THURSDAY, FEBRUARY 12, 1914.

A GERMAN INTRODUCTION TO THE STUDY OF MIMICRY.

Mimikry und Verwandte Erscheinungen. By Dr. Arnold Jacobi. Pp. ix+216. (Braunschweig: F. Vieweg und Sohn, 1913.) Price 8 marks.

THE scope of the work before us is sufficiently indicated by a list of its main sections. A brief general introduction is succeeded by a division of the subject under nine heads:—(i.) Protective Colouring; (ii.) Protective Resemblance; (iii.) Warning Colours; (iv.) Mimicry or Protective Imitation; (v.) The Imitation of Aculeate Hymenoptera, or "Sphecoidie"; (vi.) The Imitation of Ants, or "Myrmecoidie"; (vii.) The Imitation of Beetles; (viii.) Mimicry in Lepidoptera; (ix.) The General Characteristics of Mimetic Lepidoptera. Some of the principal memoirs in the literature of the subject are named in a short list at the end of the volume, but anything like a complete treatment is manifestly impossible in a work of this size.

Protective colouring (Schutzfärbung) and protective resemblance (Schützende Aehnlichkeit) are the terms employed by the author for the two kinds of cryptic colouring which have been called general and special protective resemblance. In the first the animal seems to melt into its surroundings; in the second it resembles some actual object. No mention is made of Thayer's interesting combination of the two principles in animals with a general obliterative colouring upon which are represented the details of the normal environment. Nor is there any reference to the same naturalist's brilliant interpretation of the white under-sides of animals.

The criticism, urged on p. 8, that we do not *know* whether the cryptic appearance is truly advantageous and really exists for the eye of the insect-eater can only be fully met by increased knowledge. In the meantime it is obvious that certain birds do hunt for their prey over tree-trunks that are not swept bare, even after many months of intermittent searching, but still harbour sufficient pupæ to keep up the average numbers of the species. We know too that birds will assemble in order to feed, when insects which must ordinarily be searched for are driven out by a grass fire or by "Driver" ants on the raid. And no one who has watched the pursuit of a cryptically coloured moth by birds in the immediate neighbourhood can doubt that it would have been attacked when at rest if only it had been seen.

The resemblances of the Membracidæ to thorns, bark, &c., is dismissed by the author (p. 15) as examples of "Museum Mimicry," for the very inadequate reason that these Homoptera are "mighty jumpers," and when disturbed "disappear after the manner of the flea." Well-concealed species are generally swift in their movements when they are disturbed. Furthermore, W. A. Lamborn has shown that the dark, bark-like West African Membracids are ant-attended when found on green stems. Companies of individuals are always found on old bark, as are females engaged in egg-laying—a very prolonged operation, lasting from thirty-six to forty-eight hours, during which the insect clings tenaciously to the egg-mass and is with difficulty disturbed (Trans. Ent. Soc., 1913, pp. 494–7). The author admits the wonderfully ant-like appearance of some tropical American Membracids, but rejects an interpretation based on the theory of mimicry because ants run and Membracids jump. The idea of a second line of defence does not seem to have occurred to him; and yet in nearly all the examples he accepts there *is* a second line, depending on powers of flight very different from those of the model.

The author has evidently taken considerable pains in studying the work that has been done in this country and expresses regret that his compatriots have not taken a larger share in it. There is, however, one subject which has escaped him, viz., the power of individual adjustment to the colours of the environment as exhibited by insects. On this power he can find nothing in English except "a meagre experiment . . . on butterfly pupæ"! (p. 25). The present writer is, moreover, bound to disclaim the honour of having influenced some of the names that are here set down—for example, the late Thomas Belt, whom he never had the pleasure of seeing, but to whom, for the "Naturalist in Nicaragua," he owes a deep debt of gratitude. Although the author writes with generous appreciation of British work, and appears to agree with its general tendency, he differs strongly from many conclusions on special points, and offers criticisms which it will be a pleasure to attempt to meet on some future occasion.

It is satisfactory to find the recognition, on p. 35, of a fact often forgotten—"that even the protective adaptation which is apparently the most perfect does not give security against detection—that creatures thus equipped have their special foes which can find them out, at least when driven by hunger." Similarly the polymorphism of the leaf-butterflies, Kallima, &c.—a stumbling-block to

many—is clearly explained. "This multiplicity of patterns is the very thing which assists the efficiency of the leaf imitation, since the faded, dried, half-rotten leaf occurs in nature in a thousand forms and colours, with its transition from green to yellow and brown, its slits and jags, its traces of gnawing and of mould and fungi" (p. 37). And the objection, sometimes raised by those who have not sufficiently considered the subject, that a Kallima may be seen resting with expanded wings on green foliage is also effectively answered on p. 39.

For Warning Colours and in other parts of the book the author accepts the terminology introduced in this country in 1890. Haase's term, "Immunity" is wisely used only in a restricted sense. The unqualified word, carrying with it the assumption that the bearers of warning colours are exempt from all attack, even by parasitic foes—an assumption carefully guarded against on p. 52—gives an entirely mistaken impression. That such insects have their special enemies has now been shown by many observers. A good example is the highly conspicuous *Acraea zetes*, of which Dr. G. D. H. Carpenter collected in Uganda seventy pupæ and full-fed larvæ, but only reared sixteen butterflies. All the others—77 per cent. of the whole—were destroyed by parasitic insects.

The theory of aposematic or warning colours is considered to stand on a much firmer foundation than that of cryptic colouring (p. 50); but the author, accepting the conclusions published in the Proceedings of the Zoological Society in 1887, recognises the intimate relationship between the two. "Aposematic species restrict the food available for insect-eaters" and must therefore "pass on to other non-protected species the onus of satisfying the hunger of their foes. Now, if these, by any process of development, also attained immunity, the foe would be compelled to overcome his disgust, and accept the disagreeable food, and thus the advantage of the warning colour as an advertisement would be reversed, for it would facilitate the discovery of the prey" (p. 52).

The treatment of terrifying markings is inconsistent. They are ridiculed on p. 23, but taken seriously on pp. 56–59. It must be freely admitted that markings which make so strong an appeal to the imagination require to be tested and retested by carefully observing their effect upon enemies, before the bionomic meaning can be accepted as proved. This can scarcely be claimed at present for any examples except the terrifying Sphinx larvæ, the objects of superstitious fear by man in different countries, and proved by four observers to excite fear in animals. This, the clearest example, is doubted by the author, although he accepts the far more problematical interpretation of the markings and attitude of the eyed hawkmoth (*Smerinthus ocellatus*) as terrifying. Such an interpretation is probably correct, but before accepting it we require at least as much evidence as has been collected for the larvæ.

In the historical account of mimicry a common error is repeated. H. W. Bates himself, in his classical memoir (Trans. Linn. Soc., vol. xxiii., 1862, p. 495), grouped together the phenomena of mimicry and protective resemblance, and did not, as stated on pp. 60, 61, understand the former "as referring only to similarity in form and colour between creatures of different systematic position."

It is well-nigh impossible to get rid of an error of this kind when once it has been fairly started. However, we must do our best. Bates, on pp. 508–10 of his paper, quotes numerous examples of procryptic resemblance to twigs, bark, lichen, the excrement of birds and caterpillars, dewdrops, &c., concluding with the words, on p. 510: "I think it will be conceded that all these various kinds of imitative resemblances belong to the same class of phenomena and are subject to the same explanation. The fact of one species mimicking an inanimate object, and another of an allied genus a living insect of another family, sufficiently proves this." A footnote on pp. 508–9 is even more conclusive; for the actual term "mimicry" is applied to the procryptic examples. Referring to Rössler's interpretation of the buff-tip moth in the resting attitude, Bates adds in a note: "In an article on resemblances between insects and vegetable substances (*Wiener Entomol. Monatschrift*, 1861, p. 164), the author enumerates many very singular cases of mimicry; he also states his belief that the mimicry is intended to protect the insects from their enemies." The convenient restriction of the term mimicry to the resemblances to other specially defended animals—the models—came later, and is due to Wallace.

Returning to the author's section on mimicry, we notice a simple and convenient device for representing the mimetic association between two species, the names being connected by an arrow pointing in the direction of the model.

In the sub-section on "Mimicry among Batrachians" there is an interesting footnote on p. 75, suggesting the specific identity of the conspicuous, distasteful amphibian, which, as the author says, "hops about in all Darwinian literature as 'Belt's Frog.'" The species, he thinks, "can be nothing but *Atelopus varius*, which is extremely common in Central America." My friend, Mr. G. A. Boulenger, however, does not entirely

agree with this conclusion. "It is quite possible," he writes, "that Belt's frog was *Atelopus varius*, Stannius, but it is more probable that it was *Dendrobates typographus*, Keferstein (*ignitus*, Cope), which occurs also in Nicaragua. All the *Dendrobates* appear to be very poisonous."

The section on mimicry of ants—one of the most important in the work—is enriched by an excellent summary, on pp. 114–23, of Wasmann's splendid researches.

Vosseler's account of the life-history of the Locustid *Eucorypha fallax* is given at considerable length and illustrated, on pp. 107–12. An ant-like larval stage of this insect was described long ago as *Myrmecophana fallax* by Brunner von Wattenwyl, and it is most satisfactory that Vosseler's excellent observations have now put this often-quoted example of mimicry in its true position. He shows that "after the fourth change of skin" there is "a change from a mimetic to a cryptic appearance," the succeeding stage being leaf-like in colour and exhibiting a correspondingly altered behaviour. The change thus begun continues to the end, the winged imago being beautifully leaf-like. In correspondence with these changes Vosseler does not admit that any feature in the likeness is unnecessary. And yet this was one of the very cases on which Brunner founded his conception of "hypertelic" resemblance, or resemblance that attains an altogether unnecessary perfection in detail—that is, in fact, "too good to be true."

The illustrations, especially those that are coloured, are rather rough, but they are, on the whole, well selected and serve their purpose. It is a pity that the two species of Heliconius figured on pp. 144 and 145 were not accompanied by *Melinaea imitata* and *Mel. ethra*, instead of *Mechanitis doryssus* and *Mech. lysimnia* respectively. If room could be found for only one Ithomaeine, there is no doubt that Melinaea should have been the genus selected. The mimetic females of the African *Papilio dardanus* are so complicated that much care is required to avoid mistakes. It is unfortunate that the only characteristic eastern and south-eastern Danaine model, *Amauris echeria*, and mimetic form (*cenea*) of *dardanus* should be described on p. 163 as West African.

But when every criticism has been urged, we must admit that the book will be very useful. Haase's important monograph is too large and expensive to be likely to reach many hands, and we welcome the appearance of a German work of small price and moderate size, which will serve as an introduction to this interesting and much-debated subject. E. B. P.

TEXT-BOOKS OF CHEMISTRY.

(1) *General Chemistry Laboratory Manual.* By Prof. J. C. Blake. Pp. x+166. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 8*s.* net.

(2) *Practical Chemistry.* Qualitative Exercises and Analytical Tables for Students. By the late Prof. J. Campbell Brown. Sixth edition. Edited by Dr. G. D. Bengough. Pp. 78. (London: J. and A. Churchill, 1913.) Price 2*s.* 6*d.* net.

(3) *Organic Chemistry for Students of Medicine.* By Prof. J. Walker, F.R.S. Pp. xi+328. (London: Gurney and Jackson; Edinburgh: Oliver and Boyd, 1913.) Price 6*s.* net.

(4) *Quantitative Analysis in Practice.* By Prof. J. Waddell. Pp. vii+162. (London: J. and A. Churchill, 1913.) Price 4*s.* 6*d.* net.

(5) *La Catalyse en Chimie Organique.* By Paul Sabatier. Pp. xiv+255. (Paris and Liège: Librairie Polytechnique, Ch. Beranger, 1913.) Price 12.50 francs.

(1) THE exercises in this manual are complementary to the author's "General Chemistry: Theoretical and Applied," and accordingly the work can scarcely be recommended to chemical students in general unless they are taking a course very similar to that planned by the author. About one-half of the book, which is interleaved throughout with blank pages for students' notes, is devoted to simple experiments, partly qualitative and partly quantitative, dealing with the chemistry of non-metallic ("acid-forming") elements. The experiments on the metals ("base-forming elements") might serve as an introduction to inorganic qualitative analysis, but would be of slight educational value unless accompanied by a course of lectures on the theory of analysis. A few simple experiments on the atmosphere, the soil, fuels, and oils, natural waters, the ferrous metals, and rocks are grouped under the heading of applied chemistry.

(2) This treatise, like the foregoing manual, is chiefly of interest as affording an indication of the subject-matter chosen for experimental study in the author's practical classes. These exercises are preceded by the following general instruction: "After performing each of the following exercises, the student should record the reactions in his note-book in the form of equations whenever an equation is possible." This excellent instruction, if conscientiously obeyed by the student and carefully supervised by a sympathetic demonstrator, would go far towards making the work educational. Yet without previous knowledge gained either from text-books of general chemistry or from lectures on the theory of analysis, the student

would scarcely be in a position to express the reactions in the form of equations. The explanations given in the text are fragmentary, and sometimes obscure and even misleading. This lack of information is specially noticeable as regards the action of solvents. No explanations are given of the solvent action of ammonium chloride on the hydroxides of magnesium and manganese, or of the changes which occur on dissolving silver chloride in ammonia, potassium cyanide, or sodium thiosulphate. It is extremely doubtful whether the reducing action of alkaline stannous chloride on bismuth hydroxide leads to the sub-oxide Bi_2O_2, or whether the interaction of potassium cyanide and copper salts gives rise to the double cyanide $K_2[(CN)_4Cu]$. Some explanation seems desirable for the instruction (pp. 24 and 39) to use "stale $NH_4.HCO_3$." On the whole, however, the working instructions are quite practicable, but, in the section devoted to the rarer elements, a distinction might, with advantage, have been made between tests requiring considerable concentrations and those appreciable even in very dilute solutions. Cerium dioxide (p. 27) is not red unless contaminated with other rare earths. The final sections of the book are devoted to organic qualitative analysis, including tests for a typical series of organic acids and the characteristic reactions of the principal organic bases with separation tables for the commoner alkaloids.

(3) In order to meet the requirement of students of medicine whose time for the study of chemistry may not exceed six months, the author has selected the chemical substances considered in the course chiefly on account of their medical interest. A novel feature in the work is the postponement of the consideration of nitrogenous compounds to the last third of the book. In spite of the condensation necessary in the circumstances, the author has succeeded in giving adequate explanations of several important and difficult subjects, such as stereoisomerism, the chemistry of the naturally occurring sugars, the cyanogen derivatives and organic amines, including alkaloids. In other shorter sections a more sketchy outline has been regarded as sufficient, but the subjects are always dealt with so suggestively that the work can be recommended as a useful introduction to the study of organic chemistry not only for medical students, but also for others requiring a general outline of the subject dealing with substances of practical interest.

(4) An introductory course of quantitative analysis in which the author lays special stress on the speed with which analytical work should be carried out. Thoroughly practical directions are given for carrying out fifteen typical exercises, and the time required for completing these analyses is indicated in each case. The analytical processes are connected with the general chemical principles underlying these operations. For example, the precipitation of magnesium ammonium phosphate affords an opportunity for discussing the chemistry of phosphoric acid and its salts. In the separation of nickel and cobalt, considerable saving of time would be effected by substituting for the double nitrite method the processes based on the use of nitroso-β-naphthol or dimethylglyoxime. The appendix contains useful sections on the chemical balance, calibration, electrolyte dissociation, and indicators.

(5) This work is a valuable *résumé* from the pen of one whose name will remain inseparably linked with the subject of "Catalysis in Organic Chemistry." The introductory chapter dealing with autocatalysis and negative catalysts is followed by sections devoted to the general survey of substances utilised as catalysts in organic chemistry, catalytic oxidations and hydrolyses, and the catalytic introduction into organic molecules of halogens, sulphur, metals, and the carbonyl and sulphonic groups. Five chapters are devoted to the important subject of catalytic hydrogenation. Although the action of metals in accelerating the addition of hydrogen to organic and inorganic substances had been known since the commencement of the nineteenth century, the systematic study of this process, which was first initiated by the author and Senderens in 1897, has since led to the development of a valuable general reaction in organic synthesis based on the employment of finely divided nickel. Due reference is made to the special processes of hydrogenation devised by Ipatieff, Paal, and Willstätter. The action of the metallic catalyst in inducing the reverse change of dehydrogenation has also been demonstrated by the author and by Zelinsky and others. In collaboration with Mailhe, the author investigated systematically the dehydrating action of the refractory metallic oxides (alumina, thoria, tungsten oxide, &c.), and laid the foundation of another general reaction in which the alcohols are converted into unsaturated hydrocarbons. Conducted in the presence of ammonia, hydrogen sulphide or organic acids, these dehydrations lead respectively to organic amines, thiols, or esters. Bearing in mind the author's brilliant achievements in this field, his views on the mechanism of catalysis are of special interest. Whether occurring in homogeneous or heterogeneous systems, catalytic change is regarded as being due to the successive

formation and destruction of unstable intermediate compounds, the author asserting that this theory, in spite of certain imperfections, has been the guiding beacon in all his researches on catalysis.

G. T. M.

MATHEMATICS: PURE AND APPLIED.

(1) *Vectorial Mechanics.* By Dr. L. Silberstein. Pp. viii+197. (London: Macmillan and Co., Ltd., 1913.) Price 7*s.* 6*d.* net.

(2) *An Introduction to the Mathematical Theory of Attraction.* By Dr. F. A. Tarleton. Vol. ii. Pp. xi+207. (London: Longmans, Green and Co., 1913.) Price 6*s.*

(3) *A First Course in Projective Geometry.* By E. Howard Smart. Pp. xxiii+273. (London: Macmillan and Co., Ltd., 1913.) Price 7*s.* 6*d.*

(1) DR. SILBERSTEIN'S "Vectorial Mechanics" is an able exposition of the power of vector analysis in attacking certain types of physical problems. Heaviside's modification of Hamilton's original vector and scalar notations is adopted throughout. So far as the simpler applications of vector analysis go, the question of notation is apparently of little consequence. Almost every vector analyst who writes a book on the subject has his own pet notation; and there is a tendency for these authors to fail to recognise that their best creations are usually Hamilton's originals disguised. Even Dr. Silberstein, who knows and works quaternions, ascribes to Heaviside a formula given long ago by Hamilton, assigns to Clifford (1878) a problem which is completely solved in the first edition (1867) of Tait's "Quaternions," and refers to Henrici and Turner as authorities in connection with a simple geometrical problem given in Kelland and Tait's "Introduction to Quaternions." One might with as much historic truth ascribe the proposition Euclid i. 47 to the first English examiner who set it in an examination paper. Indeed, the historic references throughout the book are not all that might be desired. For example, it is incorrect to speak of Willard Gibbs as the one to whom, after Hamilton, the discovery of the fundamental properties of the linear vector function is due. What of Tait's powerful paper of 1868 on the rotation of a rigid body about a fixed point? It positively bristles with new-found properties and applications of the linear vector function. Dr. Silberstein's own chapter v. is simply a reproduction of part of this memoir. Then in the second edition (1873) of his treatise on "Quaternions," Tait for the first time develops the application of the linear vector function to strains; and in the last chapter of Kelland and Tait's "Introduction to Quaternions" (1873) presents the theory in a different form. Willard Gibbs's "Vector Analysis" (not published) was printed for the use of his students in 1881 and 1884. Apart from new names and a new and extremely interesting presentation, it is doubtful if Gibbs gave in that pamphlet any important property of the linear vector function which was not to be found in the pages of either Hamilton or Tait.

Then as regards the differential operator ∇ it was unquestionably Tait who, first in his paper on Green's and allied theorems (1870), and afterwards in his treatise on quaternions (second and third editions), developed it and showed forth its power. Willard Gibbs got it partly from Tait's "Quaternions" and partly from Maxwell's "Electricity and Magnetism"; and Maxwell got it directly from Tait. Yet while giving great credit to Gibbs and Heaviside, Dr. Silberstein does not mention Tait's name once. The manner in which Dr. Silberstein leads up to Stokes's "Theorem" is not convincing, that is, if the explanation is meant to be a proof. Phrases like "we may conclude" and "we may consider" are scarcely satisfactory in establishing a far-reaching mathematical transformation. Moreover, no attempt is made to establish the useful vector extensions of the theorems of Gauss and Stokes. It is, indeed, in these integral theorems involving the ∇ that, as compared with the quaternion vector analysis, the artificiality of other vector analyses mainly appears. The transformations lack flexibility. The reason for this is that outside the quaternion vector analysis the reciprocal of a vector is tabu, and the associative law in products is despised.

Apart from the necessary imperfections of a non-associative vector algebra, Dr. Silberstein's book contains many good things. In his treatment of the rotation of a solid body and of strain there is not so much of novelty, except when in the latter case he considers discontinuous motions. In the chapter on hydrodynamics, however, there are certain interesting developments which demonstrate the directness and value of vector methods. On p. 143 the long-winded semi-Cartesian transformation is needlessly laborious; for at once in quaternion notation:

$$S\sigma\nabla\,.\,\sigma = V\sigma V\nabla\sigma + \nabla_1 S\sigma_1\sigma = V\sigma V\nabla\sigma + \tfrac{1}{2}\nabla\sigma^2,$$

where σ is the fluid velocity.

(2) After a lapse of fourteen years Prof. Tarleton has brought out the second volume of his "Introduction to the Mathematical Theory of Attraction," the first volume of which was reviewed in NATURE for April 29, 1899. The chapters are numbered consecutively with the chapters of the first volume. An elegant discussion of spherical and ellipsoidal harmonics occupies chapter viii. In chapter ix. the author develops on familiar

lines the more elementary theory of magnetism, permanent and induced, with a brief sketch of the general theory of terrestrial magnetism. Chapters x., xi., xii. take up respectively electric currents, dielectrics, and the electromagnetic theory of light. The exposition is clear throughout, and well adapted to a student reading the subject for the first time. At the same time it will probably be felt by many that the book would have appealed to a wider audience if the spherical harmonic methods mathematically developed had been applied to definite problems in electrical or magnetic distributions. The author, however, is quite consistent in this neglect of practical applications; for although chapter xii. ends with the statement that the ratio of the electromagnetic to the electrostatic unit of electric charge is approximately 3×10^{10}, it is nowhere stated that this is the numerical value of the velocity of light.

(3) Mr. E. H. Smart's "First Course in Projective Geometry" is both well planned and well written. With the exception of a brief introduction to the method of projection in space, the first six chapters are devoted to the plane geometry of triangles, quadrilaterals, and circles, in which the principles of correspondence and duality, harmonic ranges, inversion, similitude, poles and polars, are developed in a systematic manner. In chapter vii. further theorems and problems on projection are given, and these suffice for what the author regards as the main purpose of his book, namely, a logical, coherent discussion of the geometry of the conic sections. In the later chapters the principle of duality is freely introduced, and the book finishes with typical examples of reciprocation. Most of the chapters contain brief historic notes which cannot fail to interest the student.

OUR BOOKSHELF.

Materials and Methods in High School Agriculture. By Prof. W. G. Hummel and Bertha R. Hummel. Pp. xi + 385 + plates. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 5*s.* 6*d.* net.

In discussing the scope of their work the authors begin with a definition of the object of agricultural work in elementary schools and also in the universities. They then find that the position of agriculture in high schools lies intermediately between these two positions. The purposes of agricultural work in the elementary schools are stated to be the opening of the minds of children to the common phenomena of nature, the inculcation of habits of observation, and the setting up of higher ideals in country life, but not to make farmers or farm labourers. In the colleges, on the other hand, the work lies in the investigation of the more fundamental problems of agricultural science and practice. The high schools should teach practical agriculture, educating their students for the actual business of the farmer; the course should not, however, be narrowly vocational, but should be cultural and disciplinary as well, and should prepare the students to be broad-minded and intelligent, progressive citizens.

Considerable stress is laid upon the necessity for finding suitable teachers; the teacher must not only possess agricultural knowledge, but be able to impart it to others. Neither the purely scientific man nor the purely practical man has turned out a success. The former fails because he lacks the proper point of view, and knows nothing of practical farming conditions; the latter fails because he does not know the first principles of the subject, and is unacquainted with the scientific basis of agriculture.

The book is full of interest, and can be cordially recommended to all who are engaged in the work of agricultural education at schools, farm institutes, and colleges.

The Deciding Voice of the Monuments in Biblical Criticism. By Dr. M. G. Kyle. Pp. xvii + 320. (London: S.P.C.K., 1912.) Price 4*s.* net.

The author of this work would probably not resent the suggestion that he writes as an advocate or partisan, rather than as an impartial assessor, in a long-drawn-out dispute. The field he surveys is a well-trodden one—the relation between the Bible and the monuments—and his attitude is that of the most traditional and conservative of writers on this subject. His thesis throughout is to the effect that modern archæological study has entirely disposed of the claims advanced on behalf of the textual criticism of the Old Testament. In his view the whole work of the critical school is discredited, and the labours of Hebrew scholars for more than a century past, so far from resulting in a truer and more accurate appreciation of the Hebrew text, have been worse than useless. His position may be indicated by the fact that he maintains the unity of the book of Isaiah, and holds that the book of Daniel embodies the prophecies of a historic person of that name who prophesied in Babylon during the exile, and was written by him or by one of his contemporaries. It does not lie within the scope of this journal to follow the author along his controversial path. But with the best will in the world to be convinced, we cannot help feeling that he is engaged in that rather pathetic process of trying to put back the hands of the clock. We feel sure he would have been far more convincing had he proved himself a less thorough-going partisan.

Astronomy. By Ellison Hawks. Pp. 120. (Manchester: Milner and Co., n.d.) Price 1*s.* net.

In these 120 pages the author presents the subject of astronomy in such a way that the beginner will wish to carry his reading further. The style is elementary, clear, and chatty, and the reader is led on from one subject to another in a natural

sequence. He is first introduced to the astronomy of the ancients, and then of to-day. The historical account of the telescope is followed by the practical forms of to-day, leading up to the famous observations of the present time. Then follow concise statements about the sun, moon, planets, comets, stars, coloured and multiple, clusters and nebulæ, &c., all of which are sufficient to give the reader an interest in the subject and a wish to know more about them. Many practical hints and much good advice are given which will be serviceable to those who are making use of small telescopes. Numerous well-chosen illustrations, many of which are from the pencil of the author, accompany the text. A glossary of astronomical terms, a brief bibliography of the more elementary astronomical books and an index bring this practical little book to a conclusion.

The Petrology of the Igneous Rocks. A Summary of the modern Theories of Petrogenesis, a Description of the Rock-forming Minerals, and a Synopsis of the chief Types of the Igneous Rocks and their Distribution as illustrated by the British Isles. By Dr. F. H. Hatch. Seventh edition, revised. Pp. xxiv+454. (London: George Allen and Co., Ltd., 1914.) Price 7*s.* 6*d.* net.

ATTENTION has been directed in these columns to this now well-known text-book on two previous occasions. On May 14, 1891 (vol. xliv., p. 25), the first edition was reviewed at length, and on May 20, 1909 (vol. lxxx., p. 337), the fifth edition was noticed. It will be sufficient to say of the present edition that it has undergone considerable revision and that new chapters on the pyroclastic rocks and the metamorphic derivatives of the igneous rocks have been added, together with numerous new illustrations.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Active Nitrogen.

A PAPER appears in the *Berichte* (vol. xxxvi., 17, p. 4095, 1914), by E. Tiede and Domcke, in which it is again maintained that the glow characteristic of active nitrogen is not seen in the absence of oxygen. In the experiment chiefly relied on, the authors prepare nitrogen in an exhausted apparatus, by heating barium or potassium azide; and they lead it through a cooled vessel straight into the discharge tube, also exhausted. They state that after careful washing out with nitrogen, no afterglow appears. We do not know how to account for their conclusion, but we can only state that in our hands the experiment gives exactly the opposite result. We used potassium azide, and after most thoroughly heating the glass and the electrodes and washing out the vessel repeatedly with nitrogen, the glow remained absolutely undiminished in intensity.

We have also tried a new experiment. Some of the liquid alloy of sodium and potassium was placed in a discharge bulb, which was charged with rarefied nitrogen. The surface of the alloy is quite bright, and the nitrogen has been standing over it for three weeks, but the afterglow is as good or better than ever. Fuller details of these experiments will be published later.

Finally, even if what Tiede and Domcke say were true (which we entirely deny), we do not see that it would alter the fact that a gas has been obtained by one of us capable of reacting in the cold with, *e.g.* hydrocarbons to form hydrocyanic acid. If this is not active nitrogen, what is it?

H. B. BAKER.
R. J. STRUTT.

Imperial College of Science, February 10.

Weather Forecasting.

MR. DEELEY'S plea (NATURE, January 29) for increased aid to meteorology certainly deserves serious consideration. Under the present condition of affairs it is not possible to issue forecasts for more than a day or two in advance with much hope of success, but there is no reason why this should continue indefinitely. Seasonal forecasts would be of immense importance to agriculture, more so, indeed, than forecasts for the following week, because, were the character of an ensuing summer known, it would be nearly always possible to plant crops that would thrive under the expected conditions. It is quite possible that if we had a sufficiency of good charts covering the greater part of the earth, seasonal forecast might be made empirically, just as daily forecasts now are, and were they as successful as the present daily forecasts, the occasions on which a fairly good harvest could not be secured would be few, for it is seldom that the weather is not favourable for some one or two crops.

The key to the whole situation lies in being able to foretell the distribution of pressure. Being given a chart with the isobars on it, it is possible to fill in a great deal more with fair certainty.

But at present we are hopelessly in the dark as to the reasons of cyclones and anticyclones, why they form and why they move. The investigation of the upper air has led to this, that all our old theories about cyclones and anticyclones must go to the scrap-heap. It has been usual, and is still for that matter, to explain a high or low barometer by saying that the air over them is respectively cold or hot. The exact opposite is the fact. If the barometer in Europe at a certain place is very low it is a practical certainty that the greater part of the mass of air lying over that place will be very much colder, and therefore heavier, than usual. Facts of this sort have to be explained before we can hope to advance much farther.

But there is very good hope for the future. If the upper air investigation has entirely altered our ideas as to the cause of pressure changes, it has also shown that the conditions prevailing above are far more simple than they are below. If an isobaric chart for a height of 9 km. for Europe could be drawn for a given date, that chart would enable us to fill in with fair accuracy the temperatures, and therefore also the pressures, for the space covered between the heights of 1 km. and 20 km. Higher than 20 km. the observations do not go, and below 1 km. the conditions are exceedingly complex, but within the limits given the temperatures do not differ very far from linear functions of the pressure at 9 km.

It seems, therefore, as though the surface changes are a sort of by-product of the changes occurring above, but the outstanding puzzle is what produces and maintains the changes of pressure above.

Increased State-aid would help to solve this problem, for daily observations at one station up to an average of about 15 km. could be carried on in England at a cost of about 1000*l.* per annum, and a daily record of the changes occurring above would be of the greatest value. Increased money aid is also desirable to enable England to join in a general scheme for the production of charts covering the whole known surface of the globe. It is not, of course, certain that any immediate improvement in the forecasts would ensue, but increased knowledge would inevitably in the long run take a practical form, just as it has in every other branch of science.

Increased aid in another form is also much to be desired. The number of observations that have been tabulated and published is immense, but comparatively little working up has been done. The physical processes of the atmosphere present many fascinating problems; to go no further, we may instance the fall of temperature with height, and the abrupt cessation of that fall at about 11 km.; the facts are fairly well known, and the mechanical and thermodynamical principles that should explain them are known. There is plenty of work for many workers, and there are probably plenty of men well equipped with the requisite knowledge of mathematics and physics looking for some useful field of work. I would therefore commend to them the problem of the general and local circulation of the atmosphere.

W. H. DINES.

Watlington, Oxon., January 30.

Dr. Bastian's Evidence for Spontaneous Generation.

WE notice, in a communication that appeared in a recent issue of NATURE (January 22, p. 579), that Dr. Bastian is apparently under the impression that we accept his own interpretation of the "organisms" which have appeared in his sealed and sterilised tubes, viz. that they really are *living organisms*.

This does not represent our position. Dr. Bastian has kindly afforded us an opportunity of examining the contents of his tubes, which were opened in our presence, and although the resemblance between the "organisms" in question to living Torulæ, &c., was sufficiently striking, it did not seem to us to be proved that the similarity went beyond mere resemblance. We were not, and still are not, convinced of the living nature of these "organisms" at all, still less that they are living organisms spontaneously generated.

One of our colleagues, Mr. Paine, is engaged in repeating Dr. Bastian's experiments with the view of solving the problem as to what may be the actual nature of the appearances in question.

J. B. FARMER.
V. H. BLACKMAN.

Imperial College of Science and Technology, January 30.

A Possible Cause of Explosions in Coal Mines.

IF a cloud of dry dust is suddenly raised by a current of air and projected against an insulated conductor, the latter becomes charged with electricity to such a potential that sparks several centimetres in length may be obtained. It does not matter much—save in respect to the sign of the charge—what the nature of the dust is, for sand, coal dust, flour, or iron filings all give rise to strong charges. Sand gives a positive charge and coal dust a negative one. It therefore appeared possible that a cloud of dust raised by a sudden fall, or other means, in a mine might charge up an insulated conductor to such an extent that a spark could pass to an earthed conductor near it, and thus fire an explosive mixture of gases if this was present.

Some observations recently taken in the Ludlow Pit at Radstock have more or less confirmed this theory. In conveying the coal from the working seam to the shaft a considerable amount of dust is raised, and, walking behind the train of wagons, any electrification due to the dust was easily indicated by a Wulf electrometer furnished with a radium-tipped wire to act as a collector. With only a moderate amount of dust the electrometer indicated a potential of more than 280 volts, and a hollow insulated conductor held in the dust-cloud was also strongly charged. Sparks, however, could not be obtained in the mine, but on making experiments in the laboratory with coal dust from the mine, it was easy to charge up a metal tube to such a potential that sparks up to 1 cm. in length were obtained from it by blowing through the tube a stream of dust.

The dust actually present in the mine was, save close up to the working seams, never pure coal. In order to minimise the risk of dust explosions, large quantities of fine flue dust from the boilers were scattered in all the workings, so as to cover the coal dust, and this flue dust gave a charge of *opposite* sign to that upon the coal. When tested in the laboratory the mixture would *not charge* a conductor to a sparking potential, whilst pure coal dust, and more particularly the flue dust, gave very strong charges. If, then, such a combination should occur as that of a sudden cloud of coal, or perhaps other dust, an insulated conductor, an earth-connected conductor near it, and an explosive mixture of gases, it is not inconceivable that an explosion might follow. I make the suggestion quite tentatively.

W. A. DOUGLAS RUDGE.

Cambridge, January 28.

The Eugenics Education Society.

IN NATURE of January 29, Prof. Pearson complains that the sentence, "but even he (Sir Francis Galton) in the *last few months* of his life saw that the popular movement he had started was likely to outgrow its knowledge, and feared that more evil than good might result from it," which appeared in his letter to *The Times* of October 15, has been misquoted in the January number of *The Eugenics Review*, the words *last few months* having been altered to *last years*. He then goes on to say: "The controversial methods which can change 'last months' into 'last years,' and then cite letters of 1909 are characteristic of that looseness of procedure which must eventually be fatal to any popular movement run by this society." As a member of the editorial committee of *The Eugenics Review*, I passed the final proofs for the press, and so share the responsibility for the mistake with Major Leonard Darwin, who actually wrote the note in question. I do not quite understand what Prof. Pearson means by "looseness of procedure." If he merely means "making mistakes," then, although I have no wish to minimise the evils and dangers of so doing, I cannot agree with him that it "must be fatal to any popular movement run by the society." I hope I shall not be accused of promulgating a dangerously original doctrine if I say that it is human to err. Indeed, Prof. Pearson has on occasion been human enough to do so himself. Yet many human institutions, including those connected with Prof. Pearson, continue to flourish.

It is possible, however, that his words contain a more serious charge, namely, that of deliberately misquoting him in order to contradict him. I do not

suppose that Prof. Pearson would actually accuse Major Darwin and myself of such dishonesty, but he has not guarded his words against the possibility of this interpretation being put on them, and so I meet the charge—in the only way possible—by a flat denial.

It is interesting to inquire how the mistake under discussion could have arisen. It seems probable that the words "last few months" conveyed the idea of some indeterminate period of time, and that this idea and not the actual words were held in the memory, afterwards to be retranslated into words as "last years." This would probably not have occurred if Prof. Pearson had himself been a little more precise in the first instance. The interview which he refers to during which Sir Francis Galton expressed doubts concerning the policy of the Eugenics Education Society took place about three weeks before Galton's death. Is three weeks the precise period which Prof. Pearson describes as a few months? The last letter quoted in *The Eugenics Review* in answer to Prof. Pearson's original letter was written, not in 1909, but in October, 1910, about three months before Galton's death.

Finally, when Prof. Pearson wrote, "I have no other effective means except through the courtesy of your columns to correct a wholly erroneous statement, which the editor of that society's journal has put into my mouth," had not he already received a letter from Major Darwin apologising for the mistake, and assuring him that it would be corrected in the next number of *The Eugenics Review*?

EDGAR SCHUSTER.

110 Banbury Road, Oxford, January 30.

Origin of Argentine Wild Horses.

ANENT the recent discussion as to the origin of the wild (or feral) horses of the Argentine Republic, there is one line of evidence to which I venture to direct attention. That is the question of infertility.

Assuming, as I suppose most reasonable people do, that the South American horses were derived originally from the north—whether in the northern part of North America or in north-eastern Asia is immaterial—and that the South African horses are similarly derived, it would seem that the Argentine species would be at least as remote geographically from the wild ancestors of the domestic horse as are the modern zebras and asses, and could not be any more nearly related genetically. The species native to the Argentine, if they continued to exist down to modern times, would have evolved in complete isolation from any northern species since the early Pleistocene at least, and probably longer as regards any Old World species. Now the infertility of crosses between zebras or asses and domestic horses is based upon a separation that does not appear to date earlier than the late Pliocene. Beyond that they must be derived from a common stock. The autochthonic Argentine horses were therefore not any more nearly related to *Equus caballus* than are the zebra or the ass. They should therefore be equally infertile when crossed with the domestic stock. (The degree of infertility of distinct species varies in different families of mammals; but the known facts regarding the horse, asses, and zebras afford a measure of its degree in this family.) So far as I know there is no record of infertility in such crosses, and since, as I am informed, the wild horses are caught and domesticated on the pampas just as they were in the western United States, any such infertility could scarcely escape notice. This would seem to me to be a decisive argument against the theory that the existing wild horses of South America are descended either wholly or partly from any surviving native stocks. The argument would apply with less force to the wild horses of the western United States and Mexico, yet even with these it would appear to be a strong point. But the geologic evidence against the survival to modern times of any native horses in North America is very nearly conclusive in itself.

Even if we admit that some of the native horses may have survived in the Argentine until the time of the Spanish settlement—and I think that the evidence for that contention is strong, and that it is quite in conformity with some other features in the faunal history of South America—the native stock would presumably be no more able to interbreed with domesticated or feral stock of *Equus caballus* than could the quagga in South Africa. It would remain separate and immiscible until exterminated. No strain of it could survive in the modern feral horses.

W. D. MATTHEW.

American Museum of Natural History,
New York, January 15.

Specific Heats and the Periodic Law.

AT his last Friday evening lecture at the Royal Institution Sir James Dewar announced his somewhat startling discovery that at temperatures of about 20° absolute the specific heats of the elements are periodic functions of the atomic weights, and are therefore not in accordance with Dulong and Petit's law (established at ordinary and higher temperatures). May I venture to point out that a simple consideration of the difference of conditions in the experiments of Sir James from those of Dulong and Petit may ultimately harmonise the two sets of results?

From Guldberg and Wage's "mass law" it follows that the velocity increases with the mass (atomic weight), but this increase of velocity takes place at higher temperatures at a very much greater rate, with the result that at higher temperatures the atomic mass becomes relatively less important, *i.e.* the special atomic properties will be less emphasised. The velocity factor becoming so predominant, a proportionately smaller additional increase of (heat) energy will be required to raise the mass to a higher temperature, *i.e.* the specific heat will be inversely proportional to the mass (Dulong and Petit's law). At very low temperatures—say at about 20° absolute—when the velocity is very small—almost negligible—the *mass* of the atom is the predominant factor, and hence we find a periodic function of the atomic weight as the expression of the specific heat as well as of the other (physical and chemical) properties. The above suggestion might be tested by experiments to find a temperature at which neither the Dulong and Petit nor the Dewar law would be strictly obeyed.

H. LEWKOWITSCH.

22 Meadway, Hampstead Garden Suburb, N.W.,
January 31.

The End-product of Thorium.

IN continuation of our letter published in NATURE of February 5, containing a suggestion as to the nature of the end-product of thorium, we would point out that, of course, our view involves atomic weights for the various disintegration products of thorium higher than is ordinarily assigned to them, and that therefore the determination of the atomic weight of any one of them would afford a test of the truth of the hypothesis.

J. JOLY.
J. R. COTTER.

Iveagh Geological Laboratory, Trinity College,
Dublin, February 7.

FIORDS AND OTHER INLETS OF THE SEA.[1]

LIKE an experienced teacher, Prof. Gregory begins his book on "The Nature and Origin of Fiords" by a definition of its subject. Fiord is a Scandinavian word, and fiords are common on a large part of the coast of Norway, but the term is often used vaguely, and sometimes, as we shall see, with unjustifiable restrictions. With him it denotes an inlet of the sea, bounded by lofty and steep opposing walls; piercing far into the land, and consisting of long straight reaches, which turn and receive their tributaries at sharp angles. Thus, though a fiord is a sea-drowned valley, not all such valleys can be called fiords. It has been carved, as the definition suggests, in a plateau more or less elevated, which consists of hard rocks, and it is named a fiard when this plateau is low, the difference between the two being obviously varietal rather than specific, and a comparatively slight elevation, on such a coast as that of Norway, might show the one to end in the other. It remains narrow to its seaward end, thus differing from an ordinary estuary, which widens in that direction, so that waves may have helped in forming it, while they have done little for the fiord; and when one of the former has an irregular outline, and is bordered by bold rugged hills, it is designated a ria, from a Spanish name. Fiords are frequent in the northern and southern portions of the globe, and practically absent from the more tropical regions; they also often bear marked signs of glaciation. That, however, does not prove them to have been excavated by ice, or justify refusing to give the name fiord to a submerged valley with the other qualifications, for any such limitation is importing a hypothesis into a definition. This geographical distribution, however, is a fact, and Prof. Gregory attributes it to terrestrial conditions, which make oscillations in level more frequent in the higher than in the lower latitudes.

FIG. 1.—Map of Milford Sound, New Zealand. From "The Nature and Origin of Fiords."

From this preliminary discussion he proceeds to describe concisely the fiords in the several parts of the globe, in order to ascertain, by inductive study of their phenomena, by what agencies they may have been formed. Beginning with those of Norway, the home of the name, he points out the more important features in each, its relation to the neighbouring district, its outline and dimensions, with details, whenever obtainable, of its subaqueous contour. The Sogne fiord in Norway, one of the most accessible to English visitors, exhibits the characteristic features of such an inlet, especially in its upper branches, not less distinctively than that grand example, Milford Sound, in New Zealand (Fig. 1). The sides, to summarise Prof. Gregory's description, are high and steep, not broken by deep gullies, so that the streams rising on the uplands frequently descend as waterfalls over the walls instead of as cataracts hidden in deep gullies. We may therefore conclude that these cascades are comparatively modern—more modern, for instance, than in the Alps, where the other habit is the more common. Those sidewalls also are often subparallel, so that the fiords for considerable distances are uniform in width, their valleys also taking a straight course. The most typical Norway fiords are surprisingly deep, the maximum in the Sogne fiord being almost 4000 ft., and the walls descend for a long way beneath the surface of the water with as steep a slope as they have for some 2000 ft. above it. Thus a cross-section of their floors is trough-like, but the longitudinal one is a concave curve. In some cases the fiord bed rises and falls more than once in this direction, as in some Alpine and Scotch lakes, but in most cases, though not in all, the fiord has an outer (submerged) rim, sometimes narrow, sometimes comparatively wide, which prevents a free influx of the deeper ocean water. This, though it may sometimes consist of moraine deposited by a retreating glacier, or of ordinary detritus, like the bar at the mouth of an estuary, must often be, as Prof. Gregory explains, a true rock barrier. This last characteristic, together with their ice-worn rocks, the truncation of spurs from the mountain on either side, and their geographical distribution, have caused some geologists not only to attribute fiords to glacier erosion, but also to refuse the name to any similar submerged valley which could not have been formed in this way.

[1] "The Nature and Origin of Fiords." By Prof. J. W. Gregory, F.R.S. Pp. xvi+542+viii plates. (London: John Murray, 1913.) Price 16s. net.

But besides the general objection to this limitation, which has already been mentioned, the Dalmatian coast can show fiords as characteristic as those of Norway, though glaciers can never have been more than unimportant features on even the highest of the Dinaric Alps (Fig. 2). A glacier which continues to descend a main valley after those in the lateral glens have shrunk and ceased to be tributaries, may have converted the latter into hanging valleys; its ice-stream may have replaced the rugged ends of spurs by smooth facets, but a river also, in similar circumstances, can produce the one and the other, and, in many cases, as Prof. Gregory shows, it can be proved that the valleys occupied by fiords are pre-glacial.

But, as he proceeds to point out, the larger features of fiords—the straight channels terminated by a sharp twist, the high angles made by tributary valleys, indicate a close connection with the greater earth movements which have determined the main physical features of the region. A set of diagrams brings out clearly the frequent relation between the fiords, the lakes, the mountain ranges, and the shore lines in different regions, showing that the first and second very frequently follow the course of important faults. This seems indubitable, but we must remember that the work of the latter, though indispensable as a preliminary, has had an indirect, rather than a direct, effect in producing the present scenery. In regard to this a too frequent use of the term "rift valleys" may sometimes mislead: for a rift means a lateral rather than a vertical displacement, and should only be applied, as I pointed out in the *Geological Magazine* for 1905, where the surface is comparatively "raw"; for the "leading lines" in such an example as the Jordan valley can only be discovered by close study of the geology. In such cases the older name, trough-fault valley, seems preferable. Apart, however, from this question of nomenclature, Prof. Gregory supports his view, both against ice-excavation and in favour of earth movements, as the primary cause of fiords, with arguments which will be very difficult to overthrow. But we must conclude, and do this by expressing our hearty thanks to him for this admirable history of fiords and other forms of inlets of the sea. It will be a great boon to students, for it is a veritable encyclopædia, full of important facts, the collection of which must have entailed long and patient labour, because they are scattered about many publications in sundry languages, and often not readily accessible.

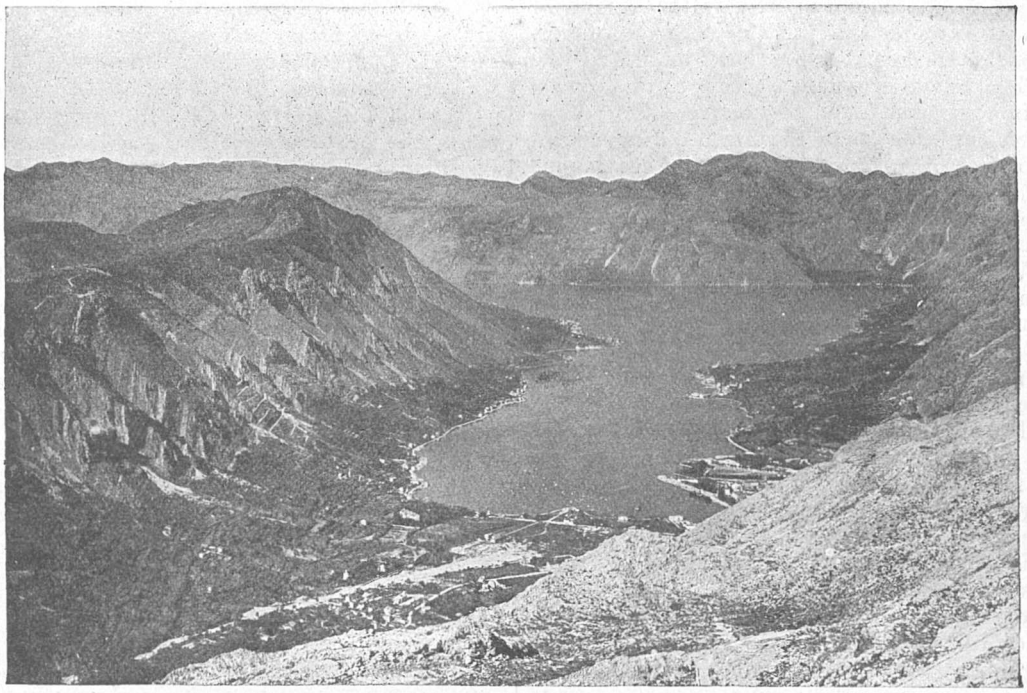

FIG. 2.—Cattaro Bay, the inner Branch of the Cattaro Fiord. The spurs on the fault-block on the left side of the view show triangular facets due to faulting. The precipitous slope above Cattaro, on the right margin of the view, is a fault-scarp. From "The Nature and Origin of Fiords."

T. G. BONNEY.

EDUCATIONAL LEGISLATION IN NEW SOUTH WALES.

THE economic, social, and educational problems which present themselves for solution in the free atmosphere of our more prosperous colonies, unhampered by tradition and conventions, and with their fresher outlook, often present features in the attempt to solve them well worthy the attention and possibly the emulation of those engaged upon similar questions at home.

We are on the eve of great educational changes, if we are to trust the somewhat vague utterances of the Lord Chancellor and of the Minister for

Education; and amongst them there are few reforms more urgent than the adoption of measures which will secure to the nation the fullest advantage of the best brains of its children.

The measures recently enacted by the legislature of New South Wales, as explained in a paper by Prof. H. S. Carslaw, reprinted from the *University Review* of Sydney, of July 13, 1913, which have for their object the opening of a clear road to the poorest scholar of talent and ability in the State from the elementary school to the university, deserve the closest attention of all who are interested in the highest welfare of the mother country.

The Act is an attempt to bring educational opportunity within reach of all those who, by ability, attainments and character, without distinction of class, can worthily take advantage of it.

It seeks to coordinate effectively the secondary schools, both public and private, with the university, so "that under it the best pupils of the schools will have unrestricted access to the highest available education," and to complete the educational system built up in the State during recent years so as to form "a progressive and continuous whole," from the primary through the secondary and technical schools to the university. In the words of Mr. Carmichael, the Minister of Education, "We want to make the university the final effort in the educational scheme as laid down by the Government; to exclude nobody, but to include everybody who has brains and application.

To this end a scheme of university exhibitions has been arranged allotting one to every five hundred of the population who are between the ages of seventeen and twenty, and exempting the holders from the payment of matriculation, tuition, and degree fees to the university.

There will thus be, on the basis of the present population of New South Wales, about 200 university exhibitions to award in 1914, and taking the average university course as four years, there would accordingly be, when the scheme is in full working order, 800 students enjoying the advantages of the Act in any one year.

But the cardinal feature of the scheme is to be found in the methods of award. All attempts at determining the merits of the candidates solely by an external examination, such as that of matriculation, are abandoned. Instead thereof, a system of leaving certificates is established, for which pupils in the duly registered high schools, whether State or private, which offer at least a four-year course beyond the primary stage approved by a specially constituted board upon which the university is largely represented, are eligible, provided they have passed through the complete four-year course to the satisfaction of the principal alike in respect of attainment, conduct, and personal character.

The pupils are then required to pass an examination in at least four subjects of their school course to the satisfaction of a board of examiners comprised of four officers of the department of public instruction and four professors or teachers of the university nominated by the senate.

The leaving certificate is thus awarded (*a*) upon the result of the four years' work in the high school; (*b*) upon the successful passing of an examination in certain subjects of the school course, and those pupils who take the highest places in the examination list are awarded the university exhibitions.

To meet, however, the cases of persons who have been privately educated or who have pursued their studies in later years and are thereby precluded from obtaining leaving certificates, a number of university exhibitions not exceeding five per cent. are offered annually to such persons who pass certain prescribed examinations. Provision is also made for students in evening tutorial classes.

Merely to exempt pupils from fees would not, however, remove the obstacles in the path of deserving but poor students, and so arrangements are made to meet such cases by bursaries in aid of their maintenance during the whole period of their studentship.

As will be inferred from the foregoing statement, the proposals are really a long step in the direction of making the university free to all competent students, and to meet this the Government is prepared largely to increase the State endowment, so that the university shall not be crippled in its resources or development.

It is part of a policy, in the words of Lord Haldane, to "secure for our national endeavours the help of our best brains," and that is its justification, and the reason why the experiment in New South Wales is deserving of the most serious consideration at the hands of our educational administrators at home.

There are those who doubt "whether the true educational ideal for an industrial community is that of an open road from the elementary school to the university," but if the university embraces, as it should, not only provision for the highest learning in all branches of knowledge, but also, as it should, training in their application, there need be little fear that the offer of "an open road" will not redound to the lasting good of the nation.

J. H. REYNOLDS.

DR. ALBERT GÜNTHER, F.R.S.

ALBERT CHARLES LUDWIG GOTTHILF GÜNTHER, whose death on Feburay 1 we announced with regret last week, was descended from a family which settled in and about Möhringen on the Filder Plateau at the beginning of the fifteenth century, his father, the Estates Bursar of Möhringen, having taken up his residence in Esslingen, where Albert was born on October 3, 1830. After attendance at the Stuttgart Gymnasium, his family destined him for the Lutheran Church, and with that view he was trained at the Theological College of Tübingen, where, as a student connected by descent with the Duke of Wurtemberg, he had free education. But science and medicine had greater attractions for the young naturalist, especially under such a teacher as Johannes

Müller, so that, after graduating as M.A. and Ph.D., and studying at Berlin and Bonn, he by and by became M.D. of Tübingen. Moreover, he, as a citizen of Prussia, did his share of military duties, and acquired the skill in the use of fire-arms that made him so good a sportsman in field and cover. He also published an account of the "Fishes of the Neckar," and a "Handbook of Medical Zoology"—visiting London thereafter in 1856.

Dr. Günther's writings had attracted the attention of Sir Richard Owen, and when they met in the British Museum, a friendship sprang up between them, the result of which was that he was ere long placed in charge of the fishes, amphibia, and reptiles in the museum. Few men could more conspicuously have justified the choice thus made, both by his contributions to systematic zoology and his capacity for administration. Thus settled at his favourite pursuits and surrounded by congenial companions, there issued from his pen a great landmark in zoology, viz. his ten volumes on Colubrine snakes, *Batrachia salientia,* and fishes; and, in addition, the Ray Society issued his fine volume on the "Reptiles of British India." His and Sir Lambert Playfair's beautifully illustrated work on the fishes of Zanzibar next appeared. With a critical eye to artistic work he had enlisted the aid of that lithographer *facile princeps,* G. H. Ford, so that almost all his papers and works were illustrated by this skilful yet delicate artist till his death in the 'seventies. To the Royal, Linnean, and Zoological Societies he contributed a long list of important papers, both systematic and structural, such as his well-known memoirs on Ceratodus and Hatteria (Sphenodon).

But the foregoing give only a partial view of the results of Dr. Günther's well-directed energy, laborious research and unflagging zeal. His "Fische der Sudsee," "Gigantic Land Tortoises," his most useful "Introduction to the Study of Fishes," his massive volumes on the "shore," "deep-sea," and "pelagic" fishes of the "Challenger," and the "Report on the Batrachia of Central America," have further to be taken into account. It may be truly said that no predecessor in his office did more continuous or more valuable work as a systematist than he. Besides, Dr. Günther was the founder and first editor of the *Zoological Record,* now carried on by the Zoological Society; and for thirty years he was the chief editor of the *Annals of Natural History.*

Yet another side of his wonderful energy and tenacity of purpose has to be recorded. The routine work in the British Museum is no light burden even for the robust, but Dr. Günther's term of office embraced a critical period, viz., after he became Keeper of the Zoological Department. Whilst to Sir Richard Owen belongs the honour of the scheme for a national natural history museum, to Dr. Günther fell much of the work of designing the galleries and cases, and, more than all, of transferring the gigantic collections to their new home. The minute of the trustees attests how ably and how successfully he accomplished this difficult task. It is interesting that, even at this early period, Dr. Günther was in favour of metal cases, though these were not adopted—probably on the score of expense. His personal influence with naturalists, travellers, and owners of estates at home and abroad was of infinite importance throughout to the national collection. Further, he reorganised the duties of the trained attendants in the museum, and thus relieved the scientific staff, which was gradually increased from four to thirteen scientific men, whose names are those of authorities in their several departments. To Dr. Günther is also largely due (1) the formation of a general library —so valuable, especially to zoologists—and (2) the designing of a separate spirit-room for the safety of the vast collections in jars, as well as for that of the institution itself. He retired from the office of keeper in 1895.

Considered from the point of view of his study, Dr. Günther was the foremost man of the day in his department; but he was also an accomplished field naturalist, equally at home in park and covert, or by lake and river. In his earlier days he was remarkably agile and hardy, and used to say he gained as much knowledge of natural history in the field as in the closet. Nor was he less keen on board a boat or yacht at sea; indeed, he more than once was the only effective zoologist on deck, as, for instance, when the late distinguished Prof. Kölliker enlisted him on a dredging expedition off the southern coast. His tanks for the preservation of rare or interesting forms for the British Museum were always in evidence on such occasions, and he spared neither labour nor care in the pursuit of his fishes and other forms. His home, moreover, reflected the dominant tastes of the man. Tree-frogs, chameleons, which fought for the best perch near the fire with tiny parrots, bird-cages indoors, and aviaries outside, the wonderful black and white gracle, the legacy of the late Lord Lilford, and other pets, made every visit memorable after his retirement from the museum; and the same may be said of the trees, shrubs, and flowers in his garden.

Thus his busy life passed to his eighty-fourth year when grave abdominal symptoms necessitated an operation, which, at first apparently successful, terminated his distinguished career. He was buried in Richmond cemetery, in the midst of a circle of sympathetic scientific friends.

Dr. Günther was the recipient of many honours from learned societies in Europe and America, whilst at home he had filled the offices of vice-president of the Royal Society, president of the Biological Section of the British Association, and president of the Linnean Society. He received the royal medal of the Royal Society, and the gold medal of the Linnean Society, as well as the medal of the Avicultural Society.

He was twice married—his first wife, Roberta McIntosh, many of whose exquisite coloured drawings have been published by the Ray Society,

dying in 1869 on the birth of her son, Robert, now the zoologist, geographer, and antiquarian of Magdalen College, Oxford; his second wife was Theodora Drake, of Fowey, a lineal descendant of a brother of Admiral Drake, who, with a son, survives him. Dr. Günther was one of the kindest parents, and spared neither time nor pains for the comfort, education, and happiness of his family, to whom, and to all who knew him intimately, he was endeared.

As a great systematic zoologist, as a naturalist who had early and independently worked out many of the problems of the distribution of animals, as a man of untiring energy and great powers of administration—these, and his solid work in the museum he loved so well, will ever be his best monument.

NOTES.

THE KING, accompanied by the Queen, opened the new session of Parliament on Tuesday, February 10. In his speech to the assembled Houses, he stated that among other measures to be presented would be one to give effect to the proposals, which were announced last session, for the development of a national system of education.

PROF. J. G. FRAZER has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public service."

WE announce with much regret the death on February 6, at sixty-five years of age, of Mr. H. B. Woodward, F.R.S., formerly assistant-director of H.M. Geological Survey.

ACCORDING to the *Revue Scientifique* the Russian Minister of Public Instruction has made a grant of 100,000 roubles (10,570*l.*) to the St. Petersburg Academy of Sciences to assist a search for radio-active minerals throughout the Russian Empire.

THE death, on January 12, is announced, at seventy-seven years of age, of Dr. C. M. Woodward, emeritus professor of mathematics and applied mechanics in Washington University, and past-president of the American Association for the Advancement of Science.

AT the annual general meeting of the Royal Astronomical Society, to be held to-morrow, February 13, the gold medal of the society will be presented to Prof. Max Wolf, director of the Heidelberg Observatory, for his work in celestial photography and spectroscopy. Prof. Wolf is expected to be present at the meeting.

DR. W. E. FARABEE, who is leading an expedition in Brazil on behalf of the University of Pennsylvania, has sent home word of the success of the first part of his journey. He had passed through the territory inhabited by the Macusi Indians, and had encountered several of the Carib tribes that were supposed to have disappeared, including the Wai Wai tribe. The ethnological study of these early inhabitants of the Caribbean region is one of the main objects of the expedition.

SIR ERNEST SHACKLETON stated at the Royal Geographical Society on Monday that on his forthcoming Antarctic expedition he proposes to take four geologists, two meteorologists, and two biologists. His scientific staff will be distributed as follows:—Trans-Continental party, one geologist; western party towards Graham Land, one geologist and another man of science; eastern party to Enderby Land, one geologist; Weddell Sea base, one meteorologist and one biologist; on board the ship one biologist, and Captain Davis, hydrographer; supporting party from the Ross Sea side, one geologist. The various parties will be sure to bring back sufficient results to justify the purely scientific side of the expedition. The main object of the expedition is the crossing of the south polar continent from sea to sea; and the very nature of the journey will solve the question of a divided or a single continental mass.

CORRESPONDENTS of *The Times* report that four slight, though distinct, earthquake shocks were recorded on February 10 by the seismographs at Albany and Washington. The tremors extended from Brooklyn to Buffalo, through Connecticut and Pennsylvania, and north to the district along the St. Lawrence River. The seismograph at the Museum of Natural History in New York shows that the shocks began at 1h. 35m. p.m., and ended at 1h. 37m. 30s. Two pronounced earthquake shocks were registered by the seismograph at Toronto Observatory—one at 11.30 a.m. and the other at 1.29 p.m. The shocks were felt generally throughout the province. The entire St. Lawrence valley around Montreal was also affected.

As announced in *The Times* of January 30, Lord Tankerville has presented to the Zoological Society a young pair of the white cattle from his park at Chillingham, Northumberland. According to an article in the same journal of February 2, the animals were caught as yearlings by enticing them with food into a trap. Although the Chillingham and other white park cattle are often termed "wild," they are really descendants of domesticated breeds which have reverted to a semi-wild state.

INFORMATION has been received that through the generosity of Mrs. Rotch, the observatory at Blue Hill, near Boston, founded by the late Prof. Lawrence Rotch, for the study of the upper air, and partially endowed by his bequest of fifty thousand dollars, has been established for five years in connection with Harvard College. Mr. McAdie, formerly in charge of the Californian section of the United States Weather Bureau, has been appointed director of the observatory, and at the same time professor of dynamical meteorology in Harvard University. We also understand that provision is to be made in connection with the French department of war for continuing the aërological work carried on by the late M. Léon Teisserenc de Bort, at his observatory at Trappes.

WE learn from *The Times* that the Austrian Geographical Society has decided to honour the memory

of Captain Scott by the posthumous award of the Hauer medal, the highest distinction the society has to offer. Another tribute to Captain Scott's memory is the erection, on the Col du Lautaret, a pass in the French Alps, at the suggestion of Dr. Charcot, of a rough stone cairn with a bronze tablet bearing the inscription :—"Captain R. F. Scott, of the English Navy, who, on his return from the South Pole, died bravely with his companions for his country and for science about March 25, 1912, stayed at Lautaret in March, 1908, to prepare for that memorable expedition."

As there will be no meeting of the British Association at home this year, it is proposed to hold in Edinburgh on Tuesday, September 8, and the four following days, a conference of observers and students of meteorology and allied subjects. One of the objects of the conference is to bring together observers in meteorology, climatology, oceanography, limnology, atmospheric electricity, terrestrial magnetism, and seismology, as well as persons who are interested in the discussion of the observations. Special attention is to be directed to the teaching of meteorology in schools and to the relation of meteorology to aviation. To ensure the success of the conference, it is important that the organising committee should know as soon as possible the names of those who propose to attend, and such persons are invited to communicate with Mr. F. J. W. Whipple, honorary secretary, at the Meteorological Office, South Kensington, S.W. The representative character of the organising committee, of which Dr. W. N. Shaw is chairman, and to which further additions are to be made, augurs well for the success of the conference.

IT is with sincere regret that we record the untimely death of Major G. E. H. Barrett-Hamilton, which, according to a cable message received at the Natural History Museum, occurred on January 17 from heart failure in South Georgia, where the deceased naturalist was conducting an investigation into the whaling industry on behalf of the Colonial Office and the museum. Of Irish nationality, and inheriting a patrimony at Killmanock, county Wexford, Major Hamilton was born in 1871, and was educated, first at Harrow, and finally at Trinity College, Cambridge. Very soon after taking his degree—if not, indeed, before—he began to devote attention to the mammals of the British Isles, one of the earliest—if not the very earliest—of his papers being on the marten in Ireland, published in *The Zoologist* for 1894, while in the following year he established, in conjunction with Mr. O. Thomas, the distinctness of the Irish stoat. This line of research culminated in "A History of British Mammals," of which fourteen parts have been already issued, this being the only work in which the subject is treated on a thoroughly modern scientific basis, and which will remain as the best memorial to its talented author. In 1896 Major Barrett-Hamilton accompanied Prof. d'Arcy Thompson to Bering Sea, as the British representatives on the Fur-Seal Commission, in which capacity he did a large amount of excellent work. This no doubt led to his being appointed last summer to the aforesaid South Georgian whaling mission, on which he started in October.

THE executive committee of the fourth International Botanical Congress, to be held in London next year, in conjunction with Dr. Briquet, the *rapporteur général* for the section of nomenclature, has issued a circular relating to the work of this section at the congress. This will consist in the completion of the rules of botanical nomenclature, issued as the result of the meetings at Vienna (1905) and Brussels (1910), by the settling of certain points left over from those meetings. The programme of work for 1915 was defined by the congress of 1910 as follows :—(1) To fix the starting point for the nomenclature of (*a*) Schizomycetes, (*b*) Schizophyceæ, (*c*) Flagellatæ, (*d*) Bacillariaceæ; (2) to compile lists of *nomina generica utique conservanda* for (*a*) Schizomycetes, (*b*) Algæ, (*c*) Fungi, (*d*) Lichens, (*e*) Bryophyta; (3) Compilation of a double list of *nomina generica utique conservanda* for the use of palæobotanists; (4) discussion of motions relating to new points which were not settled by the rules adopted at Vienna and Brussels. The carrying out of this work has been entrusted to two committees under the direction of a *rapporteur général*, Dr. J. Briquet (Geneva), assisted by Prof. H. Harms (Berlin). Copies of this circular, which contains lists of the committees and subcommittees for the various groups and other information, may be obtained from the general secretary, Dr. A. B. Rendle, British Museum (Natural History), Cromwell Road, S.W.

DETAILED plans have been published for the work of the British Antarctic Expedition under Mr. J. Foster Stackhouse. The main object will be to ascertain something of what lies between King Edward VII. Land in the Ross Quadrant and Graham Land in the Weddell Quadrant, and whether the former is a part of the Antarctic continent, or insular. The expedition will use Scott's vessel, the *Discovery*, which is intended to leave London on August 1, 1914. She is to proceed by Cape Town and Bouvet Island, the Sandwich Islands, and South Georgia to the Falkland Islands, and thence to sail for Graham Land at the end of 1915. Here exploration and scientific work are to be carried on for a year or more, the *Discovery* meanwhile working south and east. The landing party, having been relieved and reprovisioned, will explore between Graham Land and King Edward VII. Land in 1916, and after wintering, a sledging expedition will make for the Bay of Whales in King Edward VII. Land, whence the *Discovery* will convey them home by New Zealand and the Panama Canal. Lieut. A. E. Harbord, R.N., will command the ship, and the party will include Lord Congleton, Captain A. S. Cantrell, Mr. W. H. Stewart Garnett, and Mr. D. H. Pearson, as surveyors and in other capacities, while the Master of Sempill will undertake meteorological work and also the care of the electrical and motor mechanical appliances. The expedition is expected home in the later part of 1917, and its total cost is estimated at 25,000*l*. If expeditions now in the Antarctic field or about to enter it should all succeed in their various objects, the next few years should bring a working outline knowledge of Antarctica.

MR. A. F. R. WOLLASTON on January 26 described before the Royal Geographical Society his journey in Dutch New Guinea in 1912. His principal object was to ascend to the snowy ridge of Mount Carstensz, and to see what lies beyond (which is unknown); in this he only just failed of success. A canoe accident (not the first of its kind on a New Guinea river) deprived him on his return journey of valuable records and effects. In spite of these misfortunes he has brought back much valuable information concerning the physical geography and biology of the country traversed (the Utakwa valley), and also its inhabitants. These last he divides into the coast people and the mountain people, who live at elevations from 4000 to 6000 ft. or more. He also encountered a third class, of wanderers believed to come from the west. The appearance and habits of the mountain people, and their struggle for existence, were vividly described. Mr. Wollaston was accompanied by Mr. C. Boden Kloss, of the Kwala Lumpor Museum, who undertook the zoological and botanical work; he also acknowledged much practical assistance from the Dutch authorities. As regards the physical features of the country, he commented (among much else of interest) on the remarkably complex structure of the foothills, and traced the diminution in the thickness of the jungle undergrowth at about 7000 ft. of altitude, the change from the lower forest trees to pandanus and casuarina at 8000 ft., and the disappearance of trees above 10,500 ft. His progress was stopped by precipitous rocks and an ice-wall at 14,866 ft., not 500 ft. below the summit-ridge.

THE issue of *The National Geographic Magazine* for January is wholly devoted to a finely illustrated article by Mr. F. E. Johnson, entitled "Here and There in Northern Africa." It contains a splendid series of photographs depicting the racial types, particularly those of the Ouled Nail dancing girls, whose performances are familiar to visitors to Biskra. The pictures of life in the harem and in the oases are very striking, while those of the moving sand-dunes with waves like those of the sea produced by wind action are of special interest.

PROF. DALL' OSSO, of Ancona, announces an important archæological discovery in the shape of a burial-place of the Stone Age in the Valle Vibrata, in the Abruzzi. The bodies were not buried, but laid in small huts containing from two to eight each, arranged on low platforms sloping towards the centre. With a single exception the bodies all rest on one side, with the knees drawn up, a position not unlike that of the crouching pre-dynastic Egyptian, in Case A of the first Egyptian room in the British Museum. The articles found with the remains, especially the vases and other utensils, indicate a higher degree of civilisation than has been observed in other instruments of the Neolithic age.

FURTHER accounts of the excavations conducted by the British Museum on the site of Carchemish indicate that the results are more important than was anticipated. The excavation of the Acropolis has been to some extent disappointing, because much was destroyed by Roman work in the second century. But a large building recently unearthed shows a continuous series of reliefs cut in slabs of white limestone and black diorite alternatively. We have processions of the king, his family, and attendants. These slabs, which technically contrast with Mesopotamian work in height of relief and broad simplicity of treatment, deserve comparison with the best Assyrian sculptures. Much more can be done if funds are forthcoming, and it may be hoped that immediate measures will be taken to complete these excavations, which promise to throw welcome light on the little-known Hittite culture.

DR. MILLARD'S Chadwick Lectures on the subject of "The Vaccination Question in the Light of Modern Experience," are well worth careful reading. We dislike the phrase, "The Vaccination Question," for it conveys to many minds a vague notion that vaccination does not protect against smallpox. The only vaccination question is, whether "the Leicester method" can so ensure a community against smallpox that the community can wisely disregard the use of infantile vaccination. In forty years, Leicester has had only forty-six deaths from smallpox; that is very few. Doubtless, if these forty-six persons had been well vaccinated just before they were exposed to the disease, the number of deaths would have been not forty-six, but none. Dr. Millard rightly says that "in the rather remote contingency of a really serious epidemic of smallpox occurring again in Leicester, or in any town, he would advise everyone to get vaccinated, even though they had already been once vaccinated." But the phrase, "a really serious epidemic," implies a good deal of disease among those who have not got vaccinated. Doubtless, Leicester, with its magnificent sanitary service, and its not unnatural pride over its own health, and a cordon of less unvaccinated towns round it, is what one calls "fairly safe"; but contingencies, even remote contingencies, do sometimes take form in fact. We have to reckon with "unrecognised cases, especially when occurring in the tramp class," and with a host of our individual civic and domestic responsibilities, and with the bare possibility that the remnants of smallpox in this country may of themselves increase in strength.

VOL. VII. of the *Boletim do Museu Goeldi* (*Museu Paraense*), which relates to the years 1909–10, although only published in 1913, contains a narrative, illustrated by photographs of natives and scenery, of a journey from Xingú to Tapajoz, undertaken by Dr. E. Snethlage, as well as a report on scientific explorations in Pará by Mr. A. Dueke.

IN an article published in *The Egyptian Mail* of January 15 it is stated that, among other additions, the Giza Gardens have acquired a second specimen of the white-eared kob (*Cobus cob leucotis*) from the swamps of the White Nile. These two are believed to be the only examples of this antelope brought alive from the Sudan, the first having been received nearly two years ago. It is also mentioned that Mr. J. L. Bonhote, who joined the staff of the gardens some time ago, is at present rearranging the museum.

THE report of the (Egyptian) Zoological Service for 1912 contains reproductions from photographs of some of the more interesting animals in the Giza Zoological Gardens. The Government, it appears, has been taking measures for the protection of certain kinds of birds, particularly the cattle-egret (*Ardea bubulcus*). That species has suffered so severely from the plume-hunters that in the spring of 1912 only a single breeding colony remained in the whole of Lower Egypt. Thanks, however, to protective measures, more than 500 young birds were bred under natural surroundings under the care of a watchman of the Zoological Service. In Upper Egypt one large breeding colony remains, and, as the watchman reported the presence of a very large number of young birds in the country, there may be others.

IN *Symons's Meteorological Magazine* for January Mr. R. C. Mossman concludes the seventh of his interesting articles on southern hemisphere seasonal correlations, with some remarks as to the practical value of this class of research. He considers it almost certain that interaction is world-wide, but that even to-day there are not sufficient weather data for many regions. As an essential feature of this study a bipolar campaign is suggested, and also that the equatorial belt should be specially investigated. The method of using the preceding weather in one part of the earth as a means of arriving at a knowledge of what will subsequently take place in another part has already had practical application in determining the probable intensity of the Indian monsoon. He thinks that the establishment of a world-bureau is the only way to meet the situation, owing to the enormous labour involved; this question has, however, been discussed at several of the international meetings, but all efforts to found such an institution have hitherto failed.

THE December number of *Terrestrial Magnetism and Atmospheric Electricity* contains the results of the determinations of magnetic declination made by the survey ship *Carnegie* on the voyage from St. Helena to Falmouth during the autumn of 1913. From these results it appears that the British chart of the Atlantic shows the westerly declination too small by about 0·7° over that part of the course between latitudes 5° south and 20° north, and about the same amount too great between 35° and 45° north. According to a note in the same number the *Carnegie* has now returned to New York, having completed her circumnavigation cruise of 70,000 miles commenced in June, 1910.

THE introductory remarks on galvanometers and their properties with which the Cambridge Scientific Instrument Company prefaces its new catalogue of those instruments will prove of the greatest value to all who have to deal with electrical measurements. They cover such subjects as the period, the damping, the steadiness of the zero, the resistance, and the sensitiveness of the instruments, and furnish a sounder scientific basis for the choice of a galvanometer for any special purpose than can be found outside the scientific papers dealing with the subject. In order to compare different types of instruments a "factor of merit" is calculated from the behaviour of each. It is defined as one hundred times the deflection in millimetres per micro-ampere at a scale distance of a metre, divided by the square of the undamped periodic time in seconds and by the two-fifth power of the resistance of the instrument. The values are roughly one hundred for the Ayrton-Mather ordinary, 700 for the short-period instrument, 7000 for the Paschen, 150 for the Broca, and 100,000 for the Einthoven string instrument. In the last case the comparison is somewhat doubtful, as the deflections are read through a microscope, and not in the standard way described in the definition.

ONE of the subjects dealt with in a recent paper by Mr. B. Welbourn, entitled "British Practice in the Construction of High Tension Overhead Transmission Lines," and published in the Journal of the Institution of Electrical Engineers for January 15, was protection against atmospheric disturbances. He expressed the opinion that no necessity exists in this country for earth wire protection above the power lines, as experience has shown that lightning troubles are very few and no more frequent than are mechanical faults on underground cables. Horn gap arresters, with or without choking coils, erected in the open air, especially in industrial districts, he condemned as wrong in principle, as well as being untrustworthy. The extensive use of electrolytic aluminium arresters is limited by the fact that they need charging every day from the line. Moscicki condensers are coming into favour slowly, possibly because of their high first cost. A novel method which has been found satisfactory has been developed by Messrs. Merz and McLellan, who have discarded arresters on all lines which are connected to the system through transformers. About 10 per cent. of the end turns on the line side of these are insulated with special materials to a thickness of 300 to 400 per cent. of the insulation on the remaining turns. Atmospheric disturbances on the line are reflected back by the end turns of the transformers, and the oscillations are damped out by the ohmic resistance of the line.

THE Mathematical Association has issued a catalogue of the current mathematical journals of all countries of the world, with lists of the libraries in Great Britain where they are taken in, and the dates at which the series commence and terminate when discontinued. This valuable little pamphlet is published by Messrs. G. Bell and Sons, Ltd., London, price 2*s.* 6*d.*, and editorial communications for insertion in future issues are to be sent to Mr. W. J. Greenstreet, The Woodlands, Burghfield Common, near Mortimer, Berks. The present catalogue is issued on the understanding that it contains a first draft of the titles of current mathematical periodicals. Many periodicals of a general character containing mathematical articles are also included in its scope, though publications such as those of our Royal Society are excluded. The catalogue should be in every public library and in the library of every mathematician; it contains 182 entries.

IN a recent issue of *The Chemical News* (vol. cix., p. 37, January 23, 1914), Dr. J. C. Cain describes some new experiments on the estimation of alcohol in beer by Malligand's ebullioscope. This instrument was invented in 1874, and tested thoroughly at that time with French wines and with German and Scandinavian beers, but appears to have been almost forgotten. The percentage of alcohol is determined by its influence in lowering the boiling point of the water; the solid contents of the wine and beer, being of high molecular weight, are almost without effect on the boiling point. The thermometer is provided with a movable scale, which can be set to correspond with the boiling point of water as it varies with changes in the barometric pressure. It is calibrated directly to correspond with percentages of alcohol, so that no tables or calculations are required. The whole determination can therefore be carried through in a few minutes by anyone who is capable of reading a thermometer. In a series of twenty-two analyses, the percentage of alcohol found in this way was usually within 0·1 per cent. of the percentage determined by the standard method of distillation.

THE properties of alcohol and of stimulants in general in relation to their physiological effects form the subject of an address, given by Prof. H. E. Armstrong to the Institute of Brewing, which is printed in the December issue of their journal. The account given of the power of alcohol and its homologues, when used in moderate amounts, to penetrate the membrane which encloses the cell is a clear statement of facts which will have to be considered by the physiologist, and should do something to overcome the prejudice against alcohol which exists in the minds of otherwise fair-minded people. The ill-effects produced by alcoholic beverages are more probably to be ascribed to the presence of small proportions of still more active substances. The action of alcohol and similar hormones is to accelerate the rate of passage of water and diffusible substances through the cell walls. Probably the ordinary changes involved in the life of the living cell cannot go on without some kind of stimulus from without to disturb equilibrium, so that, particularly with a simple diet, some form of stimulant must be taken with the food. Such stimulants are not necessarily alcoholic, as one of the most common digestive stimulants is carbonic acid—*e.g.* aerated waters. Excess of such stimulants are contained in meat extracts, the supposed body-building power of which is almost entirely fictitious, being due to an increased proportion of water in the cells.

THE strength of stayed flat plates forms the subject of a report issued by Mr. C. E. Stromeyer, chief engineer of the Manchester Steam Users' Association. Mr. Stromeyer has analysed and correlated a number of experiments on this subject, and suggests empirical formulæ for practical use. Some interesting information is included regarding working conditions. Thus, one of Mr. Stromeyer's inspectors examined recently a loco-portable boiler, and found that the firebox had wasted almost to the vanishing point. The thickness of the crown plate, as gauged by the inspector, varied from one-thirty-second to one-sixteenth inch, yet this flat plate had withstood satisfactorily a working pressure of 70 lb. per sq. in., the stays being pitched at $5\frac{1}{4} \times 4\frac{1}{2}$ in. centres. No bulging was reported. Reference is made to Bach's experiments, and we are reminded that fuller details of these experiments may be expected shortly.

TEACHERS of geography who have adopted modern methods of instruction should examine the coloured "Contour Hand Maps" of the counties of England and Wales which are being published at the price of 2*d.* net each by Messrs. G. W. Bacon and Co., Ltd. Judging from the eight specimen maps which have been received, teachers will have no difficulty in devising an abundance of practical exercises which will make easy to young people an appreciation of the relief of an area from a study of its contoured map.

OUR ASTRONOMICAL COLUMN.

DETONATING FIREBALL OF JANUARY 19.—Mr. W. F. Denning writes:—"A few minutes after 7 p.m. on January 19 a magnificent meteor was seen at Reading, Oxford, and other places in that part. It illuminated the sky with a brightness superior to the full moon, and startled many persons as the night had been very dark, and the transformation was almost instantaneous. The fireball traversed a long arc extending probably over 60°, at a slow rate of motion, the estimated duration being from five to seven seconds.

"A few minutes after the meteor had disappeared a heavy sound as of distant artillery was distinctly heard at many places, and there was a decided vibration of houses, the windows shook, crockery ware rattled, &c., as during an earthquake. At Oxford there was a loud report rather like thunder. At Finstock, Oxon., the noise is said to have resembled the boom of a heavy gun rather than a clap of thunder. At Shinfield, near Reading, and at other places in Berks, the doors and windows rattled. Certain persons who did not see the meteor thought that the disturbance was due to an earthquake shock. At Wallingford the sound followed the light three minutes, so that the explosion may have been about thirty-seven miles distant. This represents the motion of sound in ordinary air. In the rarer atmosphere of great elevations it travels much slower, and the distance may therefore have been greater. The fireball seems to have passed from N.E. to S.W. from Hertfordshire to Berkshire, at a height of about fifty-one to eleven miles. It had a luminous flight of about sixty-seven miles, and a velocity of about twelve miles a second.

"During the last fifteen years an unusually large number of fireballs have appeared in the month of January. Mrs. Fiammetta Wilson has informed me that there is an old Roumanian superstition that bolides may be abundantly observed from January 14–20, and especially on January 19."

COMET 1913*f* (DELAVAN).—Dr. G. van Biesbroeck, of the Uccle Observatory, sends to the *Astronomische Nachrichten*, No. 4711, his determinations of the parabolic elements and ephemeris of comet 1913*f*, discovered by Delavan. The former are based on observations made on December 19 and 29, 1913, and January 14 of this year, and the ephemeris satisfied the latest observation of this object made on January

22. The following is the portion of the four-day ephemeris for the rest of the present month :—

oh. M.T. Berlin.

		R.A. (true) h. m. s.	Dec. (true) ° ′	Mag.
Feb.	13	... 2 38 59	... +0 48·7	... 10·8
	17	... 39 27	... 1 31·0	... ,,
	21	... 40 11	... 2 13·8	... ,,
	25	... 41 9	... 2 57·0	... ,,
March	1	... 2 42 22	... +3 40·7	... 10·8

The brightness is calculated on the assumption that on December 17 the comet was of magnitude 11·0.

DARK REGIONS IN THE SKY.—Prof. Barnard contributes some valuable observations regarding the appearance of the very dark areas in star clouds and nebulæ which have attracted attention from time to time. The number of such areas is quite considerable, and he promises at some future time to make a catalogue of them. In his paper to the current number of *The Astrophysical Journal* (vol. xxxviii., No. 5) he describes two of these remarkable areas, namely, one in the star cloud of Sagittarius, and another in the nebulous stream south of ρ Orionis. While photographs of the Sagittarius star cloud show a small and definite spot, Prof. Barnard has made numerous visual observations and has been led to the result that the object is not a vacancy among stars, but a more or less opaque body. With regard to the second dark area, the dark notch in the nebulous stream is, as he says, "clearly a dark body projected against and breaking the continuity of, the brighter nebulosity." He further states :—"Possibly this is a portion of the nebula itself nearer to us, but dark and opaque, that cuts out the light from the rest of the nebula against which it is projected." Visual observations by him with the 40-in. refractor confirmed his view that an obscuring medium was the origin. It is interesting to direct attention to the photographs of some spiral nebulæ seen edgewise as photographed by Dr. Isaac Roberts, such as H̲IV 24 Comæ Berenicis, where it is stated, "the photograph shows the nebula to be, almost certainly, a spiral viewed edgewise, the dark line across it being caused by the fainter portion of the nebulous convolutions being now turned towards the earth; they would thus be dense enough to obscure the nucleus and its surroundings, but not bright enough to impress the film, they thus appear as a dark line." Markings somewhat analogous to that described by Prof. Barnard in the nebulous stream of ρ Orionis are illustrated in Roberts's nebulous region round the cluster N.G.C., Nos. 2237–39 Monocerotis, in which "black tortuous rifts meander through the nebulosity . . . margins are sharp and well defined . . . like cleanly-cut cañons."

A REVIEW OF GEOGRAPHICAL REVIEWS.

BY means of a brief survey of some of the more important articles which have appeared in recent issues of leading foreign geographical periodicals, it is possible to compare and in a measure contrast the trend of geographical study in different countries. We may broadly classify such articles mainly under the departments of (1) travel and exploration, wherein travellers present general accounts of their observations and experiences, (2) physical geography, (3) human geography, and (4) cartography and geography. It is to be expected that at the present stage of the world's progress the department of travel should be finding a place of lower importance relatively to the rest than that which it formerly occupied; it is also natural that this tendency should be more clearly remarked in foreign publications even than in our own *Geographical Journal*, in view of our wide territorial interests.

During the past year, however, we find evidence in all the geographical publications under notice of the international character of the interest in Arctic and Antarctic research, with especial reference to the work of Filchner in *Petermanns Mitteilungen*, and of V. Stefánsson in the Bulletin of the American Geographical Society, together with universal appreciation of the results of Scott's expedition. For the rest, Dr. F. Kühn dealt at some length in the *Mitteilungen* of July with his visit to the Cordillera of San Juan, Argentina, and in *La Géographie* (the bulletin of the French Geographical Society) we have a steady record of French activities in Africa, such as the account of the Mission Rohan-Chabot in Angola (January), Capt. Niéger's "Mission d'études du transafricain" (February), M. le Terrier on the lakes of the Lower Ogowe (June), and H. Roussilhe's account of the "Mission hydrographique Congo-Oubangui-Sangi" (August).

Physical geography shares with travel the pages of the French publication almost exclusively (so far as concerns leading articles); the direction of this branch of study is in general towards detailed work in limited areas, a tendency which is also very clearly marked in the *Bolletino della Reale Società Geographica* (Italy) and the American Bulletin, for in both these countries this department of geographical study stands, as in France, in an eminent position. In all three the limitations of geomorphology appear to be clearly recognised; the land-form, not its geological composition (at least not primarily) is the subject of investigation. Examples are Sumner Cushing's study of the east coast of India (Bulletin, February), the Ohio floods of 1913, by Robert M. Brown (*ibid.*, July), Etienne Clouzot's "Modifications littorales de l'île de Noirmoutier" (*La Géographie*, January), P. Lemoine's "Régions naturelles du département du Gard" (*ibid.*, March), R. Blanchard's "Morphologie du Caucase" (*ibid.*, June), while in all three countries it is clear that growing importance is attached to the branch of potamology; while climate, vegetation, and (in France) glaciers, also provide material for study.

The department of human geography holds a markedly more prominent place in the *Mitteilungen* than in other journals; perhaps the most important contribution to it has been Dr. L. Weise's notice and map of the distribution of population in Europe (January); the recent census (as in other countries) has been made the basis of other geographical studies, such as Prof. F. Auerbach's "Gesetz der Bevölkerungskonzentration" (February), and Dr. Olbricht's "Die deutschen Gross-Städte" (August), while among other studies mention is due of Prof. Cvijic's close, and at the present moment of history peculiarly valuable, survey of the ethnographical boundaries in the Balkan peninsula (March *et seq.*) From the American Bulletin may be quoted Mark Jefferson's "Anthropogeography of North America" (March), and Mary Dopp's "Geographical Influences in the Development of Wisconsin" (June *et seq.*). In Germany and America this department is clearly more strongly developed than elsewhere.

In the department of cartography we turn naturally for guidance to Germany; it is perhaps a sign of grace that a writer in the American Bulletin, Martha K. Genthe, has done the same by contributing a "Note on the History of Gotha Cartography"; American cartographers, at any rate on the commercial side, have notoriously much to learn and to unlearn, while A. Briesemeister's large map of the

Arctic regions, presented with the Bulletin, possesses no marked merit.

Before closing this notice, reference must be made to Prof. K. Haussmann's "Die magnetischen Landesaufnahmen im Deutschen Reich und magnetische Uebersichtskarten von Deutschland in 1912" (*Mitteilungen*, January–April), and to the regular supplement on military geography in the same journal, which (apart from the interesting and suggestive fact of its mere existence) shows that that branch of study is by no means a preserve of military men.

WIRELESS TELEGRAPHY.[1]

(1) OF the last four parts of the sixth volume of the *Jahrbuch der drahtlosen Telegraphie und Telephonie*, part 3 is almost wholly devoted to an account of the doings of the recent International Radio-telegraph Conference in London, and of the fruits of their labours. In part 4 there is a return to scientific and technical matters, the principal article being one which concludes an elaborate piece of work, both theoretical and experimental, by F. Müller, on the oscillations in three coupled circuits. Part 5 contains several articles of interest. One, by S. Loewe, on the calibration of thermo-elements for accurate quantitative work—chiefly in connection with the measurement of small high-frequency currents—may be useful to others than those in Hertzian research. A very elaborate technical study of a resonance inductor for use with alternating current of 1000 periods per second is contributed by S. Kimura. An article by G. Seibt describes apparatus for the exhaustive testing of mineral substances with a view to their usefulness as detectors of electrical oscillations. Part 6 contains a paper by P. Jégou on the utility of acoustic resonance in wireless telegraphy—a matter that has received considerable attention of late on account of the widespread use of rapid sparks, producing musical notes, in signalling. F. Kiebitz contributes two articles, one dealing with an elaboration of Bjerknes's method of measuring the decay coefficient of a circuit, the other describing new experiments on antennæ consisting of long wires stretched horizontally at a height of a few metres above the surface of the earth. It is found that the state of the ground under the horizontal antennæ greatly affects the efficiency with which such antennæ can radiate. This article is followed by an interesting correspondence on the same subject.

(2) A new edition of the official handbook for wireless telegraph operators, revised in accordance with the International Radio-telegraph Convention of London, 1912, has recently been issued by the Postmaster-General. It contains eighty pages, and is sold at 3*d*. Though it does not in any way deal with scientific principles or technicological details, it will be found of interest to everyone connected in any way with wireless telegraphy. Very full instructions are given concerning the calculations of rates and of the routine of transmitting a message; this will be of interest to those of the general public who have occasion to use radio-telegraphic facilities. The comprehensive tables and lists of abbreviations to be used for commonly occurring phrases, are absolutely indispensable to the amateurs who amuse themselves by tapping other people's messages. The book closes with the regulations of the examinations for qualification as an operator on board ship.

[1] (1) "Jahrbuch der drahtlosen Telegraphie und Telephonie." Heraus gegeben von Dr. Gustav Eichhorn. Band 6, Heft 3-6. (Leipzig: J. A Barth, 1913.)]

(2) "Handbook for Wireless Telegraph Operators Working Installations Licensed by H.M. Postmaster-General." (London: Wyman and Son, Ltd., 1913.) Price 3*d*.

THE PRESERVATION OF NATURE IN GERMANY.

IN 1907 the Prussian Ministry of Education instituted the Central Office for the Care of National Monuments. The office is in the old Botanical Museum in Berlin, and it contains, besides other rooms, a library and a large hall for meetings and lectures. The staff includes a director, two naturalists, a lawyer, librarians, and clerks. Associated with the Central Office there are in the provinces of Prussia forty local committees, on which are representatives of the Imperial Government, the local administration, the agricultural and forestry departments, and the local universities and museums. The provincial committees are not supported financially by the State; they receive, however, small grants from the provincial administrations for the purpose of working expenses. The aims of the Central Office are:—(1) To discover the existence of natural monuments[1] and to investigate and preserve them; (2) to make records of their situations and the conditions of their ownership; (3) to make maps and photographs of them for permanent preservation in the office; (4) to form a collection of all the literature dealing with the dangers threatening such places and their prevention, the laws relating to the ownership of land, and any scientific books discussing in particular the areas reserved or worthy of reservation.

The publications of the Central Office are two. "Beiträge zur Naturdenkmalpflege" contains the report of the office and of the work done in foreign countries; it is circulated principally among scientific people and administrative officials. "Naturdenkmäler, Vorträge und Aufsätze" ("Natural Monuments, Lectures and Essays") is written in a more popular style, with the purpose of carrying the ideals of a love of nature among all classes of the people. Besides these periodical publications, lectures which have been held under the auspices of the office are printed and circulated in the form of pamphlets, and many provincial committees print and distribute "communications" in their own spheres of work. Courses of instruction are held from time to time at the Central Office, chiefly for the information of strangers, and every week debates are held, which are attended by residents in Berlin who are interested in the work. The department works hard to make all classes interested in the work, and in this it receives great assistance from the Administration of State Forests, the employees of which are made acquainted with the trees of scientific as well as of economic importance.

The General Order of 1907 empowered the provincial representatives of the Imperial Government to start reservations of forest, and to provide that those regions be dealt with differently from the ordinary scheme of forestry, with a view to the preservation of rare plants and animals. As a consequence of this order a large number of reservations of greater or less extent, which lack of space prevents us from enumerating here, have been laid out. It has wisely been decided that size alone is not a necessary condition of a reserve; a single tree or the face of a cliff may well be worthy of that dignity. Not only the Department of Forestry, but those of Agriculture, of Constructions, or War, and even the churches, both Protestant and Catholic, have helped to further the ends of the Central Office. What has been said above of the work done in Prussia is true also of Bavaria and Wurtemberg, and, to a less extent, of some of the smaller States of the German Confederation. This

[1] Under this title are included any natural objects of interest, whether botanical, zoological or geological, particularly those which have survived in their primitive state, untouched by civilisation.

result is doubtless due, in a great measure, to the efforts of the director of the department, who has taught his fellow-countrymen that the preservation of the natural beauties of their country for future generations is a national and a patriotic duty.

THE STUDY OF THE STARS.[1]

THE object of the American Association is the advancement of science. This is a very different matter from the diffusion of human knowledge. The universities and colleges provide liberally for the latter subject, but neglect the former almost entirely. Science is advanced by many individuals who hold offices in the universities, but seldom as a part of their official duties. Few professors are allowed to regard research as a portion of their college work, and still less frequently are appropriations made, or funds provided for original investigation. Astronomy is almost the only exception to this rule, and even here, in general, the time of the officers is mainly devoted to teaching. Observatories devoted to research, like Lick, McCormick, and Harvard, are supported by funds given specifically for their use, and receive little or no aid from the general funds of the universities with which they are associated. It is probable that American universities devote one hundred times as much money to the diffusion of human knowledge as to its advancement. The great progress made in America in some departments of astronomy is due to the fact that certain wealthy men and women have been willing to give large sums of money for this object. No other country is so fortunate in this respect, although in recent years, in Germany, large appropriations are being made by the Government for similar purposes.

The income of certain funds, like the Elizabeth Thompson, Bache, and Watson funds, are also available, but while these are of the greatest value in aiding particular individuals, the amount is too small to advance materially the entire science. The large funds which might aid individual research are unfortunately employed for other purposes. Scarcely any appropriations have been made to women from these funds. One of the greatest needs of science in America is a fund of moderate size, capable of aiding the men of real genius. The number of such men is not large, and a judicious distribution of a few thousand dollars annually would probably yield greater results than could be attained in any other way.

A visit to Europe last summer in order to attend the meetings of two national and two international astronomical societies, enabled me to visit several of the larger observatories and to interchange views with the leading astronomers of the world. I have accordingly selected as my subject for this evening, "The Study of the Stars," and I shall endeavour to transmit to you the latest views, as well as the history, of this department of human knowledge. It is my wish to present to my professional friends certain facts of a technical nature, and at the same time to make them clear to those of my hearers who have no previous knowledge of the subject. Astronomy has been called not only the oldest of the sciences, but that which has conferred the greatest benefits on man by rendering international commerce possible. While this may be true of the past, the value of the astronomy of the present day lies in its extension of human knowledge and enabling the mind of man to traverse fields which until recently appeared to be hopelessly beyond his ken.

[1] Address delivered at the Atlanta meeting of the American Association for the Advancement of Science, December, 1913, by the retiring president, Prof. E. C. Pickering.

The first catalogue of the stars was made by Hipparchus about B.C. 128, and was inserted by Ptolemy in the "Almagest," for fourteen centuries the authority in astronomy for the world. This catalogue, which contained more than a thousand stars, gave both their positions and brightness. The earliest copy that is known of the Almagest is in the "Bibliothèque Nationale" in Paris. It is a beautiful manuscript in uncial characters of the ninth century. The other later manuscripts unfortunately differ from it and from each other, so that there is some uncertainty regarding two-thirds of the stars, owing to errors of copying. A careful study of these discrepancies has been made by Dr. Peters, of Clinton, and Mr. Knobel, of London. Each spent several years on this work, and all the papers are in the hands of Mr. Knobel. He is now preparing the entire work for publication, and it is hoped that it will be in the hands of the printer in a few months.

A manuscript of nearly the same age is in the library of the Vatican, and this year a revised edition of it has been published. If we had a correct copy of the original work, it would have a great value at the present time. Half a century ago it would probably have given the best existing values of the proper motions of the stars which it contained, but recent observations enabled us to compute their positions in the time of Hipparchus, more accurately than he could observe them, assuming that the motion was rectilinear. This work, however, throws light on a possible curvature of the motions. The observations by Hipparchus of the light of the stars have a value that will be considered later.

The first accurate measures of the positions of the stars were made in the middle of the eighteenth century. The catalogue of Bradley in 1755 is even at the present time one of the best means of determining the early positions of the stars. A large number of similar, but later, observations by Hornsby are still unpublished. During the next hundred years the meridian circle, which is at present the standard instrument for determining the places of the stars, was gradually evolved. In this instrument a telescope is mounted so that it will point only to stars in the meridian, that is, to stars exactly north or south of the observer. The declinations of stars, corresponding to the latitude of points on the surface of the earth, are then measured by a finely graduated circle. Owing to the motion of the earth all stars cross the meridian twice during every twenty-four hours. The right ascension, corresponding to longitude, will be given by the time of transit. At first, this time was found by the "eye and ear" method in which the observer counted the ticks of an accurate timepiece and compared them mentally with the instant at which the star appeared to cross a wire in the field of view of the telescope. About the middle of the nineteenth century a great advance was made by recording the time electrically on a chronograph. This method was known for many years as the "American" method, owing to its introduction and general adoption in this country. This continued to be the standard method almost to the present time, and an enormous number of observations have been accumulated in this way, the total cost amounting to millions of dollars.

Perhaps the most valuable work of this kind is that of the Astronomische Gesellschaft, which, by international cooperation, secured accurate observations of the positions of one hundred and sixty-six thousand stars. All stars of the ninth magnitude, and brighter, north of declination -23°, are included. Of the twenty zones, seven were observed in Germany, four in the United States, three in Russia, one each in Algeria, Austria, England, Holland, Norway, and

Sweden. Of the American zones, one was observed at Albany, one at Washington, and two at Cambridge. Each of the latter occupied the time of an observer and several assistants for twenty years. It was expected that these stars would be re-observed after an interval of about fifty years, to determine the proper motions, or annual changes in position. As the time is approaching when this great work should be undertaken, careful consideration should be given to it.

Fortunately, the twentieth century has already developed two new methods, which might replace the older plans. The first of these is the transit micrometer, in which a motion is given to the wire in the field of the telescope, so that it shall follow closely the motion of the image of a star as it transits through the field. A wide difference of opinion exists among leading astronomers as to the best method of securing this motion. In the earlier instruments constructed by Repsold, the motion was given by a screw turned by the two hands alternately. This method certainly gives excellent results, and is still used largely in geodetic work. Anyone who has tried it will find that with the rapid motion of an equatorial star under a high power, it is difficult to satisfy himself that the wire always bisects the star. If clockwork is used, the rate must vary with the declination, and it is strange that this is not done by electrical control instead of the somewhat crude mechanical devices now employed. The wire records its position automatically on a chronograph at short intervals. The plan of permitting this record only when the observer is satisfied that coincidence takes place, as is done at Heidelberg, seems a good one. Evidently a certain relative motion will give better results than a greater or less motion. It would appear to follow logically that this apparent motion should be given to all stars and the record permitted only for the few seconds of apparent coincidence. We can expect no better results than those obtained with a filar micrometer. The best plan may therefore prove to be to give a motion to the wire nearly equal to that of the star, whatever the declination of the latter, by a suitable variation of the clockwork. The best rate could readily be determined by observing stars at different distances from the pole. Successive settings should then be made as with a filar micrometer, closing the circuit on the chronograph only when the bisection was satisfactory. A similar setting should also be made for the declinations. The two coordinates could thus be determined with an accuracy substantially the same as that of a filar micrometer. Experience has shown that one star a minute can be observed in both coordinates with the transit micrometer. There can be little doubt that positions could thus be obtained with much greater accuracy than by the methods now in use. The special advantage would be the elimination of systematic errors.

A second method of determining positions, recently developed at the Allegheny Observatory, is by plates taken with a photographic doublet. Ordinary plates must be replaced by those of plate-glass. By taking suitable precautions positions may be determined of even the faintest stars, with an accuracy at least equal to that of a meridian circle. To obtain the best results, the field should be about 5° square on an 8 × 10 plate. The focal length of the telescope would accordingly be about two metres. The large field would permit the constants of each plate to be derived from stars as bright as the eighth magnitude. The economy of this method would be very great, as compared with a meridian circle. The usefulness of the latter instrument appears to be confined to observations of the brighter stars. Accordingly, its aperture may be reduced. The ideal plan would apparently be to divide the sky into regions 5° square, and select in each five or more stars of about the eighth magnitude, and of approximately the same class of spectrum, as class K, so that all should have about the same colour. The positions of these should be determined with the greatest possible accuracy with meridian circles, as described above. Some brighter stars should be included to render available the vast number of observations of these objects made in the past. Positions of the stars in the Gesellschaft catalogues and all fainter stars should be determined by photography.

Various attempts are now being made to determine the absolute positions of the stars by means of photography. It appears probable that a pier placed under ground will remain free from irregular motions, and that if this can be accomplished, the absolute positions of the stars near the equator can be found by photography. To determine the equinox, Venus and Mercury should be photographed, as well as the sun. By the very satisfactory cooperation of the Princeton, Yale, and Harvard Observatories, the position of the moon is now determined by photography. The results of a preliminary discussion indicate an accuracy at least equal to that of the best meridian determinations, those of the Greenwich Observatory.

Excellent progress is also being made in determining the parallax of the stars by photography. The recent increase in accuracy is at least tenfold, or that of another place of decimals. A hundredth of a second of arc can be determined with greater accuracy than a tenth of a second twenty or thirty years ago.

The just criticism has been made of American astronomers that while they have contributed more than their share of the work in astrophysics, the older science of astronomy of position has been greatly neglected. This is partly due to the fact that much of this work has been left to the United States Naval Observatory, which in the past has failed to justify the liberal appropriations made for its support. While Congress has given it for many years a much larger income than that of any other observatory in the world, the law has been such that it is impossible to attain the best results. The superintendent must be a naval officer, instead of an astronomer, and even then must go to sea after a short term. Accordingly the Naval Observatory during a period of thirty-seven years had twenty superintendents with an average term of fewer than two years. The Greenwich Observatory during a period of 235 years, from 1675 to 1910, has had eight Astronomers Royal, with an average term of twenty-nine years. The work of the latter institution with but half the income has greatly exceeded that of the Naval Observatory. It should be stated, however, that within the last few weeks the Naval Observatory has established an admirable wireless time service, by which anyone, at trifling expense, can obtain accurate time within a tenth of a second. The Navy has no need of a great observatory, from which it derives but little credit. Three successive Boards of Visitors have pointed out the present unfortunate conditions, but the necessary action has not been taken by Congress. The obvious remedy is to remove the observatory to another department, or place it under the direction of the Smithsonian Institution, and appoint an astronomer at its head. What grander field of work could be undertaken by this observatory than that desired by astronomers and neglected elsewhere? For instance, computers of double-star orbits are continually complaining that while a surplus of measures of the easy objects are available, many difficult objects are neglected, although measures of them are greatly needed. The same is true of the asteroids, of variable stars, and, in fact, in almost every department of astronomy.

By making the observations desired by experts, every hour would be saved, and work of the greatest value accumulated.

Astrophysics assumed prominence as a science about forty years ago, although it was foreshadowed by certain far-seeing astronomers, like the Herschels, G. P. Bond, Huggins, Draper, and others. One department, the study of the light of the stars, was developed much earlier, originating in the Almagest, and its revision a thousand years later by Sûfi. These catalogues show that the relative brightness of the stars has not changed sensibly during the last two thousand years. Also, that the human eye has the same sensitiveness to different colours now as then. Stellar brightness was made a precise science by that great astronomer, William Herschel. His six catalogues, two of which remained unknown for eighty years, give precise measures of the light of the three thousand stars contained in them with an accuracy comparable with recent work.

In 1877, stellar photometry was taken up on a large scale at Harvard. Since then, more than two million photometric settings have been made. A station in Arequipa, Peru, permitted the southern stars to be observed on the same system as the northern stars. We have now, accordingly, measures of about eighty thousand stars, including all the seventh magnitude and brighter, many of the ninth magnitude, and some as faint as the thirteenth magnitude. The excellent work of the Potsdam Observatory gives measures of the light of fourteen thousand stars, including all northern stars of the magnitude 7·5 and brighter. The Potsdam and Harvard systems agree admirably if a correction is applied for the colour, or spectrum, of the stars. They should never be combined, or compared, unless this correction is applied.

Stellar photography, originating in the work of George Bond in 1857, has revolutionised many departments of astronomy. The great work of a chart of the entire sky, undertaken by the Paris Observatory in cooperation with several others, is a sad example of the danger of undertaking a work on too large a scale. Although several observatories have been continually at work upon it for a quarter of a century, it has been predicted that at least fifty years must elapse before it is completed, and no positions of any southern stars have yet been published. In striking contrast to this is the early completion of the Cape Photographic Durchmusterung, which gives the positions and magnitudes of nearly half a million stars south of −19°. It illustrates the results of the happy combination of skilful planning with routine organisation, conducted on a very large scale. The extension of this work to the north pole is now being planned, but with the additional condition that the colour index, as well as the photographic magnitude, will be determined. The former will be found by photographing the stars by means of their yellow or red, as well as their blue, light, the difference in the magnitudes giving the colour index.

Much might be said of the numerous applications of photography to the determination of stellar magnitude. The 60-in. reflector of the Mount Wilson Observatory, using exposures of several hours, has succeeded in photographing stars as faint as the twentieth magnitude. An international committee, with members from England, France, Germany, Russia, Holland, and the United States, has adopted a scale of magnitudes based on two investigations made at Harvard. One of these was made with the meridian photometer, and the other is an elaborate investigation by Miss H. S. Leavitt of the photographic magnitude of seventy-six stars near the north pole. A standard scale is thus provided from the first to the twentieth magnitude. We may say from the minus twenty-sixth to the twentieth magnitudes, since accordant results for the light of the sun have been obtained by Profs. W. H. Pickering and E. S. King. For many purposes photography may well replace visual photometric measures, since for stars brighter than the fifteenth magnitude photographs may be taken with yellow light.

One of the principal uses of measures of the light of the stars is the study of the variables, or those in which the brightness is not constant. A bibliography of these by Miss Cannon is recorded on about forty thousand cards. The number of known variables is now about forty-five hundred, of which three-quarters have been discovered by photography at the Harvard Observatory. There are several kinds of variable stars. Variables of long period undergo changes which repeat themselves somewhat irregularly in a period of several months, and at maximum are often several thousand times as bright as at minimum. The most useful work that an amateur can do with a small telescope is the observation of those objects. An important work undertaken by members of the British Astronomical Association has been the observation of variable stars. During the last thirteen years they have accumulated twenty thousand such observations, all reduced to the same scale, which is that of the Harvard photometry. Similar work in the United States has accumulated ten and sixteen thousand observations respectively in the last two years.

Variables of short period complete their changes in a few days, or hours. Prof. Bailey has found five hundred such objects in the globular clusters. In one of these clusters, Messier 3, out of a thousand stars one-seventh are variable, all have a period of about half a day, and their periods are known within a fraction of a second. Their light changes so rapidly that in one case it doubles in seven minutes. It is a strange thought that out of a thousand stars, looking exactly alike, there should be a hundred little chronometers keeping perfect time, and the rate of which is known with such accuracy. About a hundred and fifty variables belong to the Algol class, in which the light is uniform for a large part of the time, undergoing a sudden diminution at regular intervals. This is due to the eclipse of two bodies, one darker than the other, revolving around their common centre of gravity. An elaborate theoretical study of this problem has been made at the Princeton Observatory, and, from the photometric and photographic magnitudes made at Harvard and elsewhere, the dimensions of a large number of these systems have been determined.

Photography still can scarcely compete with other methods where the greatest accuracy is desired, as, for instance, the measures with the polarising photometer by the late Oliver C. Wendell. The masterly use of the selenium photometer by Prof. Stebbins gives results for bright stars of still greater accuracy, while the experiments in Germany with the photo-electric cell by Rosenberg and Guthnick give results which promise to revolutionise our present methods. The principal source of error appears to be the varying transparency of the air. The trial of the instrument in a location where the air is exceedingly clear and steady for long periods is greatly to be desired.

During the last twenty-five years photographs have been obtained by the Harvard Observatory in order to furnish a history of the stellar universe. Two similar 8-in. photographic doublets have been used, one mounted at Cambridge for the northern, and the other at Arequipa, for the southern stars. With each of these instruments about forty thousand photographs have been taken. The total weight of these plates is

about forty tons. As each plate covers a region 10° square, every part of the sky has been photographed, on the average, a hundred times. This work is now supplemented by two small Cooke anastigmat lenses, each having a field 30° square. The number of plates taken with these two instruments are nine thousand and fourteen thousand respectively. The exposures with the larger instruments are, in general, ten minutes, showing stars of the thirteenth magnitude. The exposures with the smaller instruments are one hour, showing stars of the eleventh magnitude. A continuous history of the sky is thus furnished from which the magnitude and position of any stellar object of sufficient brightness can be determined for a large number of nights during the last quarter of a century. A striking illustration of the value of this collection occurred when the planet Eros was discovered in 1898. It appeared that this object was nearer the earth in 1894 than would occur again for thirty-five years. An examination of the photographs showed its presence on twenty-three plates, and from their positions, the parallax of the sun and mass of the earth were determined with an accuracy equal to that of any of the methods previously used, and on which an enormous amount of time and money had been spent.

For many years the Kiel and Harvard Observatories have served as distributing centres of astronomical discoveries and observations in Europe and America, respectively. The last new star which is known to have appeared, Nova Geminorum No. 2, was discovered by Enebo at Dombass, Norway, on Tuesday, March 13, 1912. The cable message was received at Cambridge on Wednesday morning, and the star was observed at several American observatories the next evening, or the night following its discovery. An examination of the Harvard photographs showed that two plates had been taken on the preceding Sunday, March 11, on which no trace of the nova was visible, and two on Monday, March 12, showing it of nearly its full brightness. Photographs taken on Wednesday compared with those obtained a few days later showed the wonderful change in its spectrum, from the solar type with dark lines, to the typical spectrum of a nova with bright lines.

There is no department of astronomy which is now receiving greater attention than the study of the spectra of the stars. Dr. Henry Draper was the first to photograph the lines in a stellar spectrum, although Sir William Huggins had already obtained a mark from the spectrum of Sirius, and later was the first to publish his results in successfully photographing stellar spectra. The untimely death of Dr. Draper in the midst of his work led to the establishment at Harvard of the Henry Draper Memorial. For nearly thirty years Mrs. Draper has maintained an active interest in this work. By placing a large prism over the objective of a telescope, the light of all the brighter stars in the field are spread out into spectra, so that instead of photographing the spectrum of one star at a time, as with a slit spectroscope, as many as a thousand have sometimes been taken on a single plate. Such photographs, covering the entire sky, have been taken with the two 8-in. doublets already mentioned. A study of the spectra thus obtained enabled Mrs. Fleming to discover many hundred objects the spectra of which are peculiar. Among them may be mentioned ten of the nineteen new stars known to have appeared during the years in which she was engaged in this work, while five of the others were also found at Harvard by other observers. She discovered more than two hundred variable stars, ninety-one out of the 108 stars of the very peculiar fifth type, and showed that these objects occurred only very near the central line of the Milky Way. During the last two or three years a great demand has arisen for the class of spectrum of large numbers of stars. The Harvard photographs show the class of spectrum of nearly two hundred thousand stars. Miss Cannon has, accordingly, undertaken to prepare a catalogue of these objects, with the result that she has already classified about one hundred and fifteen thousand spectra, covering more than one-half of the sky. The work is progressing at the rate of five thousand stars monthly, and the results will fill seven of the large quarto Annals of the Harvard Observatory. The organisation of this work has required the most careful application of the principles of "scientific management."

One of the most important results derived from the Harvard photographs was the discovery that in certain spectra the lines were alternately double and single. This, and the discovery by Vogel at Potsdam that the lines of the variable star Algol continually changed their position, revealed the existence of spectroscopic binaries. No department of astronomy is receiving more attention, at the present time, than these objects, and in general the motion of the stars in the line of sight. The Lick, Yerkes, Greenwich, Potsdam, Bonn, and Ottawa Observatories are only a portion of those directing a large part of their energy to this subject.

One of the most important generalisations of recent times is the discovery by Prof. Campbell that the velocity of a star depends upon its class of spectrum. The proper motion of a star was similarly found by the late Lewis Boss to be dependent on the same quantity.

In conclusion, the United States has attained an enviable position in the newer departments of astronomy. Can this be maintained? In Europe, especially in Germany, observatories and instruments of the highest grade are now being constructed, the Government furnishing appliances with the most liberal hand. Perhaps the most promising sign for the future is the friendly cooperation of American astronomers, which has never been more marked than at the present time.

The possibilities of work are now greater than ever before. A small fraction of the effort expended in teaching science, if devoted to its extension and progress, would fulfil the objects of the American Association for the Advancement of Science.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—A matter about which there is considerable divergence of opinion will come up for settlement this term. The Special Board for Medicine wishes to apply to the Board of Agriculture for a grant towards the medical department. Such grants are now commonly being made to the various medical schools in other parts of England, but Government grants mean Government control, and certain members of the Senate are apprehensive that Government control would mean an undue interference with the liberty of the University. On the other hand, similar grants, with the implied control, have already been accepted by the Cambridge School of Agriculture and by the department of astrophysics. The returns from the various colleges show that there are 330 medical students now in residence in the University. An examination of the figures relating to the grant made to three of the London medical schools for their full-time students affords evidence that the grant is about 14*l*. per annum a student. Taking these two figures, it may be calculated that the Cambridge Medical School

would receive a sum of at least 4600*l.* per annum, which might be applied to the relief of its most urgent requirements. The heads of the various departments connected with the medical school have recently asked for a sum of 7000*l.* per annum to bring the manning and equipment of their departments up to date. It is obvious that no such sum could be expected, but a sum of 4600*l.* per annum would relieve the most urgent needs of the school, would render the teaching more efficient, and would enable research to be carried out in the medical school on a scale commensurate with the importance of the University.

The foreign mathematicians who attended the fifth International Congress of Mathematicians held at Cambridge in 1912 subscribed a sum to be devoted to a memorial of a permanent nature to the late Sadlerian professor, Dr. Cayley. Having in mind that the presidency of this congress so brilliantly carried through was the last public appearance of Sir George Darwin, his colleagues in the administration of the congress have desired to provide a memorial of his work in the same connection. Accordingly a brass plate with armorial decorations has been prepared, and is now offered by Sir Joseph Larmor on behalf of his colleagues to the University. It is proposed to fix this brass in the chief mathematical lecture-room in the new Lecture Rooms Building.

The Botanic Gardens Syndicate again finds its income quite inadequate to the proper maintenance of the gardens. The increase in rates and taxes, in wages, and in the cost of fuel, is such that at the present time there is a deficit of 108*l.* In a report to the Senate the syndicate requests that the annual amount allowed to the Botanic Gardens be increased from 1350*l.* to 1500*l.*, and that the deficit be extinguished.

The Physiological Laboratory Building Syndicate has published a report giving details of the expenditure of nearly 1600*l.* on fittings for the new laboratory which is rapidly approaching completion. Further fittings and furniture, however, are needed, and the syndicate is asking for power to spend an additional 500*l.* which has been provided by the University Association.

DR. WARRINGTON YORKE has been appointed to the Walter Myers chair of parasitology, recently established in the University of Liverpool.

THE current number of *The Fortnightly Review* includes an article on continuation schools in England and Germany, which is a serious indictment of the conditions prevailing in this country with regard to the provision made for the continued education of children on leaving school at fourteen years of age, and in respect of the advantage which is taken of such provision, and a very unfavourable comparison is drawn with the conditions prevailing in Germany. We have been accustomed to believe that in respect of provision for evening education we have been easily in the front rank, but a glance at the figures presented by the Board of Education in its report for 1911–12 will dispel the illusion. There were but 708,000 students of all ages in the various evening schools throughout England and Wales, and of these only 307,000 were under seventeen, out of a total child population of these ages (not including those still at elementary and secondary schools) of not fewer than two and one-third millions, so that only 13 per cent. of the children at the most impressionable period of their lives were receiving continued education in any form. But this is not all, for the attendance, taking the average of the whole country, is miserably low. In the county boroughs the average number of hours of instruction received was fifty-eight, and in the administrative counties, forty-nine, whilst no less than 18 per cent., or nearly 124,000 pupils, received fewer than fourteen hours' instruction for the session. Throughout Germany, on the other hand, laws have been passed and are in active operation for the compulsory attendance for about 240 hours per annum, or six to eight hours a week, of all children who have left school and until they are seventeen years of age, chiefly in day continuation schools and *within* the hours normally devoted to labour, and the responsibility for the due execution of the law is laid upon the employer. The course is vocational and general. As an example of the success achieved in Berlin during the year 1910–11, there were 32,000 students in attendance at compulsory schools, in addition to upwards of 36,000 of both sexes at optional schools. In the new session of Parliament a Bill will be introduced, promoted by Mr. Chiozza Money and others, for the enactment of compulsory continued education of children who have left school until they reach seventeen years of age. It is to be hoped that the Bill will receive serious attention.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 5.—Sir William Crookes, O.M., president, in the chair.—Prof. L. **Hill,** J. **McQueen,** and M. **Flack**: The conduction of the pulse wave and the measurement of arterial pressure.—J. **Barcroft,** M. **Camis,** C. G. **Mathison,** F. **Roberts,** and J. H. **Ryffel**: Report of the Monte Rosa Expedition of 1911. I. Curves representing the equilibrium between oxygen and hæmoglobin were determined for *resting* individuals at Col d'Olen and the Capanna Margherita. These and all others were capable of representation by the equation

$$y/100=\frac{K_x{}^n}{1\times K_x{}^n},$$

y=percentage saturation of hæmoglobin with oxygen; x=oxygen pressure; K=equilibrium constant of reaction; n=average number of molecules of Hb assumed to be in an aggregate. Notwithstanding a fall in the CO_2 pressure of the blood, no change in K could be detected, except as the mean of a large number of observations, when a slight fall in K, indicating decreased alkalinity of the blood, was apparent. The curves were determined in the presence of the existing alveolar CO_2 pressure. II. The blood was investigated similarly after *exercise,* which usually consisted in climbing 1000 ft. Climbs were made by the same individuals at—(1) Carlingford, co. Louth, from sea-level; (2) Col d'Olen, from 9000 ft. A diminution in K invariably occurred. Climbing at a given rate the reduction in K was much greater at high altitudes. A given reduction in K involved much more rapid climbing at low altitudes. The change in K caused by *exercise,* whether at high or low altitudes, was entirely accounted for by production of lactic acid. Determinations of the hydrogen ion concentration in the blood of one have been made. These show a defined relation between C_H and K, so that the one may be calculated from the other.—C. H. **Martin** and K. **Lewin**: Some notes on soil protozoa. Part i. The main purpose of this introductory paper is not the study of Amœbæ from a specific point of view, so much as the proof of the existence of a relatively frequent trophic Protozoan fauna in certain soils, and the rough indication of possible methods of dealing with this fauna. The startling success in the Lee Valley of the treatment of sick soils by partial sterilisation, introduced by Russell, would seem to present a very strong argument in favour of the view that

these Protozoa do exercise an important influence on plant growth in these soils. The authors have been able to establish the occurrence of a trophic Protozoan fauna in certain field soils that they have examined, and to this question they hope to return in a future paper.—J. F. **Gemmill**: The development of the starfish, *Asterias rubens*, L.—Dr. A. H. **Church**: The floral mechanism of *Welwitschia mirabilis*, Hook.

Institution of Mining and Metallurgy, January 15.—Mr. Bedford McNeill, president, in the chair.—C. W. **Purington**: The Bereozovsk gold deposit, Ural District, Russia. After a brief historical summary of the work done on the Bereozovsk estate, the author devotes considerable attention to the geological features, and especially to the occurrence of auriferous granite dykes which are more or less distinctive of this property. These dykes, of porphyritic rock of granitic type, in which is developed a considerable amount of schistosity, extend in a generally north and south direction, alternating with micaceous schist. In the immediate vicinity of the village is an area of pure granite; to the west are patches of listvenite, probably a metamorphosed dolomitic limestone; and in connection with the deposits occur bands of serpentine representing metamorphosed basic dykes. The quartz veins, worked for gold, penetrate the granite dykes (locally known as beresite), almost at right angles, and it is a curious fact that though these beresite dykes or lodes, to the number of 143, have been worked for gold over lengths ranging from 100 to 3000 ft., they only show gold values by virtue of the quartz veins which cross them. It is, in fact, not likely that the beresite is primarily auriferous, but it is so immediately situated to the intruding quartz veins as to have become impregnated by fissuring. Moreover, only within the limits of the beresite dykes are the quartz veins wide enough and rich enough to produce payable gold. The author deals with the geological problems attaching to this noteworthy occurrence.—J. Mackintosh **Bell**: The outlook for the mineral industry in Canada. For the purposes of his review, the author divides Canada into four sections, referred to respectively as the south-eastern, central prairie, western, and north central areas, and deals with these in detail. Of these, the first-named has a production almost entirely confined to coal. The central area also shows at present little metallic output. The western section, comprising British Columbia and the Yukon district, is of course notably mineral producing, but since 1907 the fourth of the author's arbitrary divisions, the north central, comprising Labrador, Ontario, Quebec, Manitoba, Saskatchewan, and part of the North-West Territories, has by the discoveries at Cobalt, Sudbury, and Porcupine, leapt into first place, though even now its latent possibilities are far from being fully realised. The author supplies much valuable information with regard to the mineral production of the various districts and as to the results to be expected when prospecting has been extended with the growth of the railroad systems of the Dominion.

Geological Society, January 21.—Dr. Aubrey Strahan, president, in the chair.—W. R. **Watt**: Geology of the country round Huntly (Aberdeenshire). Two distinct series of rocks can be distinguished—a foliated and a non-foliated. In the former occur rocks originally sedimentary and others originally igneous. In the non-foliated series, wholly of igneous origin, three main intrusions occur:—(1) The earliest and most extensive is a norite; into this is intruded (2) the heterogeneous mass known as the Central Intrusion; and (3) the large intrusion of the Carvichen Granitite. Each of these masses produces contact-alteration in the surrounding rocks. Where the Central Intrusion or the Carvichen Granitite is intruded into the earlier norite, a norite containing cordierite is produced. The original norite, by absorption of sediment, produces also along its margin a cordierite-norite.—Dr. A. **Jowett**: The glacial geology of East Lancashire. The area comprises the western slopes of the Pennines and their westerly offshoot, the Rossendale highland. Three types of drift have been recognised:—(1) Local drift, consisting of materials which can be found *in situ* in the neighbourhood; (2) Ribblesdale drift with Carboniferous Limestone; (3) north-western drift which also contains igneous rocks from the Lake District and S.W. Scotland. The distribution of the drift and the evidence of striated rock-surfaces suggest the invasion of this area by an ice-sheet which reached up to the Pennine watershed, and projected ice-lobes across it through gaps. In the N.E. portion of the area the direction of ice-movement was from north to south; in the west from N.N.W. to S.S.E., but on the south of the Rossendale highland the direction of flow curved round towards the E.N.E., and near Rochdale, towards the north. No evidence of local glaciation has been found. The limit of the N.W. drift rises at the rate of about 4 ft. a mile towards the Irish Sea; and the ice-sheet was probably more than 2000 ft. above present sea-level in the middle of the Irish Sea in this latitude. It is probable that the N.W. ice arrived in this area later, and disappeared earlier, than the Ribblesdale ice. There is no evidence for more than one glacial period.

DUBLIN.

Royal Irish Academy, January 26.—Rev. J. P. Mahaffy, president, in the chair.—H. C. **Plummer**: Note on the use of conjugate functions in some dynamical problems. Two-dimensional problems in dynamics can be transformed into other problems by means of the equation of energy and conjugate functions of the coordinates. The general form of the transformed equations is found for relative motion and the application to some particular cases is indicated.—J. R. **Kilroe** and T. **Hallissy**: Geology in connection with the Clare Island Survey. The paper gives a general account of the rocks entering into the structure of the island, and the geographical features to which they give rise. The older Palæozoic rocks, which form the bulk of the area, have been studied in the light of recent observations on similar rocks occurring close by on the mainland. An account of the glaciation of the island is also included, and the reconstruction of its recent geological history is attempted with a view to an explanation of the many problems connected with the present distribution of the fauna and flora of the district.

PARIS.

Academy of Sciences, February 2.—M. P. Appell in the chair.—G. **Humbert**: Some remarkable numerical functions.—A. **Haller** and R. **Cornubert**: The alkylation of the *cyclo*pentanones and breaking the cyclic chain of the tetra-alkyl derivatives into α and α', by means of sodium amide. A description of the preparation and properties of mono-, di-, tri-, and tetra-methyl-*cyclo*pentanones. The last-named compound, heated with sodium amide in toluene solution for seven hours, gives the open chain amide of 2 : 2 : 5-trimethylcaproic acid.—Charles **Richet**: A new type of anaphylaxis. Dogs chloroformed for the first time never show leucocytosis, but the same animal, chloroformed a second time after an interval of nineteen days, always presents strong leucocytosis. The increase in the number of leucocytes after the second administration of chloroform is gradual, reaching a maximum in six or seven days, and there is nothing corresponding to

the anaphylactic shock.—Paul **Sabatier** and M. **Murat**: The preparation by catalysis of decahydroquinoline and of decahydroquinaldine. Ten atoms of hydrogen can be added to the quinoline and quinaldine molecules by nickel catalysis, provided that the temperature of the reaction is suitably chosen and that a very active nickel is employed. The decahydroquinaldine is new, and its properties and those of some of its derivatives are given.—Georges **Charpy**: The fragility produced in iron and steel by deformation at different temperatures.—Report on a memoir by Louis Roy, entitled "On the Movement of Viscous Media and Quasi-waves."—M. H. **Parenty** was elected a correspondant for the section of mechanics in succession to M. Duhem, elected non-resident member.—The Perpetual Secretary announced the death of M. Harry Rosenbusch, correspondant for the section of mineralogy.—M. **Gambier**: Algebraic curves of constant torsion, genus not zero.—A. **Buhl**: The extensions of Stokes's formula, the Monge-Ampère equations, and analytical functions of two variables.—E. **Cartan**: The integration of certain systems of differential equations.—R. **Boulyguine**: The representation of a prime number by a series of squares.—G. **Pólya**: A question concerning integral functions.—M. de **Broglie**: The production of Röntgen-ray spectra by simple passage of the incident rays through thin sheets.—R. **Fortrat**: The simplification and regularisation of the spectral bands by the magnetic field. A discussion of a recent paper on the same subject by MM. Deslandres and Azambuja.—E. **Tassilly**: A study of the process of diazotising by the spectroscopic method. The amount of diazo-compound formed was followed by measuring the absorption and the results for aniline, orthotoluidine, and paratoluidine given graphically.—Maurice **Drapier**: The influence of shaking on the solution of copper in nitric acid. Solutions of nitric acid of strengths readily attacking copper (30 to 48 per cent.) when at rest, lose their power of dissolving the metal when rapidly rotated or shaken. As an example, a solution of 36 per cent. nitric acid which dissolved 0·397 gram of copper from a given piece of metal at rest in fifteen minutes, dissolved only 0·004 gram in the same time when the metal was rotated at 386 turns per minute.—L. **Crussard**: Limits of inflammability and the specific retardation of inflammation.—Gustave **Chauveaud**: The constitution and morphological evolution of the bodies in the vascular plants.—M. **Blaringhem**: The production of hybrids between *Triticum monococcum* and different cultivated wheats.—H. **Agulhon** and Mlle. Th. **Robert**: The action of colloidal uranium on the pyocyanic bacillus. In the presence of minute amounts of colloidal uranium the amount of pyocyanine formed by the bacillus is greatly increased.—Louis **Roule**: The larval phases and metamorphosis of fishes belonging to the family of the Nemichythydes.—Ch. **Gravier**: A new type of parasitic Crustacean from the South American Antarctic.—M. **Jay**: Remarks on the estimation of boric acid in food substances.—H. **Guillemard**: Observations on the physiological action of climate at high altitudes. Studies on the variations in the nitrogen compounds of the blood serum at high altitudes.—J. L. **Dantan**: The tendency towards the substitution of the Portuguese oyster (*Gryphea angulata*) for the native oyster (*Ostrea edulis*).—Maurice **Nicloux**: The laws of the absorption of carbon monoxide by the blood. It has been shown in the previous paper that the hæmoglobin of the blood corpuscles put in contact with mixtures of carbon monoxide and oxygen combines with the two gases in proportions defined by their respective partial pressures and governed by the law of mass action. These experiments have now been extended to living animals (dogs), and the same laws are found to be applicable. It is shown that with a given mixture of carbon monoxide and air when breathed by an animal, the carbon monoxide is fixed by the blood up to a certain limit which cannot be passed. Oxygen displaces the carbon monoxide from the blood, and pure oxygen constitutes the best treatment for carbon monoxide poisoning.—André **Mayer** and Georges **Schaeffer**: The proportion of lipoids in the tissues and the physiological activity of the cells. Thermal regulation. When the body is subjected to extremes of heat or cold variations are produced in the amounts of lipoid phosphorus in the serum.—P. A. **Dangeard**: The penetrating power of violet and ultra-violet rays through leaves.—Em. **Bourquelot** and M. **Bridel**: Ferment equilibria. Distribution and displacements in an alcoholic medium containing glucose and two glucoside-forming ferments.—Emile **Haug**: The Triassic zone of the Huveaune.—Léon **Bertrand** and Antonin **Lanquine**: The prolongation of the Bessilons sheet in the south-west of the Maritime Alps, up to the Var valley.

BOOKS RECEIVED.

Transactions of the Connecticut Academy of Arts and Sciences. Vol. xviii. A Monograph of the Terrestrial Palæozoic Arachnida of North America. By Prof. A. Petrunkevitch. Pp. 137+plates. (New Haven, Conn.: Yale University Press.)

Notes on the Blue-Green Algæ. With a Key to the Species of Oscillatoria and Phormidium. By H. Wager. Pp. 48. (London: A. Brown and Sons, Ltd.) 2*s*. 6*d*. net.

Meteorology of Australia. Commonwealth Bureau of Meteorology. The Climate and Weather of Australia. By H. A. Hunt, G. Taylor, and E. T. Quayle. Pp. 93+plates. (Melbourne: A. J. Mullett.) 5*s*.

The Philosophy of Bergson. By Hon. B. Russell, with a Reply by W. W. Carr, and a Rejoinder by Mr. Russell. Pp. 36. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd.) 1*s*. net.

Gipsy Coppersmiths in Liverpool and Birkenhead. By Andreas (Mui Shuko.) Pp. iv+66. (Liverpool: H. Young and Sons.) 1*s*. net.

Ministry of Finance, Egypt. Survey Department. Meteorological Report for the year 1911. Part i., Helwan Observatory. Pp. xvi+31. (Cairo: Government Press.) P.T.15.

Tychonis Brahe Dani, Opera Omnia. Edidit J. L. E. Dreyer. Tomus i. Pp. lix+320. (Copenhagen: Gyldendalske Boghandel.)

The Geographic Society of Chicago. Bulletin No. 5. Animal Communities in Temperate America as Illustrated in the Chicago Region. By Dr. V. E. Shelford. Pp. xiii+362. (Chicago, Ill.: University of Chicago Press; London: Cambridge University Press.) 12*s*. net.

A Text-book of Medical Entomology. By W. S. Patton and Dr. F. W. Cragg. Pp. xxxiv+768+lxxxix plates. (London, Madras, and Calcutta: Christian Literature Society for India.) 21*s*.

Stanford's Geological Atlas of Great Britain and Ireland. By H. B. Woodward. Third edition. Pp. xii+214+50 plates. (London: E. Stanford, Ltd.) 12*s*. 6*d*. net.

Aus Chiles Vergangenheit Plaudereien. By A. Wilckens. Pp. 108. (Valparaiso: C. F. Niemeyer.)

Year-Book of the Royal Society of London, 1914. Pp. 254. (London: Harrison and Sons.) 5*s*.

The Institute of Chemistry of Great Britain and Ireland. Lectures on the Research Chemist in the Works, with Special Reference to the Textile Industries. By W. P. Dreaper. Pp. 70. (London: Institute of Chemistry.)

Dental Diseases in Relation to Public Health. By

Dr. J. Sim Wallace. Pp. viii+90. (London: *The Dental Record*.) 3*s*. net.

Tabellen zur Berechnung der "theoretischen" Molrefraktionen organischer Verbindungen. By K. v. Auwers and A. Boennecke. Pp. 27. (Berlin: J. Springer.) 1.20 marks.

Die Entstehung des Lebendigen. By Prof. E. Schwalbe. Pp. 27. (Jena: G. Fischer.) 80 pfennigs.

Dynamics. By Prof. H. Lamb. Pp. xi+344. (Cambridge University Press.) 10*s*. 6*d*. net.

Kaiserliche Marine, Deutsche Seewarte. Deutsches Meteorologisches Jahrbuch für 1912. Beobachtungs-System der Deutschen Seewarte. Ergebnisse der Meteorologischen Beobachtungen. Jahrgang xxxv. Pp. vii+176. (Hamburg.)

Die Tiere der Vorwelt. By Prof. O. Abel. Pp. iv+88. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Die neueren Wärmekraftmaschinen. I., Einführung in die Theorie und den Bau der Gasmaschinen. By Prof. R. Vater. Pp. iv+120. (Leipzig and Berlin: B. G. Teubner.) 1.25 marks.

Leitfaden für das embryologische Praktikum und Grundriss der Entwicklungslehre des Menschen und der Wirbeltiere. By Prof. A. Oppel. Pp. vii+313. (Jena: G. Fischer.) 10 marks.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 12

ROYAL SOCIETY, at 4.30.—Chemical Action that is Stimulated by Alternating Currents: S. G. Brown.—The Effect of the Gangetic Alluvium on the Plumb-line in Northern India: R. D. Oldham.—Note on the Origin of Black Body Radiation: G. W. Walker.—The Transmission of Electric Waves along the Earth's Surface: Prof. H. M. Macdonald.—Transparence or Translucence of the Surface Film Produced in Polishing Metals: G. T. Beilby.—A Thermomagnetic Study of the Eutectoid Transition Point of Carbon Steels: Dr S. W. J. Smith and J. Guild.—Note on Osmotic Pressure: W. R. Bousfield.

ROYAL INSTITUTION, at 3.—Types and Causes of Earth Crust Folds: Sir Thomas H. Holland, K.C.I.E.

CONCRETE INSTITUTE, at 7.30.—Factory Construction: P. M. Fraser.

ROYAL SOCIETY OF ARTS, at 4.30.—Khorasan: the Eastern Provinces of Persia: Major Percy M. Sykes.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Some Railway Conditions governing Electrification: R. T. Smith.

FRIDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 9.—Production of Neon and Helium by Electric Discharge: Prof. J. Norman Collie.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

PHYSICAL SOCIETY, at 8.—The Moving Coil Ballistic Galvanometer: R. Ll. Jones.—Vibration Galvanometers of Low Effective Resistance: A. Campbell.—Vacuum-tight Lead-seals for Sealing-in-wires in Vitreous Silica and other Glasses: Dr. H. J. S. Sand.

MALACOLOGICAL SOCIETY, at 8.—Annual Meeting.—Presidential Address: Some Points and Problems in Geographical Distribution: Rev. A. H. Cooke.

ALCHEMICAL SOCIETY, at 8.15.—Some Notes on the Doctrine of the First Matter, with Special Reference to the Works of Thomas Vaughan: Sijil Abelul-Ali.

SATURDAY, FEBRUARY 14.

ROYAL INSTITUTION, at 3.—The Electric Emissivity of Matter. I.: The Metals: Dr. J. A. Harker.

MONDAY, FEBRUARY 16.

ROYAL SOCIETY OF ARTS, at 8.—Artistic Lithography: J. Pennell.

TUESDAY, FEBRUARY 17.

ROYAL INSTITUTION, at 3.—Animals and Plants under Domestication: Prof. W. Bateson.

ZOOLOGICAL SOCIETY, at 8.30.—Lantern Demonstration of the Helminthes collected by Scott's Antarctic Expedition: Dr. R. T. Leiper and Surgeon Atkinson, R.N.—Observations made to ascertain whether any Relation subsists between the Seasonal Assumption of the "Eclipse" Plumage in the Mallard (*Anas boscas*) and the Condition of the Testicle: C. G. Seligmann and S. G. Shattock.—Some Phases in the Female Reproductive System of the Mole (*Talpa europaea*): F. Wood Jones.—Contributions to a Study of the Dragon-fly Fauna of Borneo. II.: The Gomphinæ and Chlorogomphinæ: F. F. Laidlaw.—Note on an Imperfectly-developed Specimen of *Echinus esculentus*: H. C. Chadwick.—The Possible Connection between Spindle-length and Cell-volume: C. F. U. Meek.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—Some Aspects of Travel: Rudyard Kipling.

ROYAL ANTHROPOLOGICAL INSTITUTE (Joint Meeting with the Prehistoric Society of East Anglia), at 4.—Papers by Members of the Prehistoric Society of East Anglia.—At 8.15.—Flint Finds in Connection with Sand; R. A. Smith.—The Experimental Investigation of Flint Fracture and Problems of Early Man: S. Hazzledine Warren.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Discussion on the Lighting of Picture Galleries and Art Studios: Opened by Prof. S. P. Thompson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: The New Harbour Works and Dockyard at Gibraltar: A. Scott.

ROYAL STATISTICAL SOCIETY, at 5.—The Census of the Empire, 1911: Its Scope and some of its Results: Sir J. Athelstane Baines.

WEDNESDAY, FEBRUARY 18.

AËRONAUTICAL SOCIETY, at 8.30.—Aërial Navigation at Sea.

ROYAL SOCIETY OF ARTS, at 8.—The Preservation of Wood: A. J. Wallis-Taylor.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Interpretation of the Results of Soundings with Pilot Balloons: Dr. W. N. Shaw.—Pilot Balloon Ascents at the Central Flying School, Upavon, during the Year 1913: G. M. B. Dobson.

THURSDAY, FEBRUARY 19.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Brain of Primitive Man, with Special Reference to the Cranial Cast and Skull of Eoanthropus (The Piltdown Man): Prof. G. Elliot Smith.—Oxidases: Prof. A. J. Ewart.—A New Malaria Parasite of Man: Dr. J. W. W. Stephens.—Investigations Dealing with the Phenomena of "Clot" Formations. II: The Formation of a Gel from Cholate Solutions having many Properties Analogous to those of Cell Membranes: S. B. Schryver.—The Influence of the Position of the Cut upon Regeneration in *Gunda ulvae*: D. Jordan Lloyd.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, FEBRUARY 20.

ROYAL INSTITUTION, at 9.—Busts and Portraits of Shakespeare and of Burns: An Anthropological Study: Prof. Arthur Keith.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Annual General Meeting.—Some Modern Methods of Welding; T. T. Heaton.

INSTITUTION OF CIVIL ENGINEERS at 8.—The Use of Reinforced Concrete in Connection with Dock and Other Maritime Work: C. S. Meik.

SATURDAY, FEBRUARY 21.

ROYAL INSTITUTION, at 3.—The Electric Emissivity of Matter: Dr. J. A. Harker.

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