploding oil or gas in engines. With the ruling prices of oil, it will not be profitable to burn it in preference to coal until the price of the latter has risen to 38*s*. per ton; but oil can be profitably used in internal-combustion engines whenever and wherever the price of coal exceeds 15*s*. per ton. The greater part of the memorandum deals with the valuable experiments of Profs. Heyn and Bauer on corrosion, or rather on the influence of about forty dissolved salts in reducing or increasing corrosion. The phenomena associated with corrosion are too erratic to permit of definite conclusions being drawn, but Mr. Stromeyer gives an excellent analysis of the experiments mentioned which will be of great service to steam users who are troubled with corrosive feed waters.

WE have before us twenty-two volumes belonging to the series "Aus Natur und Geisteswelt," published by the firm of Mr. B. G. Teubner, of Leipzig and Berlin. The series now includes nearly four hundred volumes dealing with many aspects of literature, art, music, history, law, philosophy, science, and technology. The price of each volume is one mark, or 1.25 marks in cloth covers. A distinguishing characteristic of the series is the attention given to present-day problems. Among the subjects of recent volumes, for instance, are directions of modern physics, experimental cytology, regeneration, biochemistry, milk and its products, problems of modern astronomy, astronomy in relation to practical life, surgery of our time, practical mathematics, spinning, light-railways, wireless telegraphy, aërial navigation, brewing, and kinematography. Each volume is simply written and suitably illustrated, and the whole series forms a remarkably comprehensive collection of manuals of modern thought and progress. Both the editor and publisher are to be congratulated upon the production of the volumes, which should do much to promote interest in science, art, and letters among German readers.

A NEW issue of the list of second-hand microscopes and other instruments which they have on sale has been issued by Messrs. Clarke and Page, 23 Thavies Inn, Holborn Circus, London, E.C.

A CATALOGUE of works on anthropology, ethnology, primitive society, &c., also mythology and folk-lore, including a portion of the library of Sir H. H. Risley,

K.C.I.E., has just been issued by Mr. Francis Edwards, 83 High Street, Marylebone, London, W.

A SECOND edition of Mr. A. H. Mackenzie's "Theoretical and Practical Mechanics" has been published by Messrs. Macmillan and Co., Ltd. The first edition was reviewed in our issue of May 16, 1907 (vol. lxxvi., p. 50). While the general character of the book has been preserved, the new edition has been much enlarged, and in its preparation Mr. Mackenzie has had the cooperation of Mr. A. Forster. The price of the volume remains 1*s.* 6*d.*

OUR ASTRONOMICAL COLUMN.

A NEW COMET, 1912*c*.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by M. Borrelly at Marseilles on November 2. The position at 7h. 39·9m. (Marseilles M.T.) was:—

R.A. = 17h. 47m., decl. = 38° 57′ N.,

which lies about 2° N.W. of θ Herculis. The motion is said to be south-east, the magnitude 10, and the comet transits at about 3 p.m.

A second telegram from the Centralstelle states that the comet was observed by M. Abetti, at the Arcetri Observatory, on November 3, when its position at 7h. 7·6m. (Arcetri M.T.) was:—

R.A. = 17h. 55m. 12·8s., decl. = 37° 21′ 5″,

and the magnitude was estimated at 9·5. The position, at present, is favourable for observations during the evenings, when the comet is fairly high up in the north-west sky.

GALE'S COMET 1912*a*.—Photographic observations made at the Hamburg Observatory, Bergedorf, on October 9 showed the coma of Gale's comet to be elongated in the direction of the chief tail, position angle 79°, and to be about 1·1′ in diameter; a plate taken with a 5-inch objective of 25-inch focal length showed a tail 5·4° long, which was 2′ broad until it reached about 1° from the head, and then broadened out to 11′ at a distance of 5°. A shorter tail emerged in position angle 122°, and another was suspected at position angle 50°; the magnitude of the whole comet was about 5·5.

Spectrographic observations on October 10 and 15 showed a bright image of the head at 387 $\mu\mu$ ±, and the bands at 474 and 563 $\mu\mu$, the blue band being essentially brighter than the yellow; the band at 516 $\mu\mu$ was much fainter. The continuous spectrum was much fainter than the bands named, but could be seen extending right along the spectrum from 387 to 563 $\mu\mu$, and was brightest between 397 and 410 $\mu\mu$. Prof. Schwassmann states that on the whole the spectrum obtained is very similar to that given by Kiess's comet at the beginning of July, 1911. (*Astronomische Nachrichten*, No. 4608.)

SCHAUMASSE'S COMET 1912*b*.—In No. 4609 of the *Astronomische Nachrichten*, M. Fayet shows that if the comet recently discovered by M. Schaumasse is not identical with Tuttle's comet, the two objects are moving in very similar orbits. If the identity is accepted, there is an error of about 5° in the mean anomaly, and nearly 4″ in the mean motion, according to M. Raht's elements for Tuttle's comet as given in these columns last week. A tentative calculation by M. Fayet does not indicate the near approach of the comet to any great planet during the recent revolution, and he suggests the possibility that the comet may have split up, the object discovered by M. Schaumasse being only one part. It would be of interest to search for the main body near the calculated positions given in M. Miličevič's recently published ephemeris; on October 20 the position of comet 1912*b* was $\alpha = 10h.\ 3m.$, $\delta = -0°\ 43'$; whereas the ephemeris position for Tuttle's comet was $\alpha = 9h.\ 37m.$, $\delta = +73°\ 27'$.

In a later note (*Astronomische Nachrichten*, No. 4610), M. Fayet states that he finds that near the end of 1900 Tuttle's comet was near Jupiter, the minimum distance being 0·8, and a rough calculation gives October 9, 1912, as the resulting date of perihelion passage, three months earlier than the date indicated by the 1899 orbit; the new value for the mean motion (μ) is 263·94″. M. Fayet concludes that the identity of 1912*b* with Tuttle's comet is very probable, but his hurried calculations of the Jovian perturbation are necessarily only approximate. M. Schaumasse's new ephemeris gives the following positions and distances:—

Ephemeris 12*h.* (*M.T. Paris*).

1912	α	δ	log r	log Δ
	h. m.	° ′		
Nov. 7 ...	10 54·5 ...	−22 2		
11 ...	11 6·7 ...	−26 27 ...	0·0371 ...	0·1040
15 ...	11 19·1 ...	−30 41		
19 ...	11 31·9 ...	−34 39 ...	0·0536 ...	0·1218

SUNDIALS.—Several interesting articles on sundials are published in the October number of *L'Astronomie*. M. Roguet describes an elaborate dial recently erected on the south façade of Juvisy Observatory, and also discusses the history of this instrument, which he believes was invented about 550 B.C.; this article is illustrated by several interesting photographs and diagrams, the former depicting a large number of ancient, or especially interesting, dials. M. d'Aurelle Montmorin describes the "Auto," a new portable sundial, and M. Joyeux gives an interesting and detailed description of the sundial erected on the communal school at Sèvres.

VARIABILITY OF SOLAR RADIATION.—Mr. C. G. Abbot, director of the Smithsonian Astrophysical Observatory at Washington, has just returned from a five months' astronomical expedition to Bassour, Algeria. The object of the expedition was to confirm or disprove the supposed variability of the sun. The Astrophysical Observatory has been for seven years making observations on Mt. Wilson, in California, on the daily quantity of heat received from the sun. The observations are arranged in such a manner as to indicate not only the quantity of solar heat reaching the earth, but also the quantity of heat which would reach a body like the moon, which has no appreciable atmosphere.

The observations have indicated that the sun is probably a variable star having a range of variation amounting to from 5 to 10 per cent. within an irregular interval of from five to ten days. Last year Mr. Abbot observed in Algeria, while his colleague, Mr. Aldrich, observed on Mt. Wilson, in California. The object of thus duplicating the measurements was to avoid being misled by any local atmospheric conditions which might have affected Mt. Wilson observations. As nearly one-third of the circumference of the earth lies between Mt. Wilson and Algeria, it could not be expected that a similar local disturbance could affect both stations on the same day in the same manner. The observations of 1911 supported the belief that the sun is variable, but owing to cloudiness their number was not sufficient fully to establish this point. Hence it was thought best to return to Algeria this year.

The observations made by the Smithsonian party in Algeria this year were apparently very satisfactory. They occupied sixty-four days, and on more than fifty of these days Mr. Fowle made similar observations on Mt. Wilson, in California. The results of the work of 1911 and 1912 are expected to establish the supposed variability of the sun, or to show conclusively that this hypothesis can no longer be held.

OPENING OF THE NEW LABORATORIES OF BACTERIOLOGY AND PUBLIC HEALTH OF KING'S COLLEGE, LONDON.

THE completion of the arrangement by which primary and intermediate medical studies at Charing Cross Medical School are transferred to King's College, and the public health staff at King's College is afforded accommodation in their place, was marked on October 31 by the formal presentation of the laboratories by Prof. Simon Flexner, on behalf of the Medical School Committee, to the University of London, King's College.

Mr. H. A. Waterhouse presided, and in an introductory speech Dr. William Hunter, the Dean of Charing Cross, traced the development of the scheme, and suggested that the new laboratories would forward the ideal of Huxley, namely the progress of biological science.

Prof. Flexner expressed his pleasure at being present, for in so doing he considered that he would be helping the progress of public health, a science the knowledge of which is essential in all great cities, and especially in London. He spoke of the interest with which this science is regarded in America, and of the large sums of money given in order to forward research in that country, and expressed the hope that England, from whom America has learnt so much, might now follow her example in this respect.

The Hon. W. F. D. Smith (treasurer of King's College) expressed his agreement with Prof. Flexner's remarks, and said he was convinced that this day was a great one in the history of public health. He referred to the monumental skill and energy of Dr. Hunter, which had made the opening of the laboratories possible. The day, he argued, marked a stage in the policy of concentration which he was sure was a right one, as leading to a saving in labour and expense. The new laboratories would be used for research and for post-graduate teaching.

Dr. Headlam (principal of King's College) emphasised the advantages of this policy of reciprocity both to Charing Cross Hospital and to King's College. He supported a policy of concentration because he thought there was danger of money being squandered on new buildings which were not always needed. He reviewed the foundation of the Bacteriological Laboratory in 1887 by Dr. Edgar Crookshank, the first professor, and announced that Prof. Crookshank had presented his valuable library to the department. Their hope was that in time they would build up a fitting institute of hygiene within the University.

Sir Henry Miers (principal of the University) pointed out the need there was for willing cooperation of all available forces within the University, and held that Charing Cross and King's College had given a real example of what could and ought to be done in London.

The new laboratories and several structural and other improvements at the Charing Cross College were afterwards inspected by a large number of visitors.

PROBLEMS IN INFECTION AND ITS CONTROL.

THE Huxley lecture was delivered at Charing Cross Hospital (where Huxley studied) by Prof. Simon Flexner, director of the Rockefeller Institute, New York, who took as his subject "Some Problems in Infection and its Control."

After a reference to Huxley's work and to his Baltimore lecture in 1876, the lecturer alluded to the fact that we are still ignorant of the causes of several important infective diseases, and after quoting the example of scarlet fever, proceeded to discuss the biological investigation of poliomyelitis, or infantile paralysis.

This disease occasionally occurs in epidemic and pandemic form, and arose in America in the Atlantic coast cities and other places which receive the emigrant population from Europe. On clinical grounds it had been regarded as infectious, but this remained uncertain until Landsteiner and Popper in 1909 found that it could be transmitted to monkeys by intraperitoneal injection of matter taken from the spinal cord of a fatal human case. This method of transmission is, however, an uncertain one, but if intracerebral inoculation be substituted, the disease is transmitted with certainty to monkeys. No parasite, bacterial or protozoan, can be detected in the diseased tissues microscopically, and it is found that the filtrate from an emulsion of the infected cord, filtered through a porcelain filter, is capable of infecting; the organism, therefore, is ultra-microscopic. Some eighteen diseases are now known the micro-parasites of which are ultramicroscopic or invisible with the best optical appliances; these include yellow fever, rabies, and vaccinia.

The virus of poliomyelitis is resistant to drying, light, and chemical action. Animals which recover from the disease are immune from a further attack. The poliomyelitis virus can be detected only in the central nervous system, in the mucous secretion of the nose and throat, stomach and intestine, and in the mesenteric glands—nowhere else. The virus probably gains access to the body by the nose and thence to the brain *via* the olfactory nerves. Carriers, either healthy and unaffected persons, or slight and abortive cases, exist, and serve to transmit the disease. It has been suggested that insects may help to spread the disease, but at present there is no evidence of this, though the virus remains active in the bed-bug for some days. Nor is there any evidence that the domestic animals spread the disease. Proof has been given that the sporadic (*i.e.* isolated or scattered) cases of infantile paralysis are caused by the poliomyelitis virus by the fact that the blood of these children contains the same immunising substances as are present in the epidemic form of the disease, and in inoculated monkeys. There appear to be biologically different strains of the poliomyelitis virus. Attempts have been made to devise a chemo-therapy for the disease, and urotropin, a drug which has some antiseptic action and is secreted into the cerebro-spinal fluid, has been found to be of some value in preventing infection experimentally.

METEOROLOGY IN SCOTLAND.

MR. A. WATT contributes to the Journal of the Scottish Meteorological Society (vol. xv., No. xxviii.) a valuable discussion of the mean annual rainfall of Scotland. The discussion is accompanied by a table giving for 594 stations the mean annual rainfall and the number of years used, and for 129 of the stations for which records for forty years were available the amount of the maximum and minimum annual rainfall and the years of their occurrence. 1872 appears to have been for Scotland, as for Great Britain as a whole, the wettest year, and 1887 the driest. A map showing the distribution of mean rainfall over Scotland, based upon the values given in the table, forms the frontispiece to the volume. The region of greatest rainfall is near to the west coast, north of the Caledonian Canal, where the width of the high ground from west to east is relatively small, so that east winds as well as west winds can contribute to the rainfall before they have precipitated their moisture on other mountain ranges.

Mr. Watt contributes also an interesting note on the early days of the society, from which we learn that the society was contributing meteorological reports to the Registrar-General for Scotland so long ago as 1856. We note also that for a short period in 1858 the late Prof. Everett was the secretary of the society.

Dr. Aitken gives an account of some experiments on radiation temperatures. The black-bulb thermometer has always been regarded with some suspicion as possessing some of the qualities of a toy and some of a scientific instrument. The fact that a sheet of white paper, held near the bulb on the side away from the sun, produced a rise of temperature of 37° F. will give additional weight to the arguments of those who would relegate the instrument to the toy category. A very valuable result for meteorologists with grass minimum thermometers is Dr. Aitken's discovery that a piece of blackened metal tube slipped over the upper end of the thermometer prevents condensation of spirit in the upper part of the tube.

Among other contributions may be mentioned Dr. Mossmann's discussion of the climate of Chile, including some valuable tables of monthly rainfall and temperature, and Prof. Knott's review of Pernter and Exner's "Meteorological Optics," in which he ably defends the Ben Nevis observers against Pernter's criticism that they repeatedly sought for colours in their observations of optical phenomena.

The Journal includes tables giving the monthly meteorological statistics for about seventy places in Scotland, and a very valuable table of monthly rainfall at about 500 stations. According to the accounts published on p. 358 of the Journal, the collection of these statistics and the publication of the Journal have been carried out at a cost of less than 500*l.*, including all the expenditure incidental to the operations of the society.

THE FOURTEENTH INTERNATIONAL CONGRESS OF ANTHROPOLOGY AND PREHISTORIC ARCHÆOLOGY.

THE fourteenth Congress of Anthropology and Prehistoric Archæology met at Geneva on September 9–14, with a total registered membership of 555. The previous congress was held at Monaco in 1906. Since that date, numerous and important discoveries which deserved careful presentation and discussion in open session have been made throughout the world.

The congress met, in general sessions, in the Aula, or Lecture Hall, of the University of Geneva, whilst a number of lecture-rooms and halls were placed at its disposal by the federal and cantonal authorities, who spared no pains or money in helping to make the meetings a decided success. There was an honorary committee of ten, including Forrer, the President of the Swiss Republic, and Henry Fazy, President of the State Council of the Republic and of the Canton of Geneva, an executive committee of thirty eminent men of science, with Edouard Naville, hon. president; Dr. Eugène Pittard, president; Dr. Emile Yung and Alfred Cartier, vice-presidents; Dr. Deonna, secretary; Albert Lombard, treasurer; together with a distinguished *commission de réception*, comprising Théodore Bret, State Chancellor of Geneva, Chapuisat, Fatio, Favre, and Reverdin, the whole forming the machinery of the congress.

The following countries were officially represented by delegates:—*Germany*, Prof. Felix von Luschan; *United States of America*, Dr. Alès Hrdlička, Dr. Charles Peabody, and Prof. G. Grant MacCurdy; *South Australia*, Mr. Ramsay Smith; *Austria-Hungary*, Prof. M. Hoernes and Dr. Bela-Posta; *Belgium*, Baron de Loë and Prof. A. Rutot; *Cuba*, Prof. L. Montané; *Spain*, Prof. Manuel Anton-Férrandez and Prof. L. de Hoyos-Sainz; *France*, Prof. Marcelin Boule, Prof. Cartailhac, Dr. L. Capitan, and Prof. R. Verneau; *Mexico*, Señor Genaro Garcia; *Algeria*, M. Joly; *Monaco*, Prof. Marcelin Boule; *Roumania*, Prof. Tsigara-Samurgas; *Sweden*, Prof. O. Montélius.

Besides, there were official representatives or delegates of 163 scientific bodies and universities from Germany, United States of America, Argentina, Austria-Hungary, Belgium, Brazil, Canada, Egypt, Spain, France, Great Britain (England, Scotland, and Ireland being represented), Italy, Japan, Mexico, Portugal, Roumania, Russia, Sweden, and Switzerland, together with 392 unattached members of the congress from the above-mentioned countries, besides Denmark and Uruguay, who constituted the whole membership of the congress.

By a majority vote at the first session, French was made the official language of the congress, but verbal communications or papers before the congress could be presented in English, French, German, or Italian. Spanish was also added by a majority vote at a later session.

At the opening session of the congress, in the name of the Federal Council of Switzerland and of the State Council of Geneva, M. H. Fazy extended a hearty welcome to all the members present. Prof. Pittard recalled the 1866 meeting of the congress held at Neuchâtel, in conjunction with the fiftieth annual meeting of the Swiss Society of Natural Sciences. Prof. Giovanni Capellini, the venerable professor of geology in the University of Bologna, one of the founders of the congress, and sole survivor of the first meeting at Spezzia in 1865, replied to the address of welcome on behalf of the visiting delegates.

Upwards of 200 papers, read in full or in abstract, were presented by nearly as many congressists, a number altogether too great for fair treatment and discussion in open session. It was agreed that forthcoming congresses be divided into sections dealing with (1) *La pierre*; (2) *les métaux*; and that the last two days of the meetings be devoted to (3) *anthropology*.

Space will not allow us to do justice to the character of the papers presented and subjects discussed. Among the papers of wide interest to anthropologists and archæologists may be mentioned that of Prof. Marcelin Boule, director of the Institute of Human Palæontology, recently established in Paris, on the subject, *Homo neanderthalensis*. A thorough diagnosis of this ultra-human species was given by that eminent master of vertebrate palæontology. Of all the recorded specimens illustrating remains of this species available to the student of anthropology, there exist only twenty truly authentic. Neanderthal man was short in stature, with long face, bulky head, primitive characters of dentition, verticality complete, nose salient (ultra-human). *Homo neanderthalensis* goes out and disappears after the Middle Pleistocene. In the architecture of his cranium he does not resemble the short-faced Australian Bushman, as suggested, who, on the contrary, is *one* with Europeans. *Homo neanderthalensis* is *one* with the chimpanzee, and represents an archaic type, constituting in all probability a stage or phase in the series or evolution of *Homo heidelbergensis*.

Discussing the value of human palæontology, Prof. Boule stated that this new science had already taken man out of his zoological isolation and placed him in the front rank of a company of varying types constituting a human branch of vast proportion. We were far from having, as yet, a complete palæontological series of the genus Homo. In closing his remarks Prof. Boule paid a tribute to the excellence of the work done by British investigators in the field of anthropology, among others noting Huxley and Lankester.

In Victoria Hall, and under the presidency of M. S.

Reinach, of the Institut de France, Prof. O. Montélius, the distinguished delegate from Stockholm, gave an interesting lecture on Italy and Central Europe during the Bronze age. Prof. Montélius surveyed the influences of Etruscan art and industry as they spread northward from the Alps to the Baltic, especially at the time when amber became an important article of commerce. A comparative study of the various weapons, daggers, knives, and blades used previous to the evolution of the sword proper was presented by means of diagrams and photographs projected on the screen, showing the gradual spreading of the Italian influence northward. Traces of Mycenian (Greek) articles were also present in the collections covering the same period.

On Friday evening, September 13, "Cave Man" formed the subject of Prof. Cartailhac's public lecture, held in the same hall, under the presidency of Dr. Felix von Luschan, of Berlin. Prof. Cartailhac limited his observations to Palæolithic man and his culture as revealed in the discoveries made during more recent years. The artistic skill of prehistoric man was practically unknown up to 1895, when the savant Rivarré directed attention to the great importance of the discovery made in 1880 by M. Sotisla and his little daughter in the Santander cave. Some *forty* caves and more have since been searched and carefully studied by Abbé Breuil, M. Capitan, and the lecturer, who illustrated his remarks by means of lantern slides showing engravings, as well as pictures in line and colour, depicting various hunting scenes, in which the bison, reindeer, elephant, horse, and bull played a conspicuous part. Mural decorations included pictures illustrating archers, impressions of hands on the cave walls, together with figures of men and women, made by the remote occupants of these caverns.

A question radically affecting the chronology of the Stone age was raised by Mr. Reginald Smith, of the British Museum, on the strength of certain resemblances noticed between worked flints found on the surface of the chalk area and those of the Aurignacian period from caves in France.

Abbé Breuil, who has just visited England, gave a description of recent excavations in the Castillo cave in Spain. Fifty feet of accumulated deposits in the cavern had been carefully examined, and various stages determined above the base—three Aurignacian levels, and one *typical* with bone implements, followed by three Mousterian layers, separated by variant materials and stalagmitic deposits. Near the junction of these two series a warm fauna was found; then four Magdalenian levels with materials, separated by stalagmitic layers, below which came a Solutréan layer. Several hundred specimens were obtained, amongst others nests of worked quartzite implements.

References were made to the timely and generous foundations by his Serene Highness Prince Albert of Monaco of the chair of human palæontology in Paris, and to his achievements in the science of oceanography. Prince Albert, as is well known, has undertaken at his own expense the publication of the volumes describing and illustrating prehistoric man and his habitations, not only in the south of France and in Italy, but also in Spain. Several references were made to the Institut de paléontologie humaine recently established in Paris as an international institute, with Boule, Breuil, Obermaier, Verneau, Manouvrier, and others attached, marking a new era in researches pertaining to man.

A marked result of the last two congresses, held in Monaco and Geneva, is found in the earnest desire to gather together none but the most accurate information on the subjects dealt with. All materials collected and discovered in caves, tumuli, &c., must be treated as so many geological or palæontological specimens. Their precise mode of occurrence, relative position, and condition of deposition, together with a close record of all factors bearing upon the problems presented in each individual instance, must be ascertained and records made without bias or prejudice.

The Museum of History and Art of Geneva, containing valuable collections in archæology, was visited, and a reception held in its magnificent halls. The collections are admirably displayed and carefully classified. A State banquet, a reception at L'Ariana, and a garden-party at Prof. Naville's gave the congress opportunity to meet Genevans "at home."

Besides an excursion round the lake and to Chillon Castle, archæological excursions were organised by the committee to a number of lacustrine and other stations of prehistoric interest. The Station de Treytel at Bevaix and the Station de la Tène at Préfargier were visited on Monday, September 16. On the Tuesday and Wednesday following, the Museums of Bâle and Zurich (the National Museum) were visited, and their excellent collections examined. On Wednesday excavations were made in "the tumuli of Grueningen," for the benefit of the excursionists, whilst the next two days were spent in Lucerne and Berne, where the well-known anthropological and historical museums are located, the party returning to Geneva by way of Lausanne, where the historical museum proved of much interest in its collections from prehistoric sites.

Spain figured conspicuously at the congress, not only in the attendance, but also in the importance of papers presented, dealing with the wealth of recent discoveries made in that country. Following a strong representation and invitation to the congress on the part of the Marquis de Cerralbo that Spain be selected as its next place of meeting in 1915, a strong feeling in favour of that country was openly expressed. Italy withdrew its application for the fifteenth congress. It was rumoured that an anthropological or ethnographic congress will "take shape" in 1914 in the city of Washington, the membership and adherents thereto to be called together for 1916. Strong representation was made by officers and members of the fourteenth congress, held in Geneva, to consolidate and reduce the number of congresses rather than divide them.

The best side of a congress lies in the opportunities it affords men to meet and discuss outstanding problems. Much time seems to be wasted in listening to papers presented by congressists and read at breakneck speed, as these can be read to greater advantage when published. It was in the halls and lobbies of the University of Geneva, in quiet nooks and corners, alongside the numerous exhibits, and even at private functions and public receptions, that groups of two, three, and more, met one another, compared notes, became better acquainted with methods and means, discussing questions of special interest, and unravelling knotty points.

*THE SCIENTIFIC THEORY AND OUTSTANDING PROBLEMS OF WIRELESS TELEGRAPHY.**

If we have two media of different dielectric constants in contiguity, and if a line of electric force crosses the boundary, then it is well known that the conditions to be fulfilled are that the tangential component of the electric force on either side of the boundary must be continuous, and also the normal component of the electric displacement or flux must be continuous. This involves a refraction of the line

* Introductory remarks by Prof. J. A. Fleming, F.R.S., at a joint discussion by Sections A and G of the British Association at Dundee. Continued from p. 268.

of electric force in crossing the boundary. It is bent away from or towards the normal, and if K_1 and K_2 are the dielectric constants and θ_1 and θ_2 the angles the line makes with the normal, then

$$K_1 \cot \theta_1 = K_2 \cot \theta_2.$$

The law of refraction of light is

$$\mu_1 \sin \theta_1 = \mu_2 \sin \theta_2.$$

Hence, in the case of light, the velocities of the rays in the two media respectively are proportional to the sines of the angles of incidence and refraction. In the case of the electric force, the velocities are inversely as the square roots of the tangents of the angles of incidence and refraction of the lines of electric force.

If, then, we consider a Hertzian oscillator which is partly in one medium and partly in another of greater dielectric constant, there will be a distortion at the boundary of the loops of electric force which are thrown off at each oscillation. If the upper medium is air and the lower medium is a material of greater dielectric constant, then corresponding to a normal semi-loop of electric force or air, there will be a completing semi-loop in the other material which is sheared backward, as shown in Fig. 1. If in the air at the boundary surface the force is normal to the surface, it will not be normal just below that surface in the medium of greater dielectric constant. It will have a longitudinal component. As the oscillations take place, these longitudinal components of the force are periodic in space and time, and constitute the surface wave which is similar to the electric waves produced on wires.

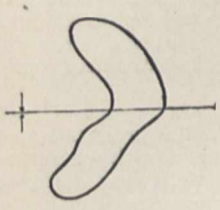

FIG 1.

If the earth were a perfect conductor, say, a ball of copper at the absolute zero of temperature, these surface waves would be confined merely to the surface skin. In the case of the actual earth, even sea water is a sufficiently poor conductor to allow the penetration of the surface wave to some little depth in it. Although the "numerical distance" is small, it is not so small as to extinguish altogether the surface wave.

The objection has been raised (see Dr. Eccles, *The Electrician*, April 5, 1912, vol. lxviii., p. 1064) that no experimental proof has been given of the actual existence of Sommerfeld's surface waves. Against this it should be noted that Sommerfeld has carefully explained that the surface waves are not separated sharply from the space waves, and may be regarded merely as a particular distribution of the moving electrostatic field near the common surface of the air and earth and accompanying electric currents in the earth. It is easy to prove that we can have surface electromagnetic waves on a *sheet*, similar in nature to electromagnetic surface waves on wires, of the existence of which we have abundant experimental proof. An argument in favour of the existence of these surface waves may perhaps be derived from the experience that high antennæ do not seem necessary for the *reception* of signals, even over long distances, thus indicating that there is a concentrated electric and magnetic field near the surface of the earth.

P. Epstein has delineated from Sommerfeld's equations a portion of the field of electrostatic force round an oscillator placed first over a perfectly conducting earth, and, secondly, over an earth of finite conductivity.[10] In the first case the loops of lines of electrostatic force are seen to terminate perpendicularly on the earth, and are divided symmetrically by the surface plane. In the second case they are distorted so that the lines at spaced intervals do not terminate perpendicularly. If, however, they have a component parallel to the earth's surface this is equivalent to a combination with a true space or Hertzian wave of a surface wave, similar to the electric waves on wires, which latter can travel along the guiding surface, irrespective of curvature of that surface.

If these conclusions are valid there is nothing to prevent the surface waves going half round the earth. It may, therefore, be quite possible to communicate by radio-telegraphy direct from England to New Zealand. There is one matter which may be of importance. Since the surface waves started from any one point reach an antipodal point by different paths it may be that unless the position of the receiving station is rightly selected, interference will arise between surface waves reaching it by different lengths of path, and hence extinction of signals for some places but not others in the same region. According to this theory, then, we need not endeavour to explain long-distance radio-telegraphy by diffraction, because true space waves are very little concerned with it.

We pass on then to consider the next question, viz. the influence of the nature of the surface in radio-telegraphy—why, for instance, it is conducted with certain wave lengths so much more readily over sea than land.

This matter has been particularly considered by Dr. Zenneck in an interesting paper. Assuming for the sake of simplicity a plane earth and plane electromagnetic waves, he discusses the effect of the conductivity and dielectric constant of the earth's crust on the wave propagation.[11]

Starting from the same equations as Sommerfeld, he arrives at an expression which enables him to calculate the damping of the waves along the horizontal boundary surface. He shows that this damping is determined by the dielectric constant and conductivity of the earth's crust. He calculates the distance the plane wave must travel before its amplitude is reduced to $1/\epsilon$ of that at the transmitter, and exhibits the results for various values of the dielectric constant and conductivity in the form of curves. Waves 1000 ft. in length over a sea surface would travel 10,000 km. before reduction to $1/\epsilon$ in amplitude, but over very dry soil only for 10 km. or less. The analysis shows that there is a considerable penetration of the wave into dry soil, but into so good a conductor as sea water the penetration is at most a metre or two. Moreover, Zenneck shows that over sea surface the lines of electrostatic force terminate nearly perpendicularly to it, but over a dry surface this is not the case. There is then a considerable rotating component, and the direction of the electric force is represented by the rotating radius vector of a semi-ellipse, the major axis of which slopes forward in the direction in which the wave is travelling. Zenneck's results have been extended by F. Hack, who has shown that underground moisture has the same effect as surface moisture in preventing degradation of amplitude.

The general result of these investigations, compared with practical experience, is to show that we can by no means consider the earth to be a perfect conductor in the case of radio-telegraphy, but that it has an extremely influential action in degrading the amplitude of the waves deforming the travelling electrostatic field, and in creating a type of surface wave which

[10] See P. Epstein, "Kraftliniendiagramme für die Ausbreitung der Wellen in der drahtlosen Telegraphie bei Berücksichtigung der Bodenbeschaffenheit." *Jahrbuch der Drahtlosen Telegraphie*, vol. iv., p. 176, 1910. Epstein has, however, only delineated the field in the air. He ought to have indicated the nature of the field just below the surface in the sea or earth, as well as to show the refraction of the lines of force at the surface.

[11] J. Zenneck, "Ueber die Fortpflanzung ebener elektromagnetische Wellen langs ebenen Leiterflache und ihre Beziehung zur drahtlosen Telegraphie." *Ann. der Physik*, vol. xxiii., p. 846, 1907. This paper was freely translated, with expository notes by J. A. Fleming, entitled "The Function of the Earth in Radio-telegraphy." See *Engineering*, June 4 and 11, 1909.

attenuates much less fast than a pure Hertzian wave and can travel round the curvature of the earth quite easily.

On the whole, we may say that the theory, as given by Zenneck and Sommerfeld, is a valuable attempt to bridge over the very serious gap in our knowledge of the reasons for certain well-ascertained facts in radio-telegraphy. Nevertheless, there are still unexplained difficulties.

Another unsolved problem in radio-telegraphy is the explanation of the effects of the atmospheric conditions and daylight upon it.

The suggested explanations are in many respects imperfect. In the earliest days of radio-telegraphy it was found that atmospheric electric discharges produced irregular and false signals, which sometimes greatly interfered with working. These were more objectionable at the time when the receiving instrument was a coherer of some kind associated with the Morse printer. Nowadays, when the reception is by telephone, it is usual to have the spark frequency at the sender high enough to give a shrill note in the telephone. The receiving operator can then distinguish, to a great extent, between the clear musical note of the right signals and the lower squeaks or grunts in the telephone due to atmospheric discharges. Nevertheless, at certain times and in certain regions the so-called atmospherics present serious obstacles to radio-telegraphic communication.

When we turn to the effect of sunlight on the propagation of radio-telegraphic waves, which was discovered and described by Mr. Marconi in 1902, we find that even after ten years we are still, intellectually speaking, very much in the dark as to the reason for this daylight effect.

The first observation made by him in 1902 was that by night signals could be received over sea from the Poldhu station at a distance of 2099 miles, whereas by day the same kind and type of signal ceased to be detectable at about 700 miles; also that at the time when the sun rose over the sending station the signals at 700 miles' distance quite quickly became very weak.[12]

Of recent years he has noticed that in the morning or evening, when the boundary between light and darkness occurs, about half-way across the Atlantic signals sent across become weak.

Also he has noticed that in sending with a coupled transmitter radiating waves of two wave lengths, whereas the longer wave length is the one generally received, there are certain periods at sunrise and sunset when the shorter wave gives the best signals.

It has also been pointed out, both by Mr. Marconi and G. W. Pickard, that soon after the time of sunrise at the sending station there is a very pronounced decrease in the strength of the signals received a few hundred miles', or at some considerable distance from a power station, but that after sunrise there is a partial recovery of strength. There is also a gradual rise in the strength of the signals soon after sunset, and a very pronounced maximum value after or about midnight. An interesting curve has been given by Prof. Pierce in his book on "Wireless Telegraphy," p. 135, taken from Pickard's observations showing the general variation of the strength of received signals at a distance of 600 miles from the Marconi station at Glace Bay during the hours of the day and night. It appears that the current in the receiving telephone at midnight was about thirty times greater than by day. Confirmatory observations have been published by the Telefunken Co.

[12] See G. Marconi, Proc. Roy. Soc. Lond., June 12, 1902. A note on the effect of daylight upon the propagation of electromagnetic influences over long distances.

Two theories have, so far, been proposed to explain this effect:—

1. The original suggestion of Mr. Marconi (which has been tentatively adopted by Prof. Zenneck) was that it is due to the effect of light in discharging the sending antenna, so that it does not reach at each oscillation such a high potential by day as in darkness.

2. The theory that the daylight effect is due to the ionisation of the air by sunlight giving it increased conductivity, and so producing absorption of the electric waves.

Neither of these theories seems to meet all the facts. If the daylight effect were an action of light on the sending antenna alone, it should be produced independently of the distance of the receiving station, whereas it is essentially a cumulative or long-distance effect.

Again, so far as measurements of the electric conductivity of air have been made, they do not give support to the theory that the daylight effect is due to air conductivity produced by ionisation, because measurements of this conductivity show it to be too small to account for the observed wave attenuation.

Prof. G. W. Pierce has made calculations which show that the air conductivity would have to be 100,000 times greater than it actually is to account for even a part of the observed effect at 3000 km. distance.

Prof. Zenneck also agrees that atmospheric conductivity by ionisation cannot account for the phenomena.

Let us, in the first place, consider theoretically the propagation of an electromagnetic wave through a medium possessing dielectric constant (K) and conductivity (σ).

It is quite easy to obtain an expression for the absorption coefficient of such a medium. Starting from the Maxwellian equations as above, we have the quantity denoted by k on a previous page defined by the equation—

$$k^2 = \frac{\mu K p^2 + j 4\pi\mu\sigma p}{c^2},$$

since k is a complex, it can be represented by $k = \alpha + j\beta$.

Hence we have—

$$\beta^2 = -\frac{\mu K p^2}{2c^2} \pm \sqrt{\frac{16\pi^2\sigma^2\mu^2 p^2}{4c^4} + \frac{\mu^2 K^2 p^4}{4c^4}},$$

and if $\frac{\sigma}{pK}$ is a small quantity, as it is when the conductivity is small and the frequency $p/2\pi$ is large, we have then—

$$\beta = \frac{2\pi\sigma}{c\sqrt{K}}.$$

If we consider a plane wave the amplitude of which varies as $\epsilon^{j(kx-pt)}$, it attenuates in amplitude to $1/\epsilon$ of its initial value in travelling a distance—

$$\frac{1}{\beta} = \frac{c\sqrt{K}}{2\pi\sigma}.$$

If ρ is the resistivity in ohms per c.c., then $\rho = (9 \times 10^{11})\sigma$, and we have—

$$\frac{1}{\beta} = \frac{\rho\sqrt{K}}{60\pi}.$$

We can therefore determine at once the absorption effect of any conducting dielectric of which the resistivity in ohms per c.c. and the dielectric constant are known. Thus, supposing the dielectric constant is 9, and the resistivity 500 megohms per centimetre cube, the value of $1/\beta$ would be nearly 80 km., or fifty miles. This is, then, the distance in which the

wave amplitude would be reduced to about one-third of that at the origin. It is clear, therefore, that to propagate waves for any considerable distance through the earth's crust the specific resistance would have to be as high as 1000 megohms per c.c. Also it is evident that unless the resistivity of the air as produced by ionisation is less, say, than 20,000 megohms per c.c., or considerably less than 10^{20} electromagnetic units, the ionisation cannot be the cause of the daylight absorption.

I believe no one has observed so low a resistivity for air near the earth's surface, or even a thousand feet up, as 10^{19} C.G.S. electromagnetic units per c.c. The point, however, requires further investigation.

On certain assumptions this atmospheric resistivity can be determined by elevating a captive balloon to the required level by a wire, and measuring the potential of the balloon when the wire is insulated, and also the current flowing through the wire when the wire is earthed. The ratio of the current in amperes to the potential in volts gives us the total conductivity S of the air. If C is the electrical capacity of the balloon, and if σ is the conductivity of the air, then it can easily be shown that $S=4\pi C\sigma$ (see J. A. Fleming, "Principles of Electric Wave Telegraphy and Telephony," second edition, p. 725). Accordingly $\rho=4\pi C/S=4\pi CI/V$, where I is the total electric current flowing along the wire to the earth, and V is the potential of the balloon.

Some useful measurements of this kind made by Messrs. A. J. Makower, W. Makower, W. M. Gregory, and H. Robinson, in 1910 ("An Investigation of the Electrical State of the Upper Atmosphere made at Ditcham," see Quarterly Journal of the Roval Meteorological Society, vol. xxxvii., October, 1911) showed that the total resistance from a certain kite at a height of 1400 ft. on a certain day was 1000 megohms. Assuming a kite capacity of 100 electrostatic units, this corresponds to a resistivity of the air equal to $12{\cdot}5\times10^{11}$ ohms, which seems rather small. A plane electric wave would, however, have to travel nearly 60,000 km. in the air to have its amplitude reduced to 1/E. Hence even this conductivity is not enough to account for the observed attenuation by daylight of long radio-telegraphic waves.

Unless, therefore, there is very much greater atmospheric conductivity than one billionth of a mho (1 bimho) per c.c. at or about 1000 ft. or so above the earth's surface, it does not appear as if air conductivity caused by ionisation due to ultra-violet light could account for the diminished amplitude of radio-telegraphic waves during daytime.

The careful measurements of the air conductivity at various heights, and at various hours of the day and night over sea and land, would give us valuable data for further testing this matter.

Sommerfeld suggests that the daylight reduction is due to the increase in the value of the coefficient k for the air by the production of conduction due to ionisation. The effect of this is to increase the value of the "numerical distance," and therefore to reduce the intensity both of the surface and the space waves. He supports this view by an observation made by Ebert, who states that he measured the conductivity of the air in brightest sunshine at a height of 2500 m. during a balloon ascent and found it to be twenty-three times greater than at the ground level.[13]

It is possible that some part of the effect may be due to actions taking place quite close to the sending antenna. This view may be supported by the interesting observations made during the nearly total solar eclipse on April 17 last, on the effect of the temporary diminution of daylight on the strength of radio-telegraphic signals.

Whilst visiting the Eiffel Tower station at Paris, Commander Ferrié, who is in charge of this station, informed me a slight increase in the strength of the signals at distant receiving stations had been noticed at the time of greatest observation of the sun at Paris.

Also in Denmark, Mr. H. Schledermann stated in a letter to *The Electrician* that observations made between the Royal Dockyard station in Copenhagen and the Blaavands Huk Lighthouse on the North Sea, at 300 km. distance, showed that during totality the signal strength was increased.

Also in England, Dr. Eccles noted an increase in the strength of atmospheric strays and signals from Clifden observed in London during greatest obscuration. These observations show that even a partial diminution of the sun's light is sufficient to increase the strength of radio-telegraphic signals, possibly by an action on the air between the stations, and especially on that near the transmitting station.

I suggest that it would be well worth while to erect temporary transmitting stations on and off the line of totality during the future total solar eclipses, for the purpose of observing the effect on radio-telegraphic signals sent out from them to other receiving stations.

Another possible explanation of this daylight diminution has, however, occurred to me which I should like to submit to you. It is well-known that sound is better heard when the wind is blowing from the source to the observer than when it blows in the opposite direction. It is also known that there are curious vagaries in sound transmission whereby loud sounds are heard sometimes better at great than at short distances. These effects were explained by Sir George Stokes as due to the fact that the velocity of sound is greater when moving with the wind than against the wind. Now, owing to friction and other causes, the velocity of the wind is generally greater at a height above the earth's surface than at the ground level. Hence, if a sound wave is travelling outwards from a centre against the wind, the upper parts move more slowly than the lower parts of the wave front, and hence the ray direction is tilted up and the sound passes over the observer's head.

The suggestion I venture to make is that when the upper layers of the air are ionised, the ions act as condensation nuclei for water vapour, and the presence of these numerous water spherules gives the upper air a larger dielectric constant.[14] Therefore an electric wave moves more slowly in it than in non-ionised air. Hence, if a plane wave is moving parallel to the earth's surface and the upper layers of air are ionised by light, the greater velocity of the wave front at the lower levels causes it to slope backwards and the direction of the ray is elevated, so that it may pass over above the receiving antenna and not affect it.

Accordingly, if in the upper region of the air the ionisation of the air by ultra-violet light increases the dielectric constant so as to retard slightly the wave velocity, the wave front would be tilted backwards and at long distances the waves might pass so far above the receiving antenna as to weaken very greatly the signals.

This tilting up of the ray will occur when the ionisation of the upper air has taken place over a part of the interval between the stations. It will be most pronounced when the greatest difference exists between the dielectric constant at the earth level and that at the level a few miles up in the air. At very large distances, say 2000 miles, an extremely small

[13] See *Ann. der Phys.*, vol. v., p. 724, 1901.

[14] See Sir J. J. Thomson, "Conduction in Gases," p. 217, who says that air exposed to ultra-violet light may be regarded as full of extremely minute drops of water.

difference in the dielectric constant of the air at low and at high levels would be sufficient to give the wave front a sufficient tilt to make the waves pass far above a receiving antenna 200 ft. high, and so weaken immensely the received signals because the effect is cumulative, and noticeable therefore only at very great distances. As an experimental contribution to the subject I have made some preliminary observations on the dielectric constant of air filled more or less with damp steam or warm mist. A tubular condenser was constructed of such kind that steam from a small boiler could be blown between the tubes, and the tubes were so supported that the condensation of the steam could cause no loss of insulation. The electrical capacity of this condenser was determined carefully by the Fleming and Dyke capacity bridge, using a telephone as a detector, and alternating currents having a frequency of 2760.[15] Employing all necessary precautions, and comparing the dielectric constant taken as unity of air nearly saturated with water vapour, with air having water globules or damp steam in it, we found that the dielectric constant of air filled with water spherules varied from 1·026 to 1·004, according to the amount of damp steam present in the space. In other words, an electric wave would travel more slowly in the steam-impregnated air than in the ordinary saturated air in the ratio of 980 to 1000, or 998 to 1000, or anything between these limits.

If, then, we consider a plane electromagnetic wave travelling with plane vertical and its lower end in ordinary air and its upper end in air containing minute water spherules, the upper end would travel more slowly than the lower, and the wave front would acquire a backward tilt sufficient, in a distance of a few hundred miles, to carry the wave right above an ordinary receiving antenna. If the ionisation of the upper air by ultra-violet light results in the production of condensation nuclei, which condense water vapour round them, then it is highly probable that the upper levels of the air have a slightly greater dielectric constant than the lower, and a difference of even a very small fraction of 1 per cent. will be cumulative in its action on the wave in giving the wave front a backward tilt in travelling over long distances.

Mr. Marconi states that over the Atlantic he has found the maximum daylight effect to occur when the shadow boundary was about half-way across the Atlantic, the sending station being in daylight and the receiving station in darkness. I think the well-known "sunrise nick" in the signal intensity curve is due to the fact that the effect is at a maximum when the greatest difference exists between the state of the upper air as regards ionisation and that near the earth. Later in the day convection currents arise to churn up the air and bring it more into a homogeneous condition, which, whatever may be the state of ionisation, is unproductive of any tilt in the wave front.

It has been frequently suggested that an explanation of long-distance radio-telegraphy may be found in the reflection of the electromagnetic waves at the under surface of a layer of ionised air in the upper atmosphere. No proof, however, has been given that this hypothetical layer of ionised air has a sufficiently defined surface to cause wave reflection. Hence, it is improbable that anything like copious reflection of long electromagnetic waves could take place at the under surface of a layer of ionised air producing an inverted mirage effect. This point, however, is one open for discussion. It is true that refraction may produce a change of ray direction which simulates reflection, as in the case of the phenomenon of the mirage. In this case the intense heat of the earth expands the layer of air next to it, and lowers its refractive index. Hence, the lower end of a plane wave of obliquely incident light travels faster than the upper end, and may do so to an extent sufficient to swing the ray right round, as if it were reflected from the layer of heated air. For a similar effect to occur with radio-telegraphic waves, it would be necessary for the upper end of the wave front to travel much *faster* than the lower end. In other words, the upper end must be in a region of less dielectric constant than the lower end.

Since the above remarks were put in type, a valuable paper has been published by Dr. Eccles (see Proceedings Roy. Soc., vol. lxxxvii. A, p. 79, 1912, on the diurnal variations of electric waves occurring in nature, and on the propagation of electric waves round the bend of the earth), in which a theory is developed of electric wave propagation in ionised air. He gives a mathematical proof that under certain assumptions as to the mass of these ions the wave velocity would be increased as compared with that in un-ionised air, and hence that a plane vertical wave front travelling with lower end near the earth and upper end in air more or less ionised by sunlight would be caused to lean forward by the increased velocity of its upper end. Hence he proves that, according to wave length and circumstances, the wave may be better able to follow round the earth's curvature, or may be prevented from doing it.

On this basis he has developed a theory of long-distance radio-telegraphy and of the inhibition of daylight upon it. The chief criticism to which I think his theory is open is that he assumes that the dielectric constant of the air is unaffected by the ionisation or condensation of water vapour on these ions. This is not absolutely certain. We know that in the case of solutions in a state of ionisation, such as dilute solutions of metallic hydrates in water, the dielectric constant of the solvent is considerably increased. As a rule, anything which increases conductivity in a dielectric increases also the dielectric coefficient. Hence ionisation may do so in the case of air. If the dielectric constant (K) is increased by ionisation, then in the expression given by Dr. Eccles for the wave velocity that velocity may be more reduced by this increase in K than it is increased by the presence of the ions.

It would seem, therefore, most necessary to settle by experiment whether the wave velocity is increased or diminished by the presence of the ions due to ultra-violet light before we can base a theory upon the constancy of the dielectric coefficient.

There is no doubt, however, that the earth's atmosphere contains something which acts at times towards radio-telegraphic waves like a fog or mist towards light waves.[16]

There are also occasions of unusual transparency when waves of 300 or 600 metres in length seem to travel round the world in an extraordinary manner. Ships provided with the ordinary ship transmitters and receivers occasionally pick up signals sent 1000 miles away. This is not due to special operative skill but to a temporary transparency of the atmosphere to radio-telegraphic waves.

The next question to which I should like to direct attention is to the present state of the theory of directive antennæ. I need not go very fully into the early history. Mr. Marconi pointed out in 1906 the special qualities of an antenna consisting of a long wire arranged so that part is vertical, but the greater

[15] For a description of this bridge and method of using it, see the paper by J. A. Fleming and G. B. Dyke, on the power factor and conductivity of dielectrics for alternating electric currents of telephonic frequency and at various temperatures, Journ. Inst. Elec. Engineers, 1912.

[16] Interesting observations have been made on this matter by Admiral Sir Henry Jackson, F.R.S. See Proc. Roy. Soc., Lond., vol. lxx, p. 254, 1902.

part horizontal, and that radiation takes place most energetically in the opposite direction to which the free end of the horizontal wire points.[17] Also by the law of exchanges a bent antenna which radiates unequally absorbs unequally in different azimuths. The question is as to the explanation of the action of this bent antenna.

In 1906, starting from a suggestion by Sir Joseph Larmor, I gave a theory based on the view that the bent antenna is equivalent to a combination of an open and closed circuit and assumed the earth to be a perfect conductor. The objection has been raised to this theory that it implies that the directivity should fall off with distance.

Experiments have not yet been made, so far as I am aware, on a sufficiently large scale and at sufficiently great distances to settle this point, and the experimental problem is undoubtedly complicated by the effect of the nature of the soil surface over which the waves travel in different dielectrics or regions. Nevertheless, Mr. Marconi's experiments show that the directivity persists for several hundred miles. Recently the problem has been discussed by H. von Hoerschelmann in the *Jahrbuch der Drahtlosen Telegraphie* (see vol. v., p. 15, 1901). According to his theory, the effect of a bent antenna is entirely due to vertical electric currents which are produced in the earth just under the horizontal part of the bent antenna. Hence the directivity depends on the conductivity of that region of the earth.

Starting from the same system of equations as Sommerfeld, he obtains expressions for the vector potential or Hertzian function which show that the function which determines the vertical field in the earth and in the air is dependent on the azimuthal angle, in such manner that there is no directivity if the earth is a perfect conductor, but that if the earth has a finite conductivity under the antenna then an unsymmetrical radiation takes place and the directivity, once created, persists even though the waves travel out later on over a good conducting surface. The mathematical work in Hoerschelmann's paper needs careful consideration by pure mathematicians to test whether the transformations of the Besselian functions he employs are valid and his analysis correct. He points out that as a consequence of his theory a bent antenna situated over a sea surface should not have the same degree of directivity as one situated over a poor conducting soil. These conclusions could easily be checked experimentally.

The general result of all the theoretical investigations of Zenneck, Sommerfeld, and Hoerschelmann is to show that the function of the earth in radio-telegraphy is by no means confined merely to guiding a space wave, but that it fulfils a most important function in assisting to create surface waves and in permitting earth currents which have directive effect. Recent experiments with antennæ laid on the ground or under the ground by Dr. Kiebitz have directed attention afresh to the matter, although many of Kiebitz's results seem only a repetition of those obtained by Marconi in 1906 with antennæ laid on the ground or a little above it.[18]

Kiebitz used as receiving antennæ wires carried on insulators placed in ditches about one metre deep. The ends of the wires were earthed through condensers. The receiving appliance was at the centre. By such antennæ properly oriented he found he could receive signals from all the principal radio-telegraphic stations in England, France, and America.

There is no need to assume that these received waves are propagated through the deep strata of the earth. The effects are exactly what might be expected from waves travelling over the surface.

The chief interest of Kiebitz's experiments lies in the confirmatory proof they give that an elevated antenna is not necessary for *reception*. On the other hand, for long-distance *transmission* an elevated aërial wire or one raised above the earth is requisite.

The chief problem yet to be faced in connection with sending antennæ is to find a form of antenna which will radiate a large power, say, 100 to 500 kw., at a relatively low frequency or long wave length consistently with high antenna efficiency.

There is room for an immense amount of research yet on improved forms of antenna. When we consider that the function of a sending antenna is something like that of a gas mantle or gas-fire radiator, viz. to transform into radiation of desired wave length as large a fraction as possible of the supplied energy, and remember what has been done in the corresponding luminous problem, it is easy to see that countless questions of great practical value in connection with antennæ for radio-telegraphy remain unsolved.

The ingenious methods of directive telegraphy due to Bellini and Tosi deserve mention, and suggest that, in the case of wireless plant erected on ships means for instantly locating the direction of the arriving waves is a matter of the greatest importance. Although the practical problem is to some extent solved, there is room for further invention in connection with it.

We can scarcely leave this discussion without some mention of the state and prospects of wireless telephony.

The essential condition of success in transmitting speech is the possession of means for creating undamped oscillations or alternating currents a frequency not less than 20,000. When the Poulsen arc generator was first introduced it was hailed as a solution of the problem, but practical experience has shown that whilst experimental feats can be performed with it, it has not the simplicity and ease of manipulation required for commercial work. The modification recently introduced by Mr. E. L. Chaffee, consisting of a copper-aluminium arc in damp hydrogen, the arc being formed between two closely adjacent plane surfaces, appears to be an improvement. The practical solution seems, however, to be in the perfection of some simple, easily managed form of high-frequency alternator. The ingenious inventions of Goldschmidt in utilising the properties of the polyphase motor to increase frequency have been developed by the Lorentz Company of Berlin, and seem likely to result in the production of a practical form of extra-high-frequency alternator suitable for radio-telegraphy and radio-telephony in a practical high-frequency machine.

In addition to the generator, inventors have wrestled with the difficulties of making a microphone transmitter which shall be able to carry a large current without heating. To conduct wireless telephony over any distance we have to modulate in accordance with the wave form of the speaking voice a very large antenna current. The problem has to some extent received solution in the liquid microphone of Majorana, the relay microphone of Dubilier, and a recently invented heavy-current microphone of Rühmer.

We seem to be, however, on the track of mechanical means for generating undamped oscillations and microphonic means for modulating them, and wireless telephony is therefore even now a practical matter

17 See G. Marconi on methods whereby the radiation of electric waves may be mainly confined to certain directions, etc., Proc. Roy. Soc. Lond., vol. lxxvii., p. 413, 1906.

18 See Dr. F. Kiebitz's "Recent Experiments on Directive Wireless Telegraphy with Earthed Antennæ." *The Electrician*, March 8, 1912, vol. lxviii., p. 868.

for a few hundred miles of distance. It is quite within possibility it may yet be conducted across the Atlantic.

As regards other inventions, we are still in want of more simple means for recording telegraphic messages. Since the coherer fell out of use the reception is mostly conducted by ear. Somewhat elaborate photographic methods, suitable for large land stations which employ the Einthoven string galvanometer, have been introduced, but what is still required is a means of calling up the operator and of recording the message on board ship which is at least as sensitive as the telephone plus the human ear, for ordinary shipboard communication.

The receiver current is, however, very small, and available power is at most a few microwatts in the form of a current of a few microamperes.

There are, therefore, innumerable practical and scientific problems in connection with radio-telegraphy which await solution. These require mathematical, physical, and radio-telegraphic knowledge of a high order to overcome them.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. F. R. MILLER has been appointed lecturer in physiology in McGill University, Montreal.

THE bequests provided by the will of the late Mr. Thomas Bartlett, of Liverpool, include one of 20,000*l.* to the University of Liverpool for the purpose of establishing scholarships of the value of 40*l.* per annum for engineering students.

AT its meeting on October 28, a letter was read by M. Liard to the council of the University of Paris from Mr. Andrew Carnegie, offering to the University the last 4000*l.* necessary for equipping the new Institute of Chemistry, in course of erection in the Rue Pierre Curie, Paris.

THE Royal Agricultural College, Cirencester, having been recognised as the centre for advisory work in forestry in the counties of Cornwall, Devon, Somerset, Gloucestershire, Wiltshire, Monmouthshire, Herefordshire, and Worcestershire, Prof. H. A. Pritchard has been appointed technical adviser, and Mr. A. D. Hopkinson lecturer in forestry and forest mycology. The vacancy caused by the promotion of Prof. R. G. Stapledon to the post of research botanist at University College, Aberystwyth, has been filled by the appointment of Mr. C. B. Saunders (London), who has for some years been lecturer in biology at Holmes Chapel Agricultural College.

PROF. A. KULIABKO, of the University of Tomsk, Siberia, informs *The Times* of the inauguration at Tomsk, on October 20, of an institution, founded by the munificence of Peter Makoushin, which aims at the instruction on a large scale of the people of Siberia. The institution in question is called the House of Science, and is meant to be a popular university, where anyone may obtain instruction, from the elementary to the secondary standard, free of charge. It includes also a section for instruction of the kind usually given at universities. The institution will give hospitality to the conferences of teachers in elementary schools; it will contain a library to be used free of charge; special evening classes will be held; while the dissemination of knowledge of sanitation and hygiene will have a leading place in the programme. A museum of practical knowledge and many other means of instruction will render the Tomsk House of Science a boon to Siberia.

THE calendar of the University of Sheffield for the session 1912–13 provides another striking example of the efforts being made by the authorities of modern universities to keep in close touch with the educational needs of the industrial centres in which they are located. At Sheffield, for instance, in addition to the comprehensive faculty of pure science, there is a faculty of applied science, in which, under suitably arranged conditions, the degrees of bachelor, master, and doctor of engineering, or bachelor, master, and doctor of metallurgy, can be secured. Students who for various reasons do not graduate in the faculty of applied science may, by attendance at day or evening classes, on complying with the regulations, secure an associateship in engineering or in iron and steel metallurgy. In mining and architecture, too, diploma courses have been arranged. It is interesting to note that arrangement has been made with the Imperial College of Science and Technology by which the University of Sheffield is recognised as being in association with the Imperial College for such of their students as may desire to specialise in the study of the metallurgy of iron and steel for the associateship of the Royal School of Mines. To meet the special needs of women a two-years' course of work in the University and the Sheffield Training College of Domestic Science has been inaugurated, and a diploma in domestic science is awarded to successful students at the end of the course. While the applied subjects are encouraged so successfully, the other departments of university work are in no way neglected, and the faculties of arts, medicine, law, and so on, are equally complete.

THE council of King's College, London, has received from the Rev. A. C. Headlam the intimation of his intention to resign the office of principal and dean of the college at the end of the present year. In the House of Commons on Monday, Sir E. Cornwall asked the President of the Board of Education whether his attention had been directed to the letter from the Rev. A. C. Headlam to the Bishop of London, dated October 11, in which Dr. Headlam alleged, as one of the reasons for his resignation, peremptory and arbitrary action on the part of the Board in requiring the removal of the college to another site; and whether he would state on what ground the Board had made such requirement without first consulting either the college or the Senate of the University on the subject. In reply, Mr. J. A. Pease said:—"I have seen the letter referred to. The Board have expressed their concurrence with the opinion of the Advisory Committee on University Grants that the present site of King's College does not admit of such extension as will enable the college to take its proper place in the University. The Board have indicated their readiness to receive a deputation from the Senate of the University of London upon the question of site, but apart from this they have taken no action in the matter, and they have made no requirement. There is no foundation whatever for the charges of discourtesy and peremptory and arbitrary action contained in the letter referred to. The Board and their Advisory Committee have no intention of interfering with the conditions of freedom and independence which are necessary to enable a university to perform its proper functions."

THE Government of India recently decided, we learn from *The Pioneer Mail*, that the time had come to endeavour to connect Indian educational institutions more closely with business firms, railways, and other employers of labour, to inquire how the former can better meet the requirements of the latter, and to point out the way to further employment of Indians in them. For this inquiry Colonel Atkinson and Mr. Dawson were selected as having special practical experience. They have completed their investigations and issued a report. The great need which the report

emphasises is that education should be made more practical, not only in technical institutes, but also in primary and secondary schools. Among special recommendations made in the report, the following may be noted:—(1) That the present system under which State technical scholarships are granted to Indians for education in technical institutions in England and elsewhere should be discontinued. That suitable stipends should be granted to Indians who have completed successfully their theoretical and practical education in India to enable them to be apprenticed for practical experience with firms of repute in England. (2) That minor technical institutes should be placed under the control of one central institution in each province. (3) That the education of skilled workmen should only be carried up to vernacular reading, sufficient elementary arithmetic for accounts and sufficient knowledge of drawing to understand a dimensioned sketch. (4) That the most promising method of training skilled workmen is to establish manual training schools for children in big centres and near big workshops; the boys to be apprenticed in workshops from the ages of twelve to fourteen years. During the apprenticeship they are to be obliged to attend afternoon classes to complete their literary education, and finally to obtain some theoretical knowledge of their work.

SOCIETIES AND ACADEMIES.

LONDON.

Institution of Mining and Metallurgy, October 17.—Mr. Edward Hooper, president, in the chair.—J. W. **Ashcroft**: The flotation process, as applied to the concentration of copper ore at the Kyloe Copper Mine, New South Wales. As a consequence of the oxidised ore at this mine being practically exhausted, the original method of treatment was found to be inadequate, and the present management introduced an experimental flotation process with the view of obtaining a better recovery and higher grade concentrate. As first planned, the plant for this flotation process was divided into a grinding section and a flotation section, and the paper deals at length with the defects which manifested themselves in the first experimental stages, and with the rearrangements dictated by experience. The chief defects were the excessive amount of oversize in the feed of the stirring boxes, the excessive dilution of the pulp, the irregularity of the overflow from the flotation chambers due to the irregularity of the feed and of the speed of the impellers, and a want of proper means to control the supply of oil. To remedy these, the grinding pans were altered to the positive feed type, and were arranged to discharge on to revolving screens, so as to keep the feed to the flotation machine more even in size; the pulp thickener was moved and placed between the screens and the flotation machine so as to keep an even feed to the stirring boxes and to regulate its density; the flotation machine was controlled by a sensitive governor to keep the speed of the stirrers constant, and an apparatus was devised to secure an even flow of oil. The results of this reorganisation proved satisfactory, and this paper gives interesting details of costs of operation, &c., and some observations on the successful working of the process.

Physical Society, October 25.—Prof. C. H. Lees, F.R.S., vice-president, in the chair.—Prof. H. **Nagaoka** and T. **Takamine**: The constitution of mercury lines examined by an echelon grating and a Lummer-Gehrcke plate. The authors have photographed the principal lines of mercury, using an echelon spectroscope crossed by a Lummer-Gehrcke plate. They find that the 5790 line consists of eight, the 5769 line of four, the 5461 line of nine, the 4359 of eleven, the 4078 of six, and the 4047 of seven components, the positions of which in general agree with those found by recent observers. They point out a simple relation between the distances of the components from the principal line in each case, and a further relation between the quotient of each of these distances by the wave-length of the principal line, which holds for all the lines.—Prof. H. **Nagaoka**: Note on the mutual inductance of two coaxial circular currents. Methods are given for the rapid calculation of the mutual inductance of two coaxial circular currents. Maxwell's first formula is converted into theta-functions, and then expanded in a Jacobian q series. The logarithmic values of this series for various values of q have been tabulated in a previous paper by the author. When the circles are near one another a series for M is given in terms of q_1, where q_1 is the complement of q. In this paper the author treats Maxwell's second formula in a similar way. A table of the values of these series found, computed to six decimal figures by T. Tishima, is given.—S. E. **Hill**: The absorption of gases in vacuum tubes. This paper is an account of experiments carried out to determine whether the absorption of gases caused by passing a discharge for some time through vacuum tubes is the result of a chemical action or is a mere physical absorption. In order to eliminate all electrode complications, the electrodeless discharge was used throughout. The bulbs examined were of soda, lead, Bohemia and Jena glass. The absorptions were noted at different pressures and curves plotted. Continued passage of a discharge causes a "saturation" effect in all the glasses. After two months none of the bulbs had recovered any of their absorptive power. That chemical actions are present is shown by peculiar deposits on the necks of the bulbs, these being unfortunately too small for analysis. The conclusion arrived at is that the disappearance is not due to physical absorption, but to definite chemical action.

MANCHESTER.

Literary and Philosophical Society, October 15.—Mr. Francis Jones, vice-president, in the chair.—A. **Adamson**: An apparatus which can be used for the exact trisection of an angle.—D. M. S. **Watson**: The larger Coal Measure amphibia. The author described the skulls of *Loxomma Allmani* and *Anthracosaurus Russelli* (Pteroplax), now preserved in Newcastle-on-Tyne Museum. The skulls had been previously described by Embleton and Atthey, but the important structure of the palate had not been made out. This was described in detail, and compared with that of other Carboniferous amphibia. It was shown that a solid, bony palate, with an articular connection between the large pterygoids and the basisphenoid, was characteristic of the group. The palatines and prevomers bear large teeth with a characteristic mode of replacement. The pre-maxillæ and maxillæ are confined to the margin of the palate, and bear smaller teeth. The large vacuities of the later Stegocephalia are absent. The skulls present remarkable resemblance to those of Seymouria and also of the Crossopterygian fishes. The relations of the quadrate were clearly determined, and seemed to indicate that the tetrapod skull was not autostylic in the ordinary sense.

PARIS.

Academy of Sciences, October 28.—M. Lippmann in the chair.—E. **Jungfleisch**: Inactive and racemic dilactylic acids. The crude acid arising from the interaction of sodium ethyl lactate and ethyl α-chloropropionate is neutralised with magnesium hydroxide. The inactive magnesium salt, being much less soluble in hot or cold water than the racemic form, separates first. The crystallographic properties of these salts and of the corresponding acids are described.—Édouard

Heckel: Cultural bud mutation of *Solanum immite*. The mutation of the tubercles was obtained after only one year's culture.—A. **Schaumasse**: The provisional elements of the comet 1912*b*.—G. **Fayet**: Probable identity of the new comet 1912*b* with the Tuttle periodic comet. By its approach to Jupiter the Tuttle comet would appear to have undergone perturbation which would account for its advance by eighty-six days.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the first quarter of 1912. Observations were possible on sixty days, and the results are summarised in three tables, showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—M. **Borrelly**: Observations of the Gale comet (1912*a*) made with the comet-finder at the Marseilles Observatory.—A. **Petot**: Certain conjugate systems.—Maurice **Gevrey**: Remarks on certain theorems of existence. A discussion of a class of functions previously considered by Holmgren.—Georges **Rémoundos**: The theorem of Picard and multiform functions.—A. **Guillet** and M. **Aubert**: An electrometric spark-gap consisting of two conducting spheres. Calculation of the charges, the potentials, the mutual action, and the disruption.—Ch. **Féry**: The principle of a new method of measuring the velocity of light. An application of the rotating mirror method, in which an electrically-controlled tuning-fork measures the angular velocity of the mirror.—A. **Boutaric** and C. **Leenhardt**: Cryoscopy in decahydrated sodium sulphate. Measurements of the molecular lowering of the freezing point with urea as the solute gave 32·05 as the value of the Van't Hoff constant; the figure 32·08 was obtained by the application of the usual formula to the latent heat of transformation of sodium sulphate.—Paul **Job** and Marcel **Boll**: The photochemical hydrolysis of very dilute solutions of chloroplatinic acids.—M. **Hanriot**: The tempering of metals. The author extends the meaning of a tempered metal to any metal which, after sufficient annealing, changes its physical properties, chemical changes being excluded.—Daniel **Berthelot** and Henri **Gaudechon**: The different modes of photochemical decomposition of glucose and galactose according to the wave-length of the radiations. A comparative study of the quantity and nature of the gases evolved from glucose and galactose in solution under the influence of ultra-violet light of three different wave-lengths.—H. **Baubigny**: Study of the double sulphites of mercury and the alkalis. The decomposition of solutions of the double sulphite of mercury and sodium differs from that of the corresponding salts of silver and copper in that no trace of dithionic acid is produced.—Maurice **Lanfry**: The action of hydrogen peroxide upon dithienyl-thiophene.—A. **Guyot** and A. **Kovache**: The action of formic acid upon the triarylcarbinols. All triarycarbinols, heated with a mixture of formic acid and a little dry sodium formate, are quantitatively reduced to the corresponding hydrocarbon, the amount of carbon dioxide produced being an exact measure of the reduction. The generality of the reaction is shown.—André **Meyer**: Some new derivatives of phenylisoxazolone.—Marie **Korsakoff**: Researches on the methods for the estimation of saponines.—Leclerc du **Sablon**: The influence of light on the transpiration of green leaves and of leaves without chlorophyll.—M. **Ringelmann**: Calculation of the yield of small water channels in irrigation.—R. **Fosse**: Researches on urea. Urea is frequently present in the higher plants, although in very small proportions. It cannot be considered as proved that the urea is a physiological product of the plant cell.—Victor **Henri**, André **Helbronner**, and Max de **Recklinghausen**: A new, very powerful lamp for the production of ultra-violet light and its utilisation for the sterilisation of large quantities of water. The U-shaped lamp can be used on a 500-volt circuit, and requires 1150 watts, giving a candle-power of about 8000.—Em. **Bourquelot** and M. **Bridel**: Syntheses of glucosides of alcohols with the aid of emulsin. β-*iso*Propylglucoside and β-*iso*amylglucoside.—M. **Tiffeneau** and H. **Bosquet**: The rôle of caffeine in the diuretic action of coffee. Coffee loses the greater part of its effects on the renal secretions if the caffeine has been removed. Caffeine is the principal, if not the exclusive, agent of the diuretic action of coffee.—Robert **Odier**: Sensitised streptococcus and sarcoma.—B. **Sauton**: The mineral nutrition of the tubercle bacillus.—Max **Kollmann**: Some points on the anatomy of the male genital organs of Lemurs.

BOOKS RECEIVED.

Homo Sapiens. By Dr. V. G. Ruggeri. Pp. viii+198. (Vienna and Leipzig: A. Hartleben.) 5 marks.

Medizinisch-chemisches Laboratoriums-Hilfsbuch. By Dr. L. Pincussohn. Pp. xi+443. (Leipzig: F. C. W. Vogel.) 13.50 marks.

New South Wales Department of Mines. Geological Survey. Mineral Resources. No. 16: The Antimony Mining Industry and the Distribution of Antimony Ores in New South Wales. By J. E. Canve. Pp. 54+maps. (Sydney: W. A. Gullick.) 2*s*.

Government of India. Department of Revenue and Agriculture. Agricultural Statistics of India for the Years 1906–7 to 1910–11. Vol. i. Pp. iii+409. (Calcutta: Superintendent Government Printing, India.) 3*s*. 9*d*.

Memoirs of the American Museum of Natural History. New Series. Parts i., ii., iii. Pp. 100+plates. (New York: American Museum of Natural History.)

Summary Report of the Geological Survey Branch of the Department of Mines for the Calendar Year 1911. Pp. x+412+10. (Ottawa: C. H. Parmelee.)

Internal Secretion and the Ductless Glands. By Prof. S. Vincent. Pp. xx+464. (London: E. Arnold.) 12*s*. 6*d*. net.

Landolt-Börnstein. Physikalisch-chemische Tabellen. New edition. Edited by Drs. R. Börnstein and W. A. Roth. Pp. xvi+1313. (Berlin: J. Springer.) 56 marks.

Nautical Astronomy. By W. P. Symonds. Pp. 130. (London: J. D. Potter.) 6*s*.

The Fundamentals of Psychology. By B. Dumville. Pp. ix+382. (London: W. B. Clive.) 4*s*. 6*d*.

The Carbonisation of Coal. By Prof. V. B. Lewes. Pp. xiv+315. (London: J. Allen and Co.) 7*s*. 6*d*. net.

Leather Chemists' Pocket-book. Edited by Prof. H. R. Procter, assisted by Dr. E. Stiasny and H. Brumwell. Pp. xiv+223. (London: E. and F. N. Spon, Ltd.) 5*s*. net.

Outlines of Physical Chemistry. By Dr. G. Senter. Third edition. Pp. xix+413. (London: Methuen and Co., Ltd.) 5*s*.

The Elements of Geography. By R. D. Salisbury, H. H. Barrows, and W. S. Tower. Pp. viii+616+vii plates. (New York: H. Holt and Co.) 1.50 dollars.

Pflanzenwachstum und Kalkmangel im Boden. By Prof. A. Wieler. Pp. vii+235. (Berlin: Gebrüder Borntraeger.) 14 marks.

Terza relazione annuale del Direttore dell' Ufficio Idrografico. By G. Margrini. Pp. 71+plates+maps. (Venezia: C. Ferrari.)

Customs of the World. Parts i. and ii. (London: Hutchinson and Co.) 7*d*. each.

Papua, or British New Guinea. By J. H. P. Murray. Pp. 388. (London: T. Fisher Unwin.) 15*s*. net.

Evolution and the Need of Atonement. By S. A.

McDowall. Pp. xvi+155. (Cambridge University Press.) 3*s*. net.

Insect Workers. By W. J. Claxton. Pp. xii+62. (London: Cassell and Co., Ltd.) 1*s*. net.

Wild Life and the Camera. By A. R. Dugmore. Pp. xi+332. (London: W. Heinemann.) 6*s*. net.

The Charm of the Hills. By S. Gordon. Pp. xiv+248. (London: Cassell and Co., Ltd.) 10*s*. 6*d*. net.

A Geography of the British Empire. By Prof. A. J. Herbertson and R. L. Thompson. Pp. 256+3 maps. (Oxford: Clarendon Press.) 2*s*. 6*d*.

The Lost World. By A. Conan Doyle. Pp. 319. (London: Hodder and Stoughton.) 6*s*.

The Home Life of the Terns and Sea Swallows. By W. Bickerton. Pp. 88+32 plates. (London: Witherby and Co.) 6*s*. net.

Radium and Radio-activity. By A. T. Cameron. Pp. 185. (London: S.P.C.K.) 2*s*. 6*d*.

Astronomy. By Dr. F. W. Dyson. Pp. vi+118. (London: J. M. Dent and Sons, Ltd.) 1*s*. net.

On the Consciousness of the Universal and the Individual. By Dr. F. Aveling. Pp. x+255. (London: Macmillan and Co., Ltd.) 5*s*. net.

The Science of Illumination. By Dr. L. Bloch. Translated by Prof. W. C. Clinton. Pp. xiv+180. (London: J. Murray.) 6*s*. net.

A Handbook of Physics. By W. H. White. Pp. xv+667. (London: Methuen and Co., Ltd.)

The Prehistoric Period in South Africa. By J. P. Johnson. Second edition. Pp. 115+plates. (London: Longmans and Co.) 10*s*.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 7.

ROYAL SOCIETY, at 4.30.—Radiation and Absorption of Light in Gaseous Media, with Applications to the Intensity of Sky Radiation: L. V. King.—A Standard Measuring Machine: Dr. P. E. Shaw.—A Spectrophotometric Comparison of the Emissivity of Solid and Liquid Gold at High Temperatures with that of a Full Radiator: E. M. Stubbs and Dr. E. B. R. Prideaux.—Optical Properties of Substances at the Critical Point: C. Smith.—Absorption of Helium and other Gases under the Electric Discharge: Hon. R. J. Strutt.—(1) The Discharge between Concentric Cylinders in Gases at Low Pressures; (2) The Influence of the Nature of the Kathode on the Length of the Crookes Dark Space: F. W. Aston.—The Determination of the Absolute Unit of Resistance by Alternating Current Methods: A. Campbell.—Some Unclassified Mechanical Properties of Solids and Liquids: A. Mallock.—Trichromatic Theory of Colour Vision. The Measurement of Fatigue of the Retina: Sir W. de W. Abney, K.C.B.

FRIDAY, NOVEMBER 8.

ROYAL ASTRONOMICAL SOCIETY, at 5.—The Constitution of the Solar Corona. III.: J. W. Nichols n.—Telescope Finders: T. K. Mellor.—Suggested Application of Mr. Innes's Formula for Magnitude of Double Stars to Observations of Certain Variable Stars: M. E. J. Gheury.—(1) The Sun-spot Minimum; Sun-spots and Prominences, 1912, October 10; (2) Sun-spots and Magnetic Phenomena, 1848–1911. The Cause of the Annual Variation in Magnetic Disturbances: Rev. A. L. Cortie.—The Transit of Mercury in 1707: G. van Biesbroeck.—The Light-source of the Andromeda Nebula: J. H. Reynolds.—Note on the Oxygen Triplet of the Infra-red of the Solar Spectrum: Royal Observatory, Edinburgh.—(1) Spectrographic Observations of the Sun's Rotation at Cambridge Observatory; (2) A Method of Measuring Spectrograms with the Help of a Cylindrical Lens: J. B. Hubrecht.—The Sidereal System: Revision of 1912 (*continued*) Maxwell Hall.—*Probable Paper:* Note on the Magnitude of Nova Geminorum: H. Jameson.

PHYSICAL SOCIETY, at 8.—On a Method of Measuring the Thomson Effect: H. R. Nettleton.—An Improved Joule Radiometer and its Applications: F. W. Jordan.—Note on the Attainment of a Steady State when Heat Diffuses along a Moving Cylinder: Miss A. Somers.—The Thermomagnetic Study of Steel: S. W. J. Smith.

MALACOLOGICAL SOCIETY, at 8.—Tivella and Grateloupia: A. J. Jukes-Browne.—Some Remarkable Shell Monstrosities: G. C. Robson.—New Mollusca from the Marine Tertiary Deposits of the North Pacific Coast of America: Ralph Arnold and Harold Hannibal.—Descriptions of new species of Limicolaria and Krapfiella from East Central Africa: H. B. Preston.

TUESDAY, NOVEMBER 12.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction of the New Dock at Methil: B. H. Blyth.—Alterations and Improvements of the Port Talbot Docks and Railway during the Last Decade: W. Cleaver.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Some unrecorded Customs of the Mekeo People of British New Guinea: R. W. Williamson.

ZOOLOGICAL SOCIETY, at 8.30.—Some Falkland Island Spiders: H. R. Hogg.—Some Points in the Anatomy of the Mouth-parts of the Mallophaga: Bruce F. Cummings.—Contributions to a Study of the Dragonfly Fauna of Borneo. I. The Corduliinæ: the Genus Amphicnemis: F. F. Laidlaw.—Some Parasites of the Scoter Duck (*Oedemia nigra*) and their Relation to the Pearl-inducing Trematode in the Edible Mussel (*Mytilus edulis*): Dr. H. Lyster Jameson and Dr. W. Nicoll.—Descriptions of Three New Fishes Discovered in the Gold Coast by Dr. H. G. F. Spurrell: G. A. Boulenger.

MINERALOGICAL SOCIETY, at 5.30.—Ilmenite from the Lengenbach Quarry, Binnenthal: Prof. W. J. Lewis.—An Account of the Minerals found in the Virtuous Lady Mine, near Tavistock: A. Russell.—Some Graphical Methods in Crystallography and Crystal Optics: A. Hutchinson.—Labradorite from Co. Down: A. Hutchinson and W. Campbell Smith.—Apparatus for Preparing Thin-sections of Rocks: Dr. G. F. Herber Smith.—Calcite Crystals from a Water Tank: R. F. Gwinnell.

THURSDAY, NOVEMBER 14.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Development of a Parasite of Earthworms: J. W. Cropper.—Further Contribution to the Study of the Inheritance of Hoariness in Stocks (Matthiola): Edith R. Saunders. The Influence of Temperature on the Absorption of Water by Seeds of *Hordeum vulgare* in Relation to the Temperature Co-efficient of Chemical Change: Prof. A. J. Brown.—Note on *Merlia normani* and the "Monticuliporas": R. Kirkpatrick.—The Chemical Action of *Bacillus cloacae* (Jordan) on Citric and Melic Acids in the Presence and Absence of Oxygen: James Thompson.—The Origin and Destiny of Cholesterol in the Animal Organism. X. The Excretion of Cholesterol by Man, when Fed on Various Diets: G. W. Ellis and J. A. Gardner.—The Comparative Anatomy and Affinities of the Araucarineæ: Prof. R. Boyd Thomson. *And other Papers.*

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Address by the President (W. Duddell.)—Presentation of Premiums.

CONCRETE INSTITUTE, at 7.30.—Presidential Address: E. P. Wells.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—Presidential Address on Recent Advances in the Theory of Surfaces: H. F. Baker.—Some Properties of Cubic Surfaces: A. B. Grieve.—The Determination of the Summability of a Function by means of its Fourier Constants: W. H. Young.—Groups of Linear Substitutions of Finite Order which Possess Quadratic Invariants: W. Burnside.—The Irreducibility of Legendre's Polynomials: J. B. Holt.—The Representation of a Summable Function by means of a Series of Finite Polynomials: E. W. Hobson.—Theory of Functions of Real Vectors: E. Cunningham.

FRIDAY, NOVEMBER 15.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—The Norwegian South Polar Expedition: Capt. Roald Amundsen.

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